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ABSTRACT

These documents contain instructional materials for the Earth/Space Science curriculum designed by the Florida Department of Education. The student guide is adapted for students with disabilities or diverse learning needs. The content of Parallel Alternative Strategies for Students (PASS) differs from standard textbooks with its simplified text, small units, reduced vocabulary level, increased frequency of drill and practice, less cluttered format, and presentation of skills in small steps. There are 16 units, and each unit contains an overview, suggestions for enrichment, unit assessment, and keys. Units include: (1) "Introduction to the Scientific Process"; (2) "Map Reading"; (3) "The Universe and Solar System"; (4) "The Earth, the Moon, and the Sun"; (5) "Space Exploration"; (6) "Rocks and Minerals"; (7) "Mountains"; (8) "Plate Tectonics"; (9) "Geologic History and Fossils"; (10) "The Water Cycle"; (11) "Rivers"; (12) "Glaciers"; (13) "Weathering and Erosion"; (14) "The Atmosphere and Weather"; (15) "Energy Sources"; and (16) "Our Environment." The teacher's guide functions to develop and apply basic concepts of the earth and its environment. Selected laboratory experiments include the use of the scientific method, measurement, laboratory instruments, and safety procedures. (YDS)

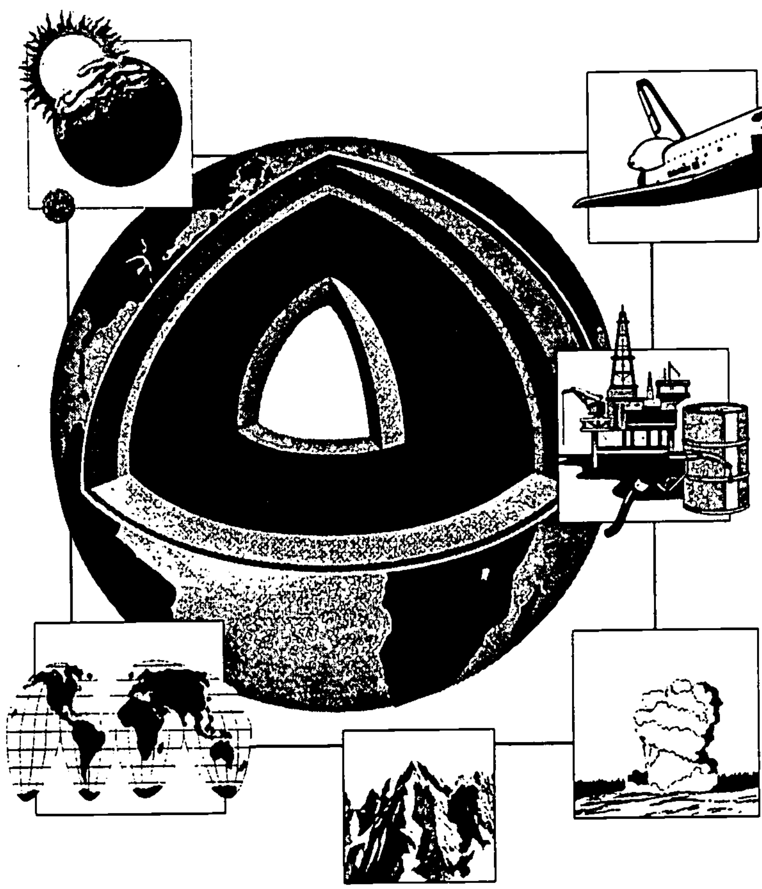
Earth/Space Science Course No. 2001310. [Student Guide and] Teacher's Guide.

Missy Atkinson

Parallel Alternative Strategies for Students

Earth/Space Science

Course No. 2001310



1999

Florida Department of Education

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1998

Florida Department of Education

COURSE DESCRIPTION - GRADES 9-12, ADULT

Subject Area: Science
Course Number: 2001310
Course Title: Earth/Space Science
Credit: 1.0
Will meet graduation requirements for Science

A. **Major Concepts/Content.** The purpose of this course is to develop and apply concepts basic to the Earth, its materials, processes, history, and environment in space.

The content should include, but not be limited to, the following:

- the nature of science
- the universe and the solar system
- the developmental cycle of stars
- the earth-moon system
- space exploration
- formation of igneous, sedimentary, and metamorphic rocks and identification and classification of rocks and minerals
- geological divisions of the earth
- formation of land forms and basic mountain types
- fundamentals of plate tectonics
- formation of rivers and water systems
- glaciers
- hydrologic cycle
- physical oceanography
- meteorology, including development of hazardous weather, weather mapping, weather systems, frontal development, and satellite imagery
- types of soils and erosion
- renewable and nonrenewable energy resources

This course shall integrate the Goal 3 Student Performance Standards of the Florida System of School Improvement and Accountability as appropriate to the content and processes of the subject matter.

B. **Special Note.** Laboratory investigations of selected topics in the content, which include the use of scientific methods, measurement, laboratory apparatus, and safety procedures, are an integral part of this course. Use of satellite imagery, image processing techniques, and model development with behavior-over-time graphs are strongly recommended.

Students earning credit in this course may not earn credit in Earth/Space Science Honors.

C. **Course Requirements.** These requirements include, but are not limited to, the benchmarks from the Sunshine State Standards that are most relevant to this course. Benchmarks correlated with a specific course requirement may also be addressed by other course requirements as appropriate.

Benchmarks from Science, Strand H, should not be taught and assessed in isolation, but should be combined with other benchmarks listed for this course.

After successfully completing this course, the student will:

1. **Use scientific methods to solve problems and demonstrate safe and effective use of laboratory instruments.**

SC.H.1.4.1 know that investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories.

SC.H.1.4.2 know that from time to time, major shifts occur in the scientific view of how the world works, but that more often, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.

SC.H.1.4.3 understand that no matter how well one theory fits observations, a new theory might fit them as well or better, or might fit a wider range of observations, because in science, the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not to absolute truth.

SC.H.1.4.4 know that scientists in any one research group tend to see things alike and that therefore scientific teams are expected to seek out the possible sources of bias in the design of their investigations and in their data analysis.

SC.H.1.4.5 understand that new ideas in science are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from unexpected findings, and usually grow slowly from many contributors.

SC.H.1.4.6 understand that in the short run, new ideas that do not mesh well with mainstream ideas in science often encounter vigorous criticism and that in the long run, theories are judged by how they fit with other theories, the range of observations they explain, how well they explain observations, and how effective they are in predicting new findings.

SC.H.1.4.7 understand the importance of a sense of responsibility, a commitment to peer review, truthful reporting of the methods and outcomes of investigations, and making the public aware of the findings.

SC.H.2.4.1 know that scientists assume that the universe is a vast system in which basic rules exist that may range from very simple to extremely complex but that scientists operate on the belief that the rules can be discovered by careful, systemic study.

2. Contrast scientific theories of the formation of the universe and the solar system.

SC.B.2.4.1 know that the structure of the universe is the result of interactions involving fundamental particles (matter) and basic forces (energy) and that the evidence suggests that the universe contains all the matter and energy that ever existed.

SC.C.2.4.1 know that acceleration due to gravitational force is proportional to mass and inversely proportional to the square of the distance between the objects.

SC.E.2.4.2	identify the arrangement of bodies found within and outside our galaxy.
SC.E.2.4.3	know astronomical distance and time.
SC.E.2.4.4	understand stellar equilibrium.
SC.E.2.4.5	know various scientific theories on how the universe was formed.
SC.E.2.4.6	know the various ways in which scientists collect and generate data about our universe (e.g., X-ray telescopes, computer simulations of gravitational systems, nuclear reactions, space probes, and supercollider simulations).
SC.E.2.4.7	know that mathematical models and computer simulations are used in studying evidence from many sources to form a scientific account of the universe.
SC.H.2.4.1	know that scientists assume that the universe is a vast system in which basic rules exist that may range from very simple to extremely complex but that scientists operate on the belief that the rules can be discovered by careful, systemic study.
SC.H.2.4.2	know that scientists control conditions in order to obtain evidence, but when that is not possible for practical or ethical reasons, they try to observe a wide range of natural occurrences to discern patterns.

3. **Describe the developmental cycles of stars.**

SC.E.2.4.1	know that the stages in the development of three categories of stars are based on mass: stars that have the approximate mass of our Sun, stars that are two- to three-stellar masses and develop into neutron stars, and stars that are five- to six-stellar masses and develop into black holes.

4. **Analyze earth, moon, and sun relationships as they apply to time and seasons.**

SC.E.1.4.1	understand the relationships between events on Earth and the movements of the Earth, its Moon, the other planets, and the Sun.
SC.E.1.4.2	know how the characteristics of other planets and satellites are similar to and different from those of the Earth.

SC.E.1.4.3 know the various reasons that Earth is the only planet in our Solar System that appears to be capable of supporting life as we know it.

5. **Identify and classify different rocks and minerals.**

SC.A.1.4.2 know that the vast diversity of the properties of materials is primarily due to variations in the forces that hold molecules together.

SC.A.1.4.5 know that connections (bonds) form between substances when outer-shell electrons are either transferred or shared between their atoms, changing the properties of substances.

SC.D.1.4.3 know that changes in Earth's climate, geological activity, and life forms may be traced and compared.

6. **Describe crustal movements and their effects, the formation of land masses, and basic mountain types.**

SC.D.1.4.2 know that the solid crust of Earth consists of slow-moving, separate plates that float on a denser, molten layer of Earth and that these plates interact with each other, changing the Earth's surface in many ways (e.g., forming mountain ranges and rift valleys, causing earthquake and volcanic activity, and forming undersea mountains that can become ocean islands).

7. **Describe the changes that occur over time in different Earth system processes.**

SC.D.1.4.3 know that changes in Earth's climate, geological activity, and life forms may be traced and compared.

SC.D.1.4.4 know that Earth's systems and organisms are the result of a long, continuous change over time.

SC.G.2.4.1 knows that layers of energy-rich organic materials have gradually turned into great coal beds and oil pools (fossil fuels) by the pressure of the overlying earth and that humans burn fossil fuels to release the stored energy as heat and carbon dioxide.

SC.G.2.4.6 know the ways in which humans today are placing their environmental support systems at risk (e.g., rapid human population growth, environmental degradation, and resource depletion).

8. **Describe and interpret types of erosion with emphasis on soil types, glaciation, ocean currents, and weather patterns.**

SC.B.1.4.1 understand how knowledge of energy is fundamental to all the scientific disciplines (e.g., the energy required for biological processes in living organisms and the energy required for the building, erosion, and rebuilding of the Earth).

SC.D.1.4.1 know how climatic patterns on Earth result from an interplay of many factors (Earth's topography, its rotation on its axis, solar radiation, the transfer of heat energy where the atmosphere interfaces with lands and oceans, and wind and ocean currents).

SC.D.1.4.3 know that changes in Earth's climate, geological activity, and life forms may be traced and compared.

9. **Assess renewable and nonrenewable earth resources.**

SC.G.2.4.1 know that layers of energy-rich organic materials have been gradually turned into great coal beds and oil pools (fossil fuels) by the pressure of the overlying earth and that humans burn fossil fuels to release the stored energy as heat and carbon dioxide.

SC.G.2.4.2 know that changes in a component of an ecosystem will have unpredictable effects on the entire system but that the components of the system tend to react in a way that will restore the ecosystem to its original condition.

10. **Interpret and develop topographic, geologic, and weather maps.**

SC.D.1.4.3 know that changes in Earth's climate, geological activity, and life forms may be traced and compared.

11. **Describe how the earth/space sciences interact with technology and society.**

SC.D.2.4.1 understand the interconnectedness of the systems on Earth and the quality of life.

SC.G.2.4.4 know that the world ecosystems are shaped by physical factors that limit their productivity.

SC.H.3.4.1 know that performance testing is often conducted using small-scale models, computer simulations, or analogous systems to reduce the chance of system failure.

SC.H.3.4.2	know that technological problems often create a demand for new scientific knowledge and that new technologies make it possible for scientists to extend their research in a way that advances science.
SC.H.3.4.3	know that scientists can bring information, insights, and analytical skills to matters of public concern and help people understand the possible causes and effects of events.
SC.H.3.4.4	know that funds for science research come from federal government agencies, industry, and private foundations and that this funding often influences the areas of discovery.
SC.H.3.4.5	know that the value of a technology may differ for different people and at different times.
SC.H.3.4.6	know that scientific knowledge is used by those who engage in design and technology to solve practical problems, taking human values and limitations into account.

Course Code

RETURN HOME

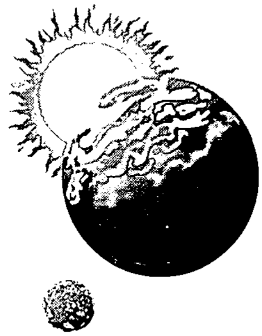
Earth/Space Science

Course No. 2001310

Bureau of Instructional Support and Community Services
Division of Public Schools and Community Education
Florida Department of Education

1999

This product was developed by Leon County Schools, Exceptional Student Education Department, through the Curriculum Improvement Project, funded by the State of Florida, Department of Education, Division of Public Schools and Community Education, Bureau of Instructional Support and Community Services, through federal assistance under the Individuals with Disabilities Education Act (IDEA), Part B.



Earth/Space Science

Course No. 2001310

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Table of Contents

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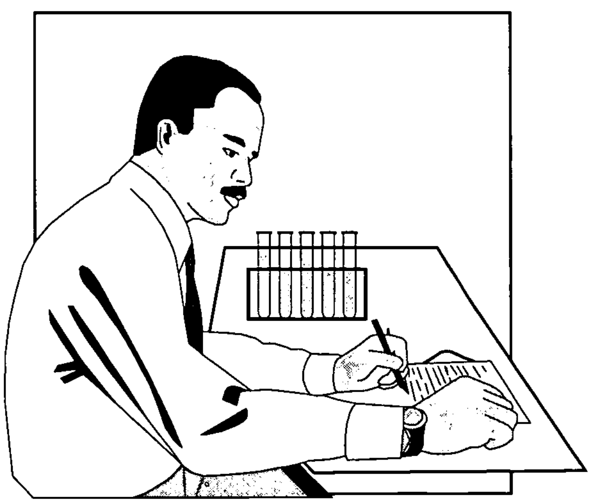
Unit 1: Introduction to the Scientific Processes



Vocabulary

Study the **scientific method** *vocabulary words and definitions below.*

conclusion .... an explanation of a problem based on observations and collected data

control group .... the part of the experiment without a variable factor; allows the results of experiment to be compared

controlled experiment .... an experiment in which all the factors are the same except for the one being tested

data .... scientific facts that are collected, usually in the form of numbers

experiment .... a way to test a hypothesis or try out an answer to a question

experimental group .... part of the experiment that contains the variable factor

fact .... an idea that has been proven by experiments

hypothesis .... an idea or statement that attempts to explain the relationship of observed factors; an educated guess

laboratory .... a place equipped and used for experimental study, research, analysis, testing, or preparation in any branch of science

observation .... noticing something, using one's senses (sight, smell, touch, hearing, or taste)

scientific method .... the steps scientists use to solve problems

theory .... a hypothesis that has withstood the test of time

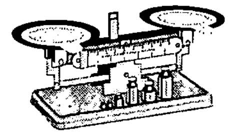
variable factor .... the factor being tested in an experiment

Vocabulary

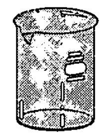
Study the **scientific apparatus** *vocabulary words and definitions below.*

apparatus .... the equipment or tools needed for a specific task, as in biology or chemistry

balance .... used to measure the mass of an object



beaker .... a glass container which is used in scientific experiments



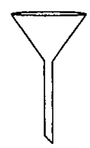
Bunsen burner ....

gas burner used to heat chemicals or apparatus

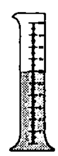
compass .... used to determine direction

eyedropper .... a glass dropper used to dispense small amounts of liquids

funnel .... used to pour liquids into containers

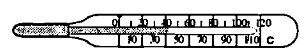


graduated cylinder ....

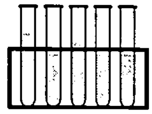


used to measure the volume of a liquid

thermometer .... instrument used to measure temperature



test tube .... multiple-purpose glass container that can be heated



tongs .... a tool with two connected curved arms, used to grasp and lift hot apparatus or chemicals

Introduction

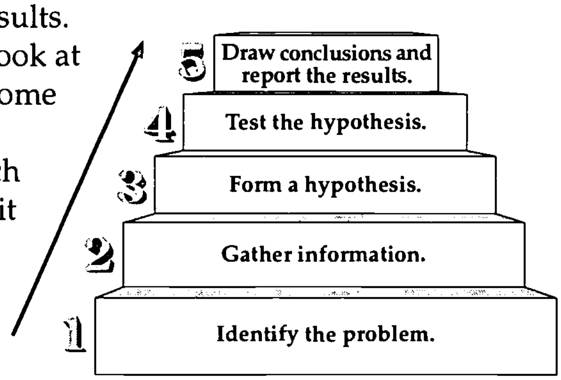
Many of us have had unanswered questions about our environment—why...? how...? when...? Some of us have gone to find answers. Most of us, however, must depend on more qualified individuals for answers. Most often, those qualified individuals are scientists—investigators in the field of science. They specialize in finding answers in an efficient and organized manner.

To investigate efficiently and in an organized way, scientists must use a certain method. This method is called the **scientific method**—a way of solving problems using specific steps. Scientists must also be careful to follow safety rules as they are conducting **experiments** in the **laboratory**. Following laboratory rules protects the results of experiments and also protects scientists from accidents.

Steps of the Scientific Method

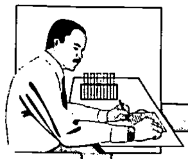
Have you ever observed something in nature and wondered what it is and how it works? If so, you have that in common with scientists. Scientists wonder about nature. They ask questions and design experiments to find the answers to their questions.

Whenever scientists have questions or problems, they use a certain method called the *scientific method* to find answers. It is a way of solving problems using five specific steps—identifying the problem, gathering information, forming a **hypothesis**, testing the hypothesis, and drawing **conclusions** and reporting the results. The method allows scientists to look at a specific problem and develop some solutions. Using the scientific method, scientists can look at each possible solution to determine if it is correct.



Step 1: Identify the problem

The first step is to identify the problem and develop a question about it. The study of a problem always begins with a question. Scientists must know exactly what the question is so that they can decide how they want to go about finding an answer to it.



In a study about the origins of coquina, a stone made of broken shell and bone found in Florida, scientists had only one question: How did coquina stone made from organisms that lived in the ocean come to be found miles away far from the beaches and sea?

Step 2: Gather information

Then information is collected about the question. **Observations** are made and recorded. Careful observations are important in gathering information. Scientists observe everything they can about a scientific problem. Scientists, studying various stones in areas it seemed they could not have formed, used many ways of collecting information to learn when and where the stone formed.

There are various ways to collect information. Some of the ways are listed below.

Ways to Collect Information

- reading about what other scientists have done on the subject
- using the senses (sight, hearing, smell, touch, or taste) to make observations
- using scientific equipment, such as a telescope

Confirmed observations can become scientific **facts**. A fact is an idea that has been proven by experiments. Observations and facts are then recorded. This recorded information becomes **data**. Scientific facts, often in the form of numbers, are called data. Scientists must use logical reasoning to interpret their data.

Step 3: Form a hypothesis

Looking at the data gathered, scientists make a guess and suggest what may be the answer to the problem. This guess, which is based on observations, is called a *hypothesis*. A hypothesis is an idea or statement that explains the relationship of observed facts to each other. It is a tool for further study of the problem. A good hypothesis must include specific explanatory information so that it can be tested.

The idea that ocean levels change was a good hypothesis for several reasons. It explained why coquina rocks were found in dry areas as well as under the sea. It predicted that the level of the ocean would not remain constant over long periods of time and could change by either spreading or receding. Very importantly, this hypothesis could be tested.

A Good Hypothesis

- explains how observed facts relate to each other
- predicts new facts
- lends itself to testing; a hypothesis that cannot be tested is of no value

Step 4: Test the hypothesis

Scientists who proposed that the ocean levels could change would not have had a useful hypothesis if they had not found a way to test it. The test of their hypothesis was as important as the hypothesis itself.

Experimentation is the scientific testing of a hypothesis. It must be done in a careful manner. Scientists must repeat experiments many times before they accept the results. They must also test important factors under different conditions.

An experiment consists of two groups—the **experimental group** (which contains the variable being tested) and the **control group** (without the variable). The factor being tested in the experiment is the **variable factor**. A **controlled experiment** is one in which all the factors are the same except for the one being tested.

Scientists must carefully design their experiments to eliminate the possibility of bias (making their results fit their hypothesis). This is why several scientists will work together or simultaneously on the same experiment to ensure accurate results. The experiment must also be repeated many times achieving the same results in order for conclusions to be made. A single result does not imply any conclusion.

During and after experimentation, scientists must make careful and complete observations. Accurate records of the results must be made in the form of charts, graphs, or tables. Scientists use these charts, graphs, and tables to analyze their data—to look for similarities and differences between the results. These analyses are used to help draw conclusions about their hypothesis.

Scientists developed ways to test their hypothesis that ocean levels change over time. They took precise measurements of the ocean levels.

Step 5: Draw conclusions and report the results

After the experiments are completed, conclusions are drawn. Scientists use the conclusions to reevaluate their hypothesis. They must decide if the conclusions confirm or contradict their hypothesis. An experiment does not always confirm a hypothesis. It may show the hypothesis as being partially or totally wrong. If the hypothesis is wrong, the scientist must go back and study the data and facts. The facts would be interpreted a different way, and the scientist would develop a new hypothesis to be tested. Even if an experiment supports a hypothesis, the experiment may need to be repeated many times before a hypothesis can be confirmed.

Scientists who studied the question of how and where coquina stones formed learned a great deal. After years of measuring, their conclusions stated that oceans could change and the coquina that was found on dry land could have formed in the ocean.

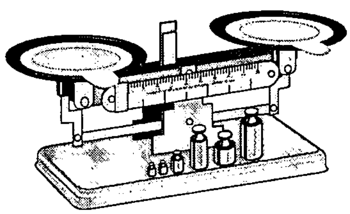
Many scientific discoveries have been made by mistakes or by forming the wrong hypothesis. Penicillin was discovered as a mold that killed all of a researcher's bacteria. Scientists often ask other scientists from different disciplines to review their research and make suggestions for refining their hypothesis or in figuring out why their hypothesis was not supported. Different conclusions may be reached by different teams of scientists working on the same problem. This difference of opinion helps the scientists reach a better understanding of the problem.

When a hypothesis has withstood the test of time, it is called a **theory**. An accepted theory, however, may change as new discoveries in science are made.

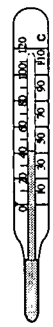
It is important to write down the results of experimentation and make them available for other scientists to use. The results may then be used to continue experimentation—to go on and make more new discoveries.

The Scientific Laboratory

Scientists are required to conduct their experiments in a very careful and precise manner. Exact measurements must be made and recorded. Making these exact measurements requires very specific equipment or scientific **apparatus**. Therefore, scientific laboratories are equipped with special apparatus for measuring and handling materials. Apparatus such as **thermometers**, scales, and **graduated cylinders** are used for measuring. Other apparatus such as **beakers**, **tongs**, **test tubes**, **funnels**, and **eyedroppers** are used for handling materials. Study the pictures of the apparatus below and learn to identify each piece by name and function.

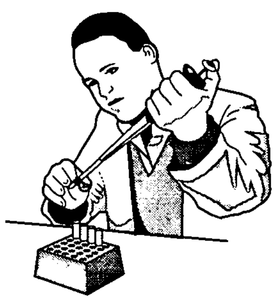


balance

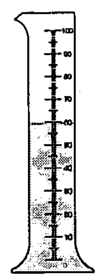


thermometer

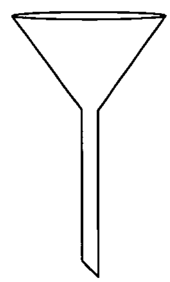
compass



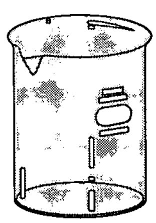
pipet



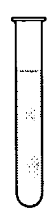
graduated cylinder



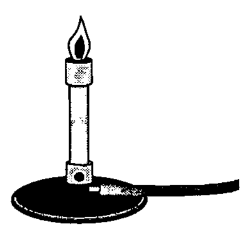
funnel



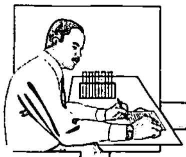
beaker



test tube

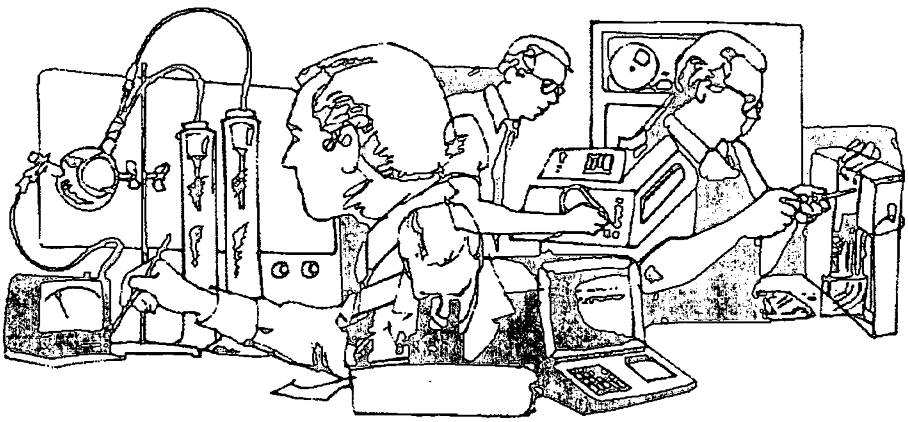


Bunsen burner



Computers and Science

Computers have become very important in scientific studies. Some experiments are performed entirely by the computer. Scientists can develop computer models or simulations to test collected data or a hypothesis. These computer simulations allow scientists to perform complicated mathematical computations more quickly and reliably. Supercomputers can perform billions of calculations per second to help solve complicated problems. Simulations are also used when the experiment may be very dangerous. Computer models help scientists refine their hypothesis and determine the type of information to be collected. Computers have helped speed up the scientific process and allow scientists to simulate past events (like the creation of the universe) or dangerous processes.



Computers also allow scientists to share information and collaborate with others doing similar research. They also allow teams of scientists from different disciplines to review or duplicate research even if they are not on the same continent. The Internet was originally developed by the Department of Defense as a means of sharing and transmitting this research data quickly. Now we use the Internet to research current scientific discoveries, to ask scientists questions about their research, or to collect data for laboratory experiments or simulations. The Internet has helped share current information among the scientific community. It is a great resource for up-to-date information. As with all other resources, however, information from the Internet must be carefully reviewed to determine accuracy and reliability.

Laboratory Safety Rules

The school science laboratory can and should be a safe place in which to explore interesting and challenging activities. There is, however, one factor that is most important—that is *safety*!

The following rules and procedures should be followed at *all* times in order to make the science laboratory a safe place.

Safety Guidelines

1. Read and follow all directions while working in the laboratory.
2. Wear protective gear, such as aprons, at all times. Wear goggles when working with dangerous or hot chemicals, or any time your teacher instructs you to do so.
3. NEVER taste or directly inhale chemicals. Test the smell of a substance by wafting or fanning some of the odor to your nose with your hand. Your teacher can show you how.
4. DO NOT bring food or drink into the lab.
5. Wash hands thoroughly after each lab.
6. DO NOT rub eyes or put hands in mouth.
7. Dress in a way that helps you work safely and efficiently in the lab. Tie your hair back. Wear cotton—it doesn't catch fire as easily as nylon or polyester. Always keep your shoes on while in the lab. Roll up long or loose sleeves.
8. DO NOT look directly down into the mouth of a filled test tube. DO NOT point the mouth of a filled test tube at another student. Liquid can splash into eyes.
9. DO NOT perform any experiments unless the instructor is in the room.
10. Report ALL minor and major accidents to your instructor. Remain calm and do not alarm others by shouting or running.
11. Know the location of the safety shower, eye wash, and fire blanket. Know how to use these important pieces of safety equipment.
12. Turn off gas burners and the gas outlets when no one is using them. NEVER leave a lit burner unattended.
13. Use tongs or gloves to handle hot objects.
14. DO NOT look directly at the sun, with or without equipment, as it may damage your eyes.
15. Keep lab tables clean and neat to prevent accidents. Wipe all areas at the end of the lab.
16. MAKE SAFETY A HABIT!

Summary

The sharing of scientific information requires that scientists be able to obtain and report their findings in an efficient and consistent manner. When answering questions, scientists use the five steps of the scientific method—(1) identifying the problem, (2) gathering information on the problem, (3) forming a hypothesis, (4) testing the hypothesis (experiment), and (5) drawing conclusions and reporting the results. Scientists must also have very specific equipment or apparatus to make accurate measurements and to handle materials properly. Just as scientists have specific rules and procedures for operating in the laboratory, we too must follow safety rules to make our experiences in the science laboratory safe and rewarding.

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

________ 1. An experiment may have only one variable factor.

________ 2. Experiments always prove the hypothesis to be true.

________ 3. A good hypothesis can be tested.

________ 4. A hypothesis attempts to explain the relationship among observed facts.

________ 5. A fact is an idea that has been proven by experiments.

________ 6. Careful observation is an important step in scientific study.

________ 7. Data is usually in the form of numbers.

________ 8. Logical reasoning has no part in a scientific experiment.

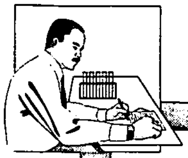
________ 9. If you get positive results from your experiment the first time, it is okay to stop and report your results.

________ 10. It is best to keep the results of your experiment a secret so that no one may steal your ideas.

________ 11. Observation is done solely with the eyes.

________ 12. A theory can be disproved if new discoveries are made.

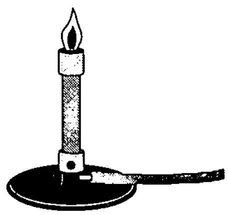
________ 13. The experiment is the last step of the scientific method.



Practice

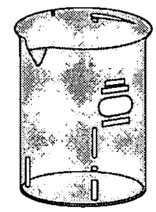
Use the list below to label the **apparatus**. *Write the term on the line provided.*

balance	compass	graduated cylinder
beaker	eyedropper	thermometer
Bunsen burner	funnel	test tube



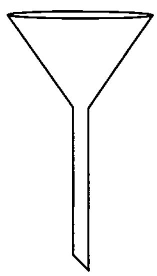
1. ____________

2. ____________

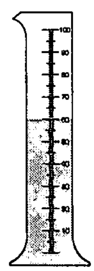


3. ____________

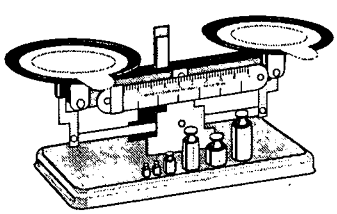
4. ____________



5. ____________



6. ____________



7. ____________

8. ____________

9. ____________

Practice

Circle the letter of the correct answer.

1. A ____________ is an instrument used to measure temperature.
   a. balance
   b. thermometer
   c. compass
   d. funnel

2. A(n) ____________ is used to dispense small amounts of liquid.
   a. eyedropper
   b. graduated cylinder
   c. beaker
   d. test tube

3. A(n) ____________ is a gas burner used to heat chemicals or apparatus.
   a. beaker
   b. compass
   c. eyedropper
   d. Bunsen burner

4. A ____________ is used to pour liquids into containers.
   a. beaker
   b. graduated cylinder
   c. funnel
   d. test tube

5. A ____________ is used to determine which direction you are facing.
   a. thermometer
   b. balance
   c. compass
   d. graduated cylinder

6. A ____________ is a multiple-purpose glass container that can be heated.

   a. graduated cylinder
   b. beaker
   c. funnel
   d. test tube

7. A glass jar which is used in scientific experiments is called a(n) ____________ .

   a. beaker
   b. test tube
   c. graduated cylinder
   d. eyedropper

8. A(n) ____________ is used to measure the mass of an object.

   a. thermometer
   b. compass
   c. apparatus
   d. balance

9. A ____________ is used to measure the volume of a liquid.

   a. beaker
   b. funnel
   c. graduated cylinder
   d. test tube

10. Scientific ____________ is used in the science laboratory.

   a. compass
   b. apparatus
   c. funnel
   d. eyedropper

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. If there is something you do not understand about the lab assignment, you should ask your teacher.

_________ 2. It is only necessary for the teacher to know where the safety equipment is and how to use it.

_________ 3. It is a good idea to bring a lunch along and to eat while working on lab activities.

_________ 4. Use tongs or gloves to handle hot equipment.

_________ 5. It is important to use good housekeeping habits in the laboratory.

_________ 6. Report all accidents to the teacher—no matter how minor.

_________ 7. Do not wear loose or baggy clothes in the lab.

_________ 8. Safety glasses must be worn when working with dangerous or hot chemicals.

_________ 9. It is important to put your nose directly over a container and breathe deeply to smell a substance in the laboratory.

_________ 10. Open test tubes should never be pointed at yourself or at others.

Practice

Find all the **hazards** *in the science lab pictured below. List them on the lines below. Be prepared to discuss them in class.*

____

____

____

____

____

____

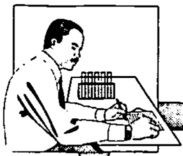
____

____

Practice

List the locations and uses of the **safety equipment** *below.*

Equipment	Location	Use
safety shower		
eye wash		
fire extinguisher		
fire blanket		
sand		
goggles		
lap aprons		
container—broken glass		



Practice

Use the list below to write the correct term for each definition on the line provided.

Bunsen burner	**eyedropper**	**observation**
conclusion	**graduated cylinder**	**thermometer**
control group	**hypothesis**	**variable factor**
experiment		

________________ 1. the factor being tested in an experiment

________________ 2. an instrument used to measure temperature

________________ 3. the part of the experiment without a variable factor

________________ 4. an idea or statement that attempts to explain the relationship of observed factors; an educated guess

________________ 5. used to dispense small amounts of liquid

________________ 6. a way to test a hypothesis or try out an answer to a question

________________ 7. to notice something using one's senses (sight, smell, touch, hearing, or taste)

________________ 8. used to measure the volume of a liquid

________________ 9. an explanation of a problem based on observations and collected data

________________ 10. a gas burner used to heat chemicals or apparatus

Practice

Use the list below to write the correct term for each definition on the line provided.

apparatus	**data**	**scientific method**
balance	**experimental group**	**test tube**
beaker	**fact**	**theory**
controlled experiment		

________________________ 1. an idea that has been proven by experiments

________________________ 2. scientific facts that are collected, usually in the form of numbers

________________________ 3. a hypothesis that has withstood the test of time

________________________ 4. a multiple-purpose glass container that can be heated

________________________ 5. the steps scientists use to solve problems

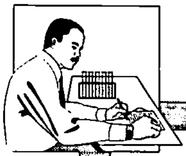
________________________ 6. an experiment in which all the factors are the same except for the one being tested

________________________ 7. part of the experiment that contains the variable factor

________________________ 8. the equipment or tools needed for a specific task, as in biology or chemistry

________________________ 9. a glass container which is used in scientific experiments

________________________ 10. an instrument used to measure the mass of an object



Practice

Circle the letter next to the **scientific method** *term that correctly completes each statement below.*

1. The factor being tested in an experiment is the __________ .

   a. variable
   b. hypothesis
   c. observation
   d. control

2. The part of the experiment without a variable factor is the __________ .

   a. observation
   b. control group
   c. experiment
   d. hypothesis

3. An idea or statement that attempts to explain the relationship of observed factors to each other is a(n) __________ .

   a. hypothesis
   b. observation
   c. fact
   d. conclusion

4. A way to test a hypothesis or try out an answer to a question is a(n) __________ .

   a. fact
   b. experiment
   c. observation
   d. data

5. To notice something using one's sight, smell, touch, hearing, or taste is a(n) __________ .

   a. observation
   b. act
   c. theory
   d. data

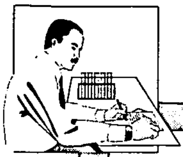
6. An explanation of a problem based on observations and collected data is a __________ .
   a. fact
   b. theory
   c. data
   d. conclusion

7. An idea that has been proven by experiments is a __________ .
   a. fact
   b. theory
   c. controlled experiment
   d. data

8. Scientific facts that are collected, usually in the form of numbers, are called __________ .
   a. data
   b. scientific method
   c. controlled experiment
   d. theory

9. A hypothesis that has withstood the test of time is a(n) __________ .
   a. theory
   b. controlled experiment
   c. scientific method
   d. observation

10. The steps scientists use to solve problems are known as the __________ .
    a. theory
    b. controlled experiment
    c. scientific method
    d. data



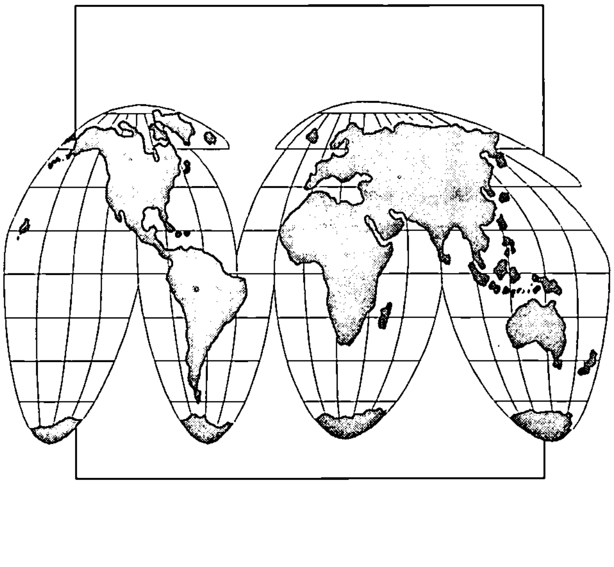
11. An experiment in which all the factors are the same except for the one being tested is a(n) ____________ .

    a. experimental group
    b. controlled experiment
    c. theory
    d. scientific method

12. The part of the experiment that contains the variable factor is the ____________ .

    a. controlled experiment
    b. scientific method
    c. theory
    d. experimental group

Unit 2: Map Reading



Vocabulary

Study the vocabulary words and definitions below.

contour interval .... the difference in elevation between two contour lines

contour lines .... lines that pass through points on a map with the same elevation

elevation .... the height above sea level

equal-area projection map .... a map that shows areas that are positioned correctly but whose shapes are distorted

equator .... imaginary line halfway between the poles; it divides north and south latitude and represents 0° (zero degree) latitude

globe .... a spherical or round model of Earth

International Date Line .... the imaginary line at 180° longitude where east and west longitude meet; at this point, one date changes to the next

isobars .... lines on a weather map that represent areas of equal barometric pressure

isotherms. .... lines on a weather map that represent areas of equal temperature

latitude .... measure of a distance north and south from the equator

legend .... explanation of the symbols used on a map

longitude .... measure of a distance east or west from the prime meridian

map .... a drawing or model of the surface of Earth showing lines of longitude and latitude and positions of physical features of the land

map projection .... a flat drawing of Earth

Mercator projection map .... a map on which both lines of longitude and latitude are parallel; it is good for navigation but gives a distorted view of the polar areas

meridians .... lines on a map that run from the north pole to the south pole that measure longitude

meteorologist .... scientist who studies and predicts the weather

parallels .... lines on a map that circle the globe in an east-west direction; these lines are used to measure latitude

polar projection .... a map that gives an accurate view of the polar regions but a distorted view of the areas near the equator

prime meridian .... an imaginary line that runs through Greenwich, England, that divides east and west longitude; it represents 0° longitude

relief .... the difference in elevation between the high and low points of a land surface

scale .... the comparison of the distance on the map to the actual distance on Earth's surface

time zones .... the 24 longitudinal divisions of Earth that represent the 24 hours of the day; each is 15° of longitude

topographic map .... a flat map of Earth that shows the surface features of the land

Introduction

Maps have been in existence for a very long time—for as long as human beings have wanted to go somewhere. There is evidence that prehistoric people drew maps on the walls of their caves to locate good hunting grounds or other shelters. Maps are used every day. They are now even computerized for use in large transportation systems. Eventually, this computerization will create maps for use in our cars.

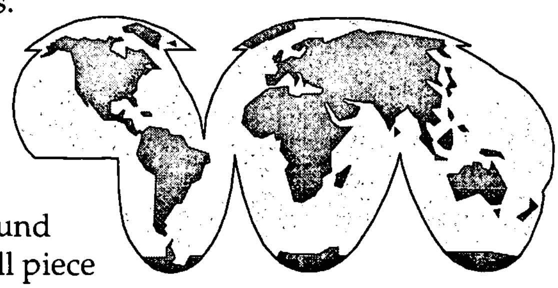
Learning how to read maps, what symbols are used, and how to draw a map are important life skills. The use of three basic types of maps—road maps, **topographic maps**, and weather maps—is essential in the study of Earth/space science.

Maps

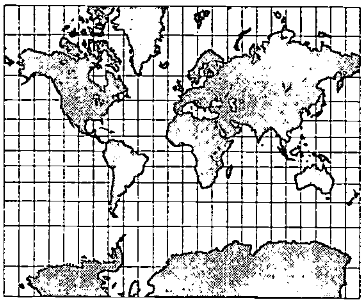
A map is a drawing or model of Earth's surface which shows lines of **longitude** and **latitude**, and positions of physical features. There are different types of maps which show different features of Earth.

A **globe** is a spherical model of Earth. Because its shape is similar to the shape of Earth, it is very accurate. Places on a globe closely correspond to the actual places where they are located on Earth. Globes are not as convenient as maps because they are not easily carried or stored.

A **map projection** is a drawing of Earth's curved surface on a flat piece of paper. A map is much more practical than a globe because it can be put in textbooks; hung on walls; and projected on television, radar screens, and computer screens. However, a map projection also has disadvantages. When a round surface is projected on a flat surface, the shape and size of land masses and oceans are distorted.



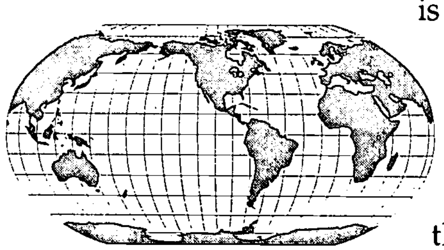
To show how a map distorts a round surface, flatten a large and a small piece of an orange skin. The larger the piece, the more it must be torn to become flat. This is true with the earth's surface also—the larger the area being shown on the map, the greater the distortion will be of that area.



On a **Mercator projection map** both the lines of latitude and longitude are straight and parallel. To understand how a Mercator projection is made, wrap a piece of paper around the **equator** of a globe and form a cylinder. Imagine the surface of the globe transferred to the paper. This gives us a map that is fairly accurate near the equator, but the land masses and oceans near the poles are greatly distorted and appear to be much larger than they really are in that area.

A **polar projection** is formed by placing a flat piece of paper on either of the poles of a globe. The longitude lines point outward like spokes of a wheel, and the latitude lines form a series of circles that get larger as they move away from the poles. This type of map provides a good picture of the polar areas, but the areas along the equator are distorted.

Another type of projection can be found on an **equal-area projection map**. It shows areas positioned correctly, but shapes may be distorted. This map is circular, with the lines of longitude meeting at the poles and the lines of latitude being equal distances apart and curving slightly.

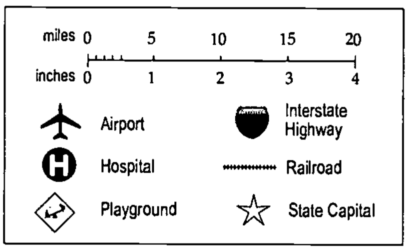


Some map projections are more accurate than others. Mercator projections produce maps that are distorted near the poles. Longitude lines are spread apart on the map to make them parallel. Polar maps, however, give an accurate view of the polar regions. Equal-area maps are useful because the land masses are located at the proper longitude and latitude.

Maps are used for different reasons. Some maps are used to show the following:

- **amount of yearly rainfall**
- **political boundaries of cities, states, and countries**
- **climatic regions**
- **barometric pressure**
- **population**
- **vegetation of an area**
- **soil types**
- **topographic features**
- **elevation**
- **weather**

Every map has a **legend** that explains the symbols used on the map. It is usually located in a box in a lower corner of the map. The legend also shows the **scale** of the map. The scale of the map compares the distance on the map to the actual distance on Earth's surface.

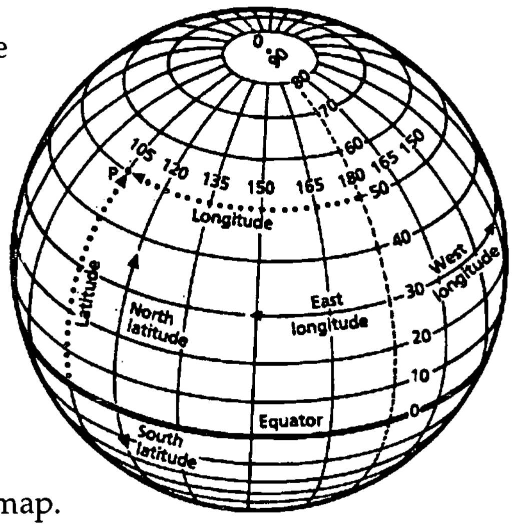


Longitude and Latitude

Maps and globes have lines drawn on them in two directions. Lines that run from the north pole to the south pole are called **meridians**. The **prime meridian** is the imaginary line that runs through Greenwich, England. The measure of distance east and west of the prime meridian is called *longitude*. Lines of longitude that are west of Greenwich are called *west longitude*, and those east of Greenwich are called *east longitude*.

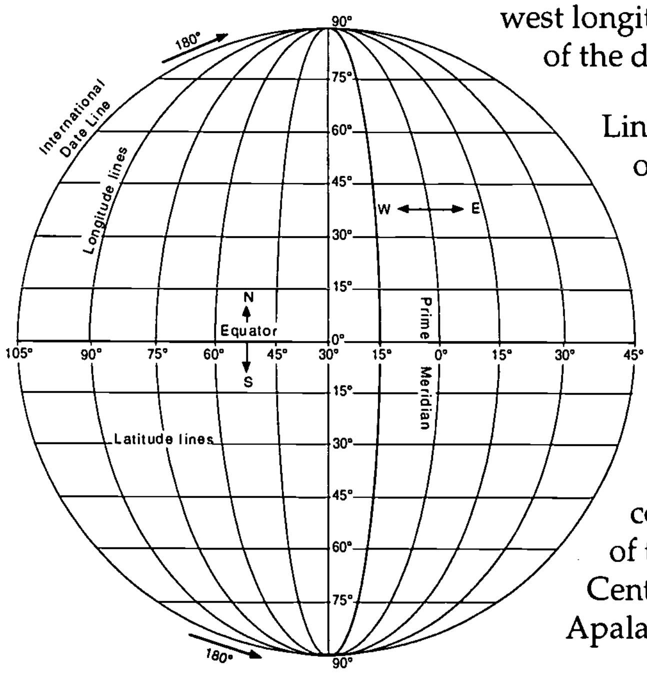
Lines that circle the globe in an east-west direction are called **parallels**. The longest of these is the equator, which is located halfway between the poles. On both sides of the equator, parallel circles (circles that are an equal distance apart) are drawn. These parallels, or circles, get smaller as they near the poles. Parallels measure the distance north and south of the equator, which is called *latitude*.

The equator is labeled 0° latitude. Since the distance from the equator to the poles is one-fourth of the distance around Earth, both poles are labeled 90° latitude. Parallels of latitude that are north of the equator are called *north latitudes*, and those south of the equator are called *south latitudes*.



Latitude and longitude are used to locate places on a map. The parallels and meridians intersect each other to form a grid or network of lines on the map. Any place on the surface of Earth can be located by giving the coordinates of the lines of latitude and longitude that cross at that point. Since distances in a circle are measured in degrees, longitude and latitude are also measured in degrees.

The prime meridian is labeled 0° longitude. Half the distance of a circle is 180°; therefore, the meridian that is halfway around the globe from the prime meridian is labeled 180° longitude. This is called the **International Date Line**. This is the place where one date changes to the next. Here longitude changes from west to east or east to west depending on the direction of travel. The International Date Line also works much like the prime meridian but in reverse. Longitudes to the east of the date line are west longitude. Longitudes to the west of the date line are east longitude.



Lines of longitude and the time of day are closely related. Just as the day is divided into 24 hours, lines of longitude that are 15° apart form 24 divisions of Earth. These divisions are called **time zones**, and there is one for each hour of the day. Four of these time zones divide the contiguous United States. Two of these in Florida—Eastern and Central—are separated by the Apalachicola River.

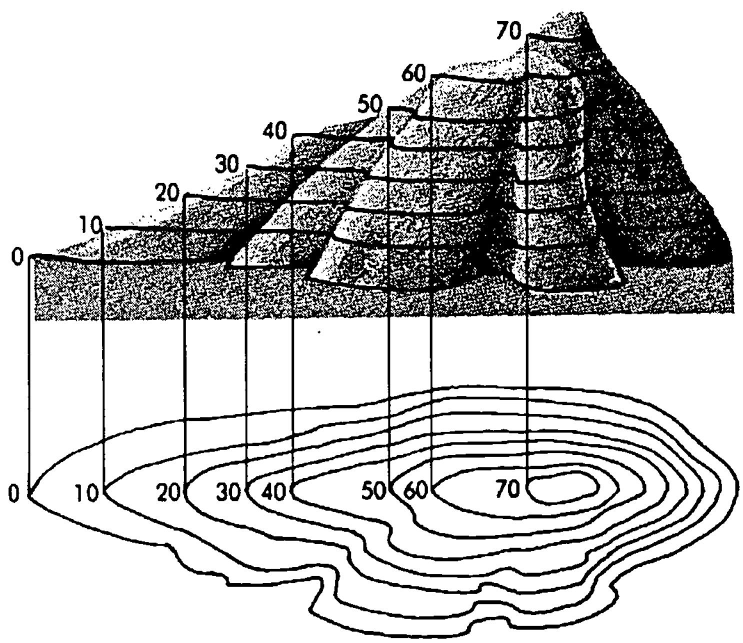
Topographic Maps

A *topographic map* is a line-and-symbol representation of natural and selected man-made features of a part of Earth's surface. These features are plotted to scale. Topographic maps show landscape features such as hills, mountains, plains, lakes, and rivers. They also show some features placed on Earth by people such as railroads, cities, dams, and roads.

Topographic maps show the shape and **elevation**, or height of surface features above sea level, of the land. In order to represent elevation on a flat map, **contour lines** are used. Contour lines are drawn to join points of equal elevation. These lines are then numbered to represent the number of feet above or below sea level of the land at that point. The difference in elevation between two contour lines is called the **contour interval.**

Topographic maps have many uses as basic tools for planning recreational sites, airports, highways, and construction of all types.

The difference in elevation between the high and low points of the land's surface is called the **relief** of the map. A map with high relief represents a lot of variation in elevation and usually indicates a very hilly or mountainous area. On the other hand, an area with low relief may be found along the coast or in the plains, where the land is generally flat.

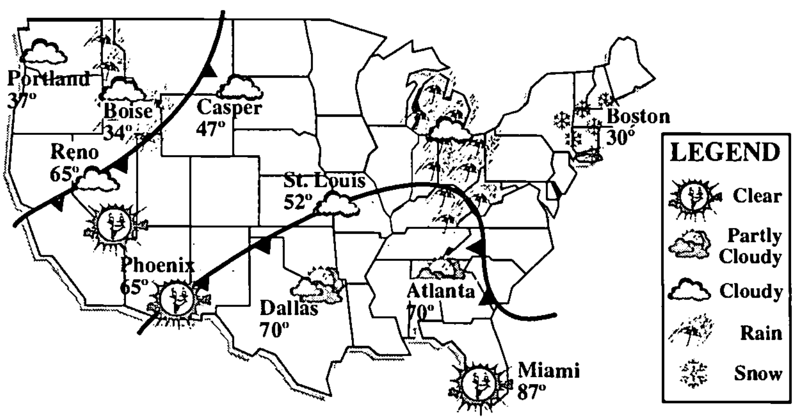


When using contour lines, the following rules apply:

- Contour lines close to form irregular ovals or circles around hills, lakes, or basins.
- Each line represents the same height above sea level all along its course.
- When contour lines cross a stream, they form a V that points upstream.
- Contour lines do not stop in the middle of the map; they either close or go to the edge of the map.
- Contour lines do not cross other contour lines that represent a different elevation.

Weather Maps

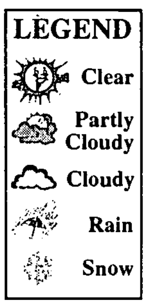
Meteorologists are scientists who study and predict the weather. They gather information about the weather from many sources, such as weather satellites, barometers, and thermometers and from observations of weather currently happening in different parts of the country. Meteorologists take this information and put it on a map, using various symbols.



Weather maps show different kinds of weather information. Places with the same barometric pressure are connected by lines called **isobars**. They show the size and position of high- and low-pressure systems. Lines that connect points of equal temperature are called **isotherms**. Weather maps may also show the direction and speed of the wind and types of precipitation, such as rain, drizzle, and snow.

Weather satellites send us pictures that show cloud covers and movement. They can also help meteorologists predict where pressure systems are moving, as well as the movement of tropical storms and hurricanes.

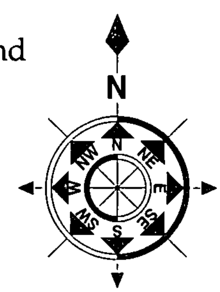
From the information gathered and represented on weather maps, meteorologists can then predict the weather for the next few days. Weather predictions are usually about 75 percent to 85 percent accurate. Due to rapidly changing conditions, it is impossible to be correct 100 percent of the time.



As with other types of maps, weather maps also have a legend which tells what the symbols on the map represent. The symbols used by the National Weather Service are standard—always the same. This makes it easier to track and predict weather conditions. For example, hurricanes are tracked by plotting the latitude and longitude of the storm. This is done every few hours. Despite this, it is still difficult to predict the course of hurricanes, since they often change directions suddenly. When tracking weather on television or in the newspaper, though, you should check the map legend because smaller, independent sources may use different symbols from those of the National Weather Service.

Summary

Different types of maps show different features of Earth and have different uses. Each type has advantages and disadvantages. Legends and scales help us interpret maps. Parallels and meridians are imaginary lines that measure distances in degrees of latitude and longitude. Special maps, such as topographic and weather maps, give special types of information.



Practice

Use a **Florida map** *to answer the following using short answers.*

1. Find the scale on the map. How many miles does one inch represent?

2. Find the legend on the map. Draw three of the symbols used on the lines below. Identify what each represents.

Symbol	Represents
____________________	____________________
____________________	____________________
____________________	____________________

3. Find the distance in miles between the following cities.

Cities	Distance
1. Fort Lauderdale—Miami	
2. Miami—West Palm Beach	
3. Fort Lauderdale—Orlando	
4. Daytona—Jacksonville	
5. Jacksonville—Miami	
6. Fort Myers—Fort Lauderdale	
7. Tampa—Sarasota	
8. Miami—Key West	
9. Gainesville—Ocala	
10. Tallahassee—Jacksonville	

4. In what counties are the Everglades? ______________________

____

5. Name the large lake near the Everglades. ______________________

____

6. What swamp is near Jacksonville? ______________________

7. Name three rivers near the city in which you live. ______________

____

8. Name two islands that are part of Florida. ______________________

____

9. What is the capital of Florida? ______________________

10. Name two cities in Florida that each of these major highways connect.

I–10 ______________________ and ______________________

I–75 ______________________ and ______________________

A1A ______________________ and ______________________

Practice

Use a **city map** *to locate the following information. Write the name of the* **street** *or* **highway** *and the* **map coordinates** *in the spaces below.*

Find	Street Name	Grid #
a major highway or interstate that goes through a city		
a street that runs east and west		
an avenue that runs north and south		
a boulevard		
city hall		
courthouse		
post office		
library		
a police station		
a hospital		
a bus depot		
your favorite restaurant		
a hotel		
a tourist attraction		
a park		
a school		

Practice

Answer the following using short answers.

1. What is a map? ______________________________

   ____

2. What is a globe? ______________________________

   ____

3. Why is a globe a more accurate representation of Earth than a map?

   ____

   ____

4. What is a map projection? ______________________________

   ____

   ____

5. Name three ways map projections can be used that globes cannot be used.

   ____

   ____

   ____

6. What is the main disadvantage of a map projection? ______________

   ____

   ____

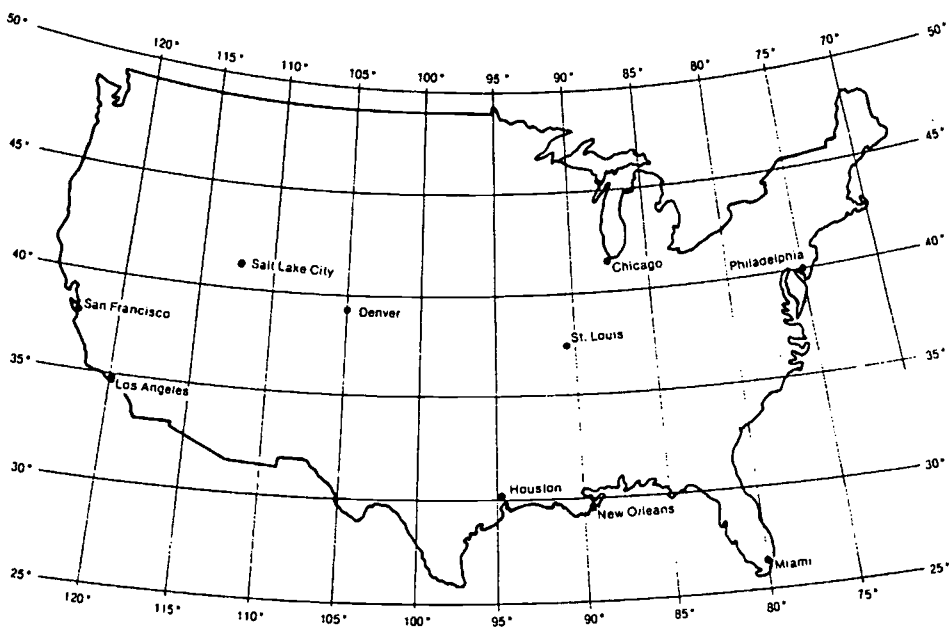
Practice

Match each phrase to the correct type of **map projection** *that it describes. Write the letter on the line provided. The letters will be used more than once.*

______ 1.	areas positioned correctly, shapes distorted	A. Mercator projection
______ 2.	made by wrapping paper around equator in cylinder	B. polar projection
______ 3.	made by placing flat piece of paper on poles	C. equal-area projection
______ 4.	both lines of latitude and longitude are parallel	
______ 5.	longitude lines point out like spokes on a wheel	
______ 6.	accurate near the equator, distorted at poles	
______ 7.	accurate near poles, distorted near equator	
______ 8.	lines of longitude meet at both poles	
______ 9.	good for navigation purposes	
______ 10.	good for showing exact location of land masses	

Practice

Use the **United States map** *below to complete the chart. Give the* **latitude** *or* **longitude lines** *of each city. If the city falls between latitude or longitude lines,* **estimate** *the correct position. There are 5° between the lines. For example, San Francisco is about halfway between 35° and 40° latitude; its latitude would be 38° and its longitude 122°.*



City	Latitude	Longitude
1. San Francisco	38° N	122° W
2. Los Angeles		
3. Salt Lake City		
4. Denver		
5. Chicago		
6. St. Louis		
7. Houston		
8. New Orleans		
9. Philadelphia		
10. Miami		

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Practice

Label the **world map** *on the next page with the following terms. Then answer the questions below.*

Africa	Australia	International Date Line
Antarctica	equator	North America
Arctic Ocean	Europe	Pacific Ocean
Asia	Greenland	prime meridian
Atlantic Ocean	Gulf of Mexico	South America

1. What continent lies between 20° and 60° north latitude and between 160° and 50° west longitude?

   ____

2. What continent lies between the equator and 40° south latitude and between 110° and 160° east longitude?

   ____

3. What continent lies between 20° north latitude and 60° south latitude and between 90° and 30° west longitude?

   ____

4. What continent lies between 40° south latitude and 40° north latitude and between 20° west longitude and 50° east longitude?

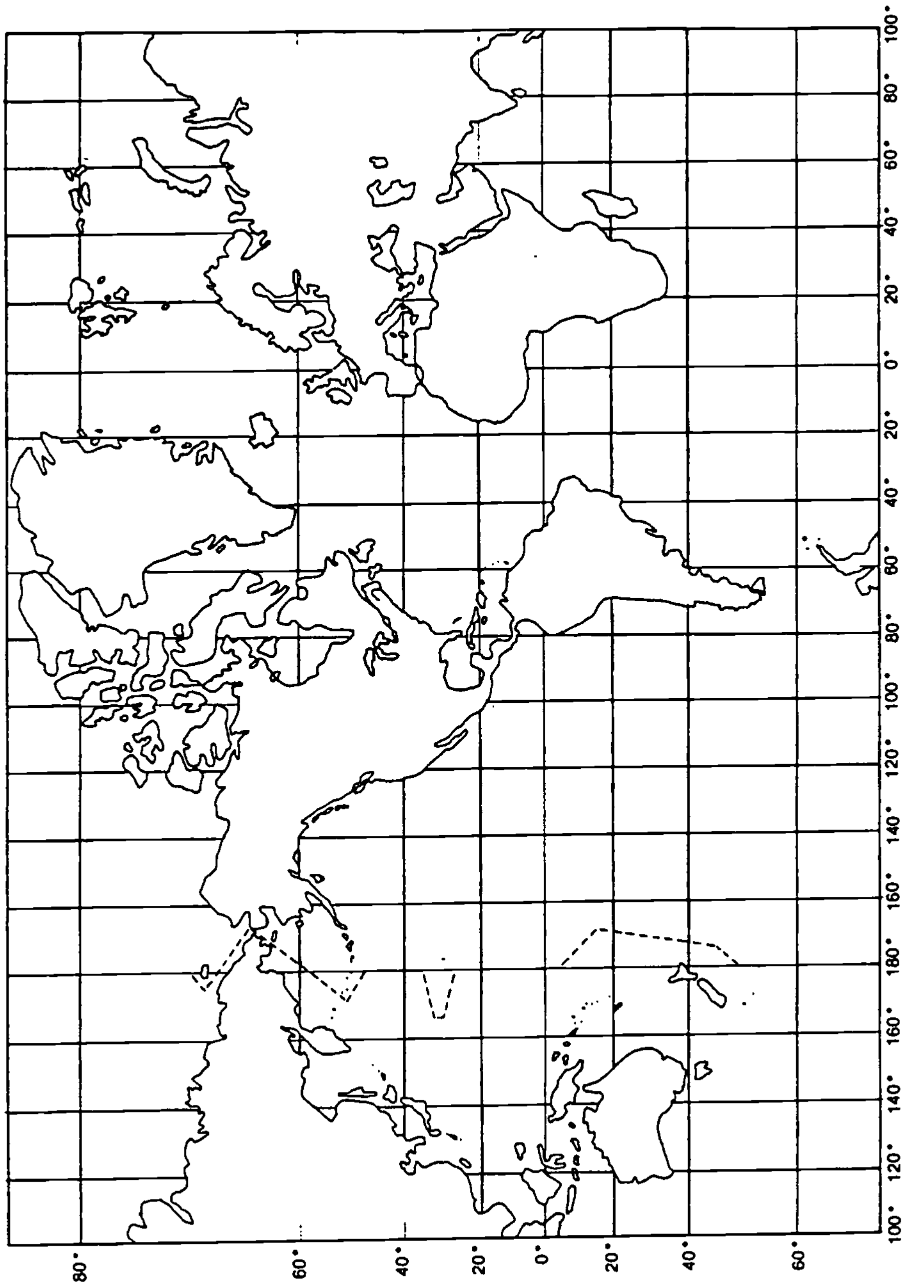
   ____

5. What continent lies between 30° and 70° north latitude and between 20° west longitude and 40° east longitude?

   ____

Practice

Use the **world map** *below to complete the practice on the previous page.*



Practice

Match each definition with the correct term. Write the letter on the line provided.

______ 1. lines that run from the north pole to the south pole

______ 2. the imaginary line that runs through Greenwich, England

______ 3. lines that circle the globe in an east-west direction

______ 4. the parallel that is located halfway between the two poles

______ 5. the measure of a distance north and south of the equator

______ 6. the measure of a distance east and west of the prime meridian

______ 7. longitude is measured in this unit

______ 8. the meridian that is halfway around Earth from the prime meridian

______ 9. the 24 longitudinal divisions of Earth that are 15° wide and that correspond to the 24 hours of the day

______ 10. latitude of the equator

______ 11. latitude of the poles

______ 12. longitude of Greenwich, England

______ 13. longitude of the International Date Line

A. 0° latitude

B. 0° longitude

C. 90° latitude

D. 180° longitude

E. degrees

F. equator

G. International Date Line

H. latitude

I. longitude

J. meridians

K. parallels

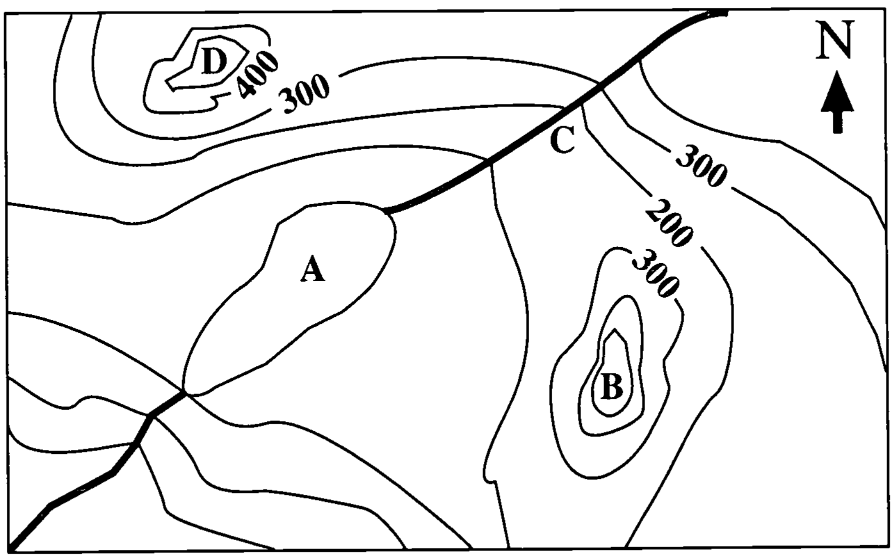
L. prime meridian

M. time zones

Practice

Use the **contour map** *below to answer the following questions.*

1. What type of landform is A? ______________________________
2. What type of landform is C? ______________________________
3. In which direction is C flowing? ___________________________
4. What type of landform is B and D? _________________________
5. What is the elevation of B? _______________________________
6. What is the elevation of D? _______________________________
7. What is the contour interval of this map? ____________________
8. What is the length of the lake in this map? (Hint: use a ruler and the scale of the map.) ______________________________



Scale: 1 cm = 100 meters

Practice

Bring in the **weather map** *from the local newspaper or the Internet. Draw the* **weather conditions** *on the maps below for four consecutive days. Try to* **predict** *what the weather map will look like for the next day based on your other maps. Make a* **legend** *at the bottom of the page for the weather maps.*

Date:

Date:

Date:

Date:

Date:

Legend

Practice

Answer the following using short answers.

1. What is a topographic map? ______________________________

____

2. What are four landscape features that topographic maps show?

____

____

3. What four features placed on Earth by people do topographic maps show?

____

____

4. What term describes the height of features above or below sea level?

____

5. How is elevation shown on a flat map? ____________________

6. What is a contour interval? ______________________________

____

7. On a map, what is relief? ________________________________

8. What landscape features are found on a map with high relief? _____

____

9. What type of land is represented on a map with low relief? ______

____

Practice

Use the list below to write the correct term for each definition on the line provided.

elevation	**legend**	**polar projection**
equator	**map**	**relief**
International Date Line	**Mercator projection map**	**time zone**
isobars	**meteorologist**	

______________________ 1. the 24 longitudinal divisions of Earth that represent the 24 hours of the day; each is 15° of longitude

______________________ 2. the difference in elevation between the high and low points of a land surface

______________________ 3. a drawing or model of the surface of Earth showing lines of longitude and latitude and positions of physical features of the land

______________________ 4. explanation of map symbols

______________________ 5. lines on a weather map that represent areas of equal barometric pressure

______________________ 6. a map that gives an accurate view of the polar regions but a distorted view of the areas near the equator

______________________ 7. scientist who predicts the weather

______________________ 8. a map on which both lines of longitude and latitude are parallel

______________________ 9. the imaginary line at 180° longitude where east and west longitude meet

______________________ 10. imaginary line halfway between the poles that represents 0° latitude

______________________ 11. the height above sea level

Practice

Use the list below to write the correct term for each definition on the line provided.

contour interval	**isotherms**	**parallels**
contour lines	**longitude**	**prime meridian**
equal-area projection map	**map projection**	**topographical map**
globe	**meridians**	

_______________ 1. a flat drawing of Earth

_______________ 2. the difference in elevation between two contour lines

_______________ 3. lines on a map that run from the north pole to the south pole that measure longitude

_______________ 4. lines that pass through points on a map with the same elevation

_______________ 5. east-west lines on a map that circle the globe and measure latitude

_______________ 6. a map that shows areas that are positioned correctly but whose shapes are distorted

_______________ 7. an imaginary line that runs through Greenwich, England, that divides east and west longitude

_______________ 8. a spherical model of Earth

_______________ 9. a flat map of Earth that shows the surface features of the land

_______________ 10. lines on a weather map that represent areas of equal temperature

_______________ 11. measure of a distance east or west from the prime meridian

Practice

Circle the letter of the correct answer.

1. ____________ are lines that pass through points on a map with the same elevation.

    a. Contour lines
    b. Isobars
    c. Scales
    d. Equators

2. The ____________ is an imaginary line that is halfway between the poles; it divides north and south latitude and represents 0° latitude.

    a. International Date Line
    b. globe
    c. equator
    d. isotherm

3. ____________ are lines on a weather map that represent areas of equal temperature.

    a. Latitude
    b. Isotherms
    c. Isobars
    d. Longitude

4. A ____________ is an explanation of the symbols used on a map.

    a. legend
    b. map
    c. Mercator projection map
    d. map projection

5. A ____________ is a map on which both lines of longitude and latitude are parallel; it is good for navigation but gives a distorted view of the polar areas.

    a. meteorologist
    b. meridian
    c. Mercator projection map
    d. polar projection

6. __________ are lines on a map that circle the globe in an east-west direction; these lines are used to measure latitude.

   a. Scales
   b. Elevation
   c. Polar projections
   d. Parallels

7. __________ is the difference in elevation between the high and low points of a land surface.

   a. Time zone
   b. Prime meridian
   c. Scale
   d. Relief

8. A __________ is a flat map of Earth that shows the surface features of the land.

   a. topographic map
   b. time zone
   c. relief
   d. scale

9. __________ is the difference in elevation between two contour lines.

   a. Equator
   b. Equal-area projection map
   c. Polar projection
   d. Contour interval

10. A(n) __________ is a spherical model of Earth.

   a. International Date Line
   b. equator
   c. legend
   d. globe

11. The __________ is an imaginary line at 180° longitude where east and west longitude meet; at this point, one date changes to the next.

    a. legend
    b. latitude
    c. equator
    d. International Date Line

12. A __________ is a drawing or model of the surface of Earth showing lines of longitude and latitude and positions of physical features of the land.

    a. meteorologist
    b. meridian
    c. map projection
    d. map

13. A flat drawing of Earth is a __________ .

    a. parallel
    b. meteorologist
    c. Mercator projection map
    d. map projection

14. A __________ is a map that gives an accurate view of the polar regions but a distorted view of the areas near the equator.

    a. scale
    b. polar projection
    c. relief
    d. prime meridian

15. The __________ is an imaginary line that runs through Greenwich, England, that divides east and west longitude; it represents 0° longitude.

    a. prime meridian
    b. scale
    c. equator
    d. time zone

16. The 24 longitudinal divisions of Earth represent the 24 hours of the day; each is 15° and is called a __________ .

    a. prime meridian
    b. scale
    c. topographic map
    d. time zone

17. A(n) __________ is a map that shows areas that are positioned correctly but whose shapes are distorted.

    a. equator
    b. International Date Line
    c. globe
    d. equal-area projection map

18. The height above sea level is called __________ .

    a. elevation
    b. equator
    c. International Date Line
    d. globe

19. __________ is a measure of the distance north and south from the equator.

    a. Map projection
    b. Map
    c. Legend
    d. Latitude

20. __________ are lines on a weather map that represent areas of equal barometric pressure.

    a. Isobars
    b. Longitudes
    c. Latitudes
    d. Isotherms

21. __________ is the measure of a distance east or west from the prime meridian.

a. Latitude
b. Mercator projection map
c. Map
d. Longitude

22. Scientists who study and predict the weather are called __________.

a. astronauts
b. geologists
c. meteorologists
d. biologists

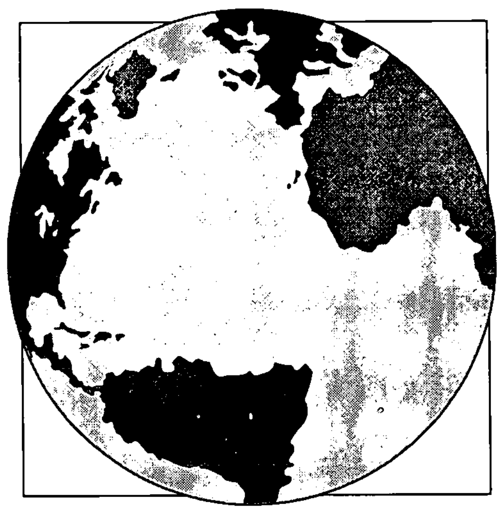
23. __________ are lines on a map that run from the north pole to the south pole that measure longitude.

a. Polar projections
b. Meridians
c. Parallels
d. Meteorologists

24. A __________ is the comparison of the distance on the map to the actual distance on Earth's surface.

a. topographic map
b. time zone
c. relief
d. scale

Unit 3: The Universe and Solar System



Vocabulary

Study the vocabulary words and definitions below.

asteroids .... fragments of rock and metal that orbit the sun; many are in a belt between Mars and Jupiter

comet .... a mass of dust and ice with a bright gaseous tail that orbits the sun

constellation .... a small number of stars that appears to form a shape or image

elliptical galaxies .... galaxies that have a very bright center that contain very little dust and gas and are spherical to disklike in shape

galaxy .... millions or billions of stars in a system

meteors .... fragments of rocky material from space that burn as they fall through Earth's atmosphere; also known as meteoroids

nebula .... a cloud of interstellar gas and dust (*pl.* nebulae)

orbit .... (noun) the path of an object revolving around another object; (verb) to revolve in a path around another object

planets .... bodies that revolve around a sun and reflect its light

satellite .... an object that revolves around a larger object

solar system .... the sun and all the planets, their moons, asteroids, meteors, and comets; all objects that move around the sun

spiral galaxies .... disk-shaped galaxies that have a center of bright stars and flattened arms that swirl around the center, and look like a pinwheel; the solar system is part of a spiral galaxy

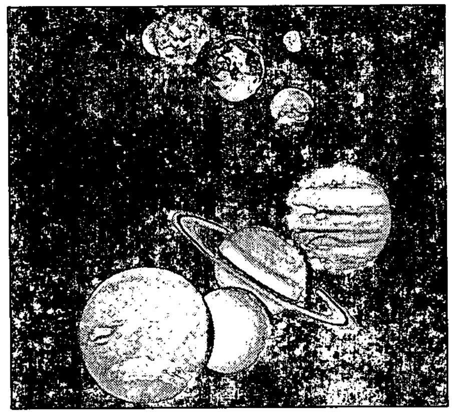
stars .... hot, bright bodies of gas constantly exploding in space

stellar equilibrium .... the balance between forces in a star including nuclear fusion, gravity, and the explosive force of the star

theory .... a hypothesis that has withstood the test of time

universe .... all bodies in space and all space between these bodies—all matter and all energy

Introduction



As early humans began to study the sky, they believed Earth to be the center of the **universe**. Their observations were based solely upon the motion of the sun, moon, **planets**, and **stars** that their eyes could see—not an actual, scaled model. In time, the astronomers were able to develop more realistic models of our **solar system** with the sun as the center of the universe. Today, we know that even this model has changed. With new technologies, today's scientists are able to learn even more about space, enabling us to understand our world and even worlds beyond our own.

Origin of the Universe

Scientists have offered many **theories**, or educated guesses, on how the universe began. The theory that most scientists accept today is called the *Big Bang* theory.

According to this theory, all of the matter and energy found in the universe was once packed together in a single body. Between 15 and 20 billion years ago there was a huge explosion, and matter and energy spread outward in all directions. As the material cooled, gas formed and collected into expanding clouds. As the clouds moved away from the center of the explosion, they cooled and condensed to form galaxies. These galaxies continued to move away from each other and are still moving today. Within these galaxies today, stars form and die while the entire universe continues to expand.

Origin of the Solar System

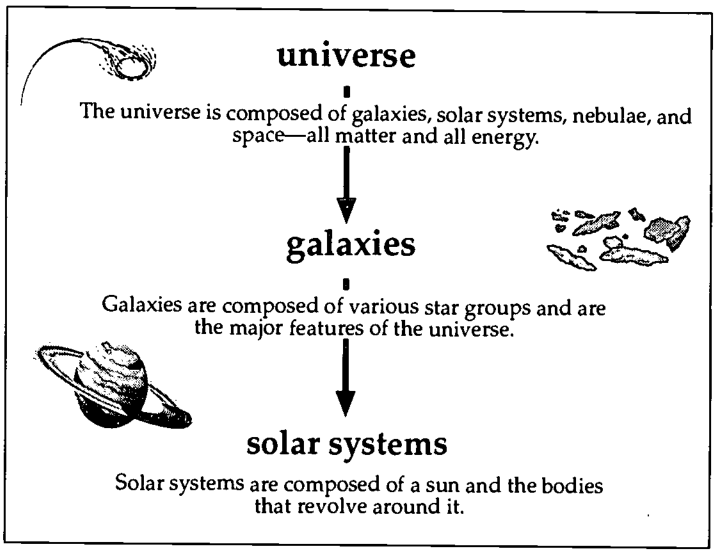
There are also many theories of how the solar system began. The force of gravity once pulled the solar system together. Scientists think that about five million years ago, gravity pulled together a large cloud of dust and gas. According to the *Dust Cloud* theory, also known as the nebular theory, a slowly rotating cloud of dust and gas—a **nebula**—formed in one of the spiral arms of our **galaxy**, the Milky Way. As the cloud shrank, its center became so dense and hot that a star, the sun, was formed. Smaller fragments of remaining material began to **orbit** the sun. In time, gravity pulled these small bits of gas and dust together. These small bits then combined to make a few larger masses. These masses formed the planets and their **satellites**. When the sun began to shine, the remaining gas and dust were driven back into space, and only the material that had condensed into solid bodies remained.

Another theory suggests that a star larger than the sun came very close to the sun. The closeness of the larger star caused explosions on the sun. The gases from these explosions condensed into particles which formed the planets.

The Universe

The *universe* is a system that contains many smaller parts. Galaxies, solar systems, nebulae, and space—all matter and energy—are the components that make up the universe.

Galaxies like our Milky Way are composed of various star groups and are the major features of the universe. Within galaxies, there are many different types of stars. Some of these stars are orbited by *satellites*. These star groups are called *solar systems*. Our sun is an example of a star with orbiting satellites. Only about one percent of all matter in the universe is found in galaxies.

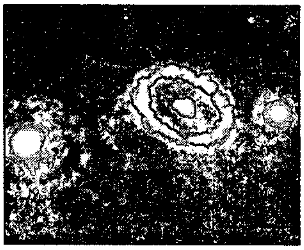


The other 99 percent of matter in the universe is in *space*. Some matter is composed of nebulae, or dust and gas clouds, that are difficult to see without special instruments. The rest is called *dark matter* because we cannot see or detect it.

Measuring Distances in the Solar System

Distances within the solar system are commonly given in AUs. AU stands for Astronomical Unit, the average distance between the sun and Earth. One AU equals 93 million miles or 150 million kilometers. The planet Mercury is .3 AUs from the sun and Earth is one AU from the sun.

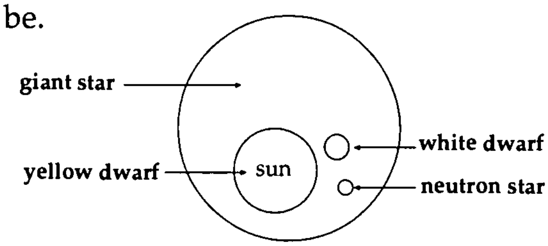
The Stars, Planets, and Heavenly Bodies



In the universe, there are many groups of billions of stars called galaxies. Galaxies are classified according to their shape. One kind of galaxy is a **spiral galaxy**. It is disk-shaped and looks like a pinwheel with large arms that unwind from the center. Earth's galaxy, the Milky Way, is a spiral galaxy. Another common galaxy is an **elliptical galaxy**, which looks spherical to flattened or disklike in shape. They have no arms and very little dust and gas.

Stars

Stars differ in size, brightness, and temperature. Our sun is average in size for a star. Stars come in a variety of sizes and colors. They range from blue to red, from less than half the size of our sun to over 20 times the sun's size. The size and temperature of a star depends on how much gas and dust collects as the star forms. The color of the star depends on the surface temperature of the star. The more mass a star starts out with, the brighter and hotter it will be.



Sizes of Stars

Earth's sun is a medium-sized star and is called a *yellow dwarf*. There are many explosions on the surface of the star as the star uses its nuclear fuel. This nuclear activity, fusion, produces all the star's light and heat.

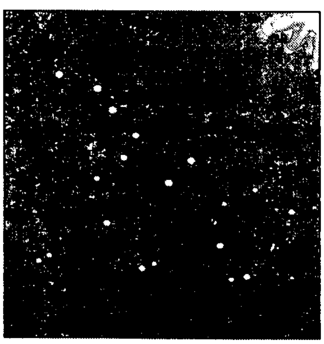
Fusion is the joining of atoms to form new atoms. In a young star, such as our sun, four atoms of hydrogen join to form one atom of helium. This process releases the heat and light of the sun. As stars age, they use all their hydrogen. At this point, their fuel becomes the helium they produced earlier.

Medium-sized stars (such as our sun) use their fuel (helium) until they reach the red giant phase. In red giants, the outer layers expand, the core contracts, and helium atoms in the core fuse to form carbon. Once the carbon core is stabilized, the end is near. The star will shed its outer layers as a gaseous cloud called a planetary nebula. The star continues cooling and shrinking until it has become a white dwarf. The star then radiates its remaining heat into the coldness of space. In the end, it will be a cold dark mass sometimes referred to as a black dwarf. Our sun is expected to produce life-sustaining levels of light energy for about another five billion years.

Stars that are five or more times as massive as our sun follow a slightly different path. When they use up their hydrogen, they eventually grow into a red supergiant (i.e., a very big red giant) and begin to shrink, growing hotter and denser. When the core becomes essentially just iron, the star has nothing left to fuse. In less than a second, the star begins the final phase of its collapse. The core temperature rises to over 100 billion degrees as the iron atoms are crushed together. In one of the most spectacular events in the universe, the explosive shock of the collapsing core propels the material away from the star in a tremendous explosion called a supernova. The exploded material moves off into space possibly colliding with other cosmic debris to form new stars, planets, or moons.

If the core remains intact after the supernova, it is called a neutron star. However, if the original star was very massive (15 or more times the mass of our sun), a black hole might form. A black hole produces no light (hence it is *black*), but it is extremely massive. Black holes have so much gravity, even light falls into them.

Stars maintain a balance between the great forces that produce radiation and fuel their nuclear fusion. This balance is called **stellar equilibrium**. As large stars grow older, they use up their remaining fuel, and this balance is thrown off, creating great explosions called supernovas and collapsing with great changes of gravity into neutron stars or black holes. In these changes, matter is neither created nor destroyed; it changes form and the remaining star particles and gases can now form new stars in the universe.

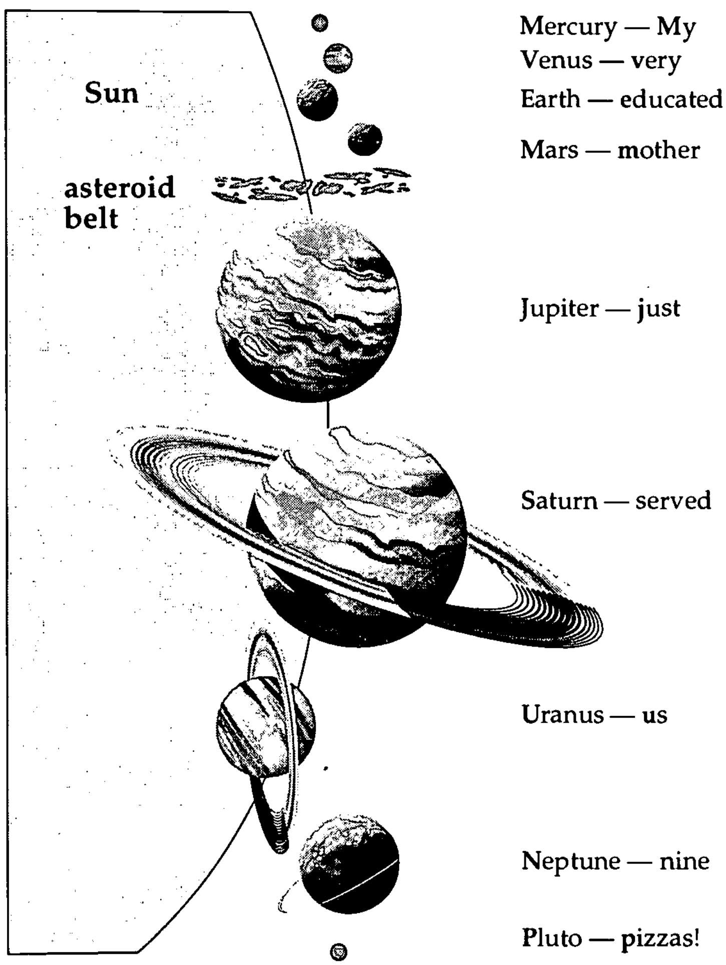

the Great Bear

When people look at the universe, they often see smaller groups of stars called **constellations**.

Constellations look like pictures or shapes. The Big Dipper and Little Dipper are constellations. The planets, sun, and moon all follow paths within a narrow belt across the sky. There are 12 constellations that appear in this belt. These constellations are called the signs of the Zodiac. The names of the signs of the Zodiac are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces.

Orbiting the sun are the nine planets of the solar system. *Planets* do not burn like stars but reflect the light of the sun. It is easy to remember the names of the planets in their order from the sun.

Just remember this sentence: My very educated mother just served us nine pizzas!



My very educated mother just served us nine pizzas!

Moons are satellites that orbit the planets. Some planets have no moons, and some have many moons. Earth has one moon. The moon accompanies Earth on its annual journey around the sun.

Masses of dust and ice with a gaseous tail, called **comets**, also revolve around the sun. Halley's Comet is the most well-known comet. It is seen from Earth every 76 years. Halley's Comet was last seen in 1986. It will not be seen again until the year 2062.

Meteors are small pieces of rocky material that sometimes enter Earth's atmosphere. When a meteor enters Earth's atmosphere, it begins to burn. This is called a *shooting star*, but it is not really a star. The rocky fragments of a meteor that hit the surface of Earth are called *meteorites*.

Asteroids are pieces of rock and metal that orbit the sun. Many are located in a belt between the planets Mars and Jupiter. These fragments of matter are similar to that from which planets were formed. They may be a broken-up planet or trapped debris. Asteroids range in size from tiny particles, too small to be seen, to masses 1,000 kilometers in diameter.

Planets

Our solar system consists of nine planets, their satellites, and many other small bodies such as asteroids, comets, and meteoroids. The planets in order from the sun are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.

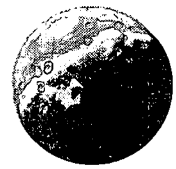
Mercury. Mercury is the planet closest to the sun. It rotates very slowly. The side facing the sun is very hot, while the side away from the sun is very cold. The spacecraft *Mariner 10* visited Mercury in 1974. It discovered a barren world with many craters. The craters have remained unchanged for billions of years because Mercury has no atmosphere or weather.

Venus. Venus is sometimes called Earth's *sister planet* because it is very similar in size, mass, and density. The atmosphere of Venus is very different from that of Earth. Venus' atmosphere is composed of carbon dioxide. It also has thick clouds of sulfuric acid. These clouds trap heat and create a greenhouse effect, causing extremely high surface temperatures. Venus is also covered by craters, but there is evidence that oceans once existed.

Earth. Earth is the third planet from the sun and is a bit larger than Venus. So far as we know, Earth is the only home of life in the solar system. It has one large moon but there are larger moons in the solar system. There are three main zones of Earth: the atmosphere; the hydrosphere (the world's water);


Earth

and the lithosphere (the solid body of the world). Earth's solid body is divided into three regions: the core; the mantle; and the crust, the outermost layer of Earth and the one to which all human activity is confined.


Mars

Mars. Mars was examined by the *Viking* spacecraft in 1976 and revisited by the Mars *Pathfinder* in July of 1997. Its red soil, suspended by windstorms, gives it the name the *red planet*. Many large volcanoes and craters dot the surface of Mars, indicating that the planet was once very active. The solar system's largest known volcano, Mons Olympus, is found here. Mars also has large ice caps. The ice does not melt because the temperature of Mars is well below freezing. Mars has two small moons—Phobos and Deimos.

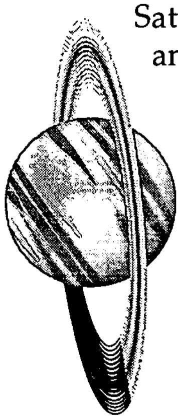

Jupiter

Jupiter. The largest planet in the solar system is the *gas giant*, Jupiter. Huge storm clouds cover the planet, including the giant red spot which is thought to be like a hurricane three times as large as Earth. In 1979, the *Voyager* spacecraft discovered a thin ring circling the planet. At least 16 moons are known to orbit Jupiter. The first four were discovered by Galileo Galilei in 1610.

Saturn. Saturn is very similar to Jupiter. It also has a dense atmosphere, storms, and rings. Saturn's rings, however, are composed of ice and form intricate patterns. Saturn has more moons than any other planet. There are at least 17, but there may be as many as 23 orbiting Saturn.


Saturn

Uranus. Uranus is also a *gas giant* like Jupiter and Saturn. The clouds that cover Uranus give it its characteristic greenish-blue color. Uranus also has a ring system, but the rings encircle the planet from top to bottom. This is because Uranus' axis is tilted at nearly a 90° angle, so it appears to have been knocked on its side. Fifteen moons orbit the planet.


Uranus

Neptune. Neptune is considered Uranus' twin. It is about the same size and has a greenish-blue color. Two thin rings encircle the planet, and it has two moons.

Pluto. The most distant planet in our solar system is Pluto. It was the last planet discovered, and due to its great distance from Earth its one moon was not discovered until 1978. Pluto is the smallest planet and may be composed entirely of frozen methane and ice.

The planets orbit around the sun in our solar system just as the moon orbits Earth. What holds the planets in this orbit? Gravity does. It is the universal force of attraction between all objects that tends to pull them toward one another just as objects are pulled towards Earth's surface. Sir Isaac Newton proposed his law of gravity in 1687. Newton's law stated that every particle in the universe attracts every other particle with a force that is proportional to the masses and inversely proportional to the square of the distance between the objects. The force of attraction between any two objects depends upon their masses and the distance between them.

Using Newton's law of gravitation, both the French astronomer Urbain Leverrier and the British mathematician John Couch Adams predicted the existence of a new planet that was causing the orbit of Uranus to be different than expected from Newton's law. Neptune was discovered in 1846 by German astronomer Johann Galle in an orbit close to its predicted position.

Summary

The nine planets—along with comets, meteoroids, asteroids, and other celestial objects—make up Earth's vast neighborhood. The planets and other heavenly bodies have at least one thing in common. They all share gravitational forces with the sun, forming a large system—the solar system. With the help of space probes, cameras, and other data-gathering equipment placed above Earth's atmosphere, scientists are able to find out more and more about our celestial neighborhood. These scientific studies are making our world seem smaller than we once imagined it to be and the universe more accessible.

Lab Activity: Dimensions of the Solar System

Purpose	**Materials**
Construct a model to show the relative distance from the sun to the planets.	• adding machine tape • metric ruler • string

Dimensions of the Solar System		
Planet	**Distance from the Sun**	
	Millions of Km	**Cm***
Mercury	58	
Venus	108	
Earth	150	3
Mars	228	
Jupiter	778	
Saturn	1427	
Uranus	2870	
Neptune	4486	
Pluto	5900	

*scale 1 cm = 50 million km

Procedure

1. Obtain a length of adding machine tape approximately 150 cm long.

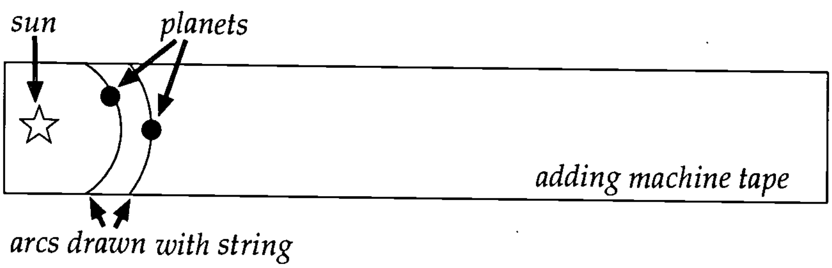
2. Using the chart above, calculate the distance in cm from the sun for each planet using the scale 1 cm = 50 million km.

$$\text{Example: Earth} \quad 150 \cancel{\text{million km}} \times \frac{1 \text{ cm}}{50 \cancel{\text{million km}}} = \frac{150 \text{ cm}}{50} = 3 \text{ cm}$$

3. Find the spot one centimeter above one edge of your tape. Draw a small star there to represent the sun. (See diagram below.)

4. To plot each planet, measure the distance from the sun and place a mark at the appropriate distance for each planet.

5. Use the string to draw arcs to represent the orbits of the planets.



6. Label the planets.

7. Draw dotted lines between Mars and Jupiter to represent the asteroid belt.

8. All of the planets through Saturn are easily visible to the naked eye. Name them.

____

____

____

9. Each of the planets between Earth and the sun are seen as the "morning star" or the "evening star." Name them.

____

____

10. What might be the possible origin of the asteroids?

11. Where are the largest planets located?

12. Where are the smallest planets located?

Practice

Answer the following using complete sentences.

1. What is the name of the most commonly accepted theory on how the universe began?

 ____

2. When do scientists think that the universe was created? __________

 ____

 ____

3. Before the Big Bang, where was most of the matter and energy found in the universe?

 ____

 ____

4. How did this big explosion affect the matter and energy that was already present in the universe?

 ____

 ____

 ____

5. According to the Big Bang theory, how were the galaxies formed?

 ____

 ____

 ____

6. What continues to happen to the stars in these galaxies today?

7. What is a slowly rotating cloud of dust and gas called?

8. What theory states that the shrinking of a large cloud of dust formed the solar system?

9. Describe another theory of how the planets were formed.

10. What are the four components that make up the universe?

Practice

Write a paragraph about the following.

1. The origin of the universe according to the Big Bang theory:

____

____

____

____

____

____

____

____

2. The origin of the solar system according to the nebular theory, also known as the Dust Cloud theory:

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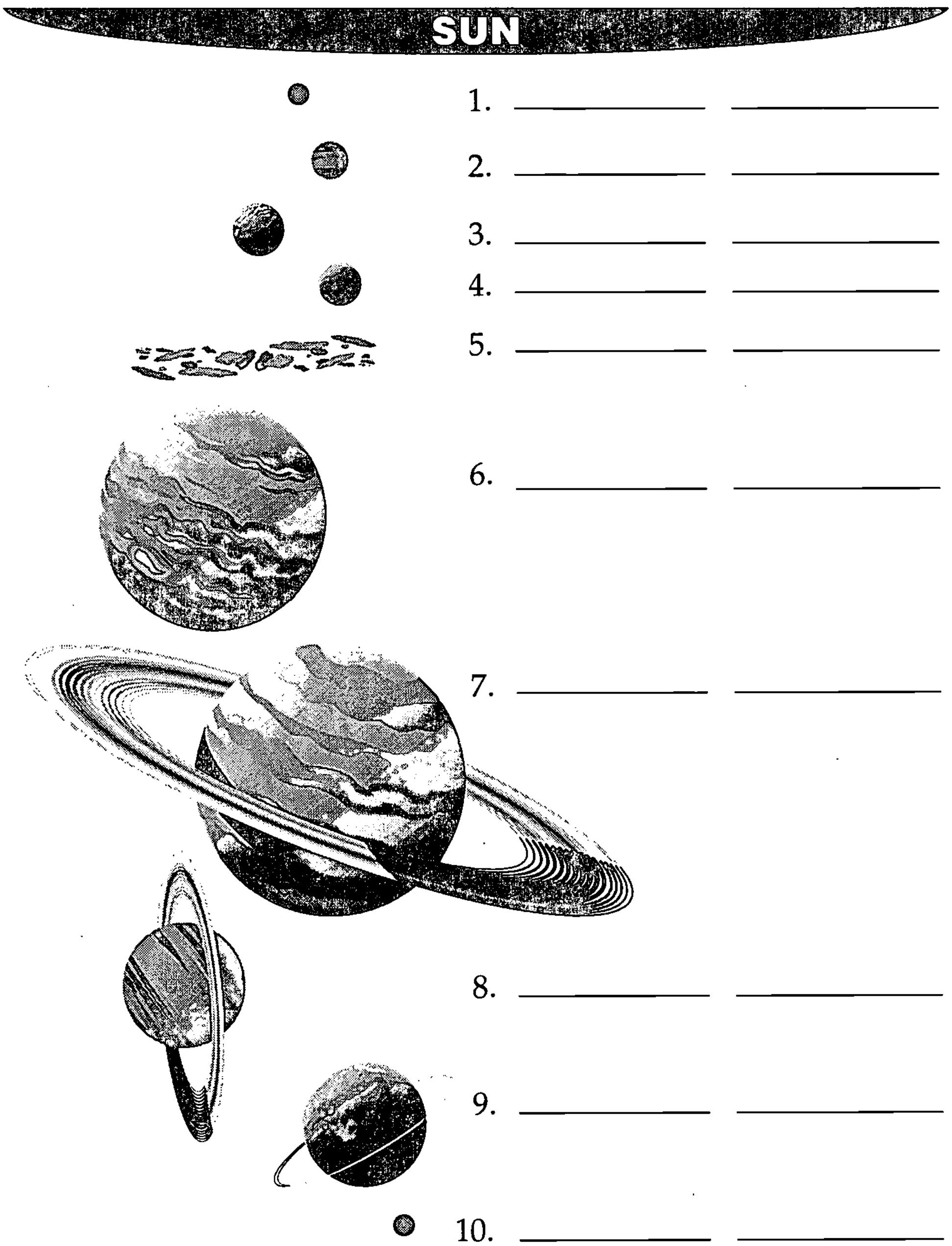
Practice

Label each **heavenly body** *illustrated below and give one characteristic.*



1. ____________ ____________
2. ____________ ____________
3. ____________ ____________
4. ____________ ____________
5. ____________ ____________
6. ____________ ____________
7. ____________ ____________
8. ____________ ____________
9. ____________ ____________
10. ____________ ____________

Practice

Use the list below to write the correct term for each definition on the line provided.

asteroids	**galaxy**	**planets**	**stars**
comet	**meteors**	**satellite**	**stellar equilibrium**
constellation	**nebula**	**solar system**	**theory**
elliptical galaxies	**orbit**	**spiral galaxies**	**universe**

____________________ 1. a mass of dust and ice with a bright gaseous tail that orbits the sun

____________________ 2. bodies that revolve around a sun and reflect its light

____________________ 3. hot, bright bodies of gas constantly exploding in space

____________________ 4. fragments of rocky material from space that burn as they fall through Earth's atmosphere

____________________ 5. millions or billions of stars in a system

____________________ 6. galaxies that have a very bright center that contain very little dust and gas

____________________ 7. galaxies that have a center of bright stars and flattened arms that swirl around the center, and look like a pinwheel

____________________ 8. a small number of stars that appears to form a shape or image

____________________ 9. an object that revolves around a larger object

____________________ 10. the path of an object revolving around another object

______________________ 11. a cloud of interstellar gas or dust

______________________ 12. the sun and all the planets, their moons, asteroids, meteors, and comets; all objects that move around the sun

______________________ 13. a hypothesis that has withstood the test of time

______________________ 14. all bodies in space and all space between these bodies—all matter and all energy

______________________ 15. fragments of rock and metal that orbit the sun; many are in a belt located between Mars and Jupiter

______________________ 16. the balance between the forces in a star

Practice

Circle the letter of the correct answer.

1. A ____________ is a mass of dust and ice with a bright gaseous tail that orbits the sun.

   a. planet
   b. meteor
   c. star
   d. comet

2. ____________ are bodies that revolve around a sun and reflect its light.

   a. Galaxies
   b. Stars
   c. Meteors
   d. Planets

3. ____________ are hot, bright bodies of gas constantly exploding in space.

   a. Meteors
   b. Elliptical galaxies
   c. Galaxies
   d. Stars

4. ____________ are fragments of rocky material from space that enter Earth's atmosphere and burn as they fall.

   a. Spiral galaxies
   b. Meteors
   c. Elliptical galaxies
   d. Galaxies

5. A ____________ is millions or billions of stars in a system.

   a. constellation
   b. galaxy
   c. meteor
   d. planet

6. ____________ galaxies are oval-shaped galaxies which are smooth in appearance and have few clouds of dust and gas.

   a. Constellation
   b. Spiral
   c. Elliptical
   d. Comet

7. ____________ galaxies are galaxies that are disc-shaped.

   a. Spiral
   b. Star
   c. Nebula
   d. Elliptical

8. A ____________ is a small number of stars that appears to form a shape or image.

   a. comet
   b. constellation
   c. galaxy
   d. meteor

9. A principle based on facts which has withstood the test of time is a ____________ .

   a. satellite
   b. planet
   c. solar system
   d. theory

10. All bodies in space and all space between these bodies, and all energy and all matter, compose the ____________ .

   a. elliptical galaxy
   b. solar system
   c. spiral galaxy
   d. universe

11. The sun and all the planets, their moons, asteroids, meteors, and comets and all objects that move around the sun compose the ____________.

    a. solar system
    b. elliptical galaxy
    c. universe
    d. spiral galaxy

12. A ____________ is a cloud of interstellar gas and/or dust.

    a. satellite
    b. nebula
    c. planet
    d. solar system

13. ____________ are fragments of rock and metal that orbit the sun, many of which are located between Mars and Jupiter.

    a. Galaxies
    b. Satellites
    c. Meteors
    d. Asteroids

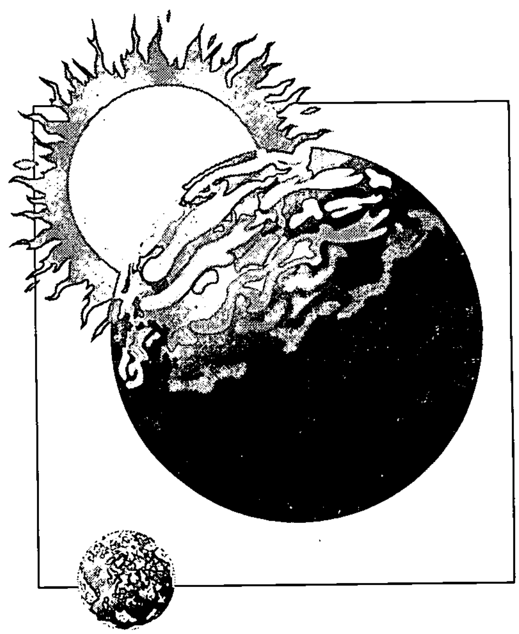
14. A ____________ is an object that revolves around a larger object.

    a. satellite
    b. galaxy
    c. constellation
    d. comet

15. The moon and planets revolve or ____________ around the sun.

    a. asteroid
    b. comet
    c. solar system
    d. orbit

Unit 4: The Earth, the Moon, and the Sun



Vocabulary

Study the vocabulary words and definitions below.

corona .... the low-density cloud of gases surrounding the sun

craters .... holes or bowl-shaped depressions on a moon or planet

ebb tide .... the movement of a tidal current away from the shore

elliptical .... oval-shaped

equinox .... either of the two times of the year when the number of hours of daylight and darkness are the same in both hemispheres; marks the first day of spring and fall; means *equal night*

flood tide .... the tidal current associated with the increase in the height of the tide

highland areas .... areas on the moon which are high mountain ranges and large craters; appear light in color

lunar eclipse .... an event which occurs when Earth blocks the light as it moves between the sun and the moon

lunar month .... the measure of time it takes for the moon to pass from one new moon to the next (29½ days)

maria (MAR-ee-uh) .... lunar seas or plains on the moon which appear dark

meteors .... fragments of rocky material from space that burn as they fall through Earth's atmosphere; also known as meteoroids

moon phase .... the changing appearance of the moon which depends on the moon's position relative to the sun

neap tide .... tide occurring at the first and third quarters of the moon when the sun, Earth, and moon form a right angle; produces tides in a medium range

orbit .... (noun) the path of an object revolving around another object; (verb) to revolve in an orbit around another object

partial eclipse .... an event which occurs when part of the sun is blocked out by the moon

penumbra .... part of a shadow cast by an object in which light from the source is only partly blocked

revolve .... to move around another heavenly body *Examples*: the moon revolves around Earth; planets revolve around the sun

rotate .... to spin on an axis *Example*: Earth rotates, causing day and night

seasons .... the four divisions of the year characterized by differences in weather and the number of hours of daylight

solar eclipse .... an event which occurs when the moon passes between Earth and the sun

solstice .... either of the two times a year when the sun is at its greatest apparent distance north or south of the equator; marks the first day of *summer* and *winter*

spring tide .... tide that occurs when the sun, moon, and Earth are in a straight line

tide .... the rise and fall of the oceans caused by the gravitational attraction between the sun, Earth, and moon

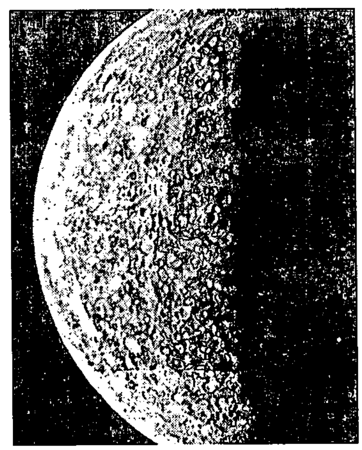
total eclipse .... an event which occurs when the sun is completely blocked out by the moon

umbra .... the part of a shadow cast by an object in which light from the source is completely blocked

Introduction

Through scientific study and space exploration, we have learned that Earth exists as a part of a larger system called the solar system. Within our solar system, the moon and Earth have a very important relationship. The relationship between sun, Earth, and moon affects many of the everyday occurrences that we take for granted—the **tides**, the amount of solar energy, the length of our days and nights, and the **seasons**. Learning about this relationship helps us to understand the why of these daily occurrences and to understand our need for future exploration of the world beyond our Earth.

The Relationship of the Earth and the Moon



Earth has one moon. The moon **revolves** around Earth about once a month. The moon also turns, or **rotates**, on its axis one time per month. Because of this, we only see one side of the moon. The moon does not give off light of its own. It reflects the light of the sun.

Earth has a blanket of air surrounding it called an *atmosphere*. The moon does not have an atmosphere because it does not have a strong enough gravitational force to hold a blanket of air around it. Since there is no atmosphere on the moon, there is no water. Without an atmosphere and water, the moon is unable to support life.

Earth is the third planet from the sun. Earth's atmosphere is different from the other planets. It contains oxygen and water vapor and thus can support life. The atmosphere also protects Earth from extremes in temperatures. Without an atmosphere, the moon is subjected to very high and low temperatures. The dark side of the moon may get as cold as –175° Celsius, and the lighted side may reach temperatures of 130° Celsius.

When viewed from Earth, the surface of the moon has light and dark areas, which sometimes combine to look like a man's face.
The light-colored areas are **highland areas**. The highland areas have mountains that are much higher than any found on Earth. The parts of the

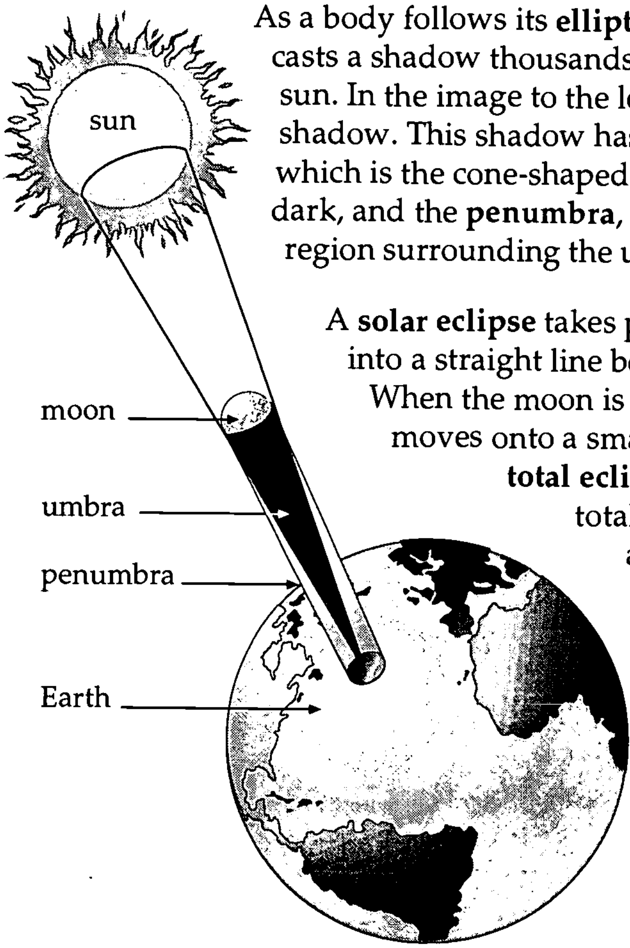
moon that appear dark are called **maria**. *Mare* (singular for maria) is the Latin word for *seas*. The maria are flat areas that look like seas, except that they do not have any water in them.

The surface of the moon also has many bowl-like depressions called **craters**. Craters vary in diameter from a few inches to over 500 miles. Most of the craters were produced long ago by the impact of **meteors**. In contrast, Earth has only about a dozen well-known craters. Although many meteors travel towards Earth, most of those meteors burn up in Earth's atmosphere. The moon, on the other hand, has no atmosphere to affect the meteors' impacts. Additional craters may have been on Earth in early geologic history, but these have been destroyed by erosion.

Solar Eclipse

As a body follows its **elliptical** orbit around the sun, it casts a shadow thousands of miles long away from the sun. In the image to the left, the moon is casting a shadow. This shadow has two parts—the **umbra**, which is the cone-shaped inner part that is completely dark, and the **penumbra**, which is the partly shaded region surrounding the umbra.

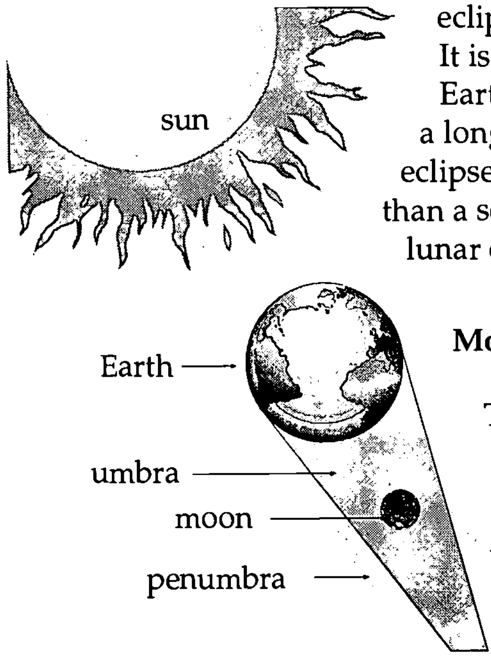
A **solar eclipse** takes place when the moon passes into a straight line between the sun and Earth. When the moon is in this position, its shadow moves onto a small area of Earth. During a **total eclipse** of the sun, the moon totally blocks out the sun and, for a short time, becomes dark. Only a halo of light from the sun's rim, called a **corona**, can be seen. Other parts of Earth that fall in the penumbra experience a **partial eclipse**, where only part of the sun is blocked by the moon. A partial eclipse is seen by many more people than a total eclipse.



Solar Eclipse

Lunar Eclipse

When the moon moves into Earth's shadow, we have a **lunar eclipse**. During a lunar eclipse, hardly any sunlight reaches the moon and, consequently, it looks very dim. A lunar eclipse will last about three or four hours. It is longer than a solar eclipse because Earth's shadow is very wide, and it takes a long time to pass through it. A lunar eclipse can be seen from more areas of Earth than a solar eclipse. Also, there are many more lunar eclipses than solar eclipses.

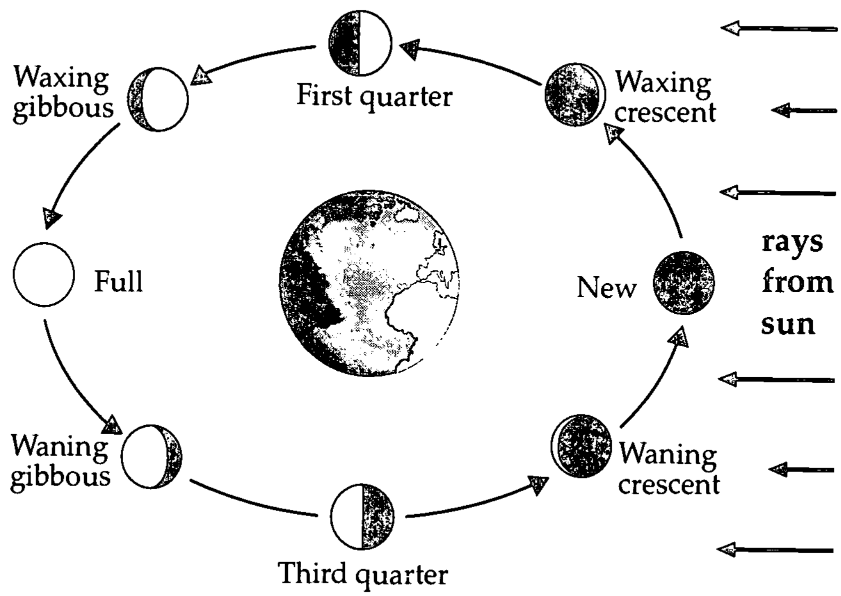


Lunar Eclipse

Moon Phases

The moon moves around Earth in exactly the same way that the planets revolve around the sun. It takes the moon 27⅓ days to make one trip around Earth. The moon also rotates or spins on its axis one time as it revolves around Earth. While the moon is moving around Earth, Earth is also moving around the sun. Therefore, it takes about two more days for the moon to return to its original position in relation to the sun and Earth. It takes a total of 29½ days for the moon to pass from one new moon to the next new moon. This period of time is called a **lunar month**.

As the moon **orbits** Earth, sometimes the side that is lighted by the sun is facing Earth, and at other times part or all of the lighted side is facing away from Earth. The different portions of the lighted side of the moon that are visible as the moon revolves around Earth are known as **moon phases**.



The circle shows the phases of the moon as seen from Earth.

New Moon—when the moon is in between Earth and the sun, the unlighted side of the moon is facing Earth and cannot be seen

Crescent Moon—just before and after the new moon; only a slice of the lighted side is seen

Quarter Moon—halfway between the new moon and full moon; half the moon is dark and half is lighted

Gibbous Moon—just before and just after a full moon; over half of the moon is lighted; it appears lopsided

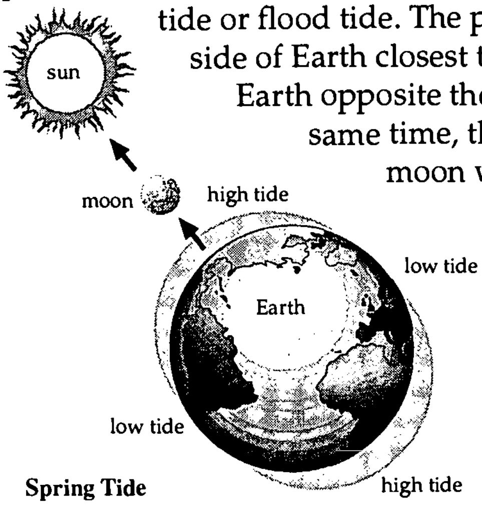
Full Moon—when the moon is on the opposite side of Earth from the sun; the entire lighted side is touching Earth

Tides

If you have gone to a beach and stayed a few hours, you probably have noticed that the ocean water does not stay at the same level. The water level of the ocean rises and falls at regular time periods. At certain times of the day the water is higher than at other times. This regular rise and fall of the ocean water is called *tides*.

Tides are the movements of the ocean water caused by the gravitational attraction among the sun, Earth, and moon. Both the moon and sun affect the tides, but the moon's effect is greater than the sun's effect because it is so much closer.

There are high tides and low tides. Tides do not change suddenly. High tides move in slowly. When the water reaches its highest level, it is called *high tide* or **flood tide**. Then, it slowly moves out until it reaches its lowest point called *low tide* or **ebb tide**. A low tide or ebb always follows a high tide or flood tide. The pull of the moon draws the water to the side of Earth closest to the moon and pushes it to the side of Earth opposite the moon. This causes high tides. At the same time, the side of Earth at 90° angles from the moon will have low tides.

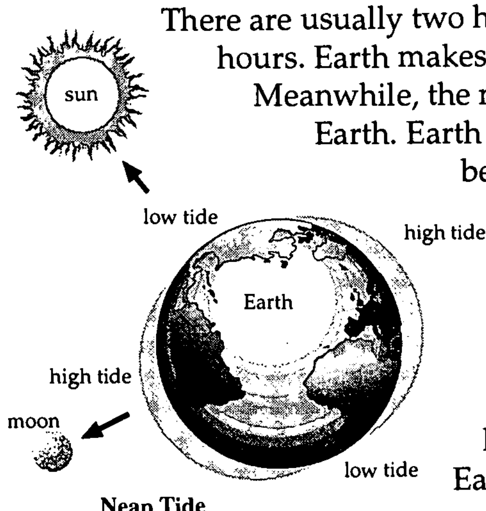


Spring Tide

Most shorelines have four tides every day. There are two high tides and two low tides. There are about six hours and 12 minutes between a high tide and a low tide. Twice every month the sun, moon, and Earth are all in a straight line. The combined gravitational pull of the sun and moon causes higher than average high tides and lower than average low tides. These are called **spring tides**. Spring tides occur during a full moon and a new moon.

The moon, Earth, and sun are also at right angles (90°) twice a month. During this time, the gravity forces work against each other creating **neap tides**. During neap tides, the high tides are lower than normal and the low tides are higher than normal. Therefore, the difference between high and low tides is less during a neap tide. Neap tides occur during the first and third quarter of the moon's phase.

There are usually two high tides and two low tides every 24 hours. Earth makes one turn on its axis in 24 hours. Meanwhile, the moon is also moving in its orbit around Earth. Earth must rotate 24 hours and 50 minutes before the moon returns to the same position overhead. The moon, then, has also moved. This results in the tides being 50 minutes later each day. For example, if it is high tide at 9:00 a.m. on Monday, the high tide will be at 9:50 a.m. on Tuesday. Low tides and high tides are about six hours apart. As Earth rotates, different locations on Earth pass through high and low tides.

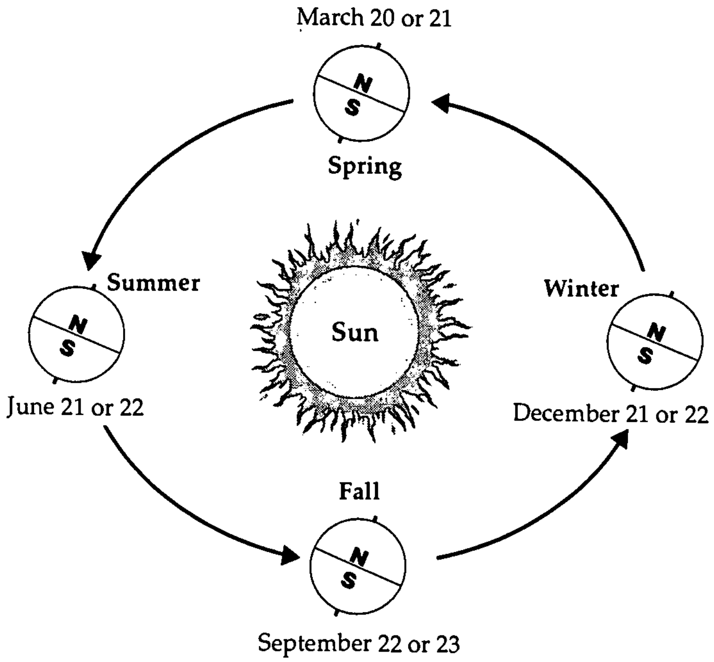


Neap Tide

Most locations in Florida experience two high tides and two low tides during a 24-hour period. This is called a semidiurnal tide. The heights of the high tides and low tides are about the same. Some places only experience a single high tide and a single low tide a day due to their location. This is a diurnal tide. Other places may experience mixed tides with varying heights of high and low tides during a 24-hour period.

Seasons

The *seasons* are the four divisions of the year characterized by differences in temperature, weather, and the number of hours of daylight. Seasons are caused by the tilt of Earth on its axis. Earth's tilt causes the duration of daylight hours to vary and the angle at which the sun's rays strike a given location to change as Earth makes its yearly revolution around the sun.



Summer begins on June 21 or 22 in the Northern Hemisphere. During summer, the Northern Hemisphere is tilted toward the sun, and thus receives more direct rays. At the same time, the Southern Hemisphere is pointed away from the sun and receives the indirect rays of the sun. Therefore, it is winter in the Southern Hemisphere and summer in the Northern Hemisphere.

Winter begins on December 21 or 22 in the Northern Hemisphere, when it is tilted away from the sun. At the same time, the Southern Hemisphere is tilted towards the sun and is having summer.

Two times a year neither pole leans towards the sun. During these times Earth is in such a position in its orbit that its axis is neither tilted toward nor away from the sun. The vertical rays of the sun strike the equator. On these two days, called the *spring* or *fall* **equinox**, daylight and night hours are the same in both hemispheres. Day and night are 12 hours long everywhere on Earth.

On March 20 or 21, the spring equinox begins in the Northern Hemisphere. September 22 or 23, the fall equinox, is the beginning of fall. Again, the seasons are opposite in the Southern Hemisphere.

As the seasons change, the number of hours of daylight and darkness also changes. The first day of summer, June 21 or 22, has the greatest number of daylight hours and is called the *summer* **solstice**. The sun is the farthest north of the equator on this day because the north pole is tilted most directly toward the sun.

After the summer solstice, daylight hours begin to decrease in the Northern Hemisphere until the winter solstice. Three months after the summer solstice comes the fall equinox. At that time, September 22 or 23, daylight and darkness are equal. Fall begins in the Northern Hemisphere, and spring begins in the Southern Hemisphere.

Daylight hours continue to decrease above the equator and increase below the equator until December 21 or 22, the winter solstice. The solstice has the least amount of daylight of the year and marks the beginning of winter in the Northern Hemisphere. At this time, the sun is the farthest south of the equator.

After the winter solstice, days continue to grow longer in the Northern Hemisphere until the summer solstice. Three months after the winter solstice comes the spring equinox. On that day, then, Earth's axis leans neither toward nor away from the sun, and day and night are equal in both hemispheres. March 20 or 21 is the beginning of spring north of the equator and the beginning of fall in the Southern Hemisphere.

After the spring equinox, daylight hours continue to increase in the Northern Hemisphere until the summer solstice—the longest day. At this time, the cycle of the seasons begins again.

At the equator, the number of hours of daylight is always the same as the number of hours of darkness. As you move towards the poles, the hours become more uneven. The tilt of Earth on its axis causes the polar areas to have uneven hours of daylight and darkness. The poles have 24 hours of daylight in summer and 24 hours of darkness during the winter.

Summary

Our moon is very different from Earth. While the moon rotates on its axis and revolves around Earth, Earth revolves around the sun. These three heavenly bodies create different shadows as they change positions. At certain times these shadows result in eclipses—lunar, solar, or total. As the moon rotates and revolves, different portions of the lighted side are visible from Earth. As a result, the moon appears to change its shape, or go through phases. The moon's gravitational pull on Earth (as well as the sun's) causes our changing ocean tides.

Practice

Answer the following using complete sentences.

1. What are two conditions of Earth that allow it to support life?

   ____

   ____

   ____

2. Is there life on the moon? ______________________________

   Why or why not? ______________________________

   ____

   ____

   ____

3. Why doesn't the moon have an atmosphere?

   ____

   ____

   ____

4. Why does the moon have much hotter and much colder temperatures than Earth?

   ____

   ____

   ____

   ____

5. Why do we sometimes see a man's face in the moon?

____

____

6. The word mare means sea in Latin, but how do the maria on the moon differ from the seas on Earth?

____

____

____

7. Describe the highland areas on the moon.

____

____

8. What are the bowl-like depressions on the moon? What caused them?

____

____

9. How large are the craters on the moon?

____

____

10. Why are the moon's craters so well preserved?

____

____

____

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

corona	**partial**	**shadows**	**three or four hours**
lunar	**partial eclipse**	**solar**	**total**
lunar eclipse	**penumbra**	**solar eclipse**	**umbra**

1. Eclipses are caused by the ______________________ cast by either moon or Earth as they pass by one another.

2. The part of a shadow that is cone-shaped and completely dark is the ______________________ .

3. The outer, partly shaded part of a shadow is called the ______________________ .

4. A ______________________ takes place when the moon passes in a straight line between the sun and Earth.

5. During a ______________________ eclipse of the sun, the moon totally blocks out the sun, and for a short time it becomes dark.

6. A halo of light from the sun's rim, called the ______________________, can be seen around the edges of the moon during a total eclipse.

7. A ______________________ eclipse can be seen by more people than a ______________________ eclipse.

8. A ____________________ occurs when only part of the moon passes in front of the sun.

9. When the moon moves into Earth's shadow, we have a ____________________ .

10. During a lunar eclipse, hardly any sunlight reaches the moon, and it looks very dim for about ____________________ .

11. There are more ____________________ eclipses than ____________________ eclipses.

12. A ____________________ eclipse can be seen from more areas of Earth than a solar eclipse.

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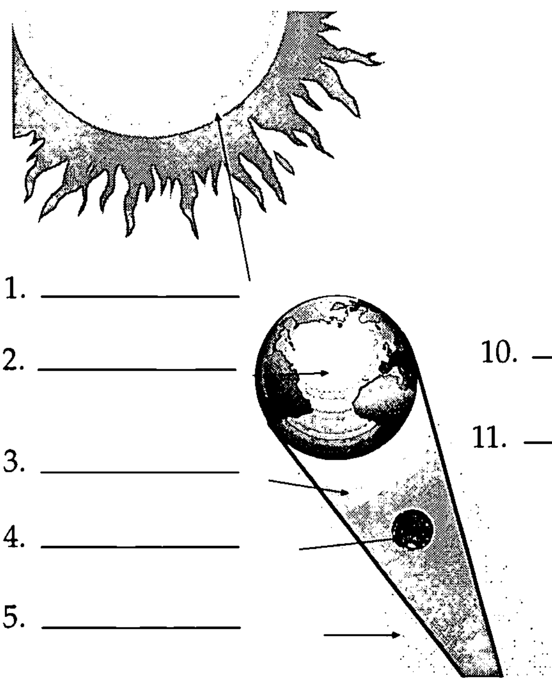
Practice

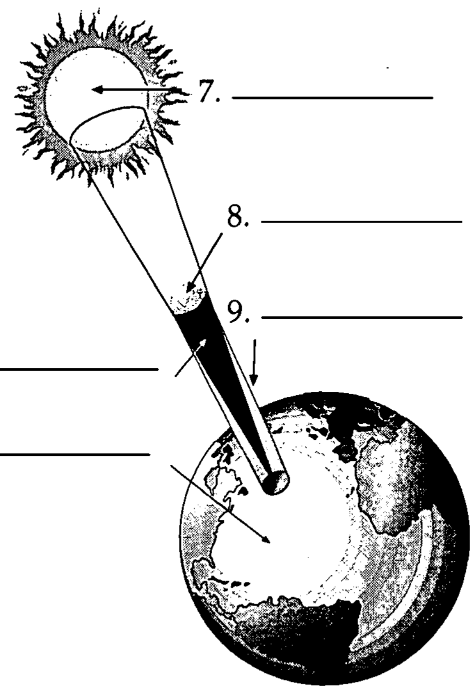
Identify the two **eclipses** *shown in the diagrams below. Use the list below to label the parts of each. (One or more words will be used more than once.) Write the correct term on the line provided.*

Earth	**solar**
lunar	**sun**
moon	**umbra**
penumbra	



1. ________________
2. ________________
3. ________________
4. ________________
5. ________________

6. ________________ eclipse



7. ________________
8. ________________
9. ________________
10. ________________
11. ________________

12. ________________ eclipse

Practice

Answer the following questions using the **weather section** *of your* **local newspaper** *or the* **Internet***; then do the activity that follows.*

1. What time will the moon rise today? ____________________
2. What time will the moon set today? ____________________
3. On what date this month is there a full moon ? ______________
4. On what date this month is there a new moon? ______________
5. Go outside and observe the moon tonight after it rises. (Check the time in the newspaper.)
6. Fill out the information on the chart below, noting the date and time of your observation. Draw the shape of the moon that you saw. Use a compass or stationary landmark to determine the location of the moon.
7. Record the same information on the same night of the week for the next three weeks and record your findings.
8. Did your results correspond with the information the newspaper gave?

   Explain. ____

   ____

Date	Time	Shape	Location

Practice

Match each definition with the correct term. Write the letter on the line provided.

______	1.	the time that it takes the moon to make one trip around Earth	A.	one
______	2.	the amount of time that it takes the moon to go through its phases from one new moon to the next new moon	B.	lunar month
______	3.	the measure of time it takes the moon to go through its phases	C.	29½ days
______	4.	the different portions of the lighted side of the moon that we see as it revolves around Earth	D.	27⅓ days
______	5.	the number of times the moon rotates during one revolution around Earth	E.	phases
______	6.	where the light of the moon comes from	F.	the sun

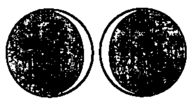
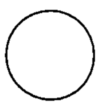
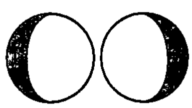
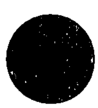
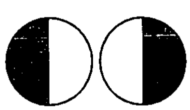
Practice

Match each definition with the correct term. Write the letter on the line provided.

______	1.	phase when the moon is between Earth and the sun; it cannot be seen because the dark side is facing Earth	A. crescent moon
______	2.	phase when the moon is on the opposite side of Earth from the sun; we see the entire lighted side	B. full moon
______	3.	phase just before and after the new moon; only a slice of the lighted side is seen	C. gibbous moon
______	4.	phase when the moon is halfway between the new moon and full moon; we see one-half of the light side and one-half of the dark side	D. new moon
______	5.	phase just before and after the full moon; looks lopsided	E. orbit
______	6.	the path that the moon takes around Earth	F. quarter moon

Practice

Name each **phase** *of the moon that is shown below. In the column on the right, tell where the moon is in* **relation** *to Earth and sun at each phase.*

	Phase	Position
1. 	____________	____________ ____________ ____________ ____________
2. 	____________	____________ ____________ ____________ ____________
3. 	____________	____________ ____________ ____________ ____________
4. 	____________	____________ ____________ ____________ ____________
5. 	____________	____________ ____________ ____________ ____________

Practice

Use the information about the **high** *and* **low tides** *of a specific location from the* **local newspaper** *or* **Internet** *to fill out the chart below for three consecutive days. Record the* **high** *and* **low tides** *for each date. Be sure to use the* **same** *location each time!*

Date	High (a.m.)	Low (a.m.)	High (p.m.)	Low (p.m.)

Use the **local newspaper** *to answer the following using short answers.*

1. When is the next first-quarter moon? ____________________

2. When is the next full moon? ____________________

3. When is the next third- or last-quarter moon? ____________________

4. When is the next new moon? ____________________

5. On what dates would you expect to find a spring tide?

____

6. On what dates would you expect to find a neap tide?

____

7. How much later is the evening high tide than the morning high tide on your first day of observation?

____

8. How much later is the morning high tide the second day than the first day?

____

9. Do the high and low tides occur at the same time on all the Florida beaches?

____

How do you know? _______________

____

____

____

10. Name two reasons why you might want to know when the tides will be high and low.

____

____

____

____

____

____

____

____

Practice

Answer the following using complete sentences.

1. Define tides. ______

2. How many high tides are there normally in a 24-hour period? ______

   How many low tides? ______

3. Does the sun or moon have a greater gravitational pull on our ocean waters?

   ______

   Why? ______

4. What kind of tides do we have when the sun, Earth, and moon are all in a straight line?

   ______

5. When do spring tides occur? ______

6. When do neap tides occur? ______

7. Describe the ocean water level during a spring tide.

____

____

8. How are the sun, moon, and Earth lined up during a neap tide?

____

____

9. Do the sun and moon's gravitational forces work together or against each other during a neap tide?

____

10. During which type of tide is the difference between high and low tide the greatest?

____

11. If there is a high tide at 10:00 p.m. one night, at what time will the high tide be the next night?

____

12. Why are the high tides and the low tides a few minutes later each day?

____

____

____

____

____

____

Practice

Answer the following using complete sentences.

1. In what three ways do the seasons differ from each other? ________

____

2. What causes Earth to have seasons? ____________________

____

3. Which way is Earth tilted when the Northern Hemisphere is having summer?

____

4. Which way is Earth tilted when the Northern Hemisphere is having winter?

____

____

____

5. Do both hemispheres have the same seasons at the same time? ____

   Why or why not? ____________________________________

____

____

6. When are the sun's rays pointed directly over the equator instead of at one of the poles?

____

____

7. What is it called when the sun is farthest north of the equator?

____

8. What else happens at this point mentioned in question 7? _______________

____

9. What is it called when the number of hours of daylight and darkness are the same?

____

10. The equinox also marks the first day of what two seasons? _______________

____

11. Where on Earth are the length of the days and nights always the same?

____

12. What parts of Earth have 24 hours of daylight in the summer and 24 hours of darkness in the winter?

____

____

13. What seasons begin on the following dates in the Northern Hemisphere?

June 21 or 22: _______________

December 21 or 22: _______________

March 20 or 21: _______________

September 22 or 23: _______________

Practice

Use the list below to write the correct term for each definition on the line provided.

craters	**lunar month**	**phases**	**solar eclipse**
elliptical orbit	**maria**	**revolve**	**solstice**
equinox	**neap tide**	**rotate**	**spring tide**
highland areas	**orbit**	**seasons**	**tides**
lunar eclipse			

______________________ 1. holes or bowl-shaped depressions on a moon or planet

______________________ 2. positions of the sun that mark the first day of summer and winter

______________________ 3. the divisions of the year characterized by differences in weather and hours of daylight

______________________ 4. either of the two times of the year when the number of hours of daylight and night are equal in both hemispheres

______________________ 5. tide occurring at the first and third quarters of the moon when the sun, Earth, and moon form a right angle; produces tides in a medium range

______________________ 6. to move around another heavenly body (examples: moon around Earth; planets around sun)

______________________ 7. the measure of time it takes for the moon to pass from one new moon to the next (29½ days)

______________________ 8. the path of an object revolving around another object

_________________ 9. an event which occurs when Earth blocks the light as it moves between the sun and the moon

_________________ 10. the changing appearance of the moon which depends on the moon's position relative to the sun

_________________ 11. the spinning movement of a body on its axis

_________________ 12. lunar seas or plains on the moon which appear dark

_________________ 13. the rise and fall of the oceans caused by the gravitational attraction between sun, Earth, and moon

_________________ 14. tide that occurs when the sun, moon, and Earth are in a straight line; causes unusually high and low tides

_________________ 15. an event which occurs when the moon passes between Earth and the sun

_________________ 16. areas on the moon which are high mountain ranges and large craters; appear light in color

_________________ 17. an oval-shaped path of one object that revolves around another object

Practice

Circle the letter of the correct answer.

1. The path of an object revolving around another object is a(n) __________ .

   a. eclipse
   b. atmosphere
   c. rotation
   d. orbit

2. An oval-shaped path of one object that revolves around another object is a(n) __________ orbit.

   a. elliptical
   b. revolution
   c. eclipse
   d. rotation

3. Earth __________ or spins on its axis, causing day and night.

   a. rotates
   b. revolves
   c. orbits
   d. craters

4. The rise and fall of the oceans caused by the gravitational attraction between sun, Earth, and moon is a(n) __________ .

   a. eclipse
   b. crater
   c. tide
   d. highland

5. Either of the two times of the year when the number of hours of daylight and darkness are the same in both hemispheres is called a(n) __________ .

   a. continental climate
   b. ozone
   c. equinox
   d. marine climate

6. The ____________ is either of the two times a year when the sun is at its greatest distance north or south of the equator; it marks the first day of summer and winter.

   a. tropical zone
   b. polar zone
   c. temperate zone
   d. solstice

7. An event which occurs when the moon passes between Earth and the sun is a(n) ____________ .

   a. atmosphere
   b. lunar eclipse
   c. solar eclipse
   d. highland

8. An event which occurs when Earth blocks the light as it moves between the sun and the moon is a(n) ____________ .

   a. atmosphere
   b. solar eclipse
   c. highland
   d. lunar eclipse

9. The light areas on the moon which are mountain ranges and large craters are called ____________ .

   a. orbits
   b. maria
   c. highland areas
   d. revolutions

10. The dark areas on the moon which are the lunar seas or plains are called ____________ .

   a. highlands
   b. craters
   c. revolutions
   d. maria

11. The holes or bowl-shaped depressions on a moon or planet are __________ .

    a. moon phases
    b. maria
    c. highlands
    d. craters

12. The four divisions of the year characterized by differences in weather and the number of hours of daylight are called __________ .

    a. temperate zones
    b. polar zones
    c. marine climates
    d. seasons

13. The moon __________ around Earth.

    a. revolves
    b. rotates
    c. marie
    d. craters

14. The tide that occurs when the sun, moon, and Earth are in a straight line is called a(n) __________ .

    a. ebb tide
    b. flood tide
    c. spring tide
    d. neap tide

15. The tide that occurs at the first and third quarters of the moon, when sun, Earth, and moon form a right angle, is called a(n) __________ .

    a. ebb tide
    b. flood tide
    c. spring tide
    d. neap tide

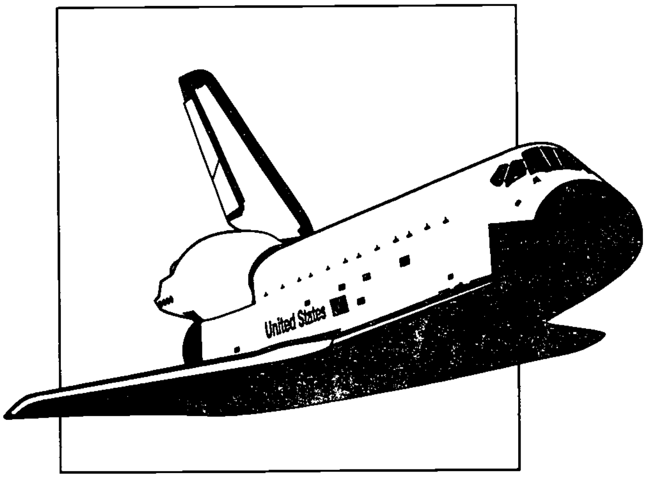
16. The changing appearance of the moon which depends on the moon's position relative to the sun is the ________.

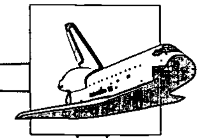
    a. lunar month
    b. moon phase
    c. partial eclipse
    d. penumbra

17. The measure of time it takes for the moon to pass from one new moon to the next (29½ days) is a ________.

    a. highland
    b. revolution
    c. lunar month
    d. moon phase

Unit 5: Space Exploration





Vocabulary

Study the vocabulary words and definitions below.

artificial .... manmade

astronaut .... a person who flies in a rocket or space shuttle

astronomer .... one who studies astronomy or makes observations of celestial phenomena

astronomy .... the science of celestial bodies and their properties

communication satellite .... a satellite that receives, amplifies, and relays signals

cosmic ray .... ray of very short wavelength and great power that hits Earth from beyond its atmosphere

detector .... device for indicating the presence of a certain substance

lunar .... of or relating to the moon; designed for use on the moon

NASA .... the abbreviation for the National Aeronautics and Space Administration

orbiter .... a spacecraft designed to orbit a celestial body without landing on its surface

payload	the load carried by a spacecraft
satellite	an object that revolves around a larger object
space probes	rocket-launched vehicles that carry instruments, cameras, and other data-gathering equipment for deep-space measurements
space shuttle	a reusable spacecraft that carries astronauts into space and returns them to Earth
space stations	living quarters in space, equipped with all the necessary instruments to work and live
telecommunication	communication over a distance
telescope	instrument for making distant objects appear larger and therefore nearer; may use lenses, mirrors, or an antenna
transmitter	instrument that sends signals from one place to another
weather satellites	satellites that continuously monitor weather conditions

Introduction

As early as 500 B.C., **astronomy**—the science or study of celestial bodies and their properties—was practiced by scholars. Pythagoras (500 B.C.), a Greek philosopher and mathematician, was observing Earth's shadow on the moon when he concluded that Earth must be a sphere. Around 200 B.C., Eratosthenes (3rd century B.C.), a Greek **astronomer**, actually computed Earth's size while demonstrating its curvature. Until the invention of the **telescope** by a later astronomer, these scholars used crude instrumentation to seek the answers about Earth and beyond. Today's technology and sophisticated instrumentation has allowed us to go far beyond the early astronomers in the study of our celestial neighborhood.

Origins of Astronomy

Earth

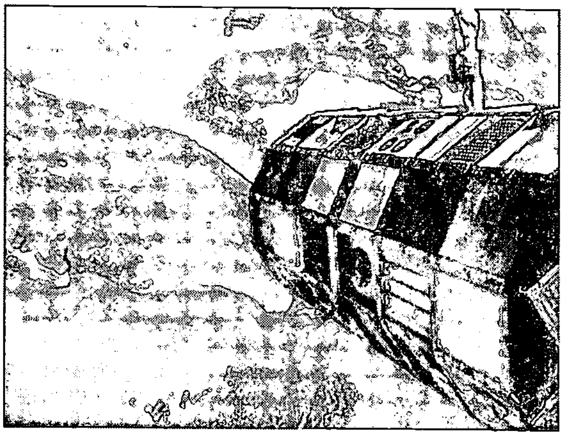
Humankind has always been interested in the skies or *heavens*. Many early civilizations (including the Egyptians and Babylonians) recorded their observations and ideas on astronomy. The early Greeks are credited with many discoveries. Aristotle, a Greek who lived about 500 B.C., believed that everything in the sky revolved around Earth. The Greeks proposed the first models of the universe. In one of these first models, Ptolemy (2nd century A.D.) also supported the view that Earth was the stationary center of the universe—a view popular at that time.

The Polish astronomer Nicholas Copernicus (1473–1543) was one of the first to challenge that view. He proposed that Earth was a planet, like the other five known planets, and that it revolved around the sun—the center of the universe. Later astronomers, such as Tycho Brahe, collected data to attempt to disprove his controversial theory. Ironically, in the early 1600s a German astronomer, Johannes Kepler (1571-1630) used this data to support the Copernican theory. Kepler proposed three laws that described the movement of the planets.

Probably the most well known of early astronomers is the Italian astronomer Galileo Galilei (1564-1642). He is considered the *father of modern astronomy*. Galileo built his own telescopes and made many astronomical observations. He discovered the first four moons of Jupiter, the relief of our moon, and sunspots. Galileo was another scientist who was persecuted for his views and was sentenced to house arrest for the last 10 years of his life.

Even before Galileo first pointed his telescope skyward, people were interested in the movements of the sun, moon, and stars. The moon is perhaps the most studied celestial object. The first astronomical phenomenon to be understood was the cycle of the moon. Today we know that cycle as the phases of the moon. The early Greek scholars realized that eclipses were simply the obscuring of the sun as the moon passes directly between Earth and the sun.

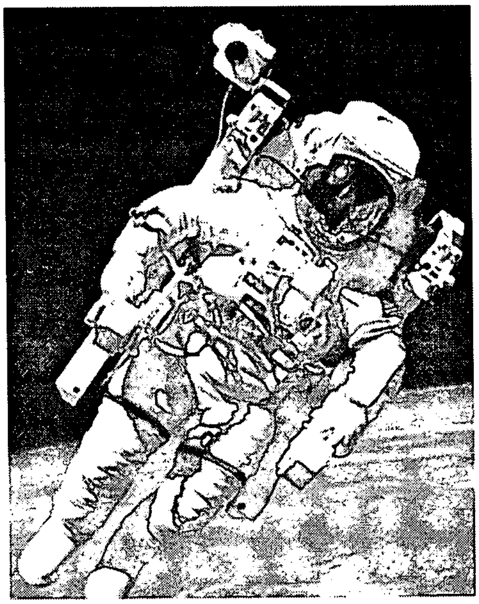
Today we are able to gather information about the solar system through the use of **space probes**. Space probes are rocket-launched vehicles that carry instruments and equipment used to gather and record data in deep space. These probes have a radio system to send pictures and information to Earth. The *Pioneer*, *Mariner*, and *Viking* were our earliest probes. *Voyager II* has visited Jupiter, Saturn, Uranus, and is continuing on past Neptune and beyond. Information from probes increases our knowledge of space.


space probe taking pictures of the coast of Florida

Gathering Information about Earth and Space

Artificial satellites and unmanned rockets have been used to pave the way for our travel into space. Unmanned rockets are powered by controls from stations on Earth. The direction, location, and speed of the rockets are controlled by using special computer or radio signals. A number of artificial **satellites** have been launched into space. Many of them receive and send radio and television signals which have improved worldwide communications.

The first **telecommunication** satellite launched in 1960 was called the *Echo I*. It was a plastic balloon with a thin aluminum coating. This coating was much like a mirror—it reflected light and radio waves. The *Echo I* was used to relay or reflect telegrams, telephone calls, and pictures back to Earth—crossing oceans and continents. Television pictures are relayed the same way. (The prefix *tele-* means *at or from a distance*.)



astronaut walking in space

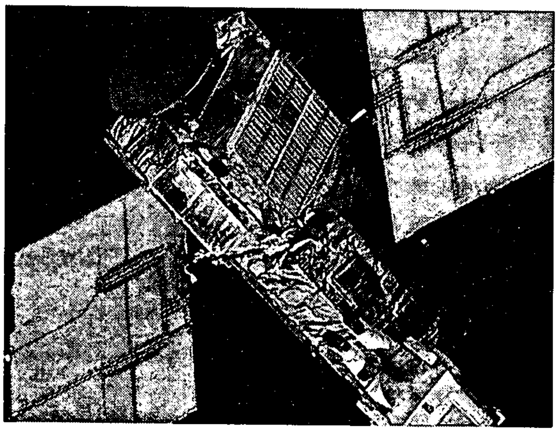
Space flights have been made safer because of the information gathered by these satellites and rockets. The *Mercury* space capsule provided scientists with data and experience in space flight itself. The *Gemini* space capsules provided **astronauts** with experience in controlling spacecrafts and working in space. Vehicles docked in space while the astronauts walked in space. The three **lunar** probes—*Ranger*, *Lunar Orbiter*, and *Surveyor*—took pictures of the moon that helped scientists choose a spot for the *Apollo* moon landing. The *Surveyor* probe actually landed on the moon, giving scientists an abundance of valuable information.

astronauts in the space shuttle

In the 18th century, scientists used hot-air balloons to measure weather conditions. Today, we have more than 8,000 weather stations around the world that make observations about our weather conditions. Reports are made by airplane pilots, ships at sea, and radar stations. Satellites are also used to monitor our weather. They are able to observe Earth's oceans and other areas where there are no weather stations. The **weather satellites** send back pictures that show how weather changes from hour to hour. These pictures help us to follow large weather patterns, and they improve the accuracy of our weather predictions. Television stations show daily satellite pictures of weather patterns.

Communication satellites are now used by many nations. The Intelsat—the world's largest satellite system—has 102 member nations and 250 ground stations. This satellite system provides a 240 channel link between the United States and Europe. The Intelsat system was used by the United States to relay the landing of *Apollo 11* on the moon. It is also used for the transmission of telephone, educational, medical, and other types of communication. More and more satellites are being placed in orbit as we expand our use of telecommunications (cell phones, beepers, satellite television, and the Internet). Many companies and agencies now have their own satellites, and personal satellites are not far off in the future.

Global Positioning Systems (GPS) are space-based radio positioning systems that provide 24 hour three-dimensional position, velocity, and time information to users anywhere on or near the surface of Earth. These measurements are used for critical navigation applications. The NAVSTAR system, operated by the United States Department of Defense, is the first GPS system available for nonmilitary uses. GPS is currently available in some cars and for marine navigation systems. GPS is also used to measure the movements of Earth's crust, to track the weather, and to help locate earthquakes.



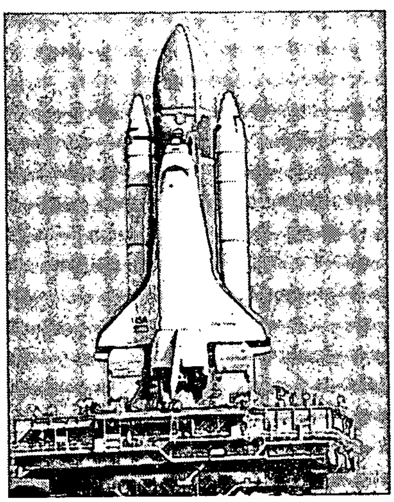
satellite

By combining GPS with computer mapping techniques, we will be better able to identify and manage our natural resources. Intelligent vehicle location and navigation systems will let us find more efficient routes to our destinations, saving millions of dollars in gasoline costs and also preventing the cause of tons of air pollutants. Travel aboard ships and aircraft will be safer in all weather conditions.

Sources Used to Collect Information

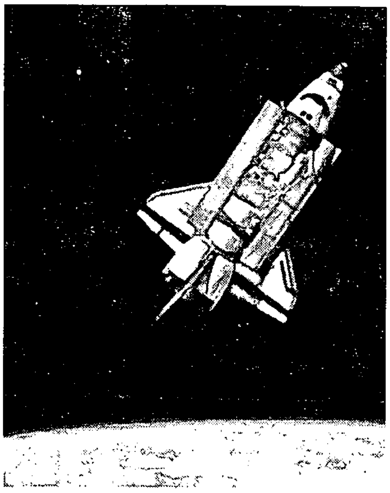
The collection of information about Earth and space requires the use of some very specialized equipment. The satellites used for information collection often have much of this specialized equipment built into them. The weather satellites that send information to Earth about the weather can take pictures of cloud covers. Hurricanes can be tracked, allowing enough time to give hurricane warnings. Temperature **detectors** help us learn how temperature changes at different heights in the atmosphere. **Cosmic ray** detectors gather information about cosmic radiation, which is harmful to people. To collect scientific data, microphones are mounted on the satellite to record the sound of meteors hitting the satellite. These recordings give scientists information for improving satellites and increasing knowledge of meteors.

In the development of the space program for the United States, the National Aeronautics and Space Administration (**NASA**) agency has used manned space travel to gather information about Earth and space. The early missions of the *Apollo* spacecraft provided data and practice for landing on the moon. Subsequent landings on the moon provided over 2,000 samples of moon rock for study. Television cameras aboard today's spacecraft send pictures of the moon, Earth, and other planets back to scientists on Earth. Radio **transmitters** are used to send information to receiving stations on the ground. Antennas detect all kinds of radiation around the spacecraft.



space shuttle

The spacecraft itself is valuable for data collection. A reusable spacecraft designed to transport astronauts, materials, and satellites to and from space—called the **space shuttle**—acts as a taxi and helps to speed up technological research and improvements. Animals are sent into space to test how the effects of a flight could affect a person's breathing, heart action, muscle tension, body temperature, and other physiological functions. The shuttle carries such **payload** as communication satellites, telescopes, special scientific experiments, and scientific equipment to be placed in orbit. After each mission is completed, the main portion of the



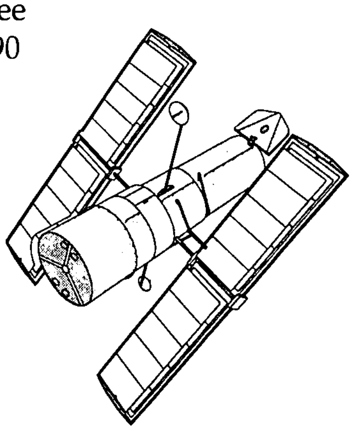
space shuttle

four-element shuttle system—the **orbiter**—glides back to Earth and lands like an airplane.

The United States and Russia have also launched **space stations**—space vehicles with living quarters, work space, and all of the equipment and systems necessary for astronauts to work and live. The space stations carry telescopes, cameras, computers, and anything needed for research projects. Future space stations may become factories or power stations for our future energy needs.

Back on Earth, all telescopes are used to concentrate information signals received from space. Some telescopes use mirrors or lenses to concentrate light waves to view images of planetary objects. Other telescopes, called *radio telescopes*, use large reflecting dishes and antennas to receive radio waves. From the ground, scientists are forced to study Earth and space more indirectly through telescopes or planetary probes that gather important information about other planets and send this information back to Earth.

The Hubble Space Telescope is designed to see 10 times more clearly into space than other Earth-based telescopes; it can see objects one-billionth as bright as the human eye can see. The Hubble telescope circles Earth every 97 minutes, 370 miles (595 kilometers) above the atmosphere. It was designed to last 15 years, with servicing every three years, the 43-foot Hubble was put into orbit in 1990 and began transmitting data back to Earth. An international project, the telescope contains equipment developed by the European Space Agency and a variety of United States institutions.



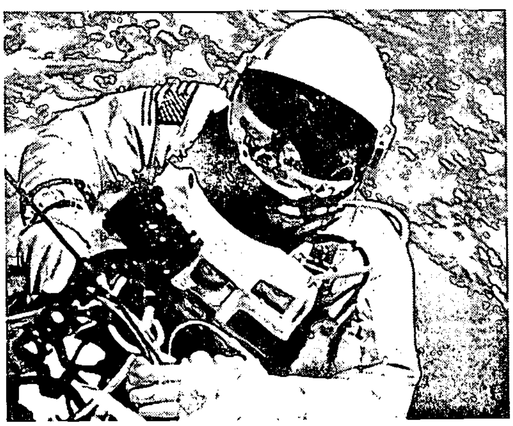
Hubble Telescope

The Hubble telescope's primary mirror (the benchmark by which telescopes are measured) is relatively small at 94.5 inches wide (2.4 meters). The mirror had a flaw which was corrected in 1993, and the Hubble has performed remarkably well since then.

The telescope is so sensitive that it can detect the equivalent of a flashlight beam from 250,000 miles away—the distance from Earth to the moon. Since the telescope is located beyond Earth's atmosphere, the telescope can receive ultraviolet and infrared light that doesn't reach Earth's surface.

The Hubble Space Telescope can be pointed anywhere in space except close to the sun, moon, or Earth's lighted side as the light is simply too bright for its sensitive instruments. Two antennas send out data and receive instructions from the ground via NASA's Tracking and Data Relay Satellite System. A receiving antenna is located in White Sands, New Mexico. The scientific data is then transmitted to other sites. The Hubble telescope has already given scientists new glimpses into the universe from discovering new galaxies to witnessing the formation of a black hole. It will be a useful tool for future scientific discoveries.

NASA Research



astronaut

Although many of us are unaware of them, the NASA space program has far-reaching effects that touch our daily lives. Technologies developed for the space program have been transferred to uses that are quite different from their original applications. These transferals have had an impact on many areas of life.

In the area of space research, NASA's technologies have created safer space travel for astronauts, provided more accurate information about the solar system, and improved command missions where unmanned satellites can probe space and gather important information. Any dangerous effects of space travel on astronauts are outweighed by the information that NASA is able to gather and put to use. This includes the remote possibility of finding homes for people on other planets.

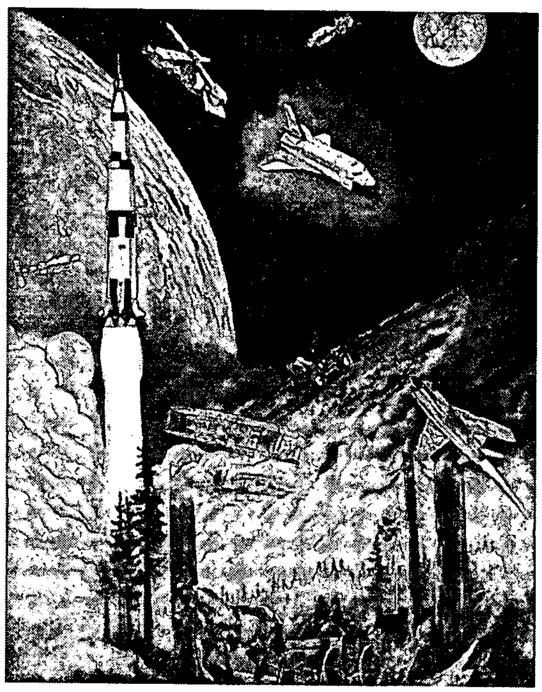
Communication is another area in which the transferal of technologies has benefitted our everyday lives. Worldwide communications (television and radio) have been greatly improved and continue to improve daily. Our accuracy in forecasting the weather has increased. There are improved warning systems for dangerous storms.

These technologies have improved our military capabilities. While research has provided us with better defenses against foreign invasion, it has also created a nuclear power race among the more powerful countries.

The many research projects must be funded in some way. Funds for science research come from federal government agencies, industry, and private foundations. Many taxpayers object to the expenditure of the billions of tax dollars that are necessary to complete the research projects. It is difficult, however, to dispute the technological advances that have been made in the United States since our decision to explore that great space beyond our Earth.

Summary

People have been interested in studying the sky and celestial bodies since the earliest times. Observations have been recorded since 500 B.C. Our ideas about the universe changed as discoveries were made by scientists such as Copernicus and Galileo. Today, through research conducted by NASA using sophisticated technology, scientists can gather firsthand information. Astronauts travel safely in space shuttles and collect data from space stations. More distant parts of the universe can be studied with probes and satellites. The technological advances in communication and other areas have benefited us in many ways.



Practice

Use library **reference materials** *to answer the following.*

1. What were the major accomplishments of the following astronomers?

   Pythagoras (500 B.C.): ______________________________

   ____

   ____

   Ptolemy (2nd century A.D.): ______________________________

   ____

   ____

   Copernicus (1473-1563): ______________________________

   ____

   ____

   Kepler (1571-1630): ______________________________

   ____

   ____

   Galileo (1564-1642): ______________________________

   ____

   ____

2. Name four instruments that are used to collect information about space.

3. Name the first communication satellite and describe its function.

Practice

Write **True** *if the sentence is correct. Write* **False** *if the sentence is* not *correct.*

________ 1. Galileo was a Greek philosopher who believed that Earth was the stationary center of the universe.

________ 2. The Polish astronomer Nicholas Corpernicus proposed that Earth was a planet and that it revolved around the sun.

________ 3. Eratosthenes, a Greek astronomer, computed the size of Earth.

________ 4. Pythagoras, an Italian astronomer, built his own telescopes.

________ 5. Galileo discovered the first four moons of Jupiter.

________ 6. Johannes Kepler supported the Copernican theory and developed his own laws of planetary motion.

________ 7. The first astronomical phenomenon to be understood was the cycle of Earth.

________ 8. A lunar probe is special instrumentation designed to be launched into space to gather information about the moon.

________ 9. An eclipse is the obscuring of the sun as the moon passes directly between Earth and the sun.

________ 10. The *Apollo* and the *Gemini* were probes sent into space to make direct observations of our solar system.

________ 11. The only way to study the moon is indirectly by instrumentation.

Practice

Match each definition with the correct term. Write the letter on the line provided.

______ 1.	a spacecraft designed to orbit a celestial body without landing on its surface	A. astronomer
______ 2.	communication over a distance	B. communication satellite
______ 3.	a satellite that receives, amplifies, and relays signals	C. detector
______ 4.	rockets that carry cameras and other instruments to study space	D. orbiter
______ 5.	one who studies astronomy or makes observations of celestial phenomena	E. space probes
______ 6.	device for indicating the presence of a certain substance	F. space shuttle
______ 7.	a reusable spacecraft that carries astronauts into space and returns them to Earth	G. telecommunication

Practice

Match each definition with the correct term. Write the letter on the line provided.

______	1.	instrument for making distant objects appear larger and therefore nearer; may use lenses, mirrors, or an antenna	A. artificial
______	2.	satellites that continuously monitor weather conditions	B. astronaut
______	3.	a person who flies in a rocket or space shuttle	C. cosmic rays
______	4.	living quarters in space, equipped with all the necessary instruments to work and live	D. NASA
______	5.	manmade	E. payload
______	6.	the load carried by a spacecraft	F. space stations
______	7.	the abbreviation for the National Aeronautics and Space Administration	G. telescope
______	8.	rays of very short wavelength and great power that hit Earth from beyond its atmosphere	H. weather satellite

Practice

Use the list below to complete the following statements.

funds	**probes**	**telescopes**
NASA	**satellite system**	**transmitters**
orbiter	**space stations**	**weather satellites**
planetary probes	**taxpayers**	**weather stations**

1. ______________________ are built into satellites to learn how temperature changes at different heights.

2. Today, there are more than 8,000 ______________________ around the world that make observations about our weather conditions.

3. ______________________ would send back pictures that show weather changes from hour to hour.

4. The Intelsat is the world's largest ______________________, and it has 102 member nations.

5. ______________________ are used to send information to receiving stations on the ground.

6. After completing a mission, the main portion of the four-element shuttle system, the ______________________, glides back to Earth and lands.

7. In the development of the space program for the United States, ______________________ uses manned space travel to gather information about Earth and space.

8. ____________________ carry telescopes, cameras, computers, and anything needed for research projects.

9. On Earth, ____________________ are used to concentrate information signals received from space.

10. From the ground, scientists are forced to study Earth and space more indirectly through telescopes or ____________________ that gather important information about other planets and send this information back to Earth.

11. Many ____________________ object to spending billions of tax dollars to complete research projects, but the technological advances in communication and other areas have benefitted us in many ways.

12. ____________________ for science research come from federal government agencies, industry, and private foundations.

Practice

Use the list below to write the correct term for each definition on the line provided.

artificial	**detector**	**space shuttle**
astronaut	**NASA**	**space stations**
communication satellite	**satellite**	**telecommunication**
cosmic rays	**space probes**	**transmitter**

________________ 1. a satellite that receives, amplifies, and relays signals

________________ 2. man-made

________________ 3. a person who flies in a rocket or space shuttle

________________ 4. rays of very short wavelength and great power that hit Earth from beyond its atmosphere

________________ 5. communication over a distance

________________ 6. instrument that sends signals from one place to another

________________ 7. device for indicating the presence of a certain substance

________________ 8. a reusable spacecraft that carries astronauts into space and safely returns them to Earth

________________ 9. living quarters in space, equipped with all the necessary instruments to work and live

________________ 10. an object that revolves around a larger object

_________________________ 11. rockets that carry cameras and other instruments to study space

_________________________ 12. the abbreviation for the National Aeronautics and Space Administration

Lab Activity

Purpose	Materials
Use the Internet to research a mission to explore space.	• reference material • Internet access

Use the list of **Internet sites** *below and other* **reference materials** *to complete this activity.*

Internet Sites:

NASA Shuttle Web
http://shuttle.nasa.gov/index.html/

The Space Experience - a guide to past and future space missions
http://www.geocites.com/CapeCanaveral/Hangar/5816/

Kennedy Space Center
http://www.ksc.nasa.gov/

NASA Web Site
http://www.nasa.gov/

NASA On-Line Resources for Educators
http://www.hg.nasa.gov/office/codef/education/online/html

NASA Classroom of the Future
http://www.cotf.edu/

NASA Observatorium
http://observe.ivv.nasa.gov/nasa/core.shtml

NASA Observatorium Human Spaceflight
http://observe.ivv.nasa.gov/nasa/spacefly/spacefly_index.shtml

Project Gemini
http://www.ksp.nasa.gov/history/gemini/gemini.html

Project Mercury
http://www.ksp.nasa.gov/history/mercury/mercury.html

Eye on the Universe - A Hubble Mission
http://www.thetech.org/hyper/hubble/

Hitchhiker's Guide to Hubble
http://www.discovery.com/area/specials/hubble/hubble1.html

Star Journey from National Geographic
http://www.nationalgeographic.com/features/97/stars/

Space Telescope Science Institute
http://www.stsci.edu/

Satellite Passes - shows positions of current satellites and orbiters over the United States)
http://www.bester.com/satpasses.html

GOES Project Science
http://climate.gsfc.nasa.gov/~chesters/goesproject.html

The Satellite Site - What is a satellite? Build one on the Internet.
http://www.thetech.org/hyper/satellite/

1. Name of the space mission or satellite: ____________________

2. Date of mission: ____________________________________

3. Major purpose: ______________________________________

4. Scientific discoveries made by exploration: ________________

   ____

   ____

5. Why was this mission helpful to the exploration of space and future discoveries?

   ____

   ____

   ____

Practice

Circle the letter of the correct answer.

1. An object that revolves around a larger object is a __________.

    a. space shuttle
    b. space station
    c. transmitter
    d. satellite

2. The abbreviation for the National Aeronautics and Space Administration is __________.

    a. NASA
    b. NAAA
    c. NATA
    d. ASA

3. Rocket-launched vehicles that carry instruments, cameras, and other data-gathering equipment for deep-space measurements are called __________.

    a. space probes
    b. space shuttles
    c. detectors
    d. cosmic rays

4. __________ are living quarters in space, equipped with all the necessary instruments to work and live.

    a. Space shuttles
    b. Satellites
    c. Space probes
    d. Space stations

5. A __________ is a reusable spacecraft that carries astronauts into space and returns them to Earth.

    a. satellite
    b. space probe
    c. space shuttle
    d. space station

6. ____________ is communication over a distance.

   a. Telecommunication
   b. NASA
   c. Astronaut
   d. Cosmic rays

7. A person who flies in a rocket or space shuttle is a(n) ____________ .

   a. satellite
   b. cosmic ray
   c. astronaut
   d. detector

8. ____________ are rays of very short wavelength and great power that hit Earth from beyond its atmosphere.

   a. Transmitters
   b. Detectors
   c. Cosmic rays
   d. Shuttles

9. ____________ means manmade.

   a. Telecommunication
   b. Detector
   c. Cosmic rays
   d. Artificial

10. A ____________ is a device for indicating the presence of a certain substance.

    a. space probe
    b. telecommunication
    c. transmitter
    d. detector

11. A ____________ is an instrument that sends signals from one place to another.

    a. transmitter
    b. detector
    c. cosmic ray
    d. satellite

12. A(n) ____________ is a spacecraft designed to orbit a celestial body without landing on its surface.

    a. orbiter
    b. transmitter
    c. satellite
    d. space probe

13. The load that is carried by a spacecraft is called the ____________ .

    a. orbiter
    b. payload
    c. space shuttle
    d. satellite

14. An instrument that concentrates signals from space for viewing objects is a ____________ .

    a. transmitter
    b. space probe
    c. satellite
    d. telescope

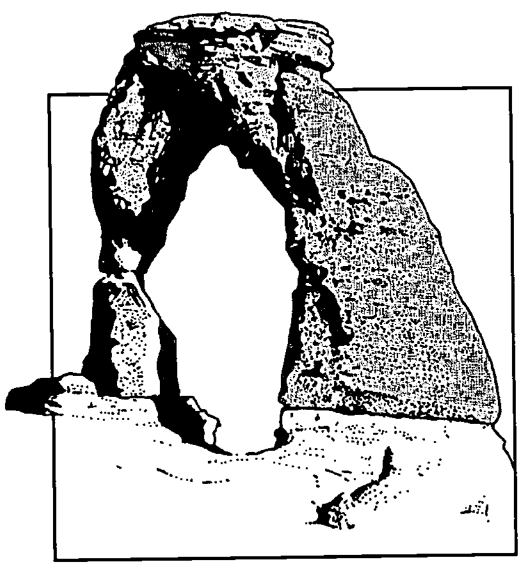
15. One who studies astronomy or makes observations of celestial phenomena is a(n) ____________ .

    a. astronaut
    b. detector
    c. astronomer
    d. transmitter

16. The science of celestial bodies and their properties is called ____________ .

    a. geology
    b. astronomy
    c. astrology
    d. biology

Unit 6: Rocks and Minerals



Vocabulary

Study the vocabulary words and definitions below.

cleavage .... the tendency of a mineral to break along a smooth or flat surface

conglomerates .... rocks composed of rounded fragments varying from small pebbles to large boulders in a cement

crystal .... a solid shape in which the atoms are arranged in a definite pattern forming flat faces

extrusive .... igneous rocks that cool on Earth's surface

fracture .... the tendency of a mineral to break along a jagged, uneven, or curved surface

fragmental rocks .... the first group of the formation of sedimentary rocks made from pieces or fragments of rocks

gems .... rare, precious, or semiprecious minerals

igneous rock .... a rock formed after magma has cooled

inorganic .... materials that do not contain carbon and have never lived intrusive .... igneous rocks that cool below Earth's surface

lava .... melted rock (magma) on the surface of Earth

luster .... the reflecting qualities of a material; its shine or surface appearance

magma .... melted (hot liquid) rock found inside Earth

metallic minerals .... minerals that have a shiny appearance and are good conductors of heat and electricity

metals .... minerals that conduct heat and electricity; have shine

metamorphic rock .... an igneous or sedimentary rock that has been changed by heat and pressure

mineral .... an inorganic substance with a definite chemical formula and specific shape

mineralogist .... a scientist who studies and identifies minerals

Mohs' scale .... a scale used to test the hardness of a mineral

nonmetallic minerals .... minerals without metal, with no shine

nonmetals .... minerals that do not conduct heat or electricity; have no shine

ore .... a rock or mineral from which metals and nonmetals can be removed in usable amounts

organic .... materials formed from the remains of plants and animals

rock .... a solid material made of one or more minerals

rock cycle .... continuous change of rocks from one form to another

sediment .... small pieces of rock

sedimentary rock .... rock made up of several layers of sediment cemented together

specific gravity .... the ratio or relationship between the mass of the mineral and the mass of an equal volume of water

Introduction

Rocks and **minerals** form the basis of the soil that we walk upon. The study of their formations and their properties enable us to identify common rocks and minerals found in our environment.

As a result of physical and chemical processes, Earth's materials constantly change. Heat and pressure cause rocks to change from one form to another in a continuing cycle. The forces acting on Earth create many landforms and rock structures, which affect the topography of an area. Florida's most common rock is limestone. Reefs, caves, and sinkholes are features of our state's unique environment.

Properties of Minerals

Most of the solid part of Earth's crust consists of *minerals*. The most common minerals are formed from eight common elements. Minerals have five special characteristics, which are described below.

Mineral Characteristics

1. A mineral occurs naturally in Earth; it is not manufactured.
   Iron is a mineral because it is a naturally occurring substance found on Earth. Steel, however, is manufactured, so it is not a mineral.

2. Minerals are **inorganic**. They are not made from things that are living or were once living.
   Coal is *not* a mineral because it is **organic** and is composed of the remains of plants and animals. Quartz is a mineral because it is inorganic and is composed of the nonliving substances of iron and oxygen.

3. Minerals are always found as solids in Earth.

4. Minerals always have a definite chemical composition. They have the same kinds of atoms in the same proportions in every sample.

5. There is a definite geometrical arrangement or orderly pattern of atoms in most minerals. This orderly arrangement forms **crystals**.

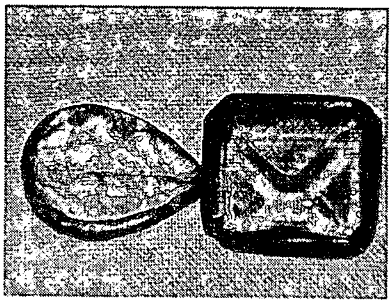
Minerals from which **metals** or **nonmetals** can be removed in large enough amounts to be usable are called **ores**. Metals are minerals that can conduct heat and electricity and have a shine to them. Gold, silver, aluminum, and copper are examples of metals. Nonmetals are not shiny and do not conduct heat and electricity well. Nonmetals are often gases or soft solids. Some examples of nonmetals found in ores are sulfur, phosphorus, oxygen, and nitrogen.

Gems are rare minerals that are beautiful, long-lasting, and durable. Precious gems are very rare, beautiful, and valuable. These include diamonds and emeralds. Gems are usually cut into specific shapes. Other gems such as opals, turquoise, and topaz are semiprecious.

The shape of gems is a product of their structure. That is, a diamond is shaped a certain way because of the way its atoms are assembled. When two or more atoms are brought close enough together, an attractive force between the electrons of the atoms and/or the nucleus of the other atoms can result. If this force is strong enough to keep the atoms together, a chemical bond is said to be formed. Crystals are formed when atoms combine by sharing electrons in regular patterns as a substance (usually a liquid) is cooled. All rocks and minerals are formed from atoms sharing bonds with other atoms. This bonding or sharing of electrons produces a new chemical substance with different physical properties. For example, diamond and coal are composed of carbon atoms, but they have different physical properties resulting from the different type of bonds between the atoms.

Mineral Identification

Mineralogists are scientists who study and identify minerals. Some minerals can be recognized by their appearance. However, because so many minerals look alike, tests have been developed to help identify minerals. Knowing the properties of minerals makes it easier to identify them.



gems are rare minerals

Physical Properties

Many minerals can be identified by their physical properties, such as color, texture, hardness, or **luster.** Other minerals must be tested with chemicals to determine their identity. Below are some tests that can be performed to identify minerals by their physical properties.

Luster. Luster is usually determined by deciding whether the mineral is shiny (reflects light) or not. A **metallic mineral** (such as the metals silver or gold) is shiny and is said to have a metallic luster. Minerals that do not shine like a metal are said to have a nonmetallic luster. These **nonmetallic minerals** may look dull, pearly, glassy, silky, or transparent (light can pass through).

Color. The color of a mineral is one of the first physical properties to be observed. However, color can be used in determining only a few minerals—those which are always the same color. The mineral gold, which is a metallic yellow, is an example. Other minerals are turquoise (blue-green), sulfur (yellow), hematite (dark red), and azurite (deep blue). The color of many other minerals can change because of impurities in them. Also, several minerals can have the same color. Calcite, talc, and halite are all white, for example. So, to be sure, other tests are needed to identify minerals.

Shape. Many minerals can be identified by whether they have a crystal form. A crystal form is a regular, geometric pattern that creates flat faces. The different crystal forms also aid in identifying minerals. Crystalline form is not natural for all minerals. That is one reason to use other methods of identification.

Cleavage. The way a mineral breaks is described as either **cleavage** or **fracture.** Minerals cleave if they break along a smooth, flat plane. Some rocks cleave in only one direction, such as mica, which splits into thin sheets. Other rocks will show perfect cleavage in several directions. Feldspar splits in different directions, but nearly always at right angles.

A gentle tap of a hammer on the mineral will make it cleave or split. Some minerals do not split in a definite direction. When the break causes an irregular surface, it is called a *fracture.* The surface may be rough and curved with thin, jagged points. Quartz is a mineral that does not break in any certain pattern.

Streak. A streak test reveals the true color of the mineral. A streak is the color of the powdered mineral. You may have done something similar to a streak test if you used a soft stone to write on the sidewalk. To find the streak color, rub the unknown mineral on a hard, rough, white surface (like the unglazed side of a bathroom tile or a streak plate). It may leave a streak of color. The color of the streak is used to identify the mineral.

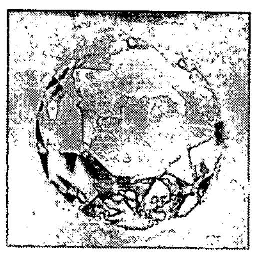
The color made by the streak test is always the same, but it may not be the same color as the larger piece of the mineral. Some minerals, however, streak the same color as they appear. For example, talc is white and its streak is white. The streaks of some minerals are different from their appearance. Hematite, for example, may be red or black, while the powder from the streak test is always cherry red. Also, the mineral iron pyrite is yellow, but it has a greenish-black streak.

Of course, for a mineral to leave a powder on the streak test, it must be softer than the streak plate. This is why minerals harder than a porcelain tile (measuring more than five on the **Mohs' Scale** of Hardness) will not leave a streak.

Specific Gravity. **Specific gravity** is useful in recognizing heavy minerals and many jewels. The specific gravity of a mineral is its weight compared to an equal volume of water. For example, if a mineral weighs four times as much as an equal volume of water, its specific gravity is four.

Minerals which contain metals are usually dense. The density, or *heft*, is judged rather than actually measuring specific gravity.

Hardness. Hardness is one of the properties most useful in identifying a mineral. Hardness is a mineral's resistance to being scratched. In other words, "What can it scratch?" or "What can scratch it?" We test a mineral against other minerals. The harder mineral will always scratch a softer mineral.



A diamond is the hardest mineral.

A German mineralogist named Friedrich Mohs (1773-1839) worked out a scale of hardness. This scale—called *Mohs' scale*—is used to identify a mineral's hardness. Ten minerals whose hardness is known are arranged in the order of their increasing hardness. Each mineral is given a number

Mohs' Scale of Hardness

Hardness		Mineral
softest	1	talc
	2	gypsum
	3	calcite
	4	fluorite
	5	apatite
	6	feldspar
	7	quartz
	8	topaz
	9	corundum
hardest	10	diamond

from one to 10. Talc is the softest mineral, so it is given the number one. Diamond is the hardest mineral, so it is given the number 10.

A mineral will scratch any mineral with a lower number. If two minerals do not scratch each other, they have the same hardness. Diamonds will scratch all other minerals, and talc can be scratched by most other minerals.

If you are on a field trip collecting minerals, you may not be able to find other minerals needed to use for the hardness test. In such a situation a field scale can be used. The hardness determinations are not as exact as those using the minerals on Mohs' scale of hardness minerals, but they will be close enough for field use.

Field Scale of Hardness

Hardness		Test
softest	1	soft and greasy feeling, scratched easily with fingers
	2	scratched by fingernail with a lot of pressure
	3	scratched by a copper penny
	4	scratched easily by a knife
	5	scratched by a knife using a lot of pressure
	6	scratched by a steel file
	7	can scratch a steel file or piece of glass
	8	can scratch quartz
	9	(no good field tests for hardness above #8)
hardest	10	

Acid Test. There are many chemicals that could be used as a mineral test. One test often used is the hydrochloric acid (HCl) test. When HCl is put on a mineral, bubbles may occur. If bubbles are given off, then calcite is present. Hydrochloric acid detects the presence of oxygen or carbon.

The color a flame turns when a small amount of the mineral is placed in it tells what metals are present. For example, copper turns the flame green.

Other Tests. In addition to those tests described above, the shape and size of the crystals found in a mineral can assist in determining its identity. Also, magnetic properties may be present. Minerals that contain iron or magnetite are attracted by a magnet. Still other minerals have unusual or unique characteristics: halite has a salty taste; sulfur a definite smell; and jade, when tapped, will have a bell-like ring.

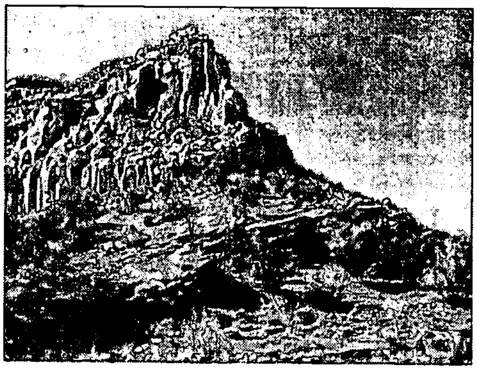
Mineral Identification	
Physical Properties	**Chemical Properties**
1. luster 2. color 3. shape 4. cleavage 5. streak 6. specific gravity 7. hardness	1. acid test 2. flame test

Major Types of Rocks

Rocks are composed of one or more minerals. About a dozen minerals are common rock-forming minerals. Elements such as oxygen, silicon, carbon, and sulfur combine with minerals to form many types of rocks. Rocks are classified into three groups, according to the way they were formed. These three groups of rocks are igneous, sedimentary, and metamorphic.

Igneous Rocks

The group of rocks known as igneous originate deep inside Earth. The word igneous means *fire-formed*. It is so hot in Earth's mantle that rocks and minerals melt and become liquid or molten material. This molten material inside Earth is called **magma**. **Igneous rocks** form when the magma cools and hardens.



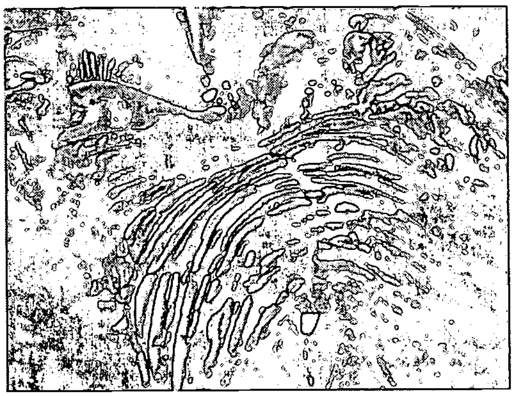
igneous

Magma below the surface of Earth cools very slowly. The magma eventually becomes solid or crystallizes within Earth. These rocks would not be seen if not for erosion. Igneous rocks that are formed inside Earth are called **intrusive**. The crystals in intrusive igneous rock, such as granite, are large because the magma cooled slowly.

Granite is the most common igneous rock. Its large crystals tell us that it was formed by cooling slowly below Earth's surface. Granite makes up much of the continental crust. It is strong and can be polished. It is used in many buildings and monuments. Granite varies in color from a light gray to a pinkish color, depending on the proportion of each of the minerals (quartz, feldspar, and mica) present in the granite.

Sometimes the molten material, magma, is pushed from deep within Earth to the surface of Earth from volcanoes. On occasion, the molten materials break through the surface. If this molten material escapes from a volcano, it is called **lava**. Lava flows on the surface. Lava usually cools very quickly, forming small crystals. Sometimes it cools so quickly that no crystals are formed.

The volcanic rocks formed when lava cools on Earth's surface and becomes solid are called **extrusive**. Basalt is a common extrusive igneous rock with small crystals. Basalt is found in areas where there were ancient lava flows. It is plentiful in the Hawaiian Islands and makes up much of the ocean's crust. Obsidian is another extrusive rock that forms when magma cools so quickly that no crystals form. It is black and glassy in appearance. Another extrusive rock is pumice. It cools so quickly that it has no crystals and has holes made by the gases escaping from the lava. It is the only rock that floats.

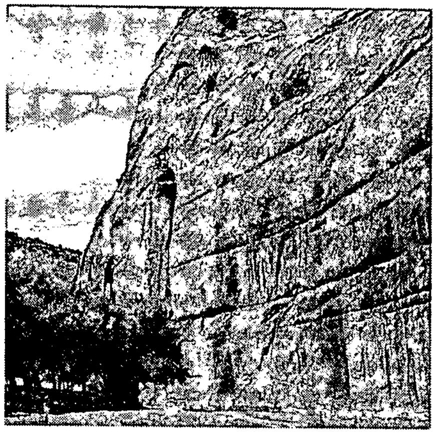

hardened lava

Sedimentary Rocks

The surface of Earth is always being broken into smaller and smaller pieces through a process called *weathering*. Broken pieces such as rocks, gravel, pebbles, sand, and clay are *rock fragments*. Rock fragments ranging in size from large gravel to microscopic bits are moved from place to place by the agents of erosion: wind, water, gravity, and glaciers. Rock fragments will settle in one place and pile up. These rock fragments that pile up are known as **sediment**. Most sediment builds up under water. Sediment piles up in layers on top of layers and over time becomes cemented together.

Sediment can harden to form **sedimentary rocks**. Sedimentary rocks are formed in two ways: (1) When new sediment piles on top of old sediment, the pressure of the weight of the top layers will harden the layers below; and (2) dissolved minerals in the water can cement the sediment together. All sedimentary rocks are made of layers, with the oldest sediments on the bottom and the newest ones near the top.

Sedimentary rocks are divided into three groups according to where the sediments came from and how the rocks were formed. The first group of sedimentary rocks are made from pieces or fragments of rocks and are called **fragmental rocks**. Rocks formed from these deposits are called *clastic* sedimentary rocks. They are further classified by the size of the pieces of rock in them. Those made of small, sand-sized grains of rock are called *sandstones*. They become cemented together by minerals such as quartz that are dissolved in the water that flows over them. *Shale* is made from clay or mud, which has somewhat larger particles than sandstone. The particles in shale are flat and are easily broken apart into flat pieces. Some fragmental rocks have large pebbles mixed with mud and sand. They are called **conglomerates**.



sedimentary

A second type of sedimentary rock is called *organic*. Organic sedimentary rock forms when the remains of plants and animals harden into rock. For example, limestone is formed from the shells of sea animals. The coral reefs off the coast of Florida are made of limestone deposits. Coal is another organic rock formed from plants that lived millions of years ago.

The third type of sedimentary rock is *chemical*. Chemical sedimentary rocks are formed when water evaporates and leaves behind mineral deposits. Halite or rock salt is a chemical rock. Many chemical rocks are found near the Great Salt Lake in Utah.

Metamorphic Rocks

The word *metamorphic* comes from the Greek words meaning *change* and *form*. **Metamorphic rocks** are rocks that used to be a different kind and have changed over time. Metamorphic rocks are formed deep within Earth where the temperature is high and the pressure is great. Rocks are changed by heat, pressure, and chemical action.


metamorphic

Heat alone can change one kind of rock into another kind of rock. This heat is supplied by magma. Heat and pressure together can change rocks, too. Rocks can also be changed by chemical actions. Magma contains chemicals that can cause changes in the rocks it touches. The new rocks are harder and may look different, and the minerals in these rocks may change.

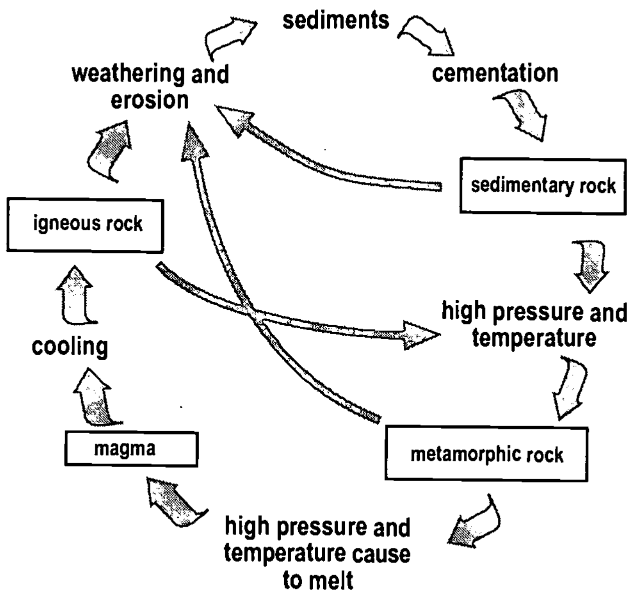
Igneous rocks and sedimentary rocks can change to form metamorphic rocks. Sedimentary rocks such as limestone, which is fairly light and grainy and can be rubbed to a smooth finish, may change into marble, which is heavy and can be polished into a glass-like luster. Shale, which feels like hard mud and crumbles under pressure, may change to slate, which is very hard, fine-grained, and brittle. Sandstone is a soft rock that is easily broken. It may change into quartzite, which is finer grained, harder, has a glass-like luster, and is not easily broken.

Granite is an igneous rock with a mixture of large and small crystals found in several colors. It may change into gneiss (pronounced *nice*), which is streaked and composed of very small crystals of many colors.

The Rock Cycle

The continuous changing of rocks from one form to another is called the **rock cycle**. Igneous rocks are the ancestor of all rocks. Wind and water caused some of the igneous rock to be broken down to eventually form sedimentary rock. Some of the igneous and sedimentary rocks became buried deep in Earth. The high temperature and pressure caused them to be changed into metamorphic rocks. Eventually the metamorphic rocks will be exposed to the surface of Earth again and be broken down into sediments by wind and water. All three types of rocks may become buried so deeply that they become a liquid, and magma will be formed again. When the magma cools, it will form igneous rock, and the cycle will repeat again and again.

The Rock Cycle



Major Florida Rock Formations

Limestone is by far the most abundant rock formation in Florida. It lies under the land in all of the state. Limestone is a sedimentary rock composed of calcium carbonate ($CaCO_3$). Florida limestones range from hard and compact to soft and chalky. They range in color from white or light gray to a light grayish brown. Limestone may be easily identified by applying a drop of hydrochloric acid, which causes the calcite particles to bubble.

Limestone in the state is divided into several types. Key Largo limestone is found in the Florida Keys and contains fossil corals. Another type of limestone is oolite. Oolites are small rounded grains which look like fish eggs. These grains are formed by the deposition of layers of calcite around tiny particles, such as sand grains or shell fragments. It is found in several southern Florida counties.

Another type of Florida limestone is coquina. Coquina limestone is composed of shells and quartz sand grains that have been cemented together. Coquina has long been used as a building stone in Florida and is used today in architecture because of its unusual beauty. As you would expect, coquina is rarely found far from the coast.

In many areas of north and central Florida, underground water dissolves the limestone and carries it away, forming underground caves and caverns. During periods of drought, the roofs of these underground structures sometimes cave in, forming sinkholes.

Florida produces millions of tons of limestone and other minerals each year. Limestone production is a major industry in Florida. Most of the limestone produced in the state is crushed for use in making roads and concrete. It is also used as a conditioner for soil in agriculture, riprap (broken stone for foundations), and building stone walls.

Dolomite, common clay, kaolin (china clay), fuller's earth, and quartz sand are other common Florida rocks. These valuable natural resources are important for the state's economy. (See chart below for information about the uses of these rocks.)

Rocks	Uses
limestone	roads, concrete, cement, fertilizer, soil conditioner
dolomite	agricultural lime, cut stone
common clay	roads, brick, cement
kaolin	ceramics, tile, rubber, plastics, paper, paint
fuller's earth	absorbent (kitty litter, oil dry), insecticides, soaps, plastics, paints

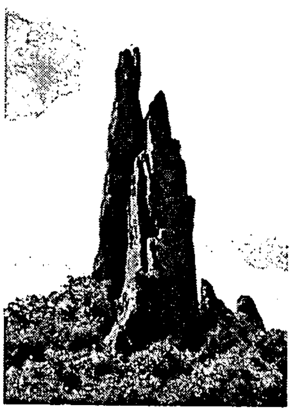
Summary

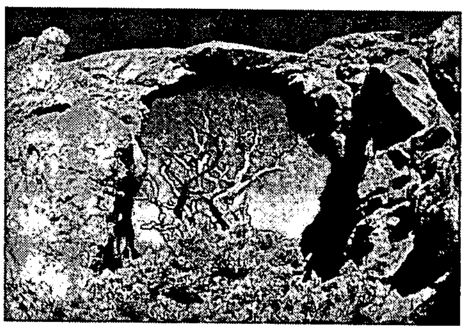
Earth's crust is composed of elements which combine to form minerals. Minerals have five essential characteristics: naturally formed, inorganic, solid, a definite chemical formula, and an orderly arrangement of atoms. Minerals are identified by their physical properties, including luster, color, shape, cleavage, streak, specific gravity, hardness, and certain other tests.

Rocks are composed of one or more minerals. The three major types of rocks are igneous, sedimentary, and metamorphic. Rocks are continually changing from one form to another through the rock cycle.

Florida's rock formations consist of mostly limestone. Key Largo, oolite, and coquina are three of the different types. Florida's other rock formations include dolomite, common clay, kaolin, fuller's earth, and quartz sand. These natural resources are important for the state's economy.

Interesting rock formations found in the United States.





Practice

Use the list below to write the correct term for each definition on the line provided.

aluminum	**inorganic**	**ores**
atoms	**metals**	**rocks**
copper	**minerals**	**silver**
definite	**naturally**	**solid**
gold		

1. Our soil is made of ______________________ and ______________________ .

2. Five essential characteristics that all minerals have are as follows:

   1) ______________________ formed; are

   2) ______________________ ; are

   3) ______________________ ;

   4) have a ______________________ composition; and

   5) most have a definite geometric arrangement of ______________________ .

3. Rocks or minerals from which we can remove usable amounts of metal are called ______________________ .

4. Minerals that conduct heat and electricity and have a shine to them are called ______________________ .

5. Four metals are ______________________ , ______________________ , ______________________ , and ______________________ .

Practice

Use the list below to write the correct term for each definition on the line provided.

diamonds	**nitrogen**	**phosphorus**
emeralds	**opals**	**sulfur**
gems	**oxygen**	**topaz**

1. Four nonmetals are ________________________,
   ________________________, ________________________,
   and ________________________ .

2. Rare minerals that are beautiful, long-lasting, and durable are called ________________________ .

3. Two precious gems are ________________________ and ________________________ .

4. ________________________ and ________________________ are two semiprecious stones.

Lab Activity 1: Identifying Minerals—Luster

Purpose	Materials
Identify the luster of certain mineral samples.	• mineral samples

1. Observe each mineral and describe its luster.
2. When you have determined the luster, place a check in the appropriate space on the chart below.
3. When you have finished, return each mineral to its own box.

Metallic		Nonmetallic					
color		dull	pearly	glassy	silky	sparkling	other
A							
B							
C							
D							
E							
F							
G							

4. Why is this test useful? ______________________________

____

____

Lab Activity 2: Identifying Minerals—Color, Shape, and Cleavage

Purpose	**Materials**
Identify the color, shape, and cleavage of certain mineral samples.	• mineral samples

1. Look at each sample mineral. (These samples have already been split.)

2. Determine the color of each sample. Record your observations in the chart.

3. Observe each mineral and try to describe its shape (square, rectangle, round, oval, diamond, no shape). When you have determined the shape, write your answer in the chart below.

4. Then, for each mineral, decide if it has any flat surfaces. If it does, write *flat*. If it does not, write *not flat*.

5. Use your answers from the chart below to answer the questions on the following page.

Sample	Color	Shape	Surface
A			
B			
C			
D			
E			
F			
G			

6. Which samples are the same color? ____________________

____

7. Which samples do you think are the same mineral? ____________

____

Why? ____

8. Do you think color is an important clue in identifying these minerals? ______ Why or why not? ____________________

____

9. Which samples have flat surfaces? ____________________

____

10. Which samples do not have flat surfaces? ____________________

____

11. Which samples have cleavage? ____________________

____

12. Which samples fracture? ____________________

____

13. Why is this test useful in identifying minerals? ____________

____

____

____

____

Practice

Below are 10 **descriptors for minerals**. *Each one is the result of a certain* **mineral test**. *Which test is it? Choose the test from the list, and write the name of the test next to the correct descriptor. One or more tests will be used more than once.*

Mineral Tests

cleavage	**hydrochloric acid**	**specific gravity**
color	**luster**	**streak**
hardness	**shape**	

1. soft ______________________
2. dull ______________________
3. geometric figure ______________________
4. deep blue ______________________
5. smooth, flat surface ______________________
6. cherry red powder ______________________
7. weight ______________________
8. bubbles ______________________
9. break ______________________
10. shiny ______________________

Lab Activity 3: Identifying Minerals—Hardness

Purpose

Identify the hardness of certain mineral samples.

Materials

- mineral samples
- hardness field scale

1. Label each sample with a different letter.
2. Using the hardness field scale on page 153, test sample A for each of the properties on the list.
3. After you have determined the mineral's hardness, record your answers below.
4. Repeat the procedure for each mineral sample.
5. What is the hardness number for mineral A? ____________
6. What is the hardness number for mineral B? ____________
7. What is the hardness number for mineral C? ____________
8. What is the hardness number for mineral D? ____________
9. What is the hardness number for mineral E? ____________
10. What is the hardness number for mineral F? ____________
11. What is the hardness number for mineral G? ____________

Lab Activity 4: Mineral Identification—Hydrochloric Acid Test

Purpose	**Materials**
Identify minerals using the hydrochloric acid test.	• mineral samples • eyedropper • hydrochloric acid

1. Take the mineral in sample A, and with an eyedropper, place a drop of hydrochloric acid (HCl) on it. *Caution:* Be very careful when using HCl—wear safety goggles and aprons. Clean up all spills immediately!

2. On the chart below, record what happens.

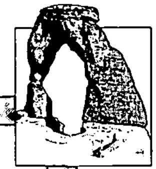
3. Repeat steps one and two with each sample.

Sample	Reaction with HCl	Calcite ?
A		
B		
C		
D		
E		
F		
G		

4. Why do you think this test is considered helpful in identifying minerals?

____

____



Lab Activity 5: Mineral Identification—Physical Properties

Purpose	**Materials**
Identify minerals using physical properties.	• mineral samples

1. Use the key below to identify mineral samples. For each sample, begin at 1. Either 1A or 1B will describe the mineral. Follow the directions given. Continue following directions until the mineral is identified.

2. Record the name of the mineral on the chart on the following page.

3. Start again with the next sample.

Dichotomous Key: Minerals

1.	A.	Metallic	Go to 2
	B.	Nonmetallic	Go to 3
2.	A.	Shiny gray color	Galena
	B.	Brassy yellow color	Pyrite
3.	A.	Scratches glass	Go to 4
	B.	Does not scratch glass	Go to 5
4.	A.	Cleavage	Feldspar
	B.	No cleavage	Quartz
5.	A.	Earthy, dull appearance/no cleavage	Go to 6
	B.	Cleavage/shiny appearance	Go to 7
6.	A.	Yellow color	Sulfur
	B.	Red to brown streak	Hematite
7.	A.	Cubic cleavage/salty taste	Halite
	B.	Crystal shape/double image when placed on printed page	Calcite

Mineral		Mineral	
A		E	
B		F	
C		G	
D		H	

Lab Activity 6: Forming Crystals

Purpose	**Materials**
Observe the formation of crystals.	• water • 2 shallow, ovenproof glass dishes • salt • sugar

1. Boil a small amount of water.
2. Stir in as much salt or sugar as will dissolve. Stop adding salt or sugar when it starts settling on the bottom without dissolving.
3. Label two shallow, ovenproof glass dishes A and B.
4. Divide the solution into the dishes.
5. Slowly heat the dish labeled A over a flame until the water is evaporated. (Be careful to watch so it does not burn.)
6. Set aside dish B for several days, then check it for crystals.
7. Describe the crystals in dish A. ________________________

____

____

____

8. How did the crystals form in dish A? ________________________

____

____

____

9. Describe the crystals in dish B. ______________________

____

____

____

____

____

10. How did these crystals form? ______________________

____

____

____

____

____

11. What is your conclusion about the formation of the crystals?

____

____

____

____

____

____

12. Which dish is most like extrusive rocks? ______________________

13. Which dish is most like intrusive rocks? ______________________

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct. In each* **false** *statement,* **circle** *the word or words that make the statement* false.

_________ 1. Color is a property of minerals.

_________ 2. Texture is how a mineral shines.

_________ 3. Streak is a property of minerals.

_________ 4. All minerals streak the same color.

_________ 5. All minerals have the same density.

_________ 6. Some minerals are softer than others.

_________ 7. A mineral has cleavage when it breaks along rough surfaces.

_________ 8. Most minerals have crystals.

_________ 9. Some minerals are shiny.

_________ 10. A mineral fractures when it breaks along flat surfaces.

_________ 11. Talc is the hardest mineral.

_________ 12. Diamond is the softest mineral.

_________ 13. The ability of a magnet to attract a mineral can help identify it.

_________ 14. All samples of a mineral will be the same color.

_________ 15. Some minerals fizz or bubble when acid is dropped on them.

Practice

Match each description with the correct name of the **mineral identification test**. *Write the letter on the line provided.*

______ 1.	the way a mineral reflects light; it may have a metallic, glassy, pearly, greasy, silky, or brilliant appearance	A. acid test
______ 2.	the color of a mineral in its powdered form; shown by rubbing the mineral across a piece of unglazed porcelain	B. cleavage
______ 3.	a mineral's resistance to being scratched; it is measured on a scale from one to 10	C. color
______ 4.	when a mineral breaks along a smooth or flat surface	D. crystals
______ 5.	when a mineral breaks along an uneven or curved surface	E. flame test
______ 6.	the comparison of the weight of the mineral with an equal amount of water	F. fracture
______ 7.	atoms arranged to form flat faces	G. hardness
______ 8.	can be attracted by a magnet	H. luster
______ 9.	the mineral will bubble or fizz when acid is dropped on it	I. magnetic properties
______ 10.	the color of flame given off by a mineral gives its identity	J. Mohs' scale
______ 11.	scale used to measure the hardness of a mineral	K. specific gravity
______ 12.	one of the first observable properties	L. streak

Lab Activity 7: Forming Sediments

Purpose

Use laboratory materials to form sediments.

Materials

- large container
- sodium carbonate
- calcium carbonate
- water
- 2 test tubes

1. Dissolve about 1 gram of sodium carbonate in 10 milliliters of water in a test tube.

2. In a second test tube, dissolve about 1 gram of calcium carbonate in 10 milliliters of water. (Both of these solutions should be clear and colorless.)

3. Pour the contents of these two test tubes into the same larger container.

4. What happened? ______________________________

____

____

____

5. After a few minutes, what forms in the bottom of the container?

____

____

6. How could this be similar to the way sediment forms in the water?

____

____

____

Lab Activity 8: Form Sedimentary Rocks from Other Rocks

Purpose	Materials
Form sedimentary rocks from other rocks.	• large jar • mixture of sedimentary particles • paper cups • plaster of Paris

Part 1

1. Mix some soil, sand, and pebbles in a jar.
2. Add water and stir or shake this mixture well. Watch how the particles settle.
3. Which one settled first? ______________________________
4. Why do you think it settled first? ______________________________

   ____
5. Does it settle in layers? ______________________________

Part 2

1. Pour the mixture above into a paper cup.
2. Very carefully, pour the water out of the paper cup, leaving a mixture of sand, soil, and pebbles.
3. Mix a small amount of plaster of Paris in another paper cup. The plaster should be thin and watery.
4. Pour plaster of Paris into the first cup with the sand, soil, and pebble mixture.
5. Set aside to dry.

6. The next day, if the plaster of Paris is dry, tear away the paper cup.

7. Describe what you see when you tear away the paper cup.

Lab Activity 9: Rock Types

Purpose	**Materials**
Identify rock types by their physical characteristics.	• rock samples • magnifying glass

Rock	Color	Fragments Present	Describe Layers	Describe Crystals Present	Color Bands	Texture	Rock Type
A							
B							
C							
D							
E							
F							
G							

1. Choose a rock sample and examine it carefully.

2. Record the physical characteristics in the chart above.

3. Compare the characteristics with rock characteristics described in the unit.

4. Determine the type of rock, and record it in the chart above. Write **I** for Igneous, **M** for Metamorphic, and **S** for sedimentary.

5. Repeat for each sample.

6. List three characteristics used to identify igneous rocks.

____

____

____

7. List three characteristics used to identify sedimentary rocks.

____

____

____

8. List three characteristics used to identify metamorphic rocks.

____

____

____

9. What type of rock is the easiest to identify? ________________

   Why? ____

____

____

10. Does color aid in the identification of rock types? ____________

   Explain. ______________________________________

____

____

____

Practice

Use the drawing of the **rock cycle** *on page 160 to answer the following by writing* **yes** *or* **no.**

> **The Rock Cycle**
>
> A rock may change in many different ways. A rock may even repeat the changes over and over again. This is known as the rock cycle. Follow the arrows in the diagram on page 160 to see how a rock of one kind can be changed into a rock of another kind.

1. Is there a specific place in the cycle where the rock cycle begins?

   ____

2. Do the changes in a rock's form take place in any special order?

   ____

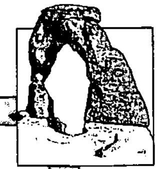
3. The arrows show the paths a rock can take to change into another type of rock. Can the paths be traveled in all directions? __________

4. Can a sedimentary rock turn into either a metamorphic or igneous rock? ______________________________

5. Can a metamorphic rock turn into either a sedimentary or an igneous rock? ______________________________

6. Can an igneous rock turn into either a metamorphic or a sedimentary rock? ______________________________

7. Can a rock change into another type of rock (igneous, metamorphic, sedimentary) in any order? ______________________________



Answer the following using complete sentences.

8. What does the word cycle mean? ______________________________

____

____

9. Why do you think mineralogists call this a cycle? ______________

____

____

____

10. What takes place for an igneous rock to become a metamorphic rock?

____

____

____

____

____

11. What takes place for a sedimentary rock to become a metamorphic rock?

____

____

____

____

____

12. What takes place for an igneous rock to become a sedimentary rock?

____

____

____

____

13. What takes place for a metamorphic rock to become a sedimentary rock?

____

____

____

____

14. What takes place for a metamorphic rock to become an igneous rock?

____

____

____

____

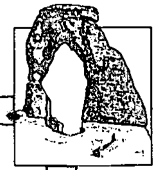
15. What takes place for a sedimentary rock to become an igneous rock?

____

____

____

____



Practice

Answer the following using complete sentences.

1. What is the most abundant rock formation in Florida? ____________

____

____

2. What is the chemical name and formula for limestone? ____________

____

____

3. What are some uses of limestone? ______________________

____

____

____

4. Name three different types of limestone. ____________________

____

____

____

____

5. Which type of limestone is found on the coast of Florida? ________

____

____

____

6. How is coquina limestone formed? ______________________________

7. What are three other important types of rocks found in Florida?

8. Why are these three important to the state? ______________________

9. How are the underground caves and caverns found in Central Florida formed?

10. How does a sinkhole form? ______________________________

Practice

Circle the letter of the correct answer.

1. ____________ is not one of the three main types of rocks.
   a. sedimentary
   b. igneous
   c. metamorphic
   d. conglomerate

2. Igneous rock that cools inside Earth is called ____________ .
   a. extrusive
   b. intrusive
   c. sedimentary
   d. metamorphic

3. Sedimentary rocks are the result of ____________ .
   a. weathering
   b. fire
   c. heat
   d. pressure

4. The rock that floats is ____________ .
   a. granite
   b. basalt
   c. halite
   d. pumice

5. The coral reefs off Florida's coast are made of ____________ .
   a. sandstone
   b. limestone
   c. shale
   d. granite

6. Coal is a(n) ____________ rock.
   a. chemical
   b. fragmental
   c. organic
   d. extrusive

7. Rocks that change in form are called __________ .

   a. igneous
   b. sedimentary
   c. metamorphic
   d. fragmental

8. __________ sedimentary rocks form when water evaporates and leaves behind a mineral deposit.

   a. Fragmental
   b. Organic
   c. Intrusive
   d. Chemical

9. Rocks made of large pebbles mixed with mud and sand are __________ .

   a. conglomerates
   b. sandstone
   c. limestone
   d. shale

10. Igneous rocks are also known as __________ .

   a. rocks that have changed in form
   b. fire-formed rocks
   c. rocks that result from weathering
   d. organic

11. Marble is a metamorphic rock that forms from __________ .

   a. shale
   b. limestone
   c. sandstone
   d. granite

12. __________ is not a metamorphic rock.

   a. marble
   b. gneiss
   c. slate
   d. granite

Practice

Use the list below to write the correct term for each definition on the line provided.

gems	**magma**	**ore**
igneous rock	**metamorphic rock**	**sediment**
inorganic	**mineral**	**sedimentary rock**
lava		

_______________ 1. does not contain carbon and has never lived

_______________ 2. a rock or mineral from which metals and nonmetals can be removed in usable amounts

_______________ 3. rare, precious, or semiprecious minerals

_______________ 4. an igneous or sedimentary rock that has been changed by heat and pressure

_______________ 5. an inorganic solid with a definite chemical formula and specific shape

_______________ 6. small pieces of rock

_______________ 7. melted rock found inside Earth

_______________ 8. rock made up of several layers of sediment cemented together

_______________ 9. a rock formed after magma has cooled

_______________ 10. melted rock on the surface of Earth

Practice

Use the list below to write the correct term for each definition on the line provided.

cleavage	**luster**	**nonmetallic**
extrusive	**metallic**	**rock**
fracture	**mineralogist**	**rock cycle**
intrusive	**Mohs' scale**	

______________________ 1. a scientist who studies and identifies minerals

______________________ 2. continuous change of rocks from one form to another

______________________ 3. the tendency of a mineral to break along a jagged, uneven, or curved surface

______________________ 4. the tendency of a mineral to break along a smooth or flat surface

______________________ 5. a solid material made of one or more minerals

______________________ 6. igneous rocks that cool on Earth's surface

______________________ 7. a scale used to test the hardness of a mineral

______________________ 8. minerals without metal, with no shine

______________________ 9. the reflecting qualities of a material

______________________ 10. igneous rocks that cool below Earth's surface

______________________ 11. has a shiny appearance

Practice

Circle the letter of the correct answer.

1. A rock formed after magma has cooled is ________ .
   a. sedimentary rock
   b. sediment
   c. metamorphic rock
   d. igneous rock

2. The melted rock found inside Earth is ________ .
   a. magma
   b. sediment
   c. metamorphic rock
   d. sedimentary rock

3. The melted rock on the surface of Earth is ________ .
   a. lava
   b. sedimentary rock
   c. ore
   d. metamorphic rock

4. Small pieces of rock are ________ .
   a. sedimentary rock
   b. ore
   c. metamorphic rock
   d. sediment

5. Rock made up of several layers of sediment cemented together is ________ .
   a. ore
   b. metamorphic rock
   c. sedimentary rock
   d. inorganic

6. A rock changed by heat and pressure is ________ .
   a. ore
   b. inorganic
   c. mineral
   d. metamorphic rock

7. A rock or mineral from which metals and nonmetals can be removed in usable amounts is a(n) __________ .

   a. gem
   b. crystal
   c. mineral
   d. ore

8. An inorganic substance with a definite chemical formula and specific shape is a(n) __________ .

   a. crystal
   b. inorganic
   c. mineral
   d. luster

9. Materials that do not contain carbon and have never lived are called __________ .

   a. metallic minerals
   b. nonmetals
   c. crystals
   d. inorganic

10. Rare, precious, or semiprecious minerals are called __________ .

    a. gems
    b. metallics
    c. crystals
    d. nonmetallics

11. The surface appearance of a material is called its __________ .

    a. rock cycle
    b. lava
    c. fracture
    d. luster

12. Minerals that have a shine and are good conductors of heat and electricity are __________ .

    a. rocks
    b. crystals
    c. nonmetallic
    d. metallic

13. Minerals without metal and that have no shine are ____________ .

    a. rocks
    b. gems
    c. nonmetallic
    d. crystals

14. A scale used to test the hardness of a mineral is ____________ .

    a. Mohs' scale
    b. nonmetallic
    c. metallic
    d. inorganic

15. The continuous change of rocks from one kind to another is a ____________ .

    a. rock cycle
    b. metallic
    c. Mohs' scale
    d. nonmetallic

16. A solid material made of one or more minerals is a ____________ .

    a. Mohs' scale
    b. nonmetallic mineral
    c. metallic mineral
    d. rock

17. The breakage of a mineral along a jagged, uneven, or curved surface is a(n) ____________ .

    a. fracture
    b. cleavage
    c. nonmetallic
    d. organic

18. A scientist who studies and identifies minerals is a ____________ .

    a. geologist
    b. biologist
    c. chemist
    d. mineralogist

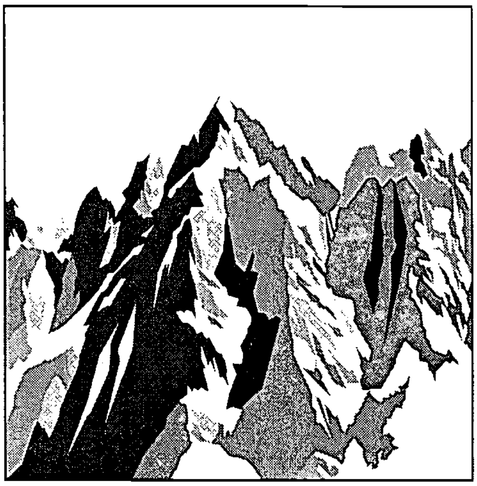
19. The tendency of a mineral to break along a smooth or flat surface is a(n) __________ .

   a. organic
   b. fracture
   c. cleavage
   d. intrusive

20. Igneous rocks that cool on Earth's surface are called __________ .

   a. nonmetals
   b. extrusive
   c. intrusive
   d. organic

Unit 7: Mountains



Vocabulary

Study the vocabulary words and definitions below.

dissected mountains .... mountains formed by the erosion of a plain or plateau

dome mountains .... mountains formed when rocks are pushed up by internal forces within Earth

fault-block mountains .... mountains formed by the movement of large amounts of rock along a crack in Earth's crust

folded mountains .... mountains formed as a result of the bending of rocks in Earth's crust

glacier .... large, moving mass of ice and snow

gorge .... a very steep valley between young mountains

hills .... landforms less than 600 meters high

mountain range .... a series of mountains parallel to each other

mountain system .... a group of mountain ranges

mountains .... landforms that are at least 600 meters high plain .... a flat area of low elevation

plateau .... a flat area of land over 600 meters above sea level

relief .... the difference in elevation between the high and low points of a land surface

slope .... side of a mountain

summit .... top of a mountain

volcanic mountains .... mountains formed by volcanoes

weathering .... the breaking down of rocks and other particles by wind, water, and ice

Introduction

As we admire the landscapes of the planet Earth, we find that some of the most spectacular sceneries are the high peaks and the steep canyons of the landform that we call **mountains**. The majestic outlines of this landform never seem to change; however, we know that Earth's surface is constantly changing. Evidence of folding, faulting, or volcanism can be seen in mountains. Mountains can also be changed by erosion from wind, water, and ice.

Mountains are indicators of the past or present changes of Earth's surface. Understanding the events that occur in the formation of mountains will help us to understand better the evolution of our planet Earth.

Mountains

Mountains are landforms that are at least 600 meters above the surrounding lands. Those less than 600 meters are called **hills**. This difference in height or elevation among landforms is called **relief**.

Some common features of mountains include the following: the **summit**, or the top of a mountain; the **slope**, or side of the mountain; and a very steep valley between young mountains, known as a **gorge**.

The Rocky Mountains and the Himalayan Mountains are examples of **mountain ranges**—a series of mountains parallel to each other. A group of mountain ranges is called a **mountain system**. For example, the mountain systems of the United States include the Rockies and the Appalachians.

mountain range

Mountain formations change over time. Different types of **weathering** such as wind, water, and ice will wear away mountains. For example, **glaciers**, large, moving masses of ice and snow, are found on some mountains. As a glacier moves through a mountain range, it will carve valleys and peaks, changing the surface of the mountains. The Matterhorn in Switzerland is an example of a peak formed by a glacier.

When a mountain is young, it is usually bigger than an older mountain. The valleys of young mountain ranges are steep and narrow. The valleys of old mountain ranges are wide. The Appalachian Mountain range is an example of an old mountain system; while the Rocky Mountains are an example of a young mountain system.

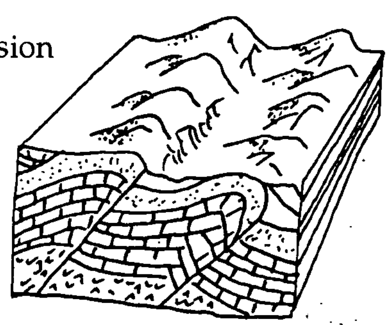
	Young Mountains	Old Mountains
size	larger	smaller
appearance	rugged	worn by erosion
valleys	steep and narrow	wide
example	Rocky Mountains	Appalachian Mountains

Types of Mountains

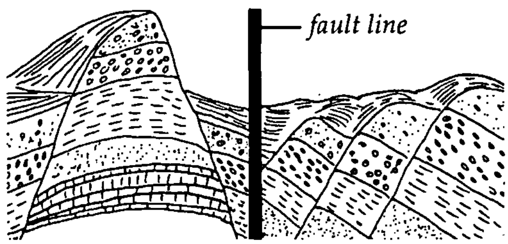
The world's largest mountain ranges are **folded mountains**—mountains formed as a result of the bending of rocks in Earth's crust. These include the Rocky and Appalachian mountains of the United States, the Himalayan Mountains in Asia, the Alps of Europe, and the South American Andes. These ranges were formed over millions of years.

During the formation, sediment is deposited in areas along continental margins where the crust sinks. As the sediments are buried deeper and deeper, the pressure on the sediments increases greatly. Since they are sinking deeper into Earth, their temperature increases. This increase in temperature and pressure causes the sediment to become folded, warped, and twisted. As this happens, the sediments are uplifted to form folded mountains.

Some folded mountains are formed by the collision of crustal plates. These collisions occurred very slowly over long periods of time as the continents moved to their current positions. The Himalayan Mountains were formed when India *crashed* into Asia and pushed up the tallest mountain range on the continents. In South America, the Andes Mountains were formed by the collision of the South American continental plate and the oceanic Pacific plate.



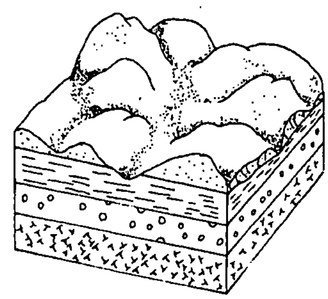
folded mountains



fault-block mountain

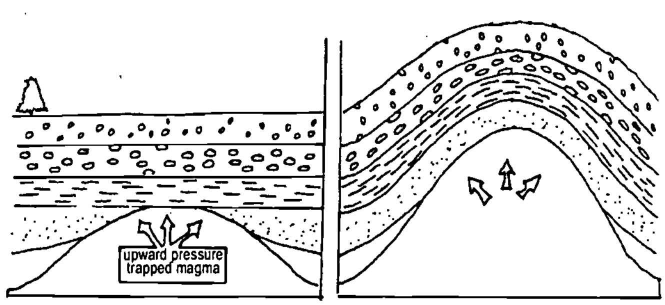
Fault-block mountains are formed by the movement of large amounts of rock along a crack in Earth's crust. Pressure within Earth can break apart Earth's crust. The rock that makes up Earth's crust will split. This breaking or splitting of the rocks is called a fault. The rising land between two faults can become a fault-block mountain. The Grand Tetons of Wyoming and the Sierra Nevada mountain range of California are examples of mountains formed by faulting.

The mountains in New Zealand are examples of **dissected mountains**. Dissected mountains are formed by the erosion of a **plain** or **plateau** usually by a river or stream. These mountains will eventually wear down to sea level.


dissected mountain

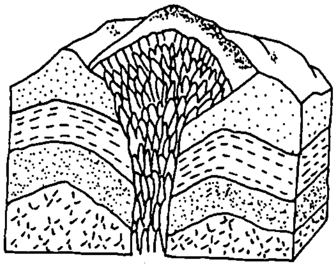
Another type of mountain is a **dome mountain**. These mountains are formed when the rocks are pushed up by internal forces within Earth, creating a dome-shaped mountain.

Magma under the surface of Earth has great pressure. If this magma is trapped, it builds up pressure. As it builds up pressure, it pushes upward, causing the layers of rock to rise. Even though these layers of rock are pushed upward, the magma cannot break the crust above it. The crust is then lifted and a dome mountain is formed.



dome mountain

Dome mountains are rounded. They are not as high as folded mountains or fault-block mountains. In the United States, dome mountains are found in the Black Hills of South Dakota and the Adirondacks in New York.



volcanic mountain

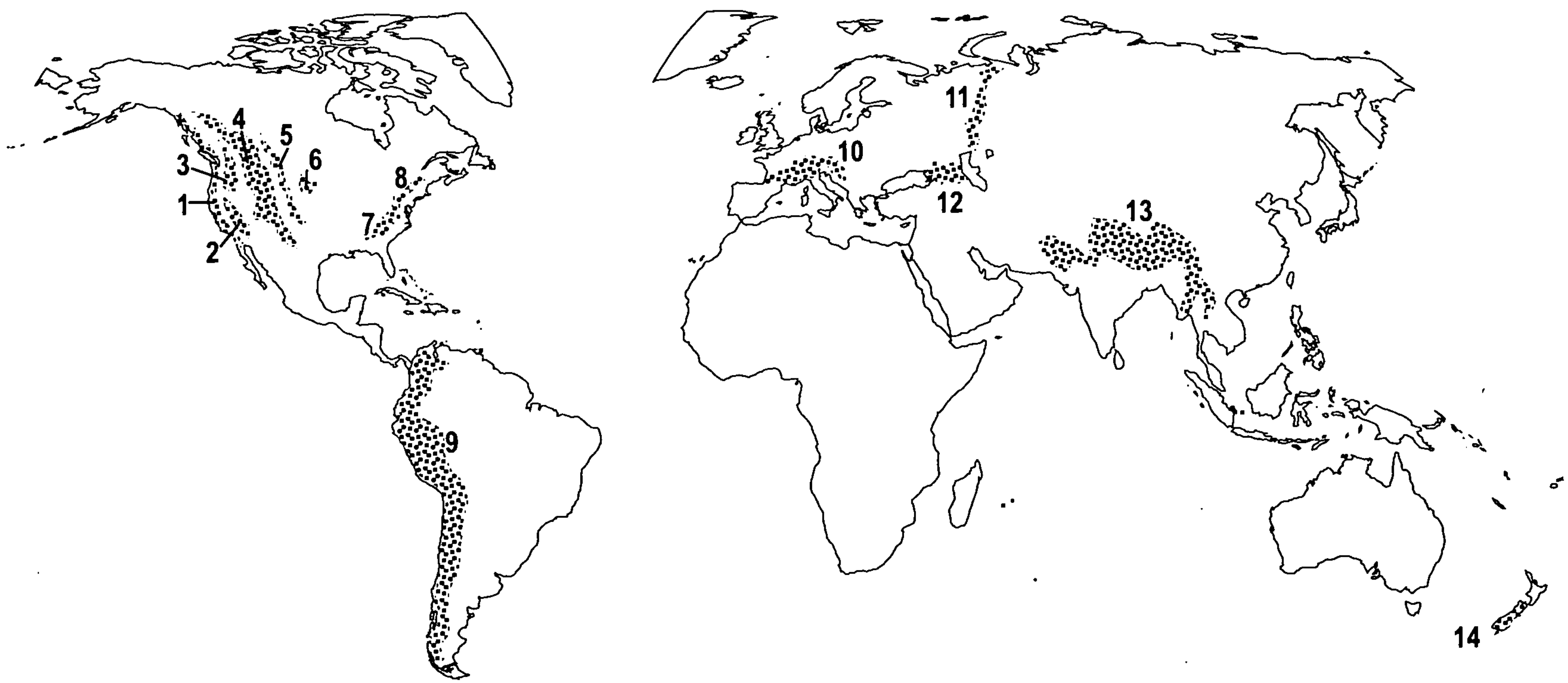
As the name suggests, **volcanic mountains** are formed by volcanoes. Lava and other igneous material from volcanoes have formed mountains in many different areas of the world. The Cascades of Washington (which includes Mount St. Helens) are volcanic mountains. Sometimes these mountains become active volcanoes and erupt like Mount St. Helens in 1980 and the Philippines' Mount Pinatubo volcano in 1991.

Types of Mountains	Examples
Folded	Rockies; Appalachians; Himalayas; Alps; Andes
Fault-Block	Sierra Nevada; Grand Tetons
Dissected	New Zealand
Dome	Adirondacks; Black Hills
Volcanic	Cascades

Ages of Mountain Ranges

Range	Continent	Age (in years)	Type
Cascades	North America	1,000,000	volcanic
Himalayas	Asia	25,000,000	folded
Alps	Europe	40,000,000	folded
Andes	South America	70,000,000	folded
Rockies	North America	70,000,000	folded
Coast Ranges/Sierra Nevadas	North America	135,000,000	fault-block
Juras	Europe	135,000,000	folded
Caucasus	Eurasia	225,000,000	folded
Urals	Eurasia	225,000,000	folded
Appalachians	North America	225,000,000	folded
Green Mountains (Vermont)	North America	500,000,000	dome
Adirondack Mountains	North America	2,500,000,000	dome

Study the map of the mountain ranges on the next page.



1. Pacific Coastal Range
2. Sierra Nevada
3. Cascades
4. Rockies
5. Grand Tetons
6. Black Hills
7. Appalachians
8. Adirondacks
9. Andes
10. Alps
11. Urals
12. Caucasus
13. Himalayas
14. Southern Alps or New Zealand

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Summary

Mountains are landforms at least 600 meters above the surrounding land. Mountain features include the summit, slopes, and gorges. A series of mountains is a mountain range, and a group of ranges is a mountain system. Mountain formations change over time by weathering. Types of mountains include folded, fault-block, dissected, dome, and volcanic mountains.

Practice

Use the list below to complete the following statements.

Adirondacks	**dome mountains**	**Mount St. Helens**
bending	**erosion**	**New Zealand**
Black Hills	**Grand Tetons of Wyoming**	**volcanoes**
dome		

1. Magma pushes rock layers up to form ________________________ mountains.

2. Dome mountains are found in the ________________________ of South Dakota and the ________________________ in New York.

3. ________________________ mountains are not as high as folded or fault-block mountains.

4. Dissected mountains are formed by ________________________ .

5. Volcanic mountains are formed by ________________________ .

6. An example of dissected mountains can be found in ________________________ .

7. ________________________ is an example of a volcanic mountain.

8. An example of fault-block mountains in the western United States is ________________________ .

9. Folded mountains are formed by the ________________________ of rocks in Earth's crust.

Practice

Use the list below to complete the following statements.

Alps	**Matterhorn**	**warp**
faulting	**narrow**	**water**
fold	**Rock**	**wide**
glaciers	**steep**	**wind**
ice	**twist**	

1. The Sierra Nevada Mountains were formed as a result of

   ______________________ .

2. ______________________ , ______________________ , and

   ______________________ weather a mountain.

3. The valleys of young mountain ranges are usually

   ______________________ and ______________________ .

4. The valleys of old mountain ranges are usually ________________ .

5. The ________________ is an example of a peak formed by a glacier.

6. The surface of a mountain can be carved and changed by

   ______________________ .

7. As sediment sinks, temperature and pressure increase, causing the

   sediment to ______________________ ,

   ______________________ , and ______________________ .

8. The ______________________ and the ______________________

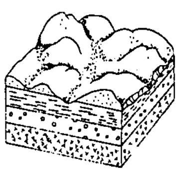
   are two examples of folded mountains.

Practice

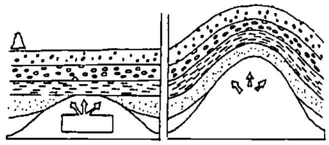
Match the **mountains** *below with the correct* **mountain type***. Write the letter on the line provided.*

______	1.	Sierra Nevada	A.	dissected
______	2.	New Zealand	B.	dome
______	3.	Mount St. Helens	C.	fault block
______	4.	Appalachian	D.	folded
______	5.	Black Hills	E.	volcanic

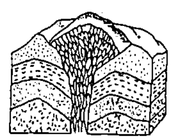
Identify the **mountains** *below with the correct* **mountain type***. Write the type on the line provided.*



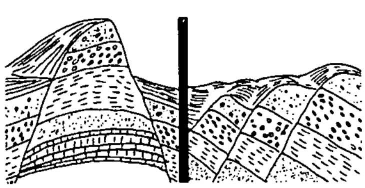
6. ____________



7. ____________



8. ____________



9. ____________

10. ____________

Practice

Answer the following using complete sentences.

1. What is the difference between a hill and a mountain?

2. Explain why older mountains are smaller than younger mountains.

3. Explain how any two of the four types of mountains are formed.

Practice

Use the list below to write the correct term for each definition on the line provided.

dissected mountains	**hills**	**relief**
dome mountains	**mountains**	**slope**
fault-block mountains	**mountain range**	**summit**
folded mountains	**mountain system**	**volcanic mountains**
glacier	**plain**	**weathering**
gorge	**plateau**	

________________________ 1. a flat area of low elevation

________________________ 2. a flat area of land over 600 meters above sea level

________________________ 3. a group of mountain ranges

________________________ 4. mountains formed by volcanoes

________________________ 5. mountains formed by the erosion of a plain or plateau

________________________ 6. mountains resulting from rocks being pushed up by internal forces within Earth

________________________ 7. mountains formed from the bending of rocks in Earth's crust

________________________ 8. top of a mountain

________________________ 9. the difference in elevation between the high and low points of a land surface

________________________ 10. a series of mountains parallel to each other

________________________ 11. side of a mountain

________________________ 12. landforms that are at least 600 meters high

______________________ 13. landforms less than 600 meters high

______________________ 14. a very steep valley between young mountains

______________________ 15. mountains formed by the movement of large amounts of rock along a crack in Earth's crust

______________________ 16. large, moving mass of ice and snow

______________________ 17. the breaking down of rocks and other particles by wind, water, and ice

Practice

Circle the letter of the correct answer.

1. Landforms that are at least 600 meters high are called ____________ .

   a. reliefs
   b. slopes
   c. hills
   d. mountains

2. Landforms less than 600 meters high are called ____________ .

   a. hills
   b. slopes
   c. gorges
   d. reliefs

3. The ____________ is the top of a mountain.

   a. summit
   b. relief
   c. mountain range
   d. gorge

4. The side of a mountain is its ____________ .

   a. relief
   b. mountain range
   c. gorge
   d. slope

5. The difference in elevation between the high and low points of a land surface is called ____________ .

   a. mountain rings
   b. gorge
   c. relief
   d. slope

6. A very steep valley between young mountains is a ________ .

   a. mountain range
   b. glacier
   c. mountain system
   d. gorge

7. A series of mountains parallel to each other is a ________ .

   a. volcanic mountain
   b. fault-block mountain
   c. mountain system
   d. mountain range

8. A group of mountain ranges is a ________ .

   a. structural mountain
   b. dissected mountain
   c. mountain system
   d. plain

9. ________ are mountains formed by the erosion of a plain or plateau.

   a. Plateaus
   b. Plains
   c. Fault-block mountains
   d. Dissected mountains

10. Mountains formed from rocks pushed up by internal forces within Earth are ________ .

   a. dissected mountains
   b. plateaus
   c. volcanic mountains
   d. dome mountains

11. Mountains formed by volcanoes are ________ .

   a. volcanic mountains
   b. dissected mountains
   c. dome mountains
   d. fault-block mountains

12. A ____________ is a flat area with low elevation.

    a. glacier
    b. plain
    c. summit
    d. gorge

13. A ____________ is a flat area of land over 600 meters above sea level.

    a. glacier
    b. plain
    c. plateau
    d. gorge

14. ____________ are the result of the bending of rocks in Earth's crust.

    a. Dissected mountains
    b. Dome mountains
    c. Fault-block mountains
    d. Folded mountains

15. ____________ is the breaking down of rocks and other particles by wind, water, and ice.

    a. Relief
    b. Weathering
    c. Gorge
    d. Slope

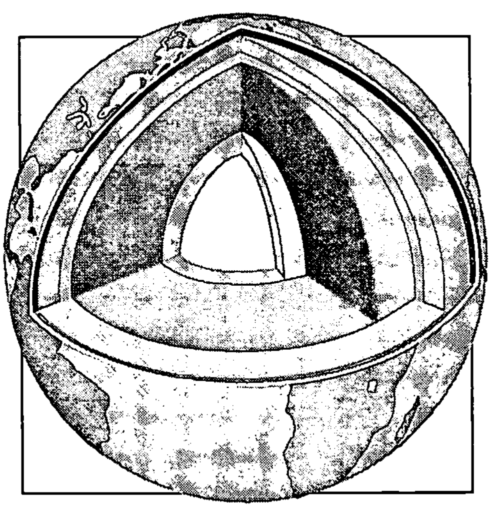
16. A ________________________ is a large, moving mass of ice and snow.

    a. summit
    b. plateau
    c. slope
    d. glacier

17. Mountains formed by the movement of large amounts of rock along a crack in Earth's crust are called ________________________ .

    a. folded mountains
    b. volcanic mountains
    c. dome mountains
    d. fault-block mountains

Unit 8: Plate Tectonics



Vocabulary

Study the vocabulary words and definitions below.

abyssal plains .... large, flat regions deep on the ocean floor

canyons .... deep V-shaped valleys found along the continental slope

continental drift .... a hypothesis suggesting that the continents have moved and been in different positions through geologic time

continental shelf .... relatively flat part of the continent that is covered by seawater; lies between the coast and the continental slope

continental slope .... the steeply dipping surface between the outer edge of the continental shelf and the ocean basin proper

continents .... the seven major landmasses found on the surface of Earth

convection currents .... the circular movements of heat through liquids or gases

core .... the innermost layer of Earth which has two parts—the *outer* portion which is liquid and the *inner* portion which is solid

crust .... the outer layer of Earth

earthquake .... a sudden movement of Earth's crust

epicenter .... the point on the surface of Earth directly above the focus of an earthquake

fault .... a break in Earth's surface along which movement has occurred

focus .... the true center of an earthquake below Earth's surface

guyots (GEE-oze) .... underwater volcanic mountains with flat tops

lava .... melted rock (magma) that comes to the surface of Earth

lithosphere .... the rigid outer layer of Earth, including the crust and upper mantle

magma .... melted (hot liquid) rock found inside Earth

mantle .... the molten layer of Earth below the crust

mid-ocean ridge .... mountain chain that rises from the ocean basins

Pangaea (pan-JEE-uh) .... the large landmass that broke up and drifted to form our present day continents

plates .... pieces of Earth's crust that move about on the mantle

plate tectonics .... theory stating that crustal plates on the surface of Earth are continuously moving due to convection currents

Richter scale .... scale used to describe the strength of an earthquake

rift .... a wide valley that separates two parallel chains of underwater mountains

Ring of Fire .... major earthquake zone that forms a ring around the Pacific Ocean; includes the western coasts of North America and South America and the eastern coast of Asia

seamounts .... underwater cone-shaped volcanic mountains

seismic waves .... waves by which energy moves away from the focus of an earthquake in all directions from the center

seismograph .... an instrument used to measure earthquake activity

seismologist .... a person who studies earthquakes

trenches .... long, narrow cracks in the ocean floor that are the deepest parts of the ocean

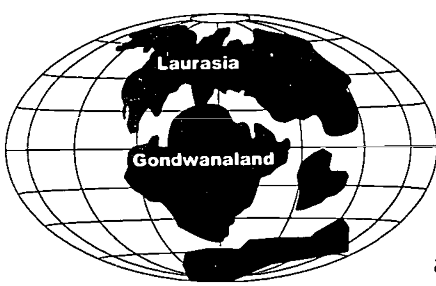
volcano .... a vent in Earth's crust through which hot, liquid rock erupts or oozes; a mountain formed of lava

Introduction

Earth's **crust** is subject to strong forces within and on the surface of Earth. Some of these forces are pushing, pulling, pressure from within, and sliding movements. When these stresses are released, violent events often occur. **Earthquakes** and **volcanoes** are some of the results. Although Earth's crust was once thought to be stationary, we now know that it is in constant motion. This movement results in new formations on Earth's surface, including hot springs, **lava** flows, and fractured valley walls. Understanding **continental drift** and **plate tectonics**, and their theoretical effects on topography, may help us solve the mystery behind the features we see on the surface of Earth.

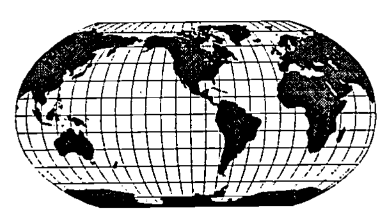
Continental Drift

The surface of Earth has seven major landmasses called **continents**. People have believed throughout history that the location of the continents was fixed. As world maps were improved, many noted that the shapes of the continents seemed to fit together like pieces of a jigsaw puzzle. This idea seemed foolish because no one understood how continents could move.



In 1912, the German meteorologist Alfred Wegener described his hypothesis of *continental drift*. He suggested that at one time all of the continents were one large landmass called **Pangaea**. Wegener believed that this giant landmass split apart and broke into two large landmasses he called *Laurasia* and *Gondwanaland*. These landmasses then broke apart and, over time, *drifted* across the ocean floor until they reached their present positions.

This hypothesis was based on several kinds of evidence. One was how the coastlines of the continents seemed to *fit* like pieces of a jigsaw puzzle. Wegener also noted that similar rock structures and fossils were found in neighboring continents across the ocean. Similarities in ancient climate were indicators, as well. His hypothesis was rejected at first, because there was no explanation for the movement of the continents.



the continents today

Further evidence in support of Wegener's hypothesis continued to be discovered. Glacial deposits and erosional scratches caused by glaciers were found in both South America and Africa. A 200-million-year-old reptile fossil was found in Antarctica that matched ones found in India and South Africa. Since Alfred Wegener's death, the theory has been generally accepted because more evidence has been found.

Earth scientists now realize that the positions of the continents are not permanent. Continents gradually move over the surface of the globe. During the 1950s and 1960s, new developments led to a broader theory known as *plate tectonics*.

Plate Tectonics

New discoveries showed that the sea floor seemed to be cracked and spreading apart. This discovery led to the theory of **plates** and plate movement. This most recent theory is called the *theory of plate tectonics*, which suggests that Earth is separated into large sections called plates—nine large ones and several smaller ones. The large plates include both continental and oceanic crust.

These plates may have separated because of **convection currents**. Convection currents transfer heat through liquids or gases. The heated material rises, and the cooler material takes its place. The difference in temperatures of the gases and liquids under Earth's crust caused movement of the plates. The plates floated on an ocean of liquid rock and gases. As the plates separated, they moved at different speeds and in different directions. Today, the plates are still moving. Scientists have measured plate movement using lasers. The plates are drifting about one to 10 centimeters a year depending on the location.

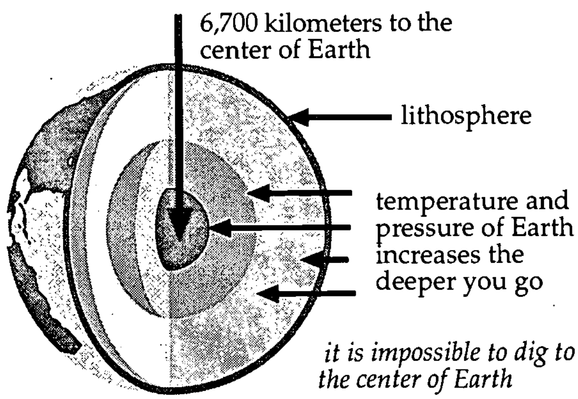
Plates may move apart (form divergent boundaries), move together (form convergent boundaries), or slide past one another (transform boundaries). These movements help explain some of the topographic features we see as well as earthquakes and volcanoes. Changes are always taking place along the edges of the plates. Divergent boundaries, plates moving away from each other, create **mid-ocean ridges** and **rift** valleys. The Mid-Atlantic Ridge, the Rift Valley in Africa, and the Red Sea are examples of divergent boundaries. Convergent boundaries, plates moving toward or underneath one another, form mountain ranges, **trenches** and volcanic island arcs. Subduction occurs when one plate is forced underneath another plate forming a trench. Many examples of these features can be found in the Pacific Ocean. Transform boundaries result from the sliding of plates along their edges. The San Andreas **fault** in California is an example of this type of boundary.

Volcanoes and earthquakes are often found in areas where the plates are sliding past each other, running into each other, or moving apart. Movement of the San Andreas fault caused the San Francisco earthquakes of 1906 and 1989.

Scientists continue to test theories about Earth's crust. Their tests and studies will lead to a better understanding of the structure of Earth.

Lithosphere

There are three major layers of Earth. They are the crust, mantle, and **core**. Each of these layers is made up of different materials. The **lithosphere** is the rigid outer layer of Earth, which includes the crust and the very top of the **mantle**. To get an idea of the lithosphere, think about digging straight down into Earth. You would pass through several different solid layers and would have to dig down about 6,700 kilometers before you would reach the center of Earth. Only about the first 100 kilometers would be the lithosphere.

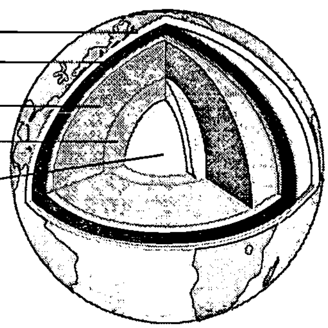


Of course, it is impossible to dig to the center of Earth. Scientists have had to use indirect means to learn about the inside of Earth. Indirect means are ways of finding out about Earth without actually touching or seeing the rocks.

Scientists have learned Earth is not the same composition all the way to the center. Scientists draw conclusions from earthquake and volcanic information recorded by instruments. This is how the depth and the temperature of Earth is estimated. Scientists have also found that the temperature and the pressure in Earth increases the deeper you go.

The ground you stand on is called the soil. The soil is a very thin layer, about six meters deep. Underneath the soil is *bedrock*, which contains minerals, rocks of various kinds, and ores. Together, soil and bedrock act like the skin of Earth. This skin is called Earth's *crust*. The crust is hard and thin. It can be as thick as 67 kilometers and as thin as eight kilometers in some spots. The crust is thickest under the continents and thinnest under the oceans.

On the diagram below of Earth's lithosphere, there is a very dark line labeled *Moho*. This is short for Mohorovicic discontinuity, the boundary between Earth's crust and mantle. It is named after Andrija Mohorovicic (1857-1936), a Yugoslav geologist. The Moho averages about three miles under the ocean basin floors and 25 miles under the continents. The Moho is not a layer, but a boundary line between the crust and the mantle.



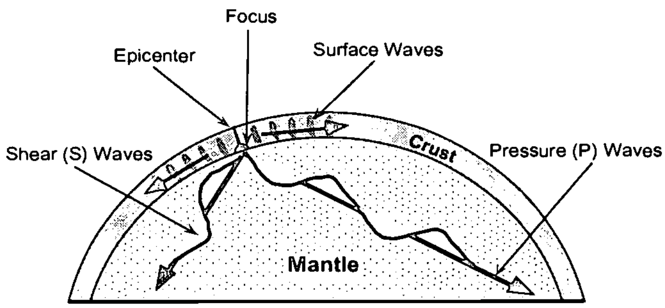
Below the crust is a layer of rock which is heavier and contains more iron than the rock found in the crust. This layer is called the *mantle*. The mantle is between 2,800 and 3,000 kilometers thick. The rock in the mantle seems to be able to flow and move about like a fluid.

The third layer of Earth, the core, is beneath the mantle and has two parts. The *outer core* is about 2,000 kilometers thick. The outer core contains melted iron and nickel. At the center of Earth is the *inner core*. It is 2,800 kilometers in diameter at the thickest point. From where the inner core begins to the very center of Earth is about 1,400 kilometers. Scientists believe the inner core is solid and contains iron mixed with some nickel and cobalt.

Earthquakes

An *earthquake* is the shaking of Earth's crust caused by plates moving inside Earth. Earth's crust is not one big piece. It is really several plates which float on the liquid, molten part of the mantle. As the plates drift or move, their edges may rub and grind against each other. This grinding, along with an upward push of the rock layers, causes earthquakes.

Earthquakes occur along a *fault*, which is a break or crack in Earth's crust. As Earth's crust bends on both sides of a fault, pressure builds up. When the rocks cannot stand the pressure anymore, they break. *Faulting* can be caused either by an uplifting that causes the surface to break or by horizontal forces that rip the crust apart. The zone inside Earth where the actual movement in the rocks occurs is called the **focus**. The place on the crust of Earth's surface directly above the focus is called the **epicenter**.



During an earthquake, energy moves away from the focus in all directions releasing energy in the form of **seismic waves**. These waves are felt as the shocks of an earthquake.

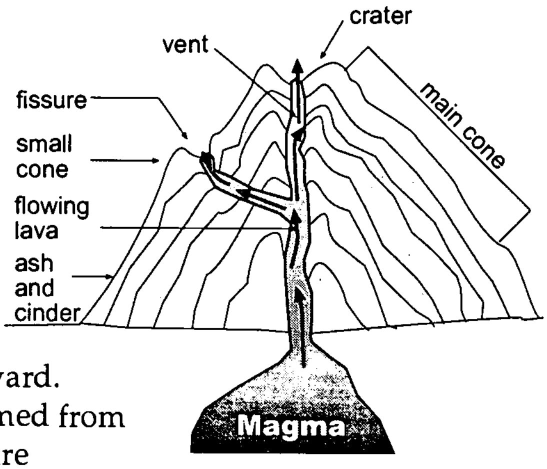
Scientists called **seismologists** study the inner structure of Earth and the changing surface of Earth in an effort to predict future earthquakes. A **seismograph** is an instrument used to measure the force of an earthquake. Some earthquakes are so slight that they go unnoticed. Other earthquakes are so powerful that the tremors cause rockslides, buildings to fall, the ground to open up, fires and explosions from broken electric and gas lines, and floodwaters released from collapsing dams.

When an earthquake is recorded, it is given a number on the **Richter scale.** The Richter scale uses numbers from one to 10 to measure the relative strength of an earthquake. The largest earthquakes ever recorded have Richter magnitudes near 8.6. The energy released from these great shock waves is about the same as one billion tons of TNT (an ingredient in explosives). Earthquakes with a magnitude less than 2.5 are not normally felt by humans.

earthquake damage

In 1906, an earthquake with a Richter scale rating of 8.25 nearly destroyed the city of San Francisco. An earthquake with a magnitude of 8.4–8.6 occurred in Alaska and lasted three–four minutes. In 1989, another major earthquake occurred in San Francisco. It measured 7.1 on the Richter scale and caused major destruction.

Volcanoes



A *volcano* is an opening in Earth's surface through which melted rock, called **magma**, erupts from inside Earth. Magma beneath the surface of Earth builds up great pressure. Scientists believe that it collects in pockets and builds up pressure. This pressure forces the magma upward. Sometimes dome mountains are formed from the pressure. Other times, the pressure becomes so great that the magma is pushed out onto the surface of Earth. When this happens, it is called an eruption. Once the magma flows out of the opening of the volcano, it is called *lava*. A hill or mountain builds up as the lava cools. This is how volcanic mountains are formed.

Volcanoes can also form in the oceans. The **Ring of Fire** is an area in the Pacific Ocean where many of the world's active volcanoes are found. Sometimes the tops of volcanoes stick out above the surface of the ocean forming islands. The Hawaiian Islands are really the tops of volcanoes.

Volcanoes affect Earth in many ways. They are responsible for changing the surface of Earth by building volcanic mountains. The lava and ash from volcanic eruptions form fertile land that can be farmed. Scientists study volcanoes to learn more about the interior of Earth.


a quiet volcano

Volcanic mountains are sometimes quiet. A quiet volcano is one where the lava oozes out and spreads over the land. Quiet volcanoes have gently sloping sides. They do not explode.


an active volcano

Explosive volcanoes are ones where the magma blasts to the surface. For the magma to come to the surface with such force, it must be held underground for a long time. The pressure builds up and becomes so great that the magma is pushed out of Earth explosively. With the magma comes rocks, cinders, ash, dust, steam, and poisonous gases. The dust and ash can cause breathing problems in humans and can even cause changes in the weather. Volcanoes can destroy property and lives. Some volcanic eruptions have triggered large earthquakes.

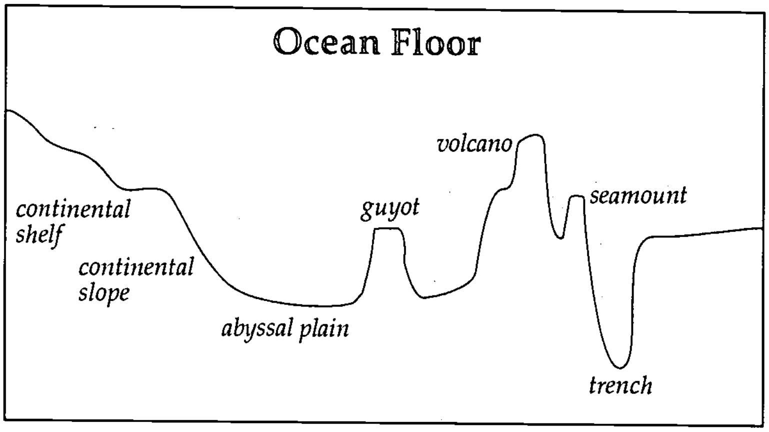
Some volcanoes are dormant, which means that they have erupted in human history but not within the past 50 years or so. They are inactive but may erupt at any time. Other volcanoes are active, like Kilauea in Hawaii, which has erupted more than 50 times in recorded history. Mount St. Helens on the Pacific Coast of the United States is an active volcano which erupted in 1980.

The Ocean Floor

Earth's ocean floor has been studied for more than 100 years. In the 1950s and 1960s, scientists invented new instruments, such as the precision depth recorder, to more accurately study and map the ocean floors. Using these instruments, scientists discovered that the land areas of the ocean floor had many of the same features as the continents.

The area where the land and the ocean water meet is called the *shoreline*. Beyond the shoreline the ocean floor begins to slope gently downward. This is called the **continental shelf**. The width of the continental shelf varies from 200 to 1200 kilometers. At the edge of the continental shelf, the ocean floor drops off at a very steep angle for four or five kilometers. This marks the boundary between the crust of the continent and the crust of the ocean basin. It is called the **continental slope**. Deep V-shaped valleys called **canyons** are found along the continental slope. Some of these underwater canyons are deeper than any found on the surface of Earth.

The ocean basin, or floor, begins at the bottom of the continental slope. There are plains on the ocean basin that are larger and flatter than any found on Earth's surface. They are called **abyssal plains**. The deepest parts of the ocean floor are long, narrow cracks called *trenches*, which cut into the abyssal plain. Most of these trenches are found in the Pacific Ocean. The Marianas Trench in the Pacific Ocean is the deepest spot on Earth. It is over 11,000 meters deep.



Many volcanic peaks rise from the plain. Some peaks rise above sea level to form islands like the Hawaiian Islands. Many old volcanic islands are now underwater. Underwater cone-shaped volcanic mountains are called **seamounts**. Seamounts with flat tops are called **guyots**.

Some of the highest mountain ranges on Earth are located under the ocean. These underwater mountain chains, rising from the plain, are called *mid-ocean ridges*. On the floor of the Atlantic Ocean are underwater mountains named the Mid-Atlantic Ridge. The Mid-Atlantic Ridge is the longest fracture on Earth. It runs around the world from the North Atlantic to the South Atlantic, into the Indian Ocean, across the Pacific, and northward to the Atlantic. This mountain chain is about 65,000 kilometers long. Underwater ridges vary greatly in size and shape. Many ridges in the Pacific Ocean are flat-topped mountains. The Mid-Atlantic Ridge is really two parallel chains of mountains separated by a wide valley called a *rift*.

Important differences between the continents and the seafloor have been noted, too. The ocean basins have many more volcanoes and earthquakes than the continents. The rocks found there differ from the rocks found on Earth's surface. Ocean basins are made of basalt; continents are made of granite. In addition, the crust of Earth is much thinner on the ocean floor than on the surface of Earth.

Summary

Scientists have collected evidence to show that Earth's continents were once one large landmass. Over time the continents separated and drifted to their present locations. By the 1960s, a theory known as plate tectonics suggested that Earth is separated into plates. These plates are still moving, and this movement helps explain volcanoes and earthquakes. The ocean floor has many of the same features as the continents, including mountains and earthquakes, even though there are important differences.

The lithosphere, or solid part of Earth, has three major layers—crust, mantle, and core. The plates of Earth's crust move. This movement along a fault in the crust may cause earthquakes. The pressure beneath the surface of Earth may cause molten rock to flow from an opening in Earth's crust and form a volcano.

Lab Activity 1: The Continental Drift

Purpose	Materials
Make a model of Pangaea.	• outline of continents (page 231) • scissors • glue • construction paper or posterboard

1. Trace and cut out the landmasses on the next page.
2. Try to fit the pieces together to form one large landmass.
3. When you have the best fit, tape the pieces to a piece of construction paper or poster board.
4. Draw your version of Pangaea.
5. Which landmasses have the best fit? ______________________

____

____

6. Why isn't the fit perfect, if the land masses were once one supercontinent?

____

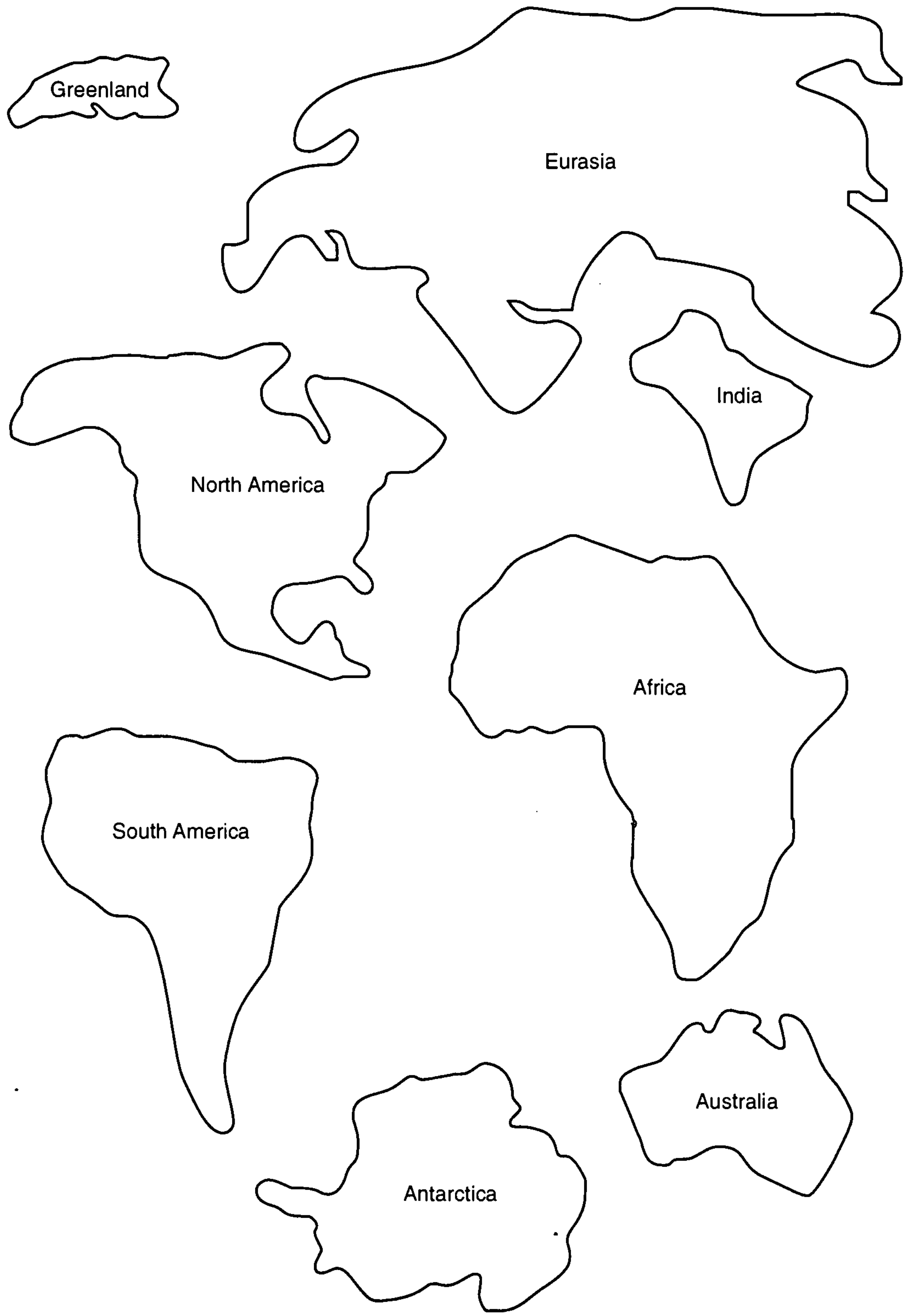
____

____

____

____

____


Greenland
Eurasia
India
North America
Africa
South America
Australia
Antarctica

Practice

Write **True** *if the sentence is correct. Write* **False** *if the sentence is* not *correct.*

_________ 1. The continental drift theory is a more recent theory than that of plate tectonics.

_________ 2. The San Andreas fault in California is really a boundary between two plates.

_________ 3. Both the theory of continental drift and plate tectonics believe that all of the landmasses on Earth were once part of one big landmass.

_________ 4. The single landmass that contained all the other land masses was called Laurasia.

_________ 5. Pangaea broke apart to form Gondwanaland and Laurasia.

_________ 6. According to the plate tectonics theory, the continents floated on the water to get to their present places on Earth.

_________ 7. There are 10 major landmasses that make up the surface of Earth.

_________ 8. Plates are no longer moving today.

_________ 9. Alfred Wegener suggested the theory of plate tectonics.

_________ 10. The shapes of the continents seem to fit together like pieces of a jigsaw puzzle.

_________ 11. Convection currents are caused by differences in the temperatures of gases and liquids under Earth's crust.

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

core	**inner**	**mantle**	**outer**
crust	**instruments**	**Moho**	**rock**
indirect	**lithosphere**		

1. The solid part of Earth is called the __________________ .

2. The three layers of Earth are __________________ , __________________ , and __________________ .

3. Scientists draw conclusions from the information recorded by __________________ .

4. When you find out about something without seeing or touching it, you have discovered it by __________________ means .

5. The __________________ contains soil and bedrock.

6. The __________________ is the boundary line between the crust and the mantle.

7. The layer below the crust is called the __________________ .

8. The mantle is made up of __________________ core.

9. Under the mantle is the __________________ core.

10. The center of Earth is called the __________________ .

11. The ______________________ core is the layer of melted material.

12. The thinnest layer is the ______________________ .

13. The thickest layer is the ______________________ .

14. The hottest layer with the greatest pressure is the

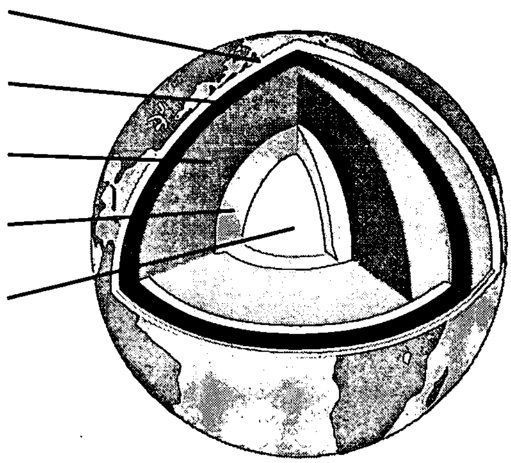
    ______________________ core.

15. The coolest layer is the ______________________ .

Practice

Look at the diagram below. On the lines, write the names of the **parts of Earth.**

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________



Complete the following chart.

Layers	Thickness	Material
crust		
mantle		
outer core		
inner core		

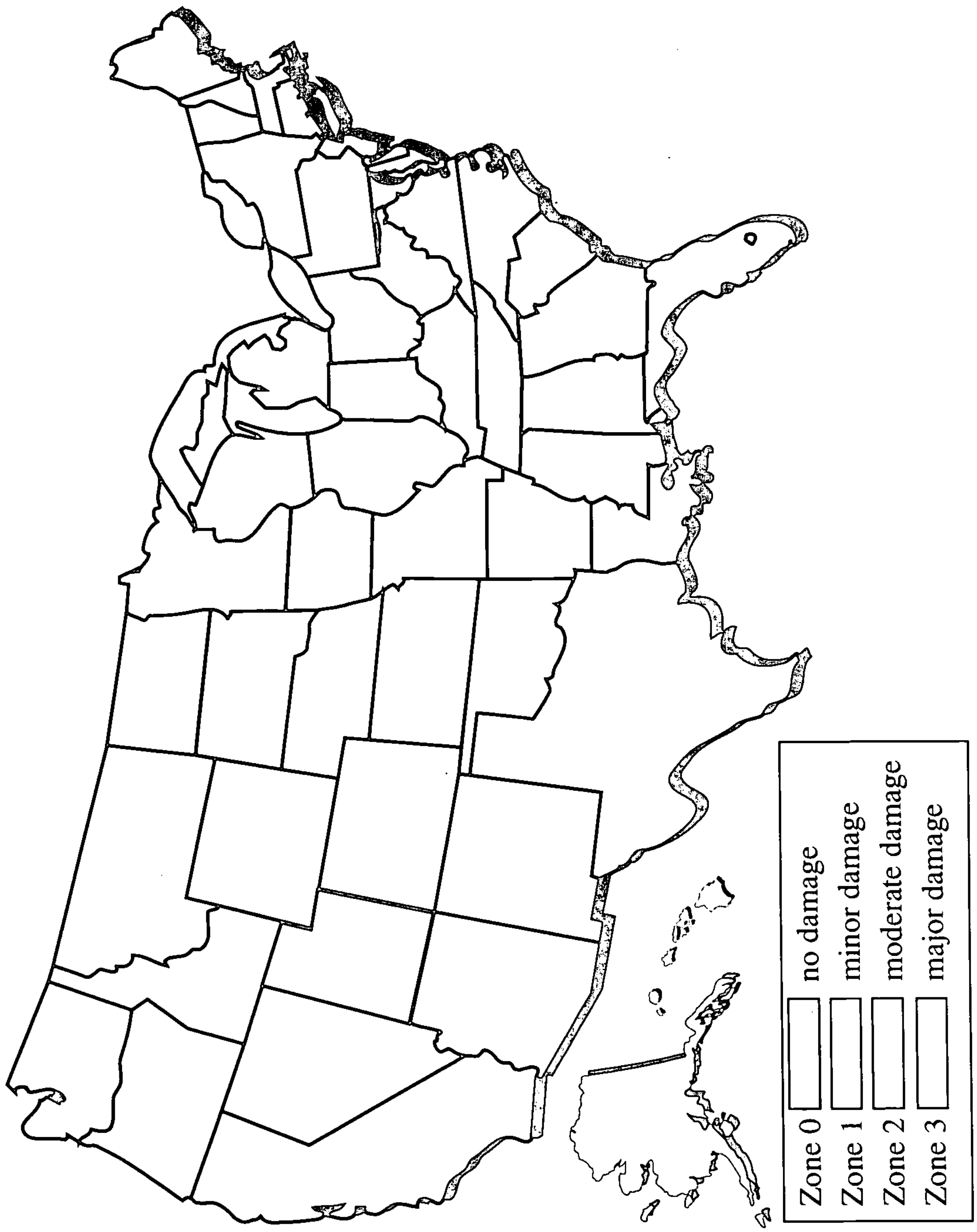
Lab Activity 2: Earthquakes

Purpose	Materials
Make a seismic-risk map of the United States.	• map of United States • colored pencils • pencil

1. Choose a color to represent each of the risk zones in the legend of the map on page 239.
2. Color the squares of the map legend to match the color chosen for each zone.
3. Plot the data from the chart on page 238 on the map. Place one dot in the state for each recorded earthquake. Place two dots in the state for each high-intensity earthquake.
4. Since California has such a large number of earthquakes, simply write the number of earthquakes on the state. In parentheses, write the number of high-intensity earthquakes.
5. Color each state according to the legend on page 239. Example: California will be colored for Zone 3.

Earthquake Locations

State	Damaging earthquakes recorded	State	Damaging earthquakes recorded
Alabama	2	Montana	10 (3 high intensity)
Alaska	12 (2 high intensity)	Nebraska	3
Arizona	4	Nevada	12 (3 high intensity)
Arkansas	3	New Hampshire	0
California	over 150 (8 high intensity)	New Jersey	2 (1 high intensity)
Colorado	1	New Mexico	5
Connecticut	2	New York	5 (1 high intensity)
Delaware	0	North Carolina	2
Florida	1	North Dakota	0
Georgia	1	Ohio	6 (1 high intensity)
Hawaii	12 (2 high intensity)	Oklahoma	2
Idaho	4	Oregon	1
Illinois	10	Pennsylvania	1
Indiana	3	Rhode Island	0
Iowa	0	South Carolina	6 (1 high intensity
Kansas	2	South Dakota	1
Kentucky	5	Tennessee	7
Louisiana	1	Texas	3 (1 high intensity)
Maine	4	Utah	9 (2 high intensity)
Maryland	0	Vermont	0
Massachusetts	4 (1 high intensity)	Virginia	5
Michigan	1	Washington	11 (2 high intensity)
Minnesota	0	West Virginia	1
Mississippi	1	Wisconsin	1
Missouri	9 (2 high intensity)	Wyoming	3


Zone 0 no damage
Zone 1 minor damage
Zone 2 moderate damage
Zone 3 major damage

248

247

Practice

Using the information gathered from **Lab 2**, *answer the following using short answers.*

1. In what states have damaging earthquakes occurred?

____

____

2. In what region have damaging earthquakes been concentrated?

____

3. What does a concentration of damaging earthquakes indicate about the underlying rock structure of the area?

____

____

4. Based on this map, in which states might future earthquakes occur?

____

____

5. In which state is the earthquake risk highest? _______________

____

6. Could you be sure that an earthquake could not occur in any area?

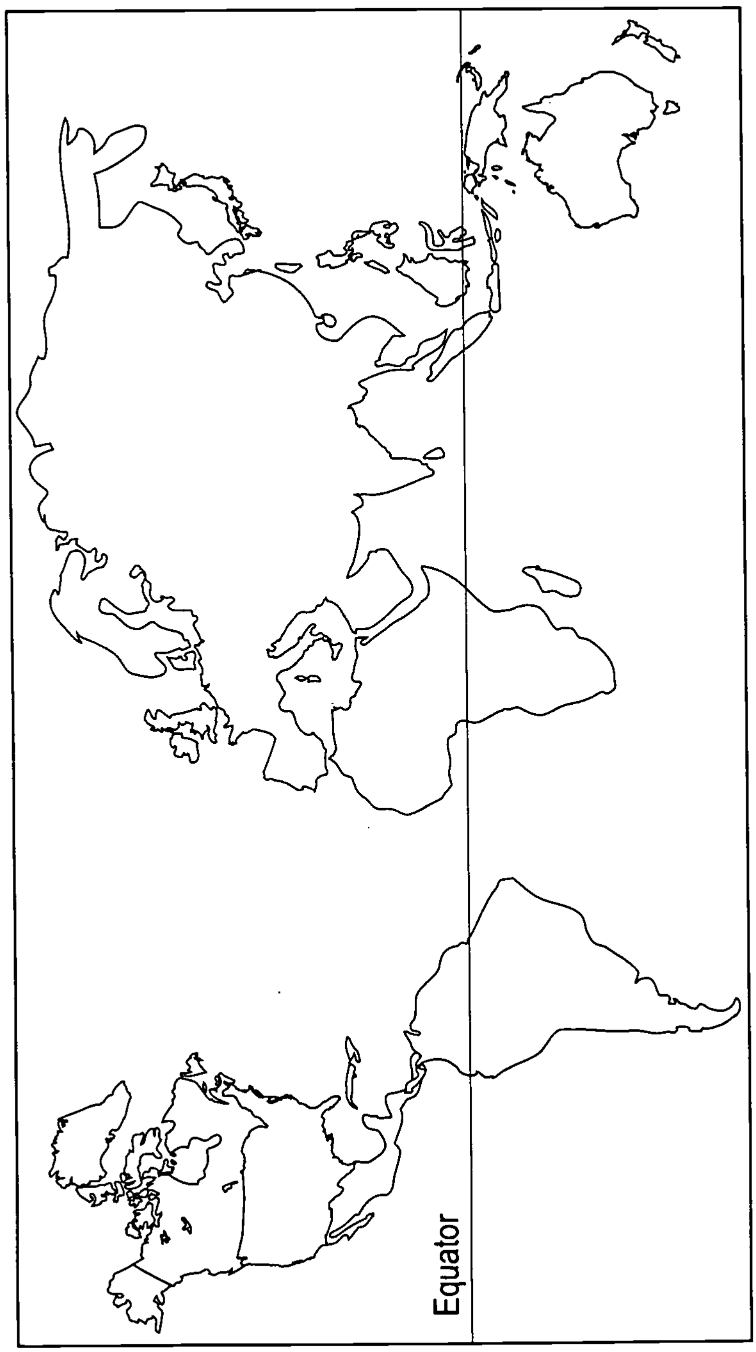
____

Why? ____

____

Practice

Use a reference book or the Internet to locate the **active volcanoes** *found on Earth. Mark their approximate location by placing a dot on the map below. Use a marking pen to trace the* **Ring of Fire** *on the map. (If using the Internet, try http://www.neic.cr.usgs.gov/current_seismicity.html.)*



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Practice

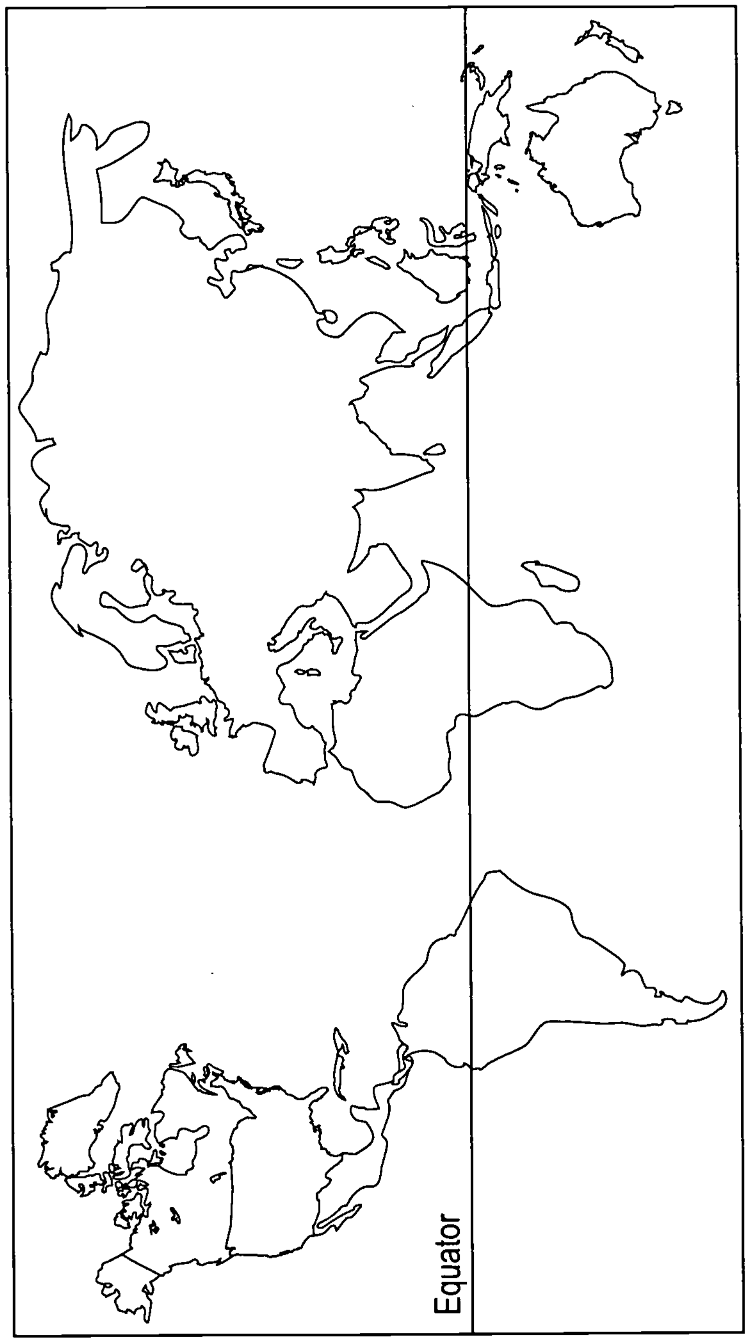
Use the list below to complete the following statements. One or more terms will be used more than once.

blasts	**inactive**	**poisonous**
erupt	**lava**	**Ring of Fire**
gentle	**magma**	**rocks**
Hawaiian	**mountains**	

1. Melted rock beneath the surface of Earth is called ________________ .
2. Melted rock that comes to the surface of Earth is called __________________________ .
3. When a volcano erupts, __________________________ comes out of it as well as __________________________ gases.
4. Quiet volcanoes have sides with __________________________ slopes.
5. Quiet volcanoes do not __________________________ .
6. Many of the world's active volcanoes are found in the ____________________ in the Pacific Ocean.
7. Cooled lava collects over time to build __________________________ .
8. Magma __________________________ out from an explosive volcano.
9. Dormant volcanoes are usually __________________________ .
10. Dormant volcanoes can __________________________ at any time.
11. The __________________________ Islands are the tops of volcanoes.

Practice

Use reference materials to locate the **mid-ocean ridges**. *Use small triangles to represent peaks to draw the mid-ocean ridge on the map below.*



Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

11,000	**earthquakes**	**mid-ocean ridges**	**slope**
abyssal plains	**Indian**	**Pacific**	**thinner**
Atlantic	**instruments**	**rift**	**trenches**
basin	**Marianas Trench**	**shelf**	**volcanoes**
canyons	**Mid-Atlantic Ridge**	**shoreline**	

1. The ocean basins have more ______________________ and ______________________ than the continents.

2. The steep drop-off at the edge of the continental shelf is the ______________________ .

3. ______________________ are deep V-shaped valleys found along the continental slope.

4. Plains found on the ocean floor are flatter and larger than those found on land. They are known as ______________________ .

5. Many ridges in the ______________________ Ocean are flat-topped mountains.

6. Another name for the ocean floor at a depth of more than 4,000 meters is the ______________________ .

7. The Mid-Atlantic Ridge is really two parallel chains of mountains separated by a valley called a ______________________ .

8. The ________________________ is the area where the water and the land meet.

9. In the late 1950s and 1960s scientists invented new ________________________ that let them study and map the ocean floor.

10. The area beyond the shoreline where the ocean slopes gradually downward is called the ________________________ .

11. The deepest parts of the ocean floor are long, narrow cracks called ________________________ .

12. Mountain chains found under the sea are known as ________________________ .

13. The longest mountain range in the world is the ________________________ . It is found in the ________________ , ________________________ , and ________________________ oceans.

14. The crust of Earth is ________________________ on the ocean floor than on the surface of Earth.

15. The ________________________ is the deepest place on Earth. It is over ________________________ meters deep.

Practice

Use the list below to write the correct term for each definition on the line provided.

abyssal plains	**continental slope**	**plates**
canyons	**convection currents**	**plate tectonics**
continents	**guyots**	**rift**
continental drift	**mid-ocean ridges**	**seamounts**
continental shelf	**Pangaea**	**trenches**

______________________ 1. pieces of Earth's crust that move about on the mantle

______________________ 2. mountain chains found under the surface of the ocean

______________________ 3. the seven major landmasses found on the surface of Earth

______________________ 4. relatively flat part of the continent that is covered by seawater and lies between the coast and the continental slope

______________________ 5. large, flat regions deep on the ocean floor

______________________ 6. deep V-shaped valleys found along the continental slope

______________________ 7. the steep drop-off at the edge of the continental shelf and the ocean basin proper

______________________ 8. the circular movements of heat through liquids or gases

_________________________ 9. the large landmass that broke up and drifted to form our present day continents

_________________________ 10. a wide valley that separates two parallel chains of underwater mountains

_________________________ 11. long, narrow cracks in the ocean floor that are the deepest parts of the ocean

_________________________ 12. a hypothesis suggesting that the continents have moved in different positions through geologic time

_________________________ 13. theory stating that crustal plates on the surface of Earth are continuously moving due to convection currents

_________________________ 14. underwater cone-shaped volcanic mountains

_________________________ 15. underwater volcanic mountains with flat tops

Practice

Use the list below to write the correct term for each definition on the line provided.

core	**fault**	**magma**	**seismic waves**
crust	**focus**	**mantle**	**seismograph**
earthquake	**lava**	**Richter scale**	**seismologist**
epicenter	**lithosphere**	**Ring of Fire**	**volcano**

________________ 1. a sudden movement of Earth's crust

________________ 2. scale used to describe the strength of an earthquake

________________ 3. instrument used to measure earthquake activity

________________ 4. the true center of an earthquake below Earth's surface

________________ 5. a vent in Earth's crust through which hot, liquid rock erupts or oozes

________________ 6. the point on the surface of Earth directly above the focus of an earthquake

________________ 7. waves by which energy moves away from the focus of an earthquake in all directions from the center

________________ 8. hot, liquid rock found inside Earth

________________ 9. the molten layer of Earth below the crust

_______________ 10. a crack in Earth's crust

_______________ 11. magma that comes to the surface of Earth

_______________ 12. major earthquake zone that forms a ring around the Pacific Ocean

_______________ 13. the outer layer of Earth

_______________ 14. the innermost layer of Earth which has two parts

_______________ 15. a person who studies earthquakes

_______________ 16. the rigid outer layer of Earth, including the crust and upper mantle

Practice

Circle the letter of the correct answer.

1. Deep V-shaped valleys found along the continental slope are ___________.

   a. trenches
   b. rifts
   c. canyons
   d. plates

2. A wide valley that separates two parallel chains of underwater mountains is a ___________.

   a. basin
   b. canyon
   c. plain
   d. rift

3. Long, narrow cracks in the ocean floor that are the deepest parts of the ocean are ___________.

   a. trenches
   b. faults
   c. mountains
   d. mantles

4. The relatively flat part of the continent that is covered by seawater and lies between the coast and the continental slope is the ___________.

   a. mantle
   b. continental shelf
   c. abyssal plain
   d. trench

5. A large, flat region deep on the ocean floor is a(n) ___________.

   a. basin
   b. abyssal plain
   c. mid-ocean ridge
   d. convection current

6. A mountain chain found under the surface of the ocean is the ________ .

   a. mid-ocean ridge
   b. convection current
   c. continent
   d. basin

7. The ________ is the steeply dipping surface between the outer edge of the continental shelf and the ocean basin proper.

   a. basin
   b. abyssal plain
   c. Pangaea
   d. continental slope

8. The ________ are the seven major landmasses found on the surface of Earth.

   a. continents
   b. plates
   c. trenches
   d. convection currents

9. ________ are pieces of Earth's crust that move about on the surface of Earth.

   a. Rifts
   b. Trenches
   c. Basins
   d. Plates

10. ________ is the large landmass that broke up and drifted to form our present day continents.

   a. Pangaea
   b. Shoreline
   c. Abyssal plain
   d. Rift

11. __________ are the circular movements of heat through liquids and gases.

a. Plates
b. Trenches
c. Mid-ocean ridges
d. Convection currents

12. A sudden movement of Earth's crust is a(n) __________ .

a. volcano
b. mantle
c. core
d. earthquake

13. The instrument used to measure earthquake activity is a(n) __________ .

a. epicenter
b. seismograph
c. volcano
d. Richter scale

14. A vent in Earth's crust through which hot, liquid rock erupts or oozes is a __________ .

a. volcano
b. rift
c. mantle
d. mountain

15. A crack in Earth's surface is a __________ .

a. mountain
b. rift
c. trench
d. fault

16. A person who studies earthquakes is a(n) __________ .

a. seismograph
b. seismologist
c. Richter scale
d. epicenter

17. The innermost layer of Earth which has two parts; the outer portion which is liquid and the inner portion which is solid is the ___________ .

    a. focus
    b. magma
    c. crust
    d. core

18. Magma that comes to the surface of Earth is called ___________ .

    a. mantle
    b. core
    c. crust
    d. lava

19. An area where many of the world's active volcanoes are found is called the ___________ .

    a. Ring of Fire
    b. fault
    c. core
    d. epicenter

20. The outer layer of Earth is called the ___________ .

    a. mantle
    b. crust
    c. core
    d. fault

21. The ___________ is the molten layer of Earth below the crust.

    a. magma
    b. core
    c. crust
    d. mantle

22. The point on the surface of Earth directly above the focus of an earthquake is the ___________ .

    a. epicenter
    b. core
    c. crust
    d. mantle

23. The __________ is used to describe the strength of an earthquake.

a. Richter scale
b. seismograph
c. lava
d. seismologist

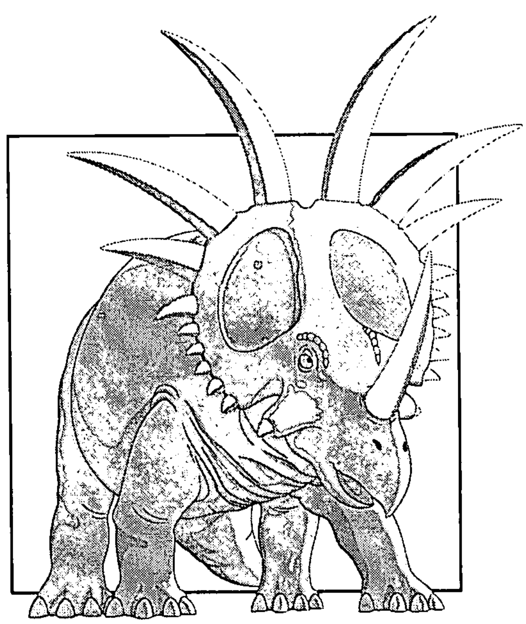
24. __________ are waves by which energy moves away from the focus of an earthquake in all directions from the center.

a. Earthquakes
b. Epicenters
c. Seismic waves
d. Volcanos

25. The true center of an earthquake below Earth's surface is the __________ .

a. core
b. fault
c. mantle
d. focus

Unit 9: Geologic History and Fossils



Vocabulary

Study the vocabulary words and definitions below.

absolute dates .... dates that tell how many years have passed since an event took place

brachiopods .... small, clam-like marine invertebrates

carbon-14 .... radioactive form of carbon found in living things which is used to determine the age of materials

cast .... a mold that has the same shape as the original fossil and has been filled with hardened sediment

Cenozoic .... the most recent geologic era of Earth; the Age of Mammals

epoch .... subdivision of a period of time in the geologic time scale

era .... the largest division of geologic time

extinct .... no longer living on Earth

fossils .... remains and imprints of life forms that once lived on Earth

geologic time scale .... the division of Earth into periods of time; the sequence of eras, periods, and epochs

geologists .... scientists who study the origin, history, and structure of Earth and the processes which form and change its surface

half-life .... the time it takes one-half of the atoms of a radioactive sample to decay

index fossils .... fossils that identify the age of the rock in which they occur; also called guide fossils
Example: The trilobite is an index fossil for the middle Cambrian Period.

law of superposition .... principle stating that sedimentary rocks are formed with the oldest layers on the bottom and the youngest on top

Mesozoic .... the geologic era of Earth from 225 million years ago to 65 million year ago; the Age of Reptiles

mold .... the empty cavity of a fossil left in a rock after the original organism has decayed

paleontologist .... scientist who studies fossils

Paleozoic .... the geologic era of Earth from 600 million years ago to 225 million years ago, known for presence of invertebrates, amphibians, and fish; the Age of Invertebrates

period .... subdivision of an era in the geologic time scale

petrification .... process by which the remains of plants or animals are replaced by stone

Proterozoic .... the first geologic era of Earth, beginning about 3,000 million years ago and lasting until 600 million years ago; the Age of Rocks

radioactive decay .... process used to determine the age of rocks based on the rate at which the radioactive materials in them decay

rate of erosion .... time it takes for land to weather away

rate of sedimentation .... amount of sediment deposited over time

relative dates .... dates that place events in order of when they took place

revolutions .... major changes in Earth's crust due to volcanic activity and crustal movement that marked the end of eras

trace fossils .... imprints from the activities of animals
Example: footprints

trilobites .... small marine invertebrates believed to be the early ancestors of the horseshoe crab

Introduction

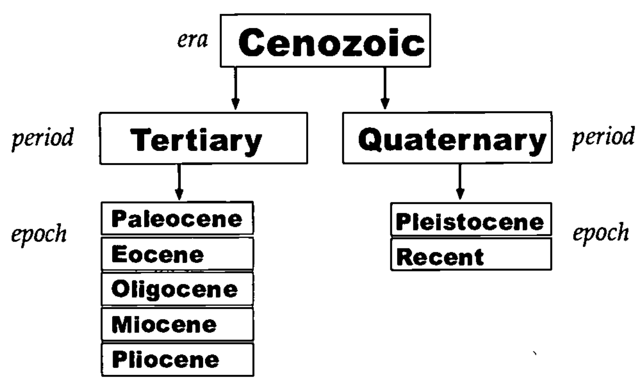
The sequence of Earth's history or geologic time covers such a large expanse of time that scientists have divided it into smaller units. **Eras**, **periods**, and **epochs**—the subdivisions of geologic time—are markers of the major changes in Earth's crust.

Changes in and on Earth's crust have caused many organisms to change or evolve over time. The study of the age of rocks, rock layers, and **fossils** is the scientists' way of solving the mystery of the earliest life form and the age of Earth.

Divisions of Geologic Time

Geologists are scientists who study the origin, history, and structure of Earth, and the processes which change its surface. Geologists believe Earth to be about 4.5 billion years old. In order to study the events that happened on Earth more accurately, Earth is divided into periods of time, creating a **geologic time scale**. The largest divisions of geologic time are called *eras*. The length of an era is measured between major changes in Earth's crust called **revolutions**. Revolutions consist of violent volcanic activity and crustal movements causing major changes in Earth's surface. There are four major eras. From oldest to most recent, they are the **Proterozoic**, the **Paleozoic**, the **Mesozoic**, and the **Cenozoic**.

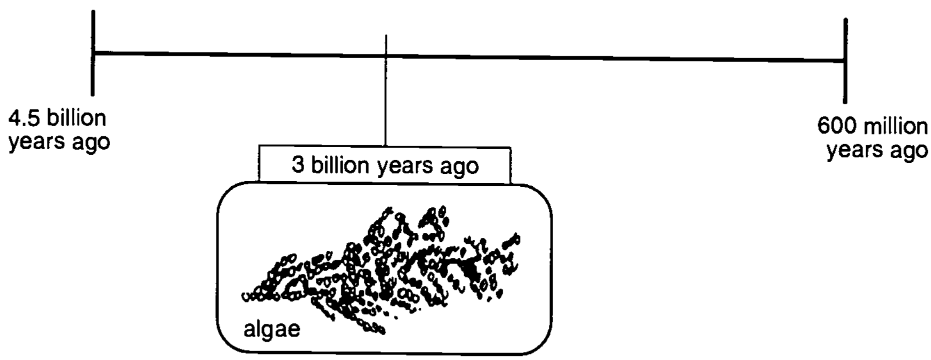
Enough is known about the three most recent eras to further break them down into smaller divisions called *periods*. The Paleozoic has seven, the Mesozoic has three, and the Cenozoic has two—thus far. Minor revolutions, such as climatic changes and the presence of fossils, mark the beginning and end of periods. Periods are usually named for the locations where these changes were discovered. For example, the Devonian Period was named after Devon, England.



Proterozoic Era

The first geologic era of Earth is called the Proterozoic. This era covers almost 90 percent of the age of Earth. It began with the formation of Earth and lasted until about 600 million years ago. Proterozoic time was marked by episodes of mountain building and the formation of the first rocks on Earth. The first living things developed during this era. They were simple, single-celled microorganisms such as protozoans and bacteria. Later, after the oceans formed, algae and simple invertebrates such as sponges and marine worms appeared. Since all of these life forms were soft bodied, they left very little fossil evidence.

Proterozoic



Events: **First rocks**
Origin of life (soft bodied)

Paleozoic Era

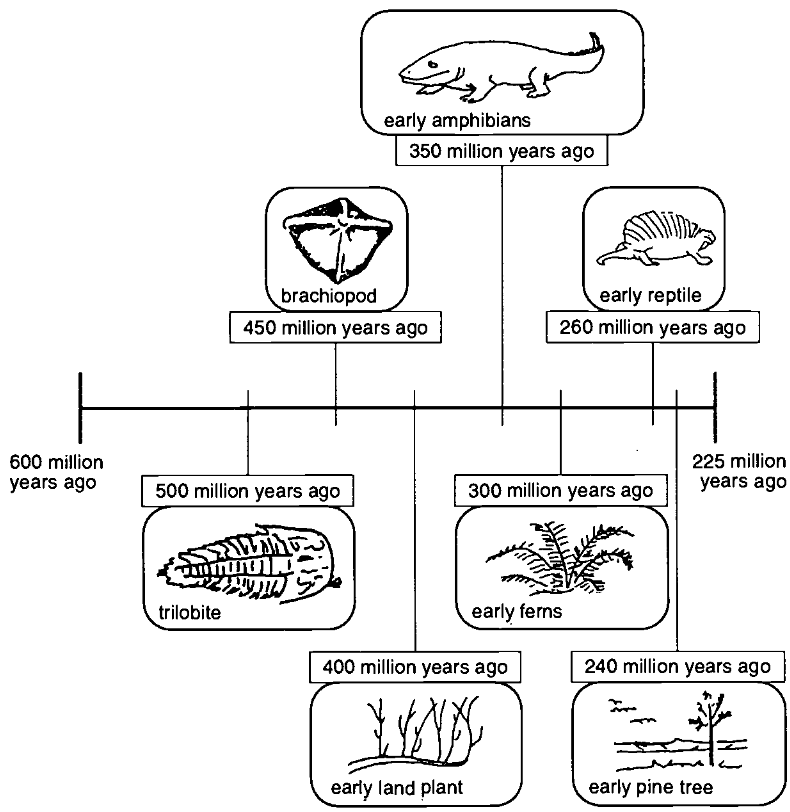
An abundance of fossils marked the beginning of the Paleozoic era, which means *ancient life*. The Paleozoic Era began 600 million years ago and lasted until 225 million years ago. It is subdivided into six periods: the Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and the Permian.

The Paleozoic Era began with the appearance of a large number of small marine invertebrates such as **trilobites**, believed to be ancestors of horseshoe crabs. There were also **brachiopods**, which were clam-like

Pangaea

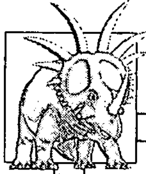
organisms. In later periods, land plants and animals developed. Vertebrate animals such as fish, amphibians, and reptiles appeared by the end of the Paleozoic Era. Thick forests of ferns and conifers (cone-bearing trees) appeared. During the second half of the Paleozoic Era, a variety of natural resources began forming. Fossil fuels, such as coal, oil, and natural gas, are found in rocks from the Paleozoic Era. During this period, geologists believe that the land portion of Earth was one huge continent now called *Pangaea*.

Paleozoic



Events: One land mass (Pangaea)
Coal and oil deposits

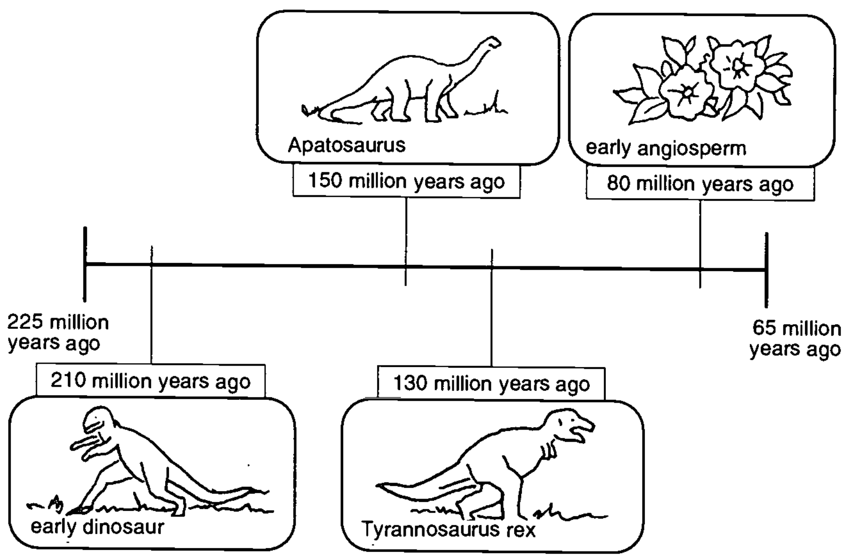
End of Paleozoic: Breakup of Pangaea



Mesozoic Era

The breaking apart of Pangaea into separate continents marked the end of the Paleozoic and the beginning of the Mesozoic Era, which means *middle life*. This era began 225 million years ago and lasted until 65 million years ago. The Mesozoic Era is divided into three periods: the Triassic, Jurassic, and Cretaceous. The climate was mild during this era. Dinosaurs and other reptiles were the dominant form of life, which gave this era the name *Age of Reptiles*. Mammals and birds made their first appearance on Earth, as did flowering plants. Major geological changes occurred on Earth during this era. Most of our major mountain ranges were formed due to the movements of crustal plates. Towards the end of this era, the climate began to change as the warm tropical climate was replaced by colder temperatures. By the end of this era, the great dinosaurs had become **extinct**, or no longer living on Earth, possibly because of their inability to adapt to the climatic changes. Others have suggested that a large meteorite collided with Earth. This impact might have caused the climate changes and the extinction of the dinosaurs.

Mesozoic



Events: Age of Reptiles
Appearance of mammals and birds
Mountains formed

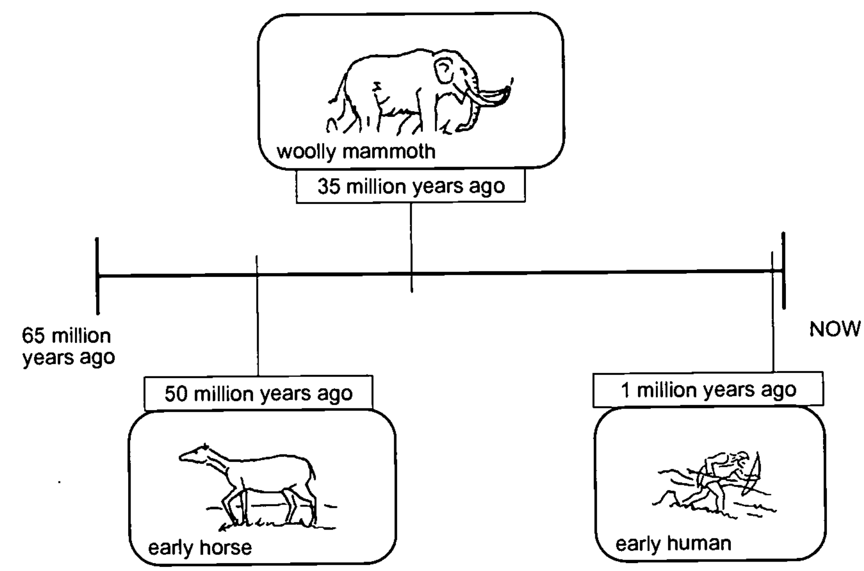
End of Mesozoic: Climate changes

Cenozoic Era

We are now in the last era, the Cenozoic Era, which began 65 million years ago. This era is commonly called the *Age of Mammals*. Because of excellent fossil records, more information is known about this era than any other era. Therefore, the Cenozoic Era's two periods, the Tertiary and Quaternary, are subdivided into smaller units called *epochs*. The Tertiary period has five epochs: the Paleocene, Eocene, Oligocene, Miocene, and Pliocene. The most recent period, the Quaternary Period, is divided into the Pleistocene and Recent Epochs. (See page 261.)

The climate late in the Cenozoic Era, in the Quaternary period, became much colder than during the Mesozoic Era. Several Ice Ages took place. Different types of large mammals that were adapted to the colder temperatures, such as the woolly mammoth, appeared. Angiosperms became the dominant plant forms because they could tolerate the colder climate. The landforms that we find today developed during this era. Humans appeared on Earth near the beginning of the last period of this era, which was between 500,000 and 1,000,000 years ago.

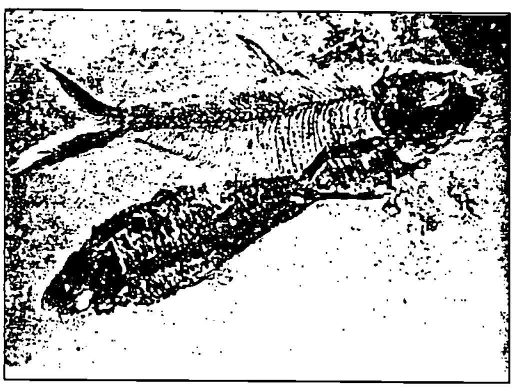
Cenozoic



Events: Ice Ages
Early humans appeared

Fossil Formation

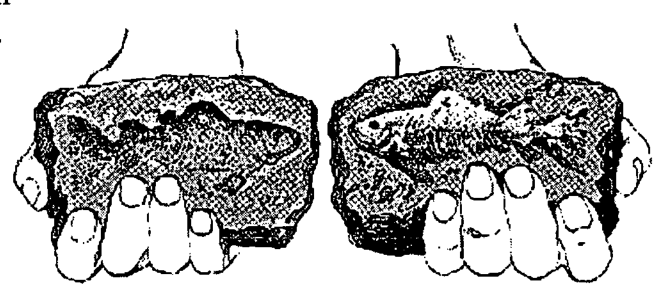
Fossils are the remains or traces of prehistoric plants and animals preserved in rock. Scientists who look for and study fossils to learn about Earth's history are called **paleontologists**. Because most dead organisms are eaten or *decay*, only about one percent of past life is left to become fossils. There are different types of fossils. Sometimes remains, or actual parts of the organism, will be found. Other times only evidence, such as a fossil footprint or imprint of the organism, will be discovered.



fish fossils

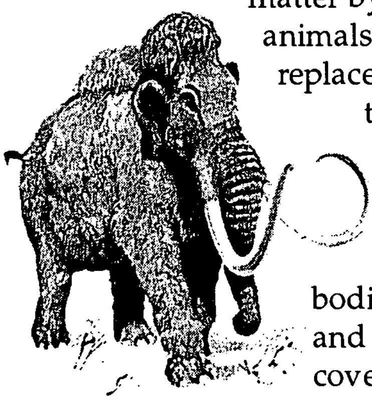
Most fossils are found in *sedimentary rock*. Organisms that lived near water were more often preserved than those that lived in drier regions. When the organism died, it must have been covered with sediment very quickly to prevent it from decaying or being eaten by other organisms. The *sediments* hardened, and the organism was preserved between the rock layers. Sometimes when an organism is buried in sedimentary rock, its soft parts decay, and the hard parts are dissolved, leaving only an impression. When this happens, a cavity called a **mold** forms in the rock in the exact shape of the organism that died. If this cavity becomes filled with sediments that harden, a **cast** of the original organism forms. This is a fossil.

Many ancient organisms left impressions in sediments that eventually hardened into rock and were preserved. Fossils formed in this way are called *imprints*. The activities of these animals left footprints, tracks, and burrows which formed fossil imprints called **trace fossils**. The trace fossils of dinosaurs and other animals that are *extinct* left important clues for scientists that led them to other discoveries about the animals.



imprint of a fossil

The remains of some ancient fossils have been preserved through **petrification**. Petrification is the gradual replacement of the organic matter by a stonelike substance. As ancient plants and animals decayed, the organic matter in their bodies was replaced by minerals. The minerals then hardened in the same shape or form of the organism that died.



Ice, tar, or resin would sometimes preserve the entire plant or animal. Entire animal bodies were buried and frozen in large masses of ice and snow. When animals fell into tar pits, they were covered with tar and thus preserved. Many large animals, including the saber-toothed tiger and wooly mammoth, have been found in the La Brea Tar Pits in California. The sticky resin of pine trees preserved entire insects that became imbedded in the resin. After thousands of years, the resin was hardened, forming *amber*. The preservation of entire animals or plants in these ways gave scientists a great amount of information about these animals and their time periods.

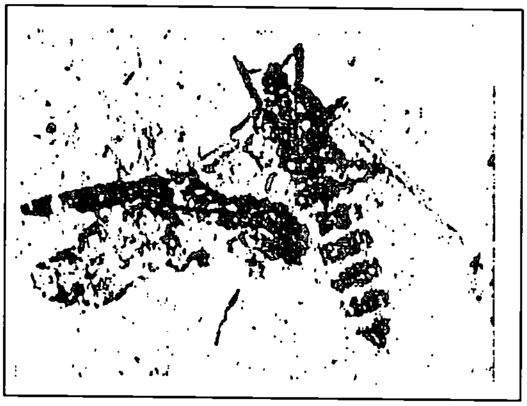
Evidence of Earth's History from Fossils

The study of fossils is important to scientists because it gives them many clues as to how living things changed throughout geologic time. Divisions of geologic time are based on the appearance and disappearance of fossils.

Fossils used to divide geologic time into units are called **index fossils** or guide fossils. Index fossils identify the age of the rock in which they occur. These are fossils of plants and animals which only lived for a short period of time but were found in many areas of Earth. It can be determined that these fossils, although found in different areas, must have formed at the same time. Other fossils are the remains and imprints of species that lived over long periods of time, but only in certain areas. The disappearance of these fossils may indicate climatic or other changes which caused the extinction of the species.

By studying fossils, scientists have also learned how the surface of Earth has changed over time. For instance, fossils can help determine if and when an area was covered with water. If fossils of marine animals are found on land, scientists can assume that the land was once covered with water. Also, fossils found in layers of sedimentary rock, such as those found in the Grand Canyon, provide clues to the past climate of the area.

Fossils are also important tools for determining the age of sediments. Since fossils contain organic material, their age can be determined by the **half-life** of the **carbon-14** in them. Once the age of the fossil is determined, the age of the sediments will be approximately the same age as the fossil. However, if a fossil is found in a cave or canyon, it can only be assumed that the age of the rock is older than that of the fossil.



bee fossils

Ways to Determine the Age of Earth

Geologists have tried to measure geologic time using several methods. Since they are dealing with such a long period of time, it is very difficult to determine the exact dates when events occurred. Geologists use both relative and **absolute dates** when measuring geologic time. Absolute dates tell us how many years have passed since an event took place. **Relative dates** place events in historical order by comparing them with other happenings that took place, but they do not tell us how many years ago the events occurred. Several methods have been used to measure geologic time. They include 1) studying **rates of sedimentation**, 2) studying **rates of erosion**, 3) studying **radioactive decay**, and 4) studying evidence of fossils.

Methods for Measuring Geologic Time

- studying rates of sedimentation
- studying rates of erosion
- studying radioactive decay
- studying evidence of fossils

Scientists have studied the rate of sedimentation, or the amount of sediment deposited over time, to determine geologic time. Most sedimentary rocks are laid down in layers with the oldest layers on the bottom and younger layers near the top. This is called the **law of**

superposition. The sedimentary rock layers of the Grand Canyon are an excellent example of this law. Sedimentary rocks only give clues to relative ages of rocks rather than giving absolute dates.

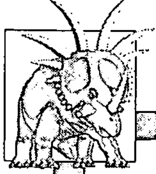
At one time, scientists believed that geologic time could be measured by the *rate of erosion*. They assumed that the rate of erosion throughout time had always been the same. Their estimates were not accurate because the rate of erosion varies with the hardness and thickness of the rock and with the amount of precipitation that fell.

In the late 1800s, the work of Antoine Henri Becquerel and Marie and Pierre Curie led to the discovery of radioactive elements. They found that certain elements, such as uranium, were radioactive and gave off invisible energy waves. These radioactive elements would decay or break apart at a constant rate called a *half-life*, which is the time it takes one-half of the atoms of a sample of the material to decay. The half-life of radioactive elements varies for each element. By determining the half-life of radioactive elements found in rocks, scientists could accurately determine the age of the rocks. Radioactive carbon, called *carbon-14*, can be used to tell the age of materials that were once living.

All living things take in a certain amount of carbon-14 from the plants they eat. When they die, the carbon-14 that is already present in their bodies begins to decay. The age of bones, shells, wood, and other remains of plants and animals can be determined by measuring the amount of carbon-14 found.

Summary

Earth's history is outlined in the geologic time scale. The largest subdivisions are called eras. Each era is divided into periods and the periods into smaller units called epochs. You are living in the Recent Epoch of the Quaternary Period of the Cenozoic Era. Ways to measure geologic time include studying rates of sedimentation, rates of erosion, radioactive decay, and evidence of fossils.



Lab Activity 1: Part 1—Geologic History

Purpose

Create a timeline showing selected ages and events in geologic history.

Materials

- meter stick
- 5 meters of adding machine tape
- pencil or markers
- scissors

1. Using a scale of 1 millimeter equals 1 million years (1mm = 1,000,000 years), convert each of the ages given below to its equivalent distance in millimeters. Write the correct number of millimeters on each line.

Age	Time	No. of Millimeters
Proterozoic Era Begins	4.5 billion years	4,500 mm
Paleozoic Era Begins		
Cambrian Period begins	570 million years	570 mm
Ordovician Period begins (first vertebrates)	500 million years	______
Silurian Period begins (first land plants)	430 million years	______
Devonian Period begins (first amphibians)	395 million years	______
Mississippian Period begins	345 million years	______
Pennsylvanian Period begins	325 million years	______
Permian Period begins (first reptiles)	280 million years	______
Mesozoic Era Begins		
Triassic Period begins (first dinosaurs)	225 million years	______
First mammals	200 million years	______
Jurassic Period begins (first birds)	190 million years	______
Cretaceous Period begins	136 million years	______
Cenozoic Era Begins		
Tertiary Period		
Paleocene begins epoch	65 million years	______
Eocene epoch begins	54 million years	______
Oligocene epoch begins	38 million years	______
Miocene epoch begins	26 million years	______
Pliocene epoch begins	7 million years	______
Quaternary Period		
Pleistocene epoch begins	2.5 million years	______
Earliest humans	2 million years	______

Lab Activity 1: Part 2—Geologic History

1. Cut a piece of adding machine tape 5 meters long. Draw a line along the tape from one end to the other. Label one end *Today*. Beginning at the *Today* line, measure and mark off the position on the tape that represents each age or event listed below.

2. Locate the following ages and events on the timeline. Write them in the appropriate places.

Late Paleozoic Era	**Pangaea begins to break up**
Early Mesozoic Era	**Dinosaurs and other reptiles are the dominant form of life**
Triassic Period	**Fish, amphibians, and reptiles appeared**
Cretaceous Period	**Fossil fuels begin to form**
Oligocene epoch	**Great volcanic activity**
Pleistocene epoch	**The Great Ice Age**

Refer to the **timeline** *to answer the following using complete sentences.*

3. How does the length of time that humans have existed on Earth compare with the duration of geologic time?

____

____

4. By looking at the timeline, what can be determined about the rate at which ages and events have occurred on Earth?

____

____

5. Explain why it would not be possible to represent the length of a person's lifetime on your timeline.

6. Name an event or a form of life from each era below.

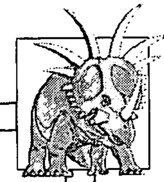
Paleozoic:

Proterozoic:

Cenozoic:

Mesozoic:

7. List the four major divisions of geologic time from oldest (earliest) to youngest (oldest).



Practice

Answer the following using short answers.

1. Name the four eras in Earth's history.

 ____

 ____

 ____

 ____

2. Do all of the eras cover the same amount of time? ______________

 Why or why not? ______________________________

 ____

 ____

 ____

3. Why isn't the Proterozoic Era divided into periods?

 ____

 ____

 ____

4. Why is the most recent era the only one that has periods further subdivided into epochs?

 ____

 ____

 ____

5. Which era covered the most amount of time in the history of Earth?

6. What are periods named after?

7. When did Pangaea start to break apart?

8. Name the periods of the Paleozoic Era.

9. Name the three periods of the Mesozoic Era from the most recent to the oldest.

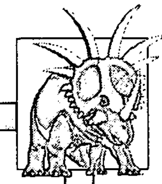
10. Name the periods and epochs of the Cenozoic Era from the most recent to the oldest.

Periods:	**Epochs:**
____________________	____________________ ____________________
____________________	____________________ ____________________ ____________________ ____________________ ____________________

Practice

Fill in the chart below with the **eras, periods,** *and* **epochs** *that make up the geologic time scale. List* **plant** *and* **animal life forms** *that lived in each era.*

Era	Period	Epoch	Life Forms
______ present to 65 million years ago			
______ 65 to 225 million years ago			
______ 225 to 600 million years ago			
______ 600 million to 3,000 million years ago			



Practice

Use the list below to complete the following statements.

amber	extinct	mold	remains
carbon-14	fossils	paleontologists	sedimentary
cast	imprint	petrification	trace
climatic	index		

1. The remains or traces of prehistoric plants and animals that are preserved in rock are called ________________________ .

2. ________________________ are scientists who look for and study fossils.

3. The actual parts of an ancient organism that are preserved are called ________________________ .

4. When evidence such as a footprint is found, it is called a(n) ________________________ .

5. Most fossils are found in ________________________ rock.

6. A cavity that forms in a rock that is the exact shape of the organism that died is called a ________________________ .

7. When the cavity of a mold fills with sediment and hardens, a(n) ________________________ of the original organism forms.

8. Fossil imprints are also called ________________________ fossils.

9. Animal species that no longer live on Earth are said to be

_______________________ .

10. Sometimes the remains of an animal are replaced by stone through a process called _______________________ .

11. Insects are sometimes preserved in the resin of trees that hardens to form a substance known as _______________________ .

12. Fossils that identify the age of the rock in which they occur are called _______________________ fossils.

13. The age of fossils can be determined by the radioactive half-life of

_______________________ .

14. The disappearance of a group of fossils may indicate a _______________________ change.

Lab Activity 2: Making Fossils

Purpose	Materials
Discover how fossils are made.	• clay • plaster of Paris • dark pencil • knife • assorted objects • petrified wood or object preserved in acrylic • leaf • tray or aluminum pan

A: Mold

1. Put clay in aluminum tray.
2. Smooth the surface of the clay.
3. Press a small object into the surface of the clay.
4. Remove object gently.
5. Set impression aside.

B: Cast

1. Mold a cube from the clay.
2. Cut the cube in half.
3. Press a small object into one half of the clay.
4. Place a pencil closely against the object to provide a tunnel for the plaster.
5. Firmly press the other half of the clay on top of the object and pencil.
6. Separate the two halves of the mold and carefully remove the object and pencil.

7. Fit the two halves of the clay securely together and place in tray with pencil hole on top.

8. Pour thick plaster of Paris (the consistency of pudding) into opening.

9. Allow to dry overnight.

10. When dry, carefully pry mold apart and break off pencil-shaped protrusion.

C: Imprint

1. Place a leaf on a sheet of paper.

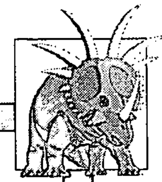
2. Rub a soft pencil over the leaf to completely coat it. (May use carbon paper.)

3. Carefully pick up leaf and place on clean sheet of paper, carbon side down, and press firmly.

4. Remove leaf from paper and discard.

5. Compare the following types of fossils.

	Mold	**Cast**	**Carbonization**	**Preservation** (petrification/amber)
Original material still present?				
Shows external structure?				
Original material must have contained hard parts (shells, bones, etc.)?				



6. Are molds and casts actual remains? ____________________

Explain. ____________________

____

____

____

____

____

____

7. How does petrification occur? ____________________

____

____

____

____

____

____

8. How do casts and preserved organisms differ? ____________________

____

____

____

____

____

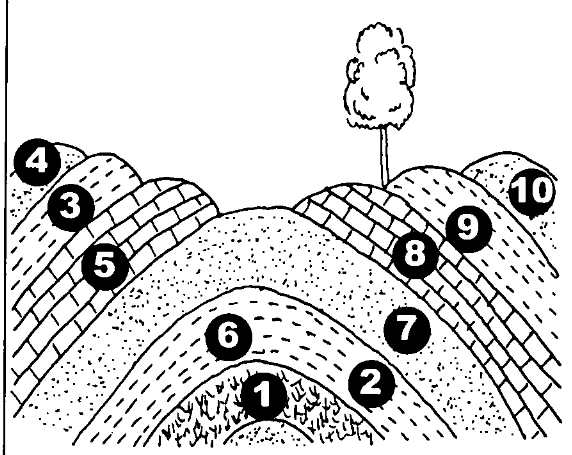
Practice

Read the information below and follow the directions.

Scientists use sedimentary rock layers to determine geologic time.

- Sedimentary rocks are laid down in layers. The oldest layers are on the bottom and youngest layers are near the top.
- Erosion can alter the surface of layers.
- Magma can invade layers. The magma is younger than the layer it invades.

1. Observe the diagrams of sedimentary rock layers on the following pages. Using the background information above, list the rock layers by number from oldest to the youngest. Some numbers may appear on the same line.
2. Write a brief history of the area, include faulting, uplifting, and erosion, on the lines provided.



Relative Ages of Rock Layers

____
(youngest)

____

____

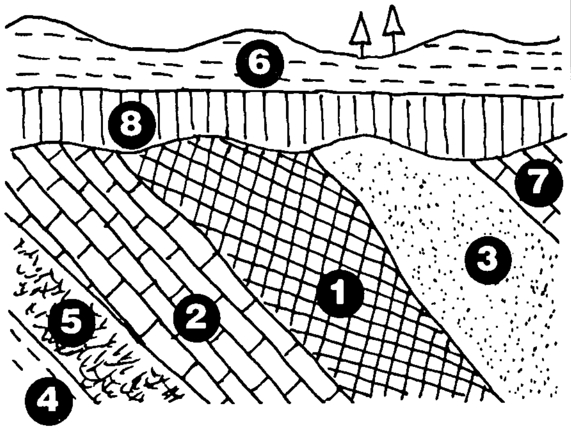
____

____

____
(oldest)

Geologic History: ____

____



Relative Ages of Rock Layers

____
(youngest)

____

____

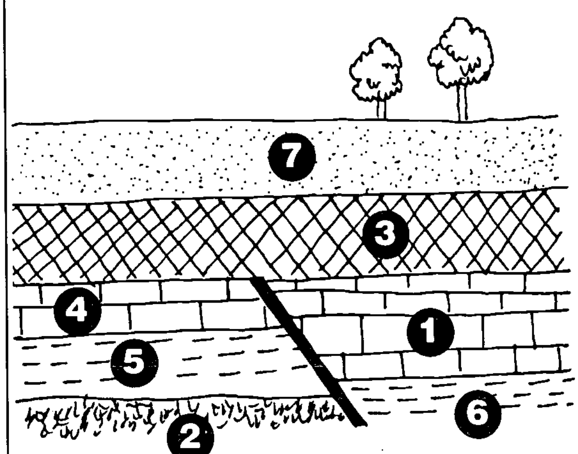
____

____

____
(oldest)

Geologic History: ______________________

____



Relative Ages of Rock Layers

____
(youngest)

____

____

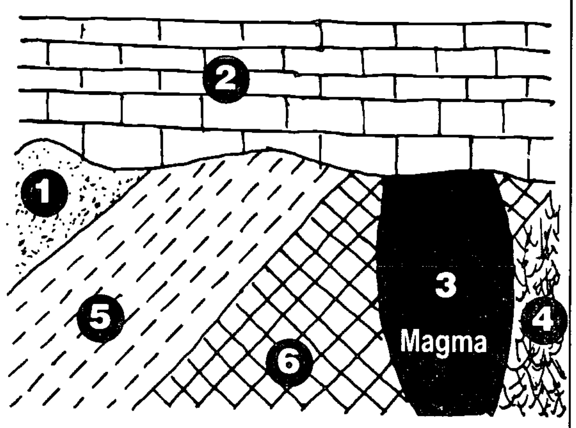
____

____

____
(oldest)

Geologic History: ______________________

____



Relative Ages of Rock Layers

____
(youngest)

____

____

____

____

____
(oldest)

Geologic History: ____

____

Practice

Answer the following using complete sentences.

1. What is the difference between absolute dates and relative dates?

2. What does the law of superposition tell us about the age of sedimentary rocks?

3. Do the clues from sedimentary rocks help determine absolute or relative dates?

4. Is the rate of erosion an accurate way to learn the age of rocks?

   Why or why not?

5. What is the most accurate way to determine the age of rocks?

____

____

6. What is a half-life? ___________________________

____

____

____

7. What is carbon-14? ___________________________

____

____

____

8. What radioactive element can be used to determine the age of anything that is living or has once lived?

____

9. What are fossils? ___________________________

____

____

10. Name four methods used to determine the age of Earth.

____

____

____

____

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. It is very easy to determine exact dates in geologic history.

_________ 2. Relative dates tell how many years have passed since an event took place.

_________ 3. Geologists use both relative dates and absolute dates to measure geologic time.

_________ 4. The law of superposition states that sedimentary rocks are laid down with the oldest rocks in the bottom layer and the newest rocks in the upper layers.

_________ 5. Sedimentary rocks give clues as to the absolute dates of rocks.

_________ 6. Geologic time can be accurately measured by the rate of erosion.

_________ 7. The rate of erosion of rocks varies with the hardness and thickness of the rock.

_________ 8. Antoine Henri Becquerel and Marie and Pierre Curie did work that led to the discovery of radioactivity.

_________ 9. Radioactive elements decay at a constant rate called the half-life.

_________ 10. Carbon-14 is used to tell the age of materials that have never lived.

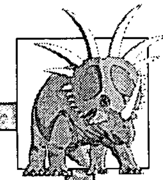
_________ 11. Carbon-14 is a method of determining the age of materials.

_________ 12. The discovery of fossils was not of much help to scientists in dating geologic time.

_________ 13. The half-life of an element is the amount of time it takes a sample to totally decay.

_________ 14. The age of fossils can be determined by measuring the amount of carbon-14 found.

_________ 15. Fossils are usually found in igneous rock.



Practice

Use the list below to write the correct term for each definition on the line provided.

Cenozoic	**Mesozoic**	**rate of erosion**
epoch	**Paleozoic**	**rate of sedimentation**
era	**period**	**relative dates**
fossils	**Proterozoic**	**revolutions**
geologists	**radioactive decay**	

______________________ 1. recent life; also called the Age of Mammals; started about 65 million years ago

______________________ 2. middle life; also called the Age of Reptiles; started about 225 million years ago

______________________ 3. Age of Rocks; started about 3,000 million years ago

______________________ 4. remains and imprints of life forms that once lived on Earth

______________________ 5. used to determine the age of rocks

______________________ 6. time it takes for land to weather away

______________________ 7. subdivision of a period of time in the geologic time scale

______________________ 8. subdivision of an era in the geologic time scale

______________________ 9. ancient life; also called the Age of Invertebrates; started about 600 million years ago

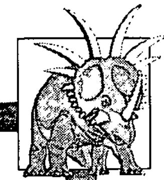
______________________ 10. the largest division of geologic time

____________________ 11. major changes in Earth's crust due to volcanic activity and crustal movement that marked the end of eras

____________________ 12. dates that place events in order of when they took place

____________________ 13. amount of sediment deposited over time

____________________ 14. scientists who study the origin, history, and structure of Earth and the processes which form and change its surface



Practice

Use the list below to write the correct term for each definition on the line provided.

absolute dates	geologic time scale	paleontologists
brachiopods	half-life	petrification
carbon-14	index fossils	trace fossils
cast	law of superposition	trilobites
extinct	mold	

_________________________ 1. imprints from the activities of fossils

_________________________ 2. dates that tell how many years have passed since an event took place

_________________________ 3. small marine invertebrates that are clam-like organisms

_________________________ 4. radioactive form of carbon found in living things which is used to determine the age of materials

_________________________ 5. no longer living on Earth

_________________________ 6. the division of Earth into periods of time; the sequence of eras, periods, and epochs

_________________________ 7. the time it takes one-half of the atoms of a radioactive sample to decay

_________________________ 8. principle stating that sedimentary rocks are formed with the oldest layers on the bottom and the youngest on top

_________________________ 9. small marine invertebrates believed to be the early ancestors of the horseshoe crab

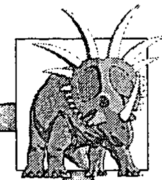
_______________ 10. a mold that has the same shape as the original fossil and has been filled with hardened sediment

_______________ 11. scientists who study fossils

_______________ 12. the empty cavity of a fossil left in a rock after the original organism has disappeared

_______________ 13. the process by which remains of plants or animals been replaced by stone

_______________ 14. fossils that identify the age of the rock in which they occur; also called guide fossils



Practice

Circle the letter of the correct answer.

1. The largest division of the geologic time scale is a(n) __________ .

   a. epoch
   b. period
   c. era
   d. half-life

2. The subdivision of an era in the geologic time scale is a(n) __________ .

   a. period
   b. era
   c. half-life
   d. revolution

3. The subdivision of a period of time in the geologic time scale is a(n) __________ .

   a. epoch
   b. period
   c. era
   d. half-life

4. The __________ Era is the most recent geologic era of Earth and is called the Age of Mammals.

   a. Proterozoic
   b. Mesozoic
   c. Paleozoic
   d. Cenozoic

5. The geologic __________ era of Earth is called the Age of Reptiles and started about 225 million years ago.

   a. Mesozoic
   b. Proterozoic
   c. Cenozoic
   d. Paleozoic

6. The __________ Era of Earth is called the Age of Invertebrates and started about 600 million years ago.

   a. Paleozoic
   b. Cenozoic
   c. Mesozoic
   d. Proterozoic

7. The __________ Era, also called the Age of Rocks, is considered to be the first geologic era of Earth.

   a. Paleozoic
   b. Cenozoic
   c. Mesozoic
   d. Proterozoic

8. The process used to determine the age of rocks by the rate at which the radioactive materials in them decay is __________ .

   a. absolute dates
   b. rate of sedimentation
   c. rate of erosion
   d. radioactive decay

9. The remains and imprints of life forms that once lived on Earth are __________ .

   a. brachiopods
   b. epochs
   c. fossils
   d. relative dates

10. The __________ is the time it takes for land to weather away.

    a. law of superposition
    b. rate of sedimentation
    c. geologic time scale
    d. rate of erosion

11. The __________ is the amount of sediment deposited over time.

    a. law of superposition
    b. rate of sedimentation
    c. rate of erosion
    d. geologic time scale

12. The scientists who study Earth and the processes which form and change Earth are ________ .

    a. brachiopods
    b. trilobites
    c. geologists
    d. revolutions

13. ________ tell how many years have passed since an event took place.

    a. Eras
    b. Periods
    c. Geologic time scales
    d. Absolute dates

14. ________ are small, clam-like organisms.

    a. Brachiopods
    b. Trilobites
    c. Geologists
    d. Fossils

15. The radioactive form of carbon found in living things which is used to determine the age of materials is ________ .

    a. half-life
    b. carbon-14
    c. epoch
    d. era

16. ________ means no longer living on Earth.

    a. Extinct
    b. Fossils
    c. Carbon-14
    d. Mesozoic

17. The time it takes one-half of the atoms of a radioactive sample to decay is its ________ .

    a. era
    b. period
    c. epoch
    d. half-life

18. The principle stating that sedimentary rocks are formed with the oldest layers on the bottom and the youngest on top is called the __________ .

   a. geologic time scale
   b. law of superposition
   c. rate of erosion
   d. rate of sedimentation

19. Major changes in Earth's crust due to volcanic activity and crustal movement that marked the end of eras are called __________ .

   a. absolute dates
   b. brachiopods
   c. revolutions
   d. periods

20. The division of Earth into periods of time is the __________ .

   a. law of superposition
   b. geologic time scale
   c. absolute date
   d. rate of erosion

21. __________ places events in order of when they took place.

   a. Eras
   b. Epochs
   c. Relative dating
   d. Geologic time scale

22. Small marine invertebrates believed to be the early ancestors of the horseshoe crab are __________ .

   a. fossils
   b. periods
   c. brachiopods
   d. trilobites

23. The process by which the remains of plants or animals have been replaced by stone is __________ .

   a. petrification
   b. organism
   c. decay
   d. imprinting

24. A mold that has the same shape as the original fossil and has been filled with hardened sediment is called a(n) ____________ .

a. cast
b. amber
c. decay
d. sediment

25. Scientists who study fossils are called ____________ .

a. paleontologists
b. biologists
c. geologists
d. organisms

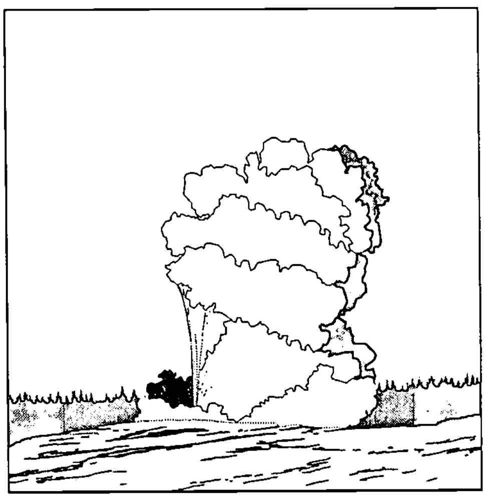
26. Fossils of organisms that identify the age of the rock in which they occur are ____________ .

a. trace fossils
b. index fossils
c. amber
d. remains

27. The empty cavity of a fossil left in a rock after the original organism has decayed is a(n) ____________ .

a. fossil
b. cast
c. imprint
d. mold

Unit 10: The Water Cycle



Practice

Study the vocabulary words and definitions below.

aquifer .... layer of rock found underground that is filled with water

artesian well .... a well in which water naturally rises above the level at which it was initially found

clouds .... condensed water vapor in the atmosphere

condensation .... the changing of a gas into a liquid

dew point .... the temperature at which water vapor condenses

evaporation .... the changing of a liquid into a gas by the escaping of atoms or molecules into the atmosphere

geyser .... a fountain of hot water erupting periodically from the ground

groundwater .... underground water that supplies wells and springs

hard water .... water that contains large amounts of dissolved minerals (magnesium and calcium carbonate)

hydrologic cycle .... the movement of water from the oceans and freshwater sources to the land and air and then back to the oceans; also called the *water cycle* .

hydrosphere .... all of Earth's water

nitrates .... pollutants from fertilizers or waste products of animals that seep into the water

phosphates .... pollutants from detergents or fertilizers that seep into water

pollutant .... substance that causes harm to the environment

pollution .... the contamination of the environment with waste

precipitation .... moisture that falls to Earth as rain, hail, sleet, or snow

runoff .... excess rainwater that drains into lakes and other bodies of water

saltwater intrusion .... when salt water moves into the bodies of fresh water

saturated .... a condition in which a substance can hold no more water

sinkhole .... a depression in a region where soluble rock has been removed by groundwater

soft water .... water that does not contain dissolved minerals

spring .... a flow of groundwater that emerges naturally at the ground surface

transpiration .... the process by which water evaporates from the leaves of plants

water cycle .... the movement of water from the oceans and freshwater sources to the land and air and then back to the oceans; also called the *hydrologic cycle*

water table .... the upper level of the saturated zone of groundwater

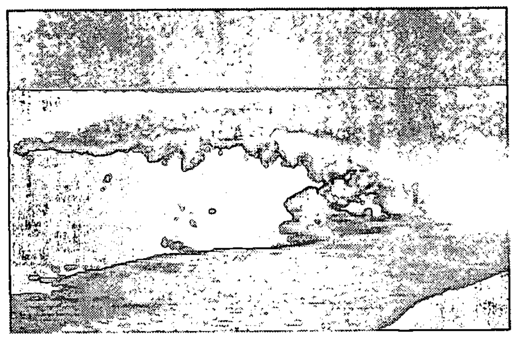
water vapor .... water in a gaseous state

Introduction

More than 70 percent of planet Earth's surface is covered by water. This 70 percent of the surface includes oceans, lakes, rivers, and other bodies of water. Water circulates among these sources in a cycle powered by the sun. This **water cycle** is essential to all life.

In Florida, water is of extreme importance, with 90 percent of the population living less than one hour away from the coast. The linkage of our freshwater system to our coastal waters by caves, tunnels, lakes, rivers, and swamps makes Florida home to many unique environments.

The Water Cycle



The **hydrosphere** is all of Earth's water. The oceans contain over 95 percent of Earth's water supply; however, its water is salty and cannot be used directly by people on Earth to drink and grow food. Earth's usable freshwater supplies are found in moving water such as rivers, streams, and **springs**, and in standing water in ponds, lakes, and wetlands. Much of our freshwater supply is frozen in polar ice caps and glaciers.

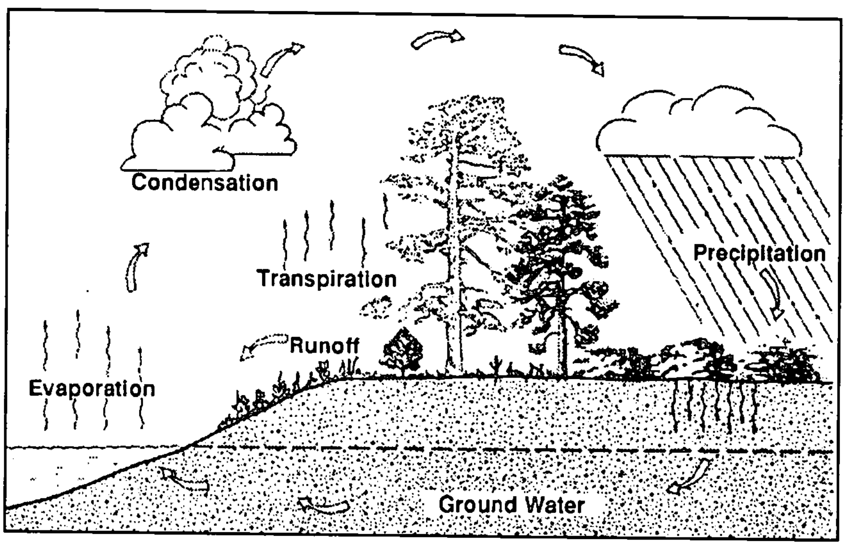
Water moves from the oceans and freshwater sources to the land and air and then back to the oceans in a continuous cycle called the *water cycle* or **hydrologic cycle.** The water cycle provides fresh, usable water to lands all over the world—even to areas where there are no bodies of fresh water nearby. The water cycle changes salty, unusable ocean water into fresh, usable water.

The water cycle has three main steps. However, the cycle is continuous—there is no beginning or end.

The first step involves the **evaporation** of water into the air. Evaporation is a process in which water changes from its liquid state to a gaseous state called **water vapor**. Most of this occurs when the sun heats the water in oceans, lakes, and other bodies of water, causing evaporation. Plants also give off water vapor from their leaves in a process called **transpiration**. Animals, too, give off water vapor as part of respiration.

In the second step of the water cycle, the water changes back into a liquid during a process called **condensation**. This occurs because water vapor cools as it rises in the atmosphere. The temperature at which water condenses is called the **dew point**. At the dew point, water condenses into tiny droplets that may form dew or **clouds**. The water that evaporates from the ocean condenses as fresh water because the salts do not evaporate.

The third and last step of the water cycle is **precipitation**. This is when the fresh water returns to Earth as rain, snow, sleet, hail, fog, or dew. Some of the water that returns to Earth will wash into the oceans, lakes, and rivers. This water is called **runoff**. The rest of the water soaks into the ground and becomes **groundwater**. Eventually, the groundwater will return to the ocean through underground channels, where it will continue in the water cycle.



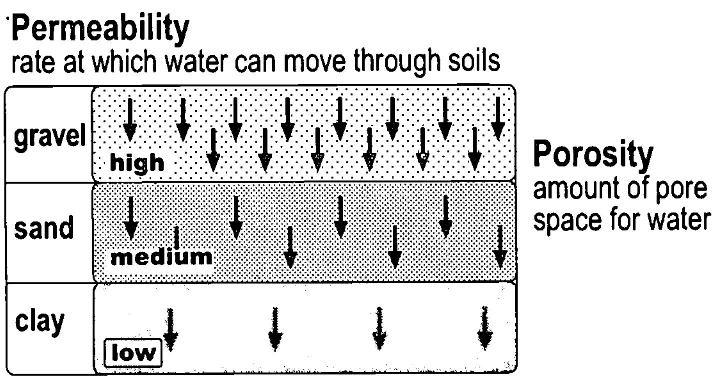
water cycle

Seawater

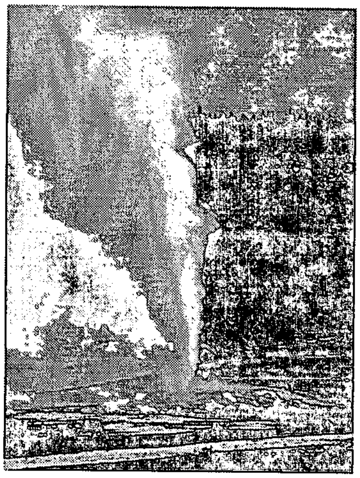
Seawater is not pure water. It contains salts and other chemical compounds. All of the salts in ocean water were carried from the land to the sea by rivers or runoff. The salinity is the amount of dissolved substances in seawater. Most seawater has a salinity of about 3.5 percent or 35 parts per thousand. Salinity of seawater increases as water is evaporated by the sun because the salts are left behind. As ice forms, salinity also increases as only the water freezes leaving the salts in the water below. Salinity of seawater decreases when the amount of water is increased by precipitation or runoff.

Groundwater

Water that soaks into the ground is called *groundwater*. Different types of rocks and soil hold different amounts of groundwater. Ground that has many pores or spaces between the soil particles can hold a lot of groundwater. When all of the pores and spaces are filled with water and the ground has all the water that it can hold, it is said to be **saturated**. The upper level of the saturated zone of groundwater is called the **water table**. When you dig a well to get water, you must dig below the level of the water table to get water to flow up through the well.



Underground water moves from high ground to lower ground. It moves more slowly underground because of friction between the rocks and the water. The larger the spaces between the rocks, the faster the water can move. **Aquifers** are layers of rock found underground that have large pores and through which water can easily move. Most aquifers are made of sand, gravel, sandstone, or limestone. Most of the time you must use a pump to get the water from an aquifer. However, sometimes when a well is dug, there is enough pressure to cause the water to flow to the surface on its own. This natural upward flow of water forms an **artesian well**.



a geyser

When water reaches the surface under pressure and flows out of natural openings in the rock, a *spring* is formed. **Geysers** are springs in which the water that flows out is hot. Usually, it takes time for the pressure and steam to build. That is why geysers flow in spurts rather than continuously. Old Faithful in Yellowstone National Park is a geyser that erupts about every hour.

Groundwater dissolves certain types of minerals, such as limestone, and carries them away, leaving hollow chambers or underground caves and caverns. Occasionally, during dry periods when the level of the groundwater is very low, the roofs of these caves may collapse, forming **sinkholes**. When the water table returns to its normal level, the sinkholes fill with water and become lakes or ponds.

Rainwater that does not contain any dissolved minerals is called **soft water**. When the rainwater filters through the ground, it dissolves calcium carbonate from limestone and becomes **hard water**.

Florida's Freshwater Systems

Florida has over 30,000 bodies of fresh water, which makes the state an excellent area for fishing and outdoor recreation. These bodies of water include lakes, rivers, ponds, canals, and swamps, the navigation of which is controlled by the United States Army Corps of Engineers.

Florida has thousands of lakes, including Lake Okeechobee—its largest and most famous. Lake Okeechobee is a large, natural lake in the heart of south-central Florida. The Okeechobee Waterway is a navigation channel which connects the Atlantic Ocean and the Gulf of Mexico.

Florida has many swamps, marshes, and other wetlands due to its humid climate and low elevation. The Everglades (also known as the River of Grass), which lies directly south of Lake Okeechobee, is the largest marsh. It is a combination of sawgrass and water. A well-known swamp is the Okefenokee swamp found along the Suwannee River in northern Florida. Because of the unstable nature of the swamp's soil, Native Americans gave it a name meaning *Land of the Trembling Earth.*

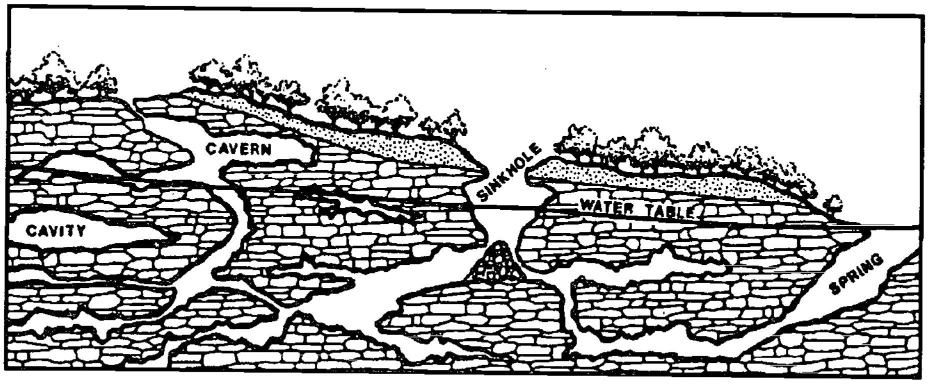
Florida has a number of rivers in its freshwater system. The St. Johns River begins in a swampy area just west of Ft. Pierce and flows in a northerly direction about 300 miles to Mayport, north of Jacksonville. It is the largest river system located entirely in the state. The St. Johns River receives part of its water flow from underground water seepage, including a large number of perennial springs. The southwest region of Florida has a system of four major rivers that all have their origin in the Green Swamp. These include the Hillsborough, Withlacoochee, Oklawaha, and Peace rivers. The Suwannee River, which flows out of the Okefenokee Swamp in northern Florida, was made famous by Stephen Foster's song "Old Folks at Home."

A major river system in northern Florida is the Apalachicola-Chattahoochee-Flint. It drains areas in Alabama, Tennessee, and Georgia, and adds their runoff to the Florida system. The Apalachicola river system is important economically because its estuary (the place where river and the Gulf of Mexico meet) is a major source of shellfish, oysters, shrimp, and crabs.

Because of Florida's low elevation, there exists a very delicate environment. Its freshwater systems are constantly monitored by the United States Army Corp of Engineers, and many of its lakes and canals are controlled by its five water management districts. The level of Lake Okeechobee is of extreme importance. In flood conditions, water is released from the lake to flow through canals and out to the ocean.

Times of drought are equally dangerous. When there is not enough rainfall, the aquifer beneath the land becomes dangerously low, allowing for **saltwater intrusion**. This is when salt water moves into the freshwater aquifer. This can contaminate our water supply reducing the amount of fresh water available.

Sinkholes are formed when the rock layers are dissolved by groundwater or the water table drops abruptly. In both cases, the underlying rock cannot support the surface rock and soil. The underground layers collapse, forming a sinkhole. They can occur unexpectedly and *swallow* houses, roads, and other buildings. Sinkholes, such as Big Dismal Sink in Leon County and Riverview Sink in Hillsborough County, are common in parts of Florida. Recent sinkholes have occurred in central Florida in Winter Park, Gainesville, and Chiefland. In January 1999 a sinkhole occurred in the northbound lane of I-95 in Palm Beach County.



sinkhole

Other factors that affect Florida's freshwater systems are **pollutants**. **Phosphates**, found in detergents and fertilizers, and **nitrates** from animal wastes and fertilizers, are two major causes of water **pollution** in Florida. These pollutants kill fish and plant life and make water unsafe for drinking. Current environmental safeguards are helping to protect our limited water supply.

Summary

Earth's water moves in a continuous hydrologic cycle through evaporation, condensation, and precipitation. Seawater makes up over 95 percent of the hydrosphere. Through evaporation in the water cycle, salt water is changed to fresh water. Groundwater is held in rocks, soil, and aquifers. The action of water may form springs, geysers, caves, and sinkholes. Florida has many freshwater bodies that provide recreation and food. We must protect our delicately balanced water resources.

Lab Activity 1: Part 1—The Hydrologic Cycle

Purpose

Demonstrate evaporation, a part of the hydrologic cycle.

Materials

- beaker, jar, or aluminum can
- crushed ice
- food coloring
- salt

1. Fill a container (beaker, jar, or aluminum can) with crushed ice.
2. Add a little salt. (Salt will make the temperature very low.)
3. Put some food coloring on the ice and mix it.
4. Let stand.
5. What do you see on the outside of the container? ____________
6. Where did this come from? ____________
7. Did it come from the water inside the container? ____________
8. How can you tell? ____________

____

____

____

____

____

____

____

Lab Activity 1: Part 2—The Hydrologic Cycle

Purpose

Demonstrate condensation, a part of the hydrologic cycle.

Materials

- large, flat dish
- medium heat-resistant container
- boiling water
- crushed ice
- hot plate

1. Fill a heat-resistant container half full of boiling water.
2. Place crushed ice in a flat dish larger than the container used in step one.
3. Put the dish with crushed ice on top of the container filled with boiling water.
4. What happens to some of the boiling water? ______________________

   ____
5. What do you see on the bottom of the dish that contains crushed ice?

   ____
6. Where do you think this came from? __________________________

   ____
7. Why do you think the water droplets form on the bottom of the dish?

   ____

   ____

   ____

   ____

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

air	**hydrosphere**	**polar ice caps**	**springs**
condensation	**lakes**	**ponds**	**streams**
evaporation	**land**	**precipitation**	**water cycle**
hydrologic cycle	**oceans**	**rivers**	**wetlands**

1. The movement of water in a cycle from the ocean and the land to the air and back again is called the ____________________ .

2. All of Earth's water is called the ____________________ .

3. Over 95 percent of Earth's water supply is found in the ____________________ .

4. Earth's usable freshwater water supplies are found in ____________________ , ____________________ , ____________________ , ____________________ , ____________________ , and ____________________ .

5. Much of our freshwater supply is unavailable to us because it is frozen in ____________________ .

6. In the water cycle, water moves from the ____________________ and the ____________________ to the ____________________ and back to the ____________________ .

7. The ______________________ changes salty ocean water into fresh water.

8. Three steps of the water cycle are ______________________,
______________________, and ______________________.

Practice

Use the list below to complete the following statements.

animals	**fog**	**rain**	**snow**
clouds	**groundwater**	**runoff**	**transpiration**
condensation	**hail**	**sleet**	**water vapor**
dew			

1. Water in its gaseous state is called ________________________ .

2. Plants give off water vapor from their leaves in a process called ________________________ .

3. ________________________ give off water vapor when they breathe.

4. The changing of a gas into a liquid is ________________________ .

5. Water vapor condenses into tiny droplets that form ________________________ or dew.

6. The six forms of precipitation are ________________________ , ________________________ , ________________________ , ________________________ , ________________________ , and ________________________ .

7. Rainwater that runs into lakes, streams, and the ocean is called ________________________ .

8. Water that soaks into the ground after a rain is ________________________ .

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. The water cycle is also called the hydrologic cycle.

_________ 2. Most of the water found on Earth is fresh water.

_________ 3. The water cycle has a beginning and an end.

_________ 4. The water frozen in polar ice caps is salt water.

_________ 5. The water cycle has three main steps.

_________ 6. Evaporation is the process in which water changes to water vapor.

_________ 7. Plants and animals give off water vapor.

_________ 8. Transpiration is the second step in the water cycle.

_________ 9. Precipitation is moisture that falls to Earth as rain, hail, sleet, or snow.

_________ 10. Clouds form when water evaporates.

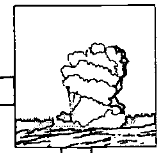
_________ 11. Water that soaks into the ground is called runoff water.

_________ 12. All of Earth's water is called the hydrosphere.

_________ 13. Groundwater stays there forever and is no longer part of the water cycle.

_________ 14. The water cycle makes it possible for areas with no nearby bodies of fresh water to have a supply of fresh water.

_________ 15. The water that evaporates from the ocean takes the salt with it as a gas.



Lab Activity 2: Seawater

Purpose	Materials
Show what happens to the salt and minerals that rivers deposit into the oceans. Demonstrate how the salinity of the water can change.	◦ 50 mL tap water ◦ 5 mL salt or 50 mL of seawater ◦ flat dish

1. Get 50 mL of seawater or pour 50 mL of tap water into a tumbler and stir 5 mL of salt into the tumbler of tap water. Keep stirring until the salt is dissolved.

2. Pour water into a flat dish.

3. Put the dish into a sunny or warm place. Leave it until all the water has evaporated.

4. What is left in the dish? ____________________

5. Taste some of what is left. Do you think the ocean is getting saltier all the time? Why?

   ____

   ____

   ____

6. What happens to the water when the sun warms the ocean?

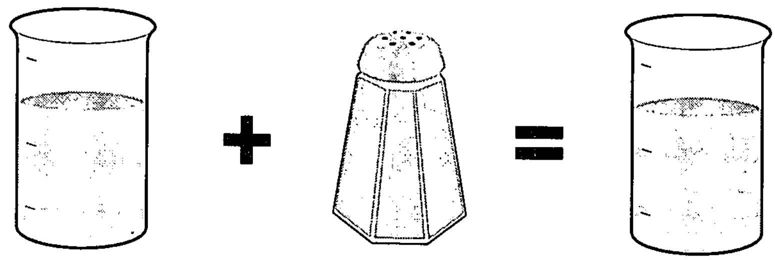
   ____

7. What is left behind when water evaporates from the ocean? ______

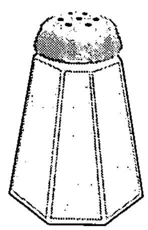
   ____

Practice

Answer each question below using complete sentences.



96.5 grams pure H_2O + 3.5 grams solid salts = 100 grams seawater



salt =

67.0%	sodium chloride	$NaCl$
14.6%	magnesium chloride	$MgCl_2$
11.3%	sodium sulfate	Na_2SO_4
2.2%	potassium chloride	KCl
3.5%	calcium chloride	$CaCl_2$
1.1%	miscellaneous	

1. What percent of the ocean's water is pure water? __________________

____

2. What percent of the ocean's water is solid salt? __________________

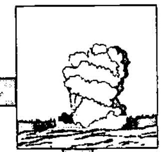
____

3. What salts are found in the ocean's water? __________________

____

____

____



Lab Activity 3: Porosity of Aquifers

Purpose

Observe what takes place in aquifers composed of different materials.

Materials

- beaker
- 200 mL graduated cylinder
- marking pen
- funnel
- filter paper
- gravel
- clay
- sand
- mud

1. Obtain a beaker, graduated cylinder, and marking pen.
2. Measure 100 mL of water in cylinder; pour water into an empty beaker. Use a pen to draw a line around water level. Pour water into sink.
3. Fill beaker with soil sample to line.
4. Fill cylinder with 100 mL of water. Slowly pour water to fill line. Determine how much water was used and record in chart below.
5. Dump water and sample in trash can—not sink.
6. Repeat for all four samples.
7. Rank the samples from 1-4 from the greatest amount of space to the least. Record the numerals in the chart below.

	Rock	Sand	Mud	Clay
Amount of Water				

Remember: The amount of water held in the sample is equal to the amount of pore space or porosity of your sample.

8. What type of material would hold the most groundwater?

____

9. What type of material would hold the least groundwater?

____

10. How does the amount of porosity relate to the size of the particles?

____

____

____

____

11. Which materials would make a good aquifer? ______________

Why? ____

____

____

____

____

____

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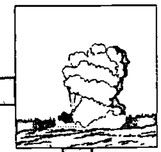
____



Lab Activity 4: Water Movement (Permeability)

Purpose	**Materials**
Demonstrate the movement of water through soil samples.	• beaker • funnel • filter paper • graduated cylinder • soil samples • marking pen

1. Obtain a beaker, funnel, and filter paper.
2. Fill graduated cylinder with 50 mL of water. Pour into beaker. Use marking pen to draw line at water level.
3. Fold filter paper into cone. Tear off small piece at end to just hold sample in funnel.
4. Fill funnel half full with sample. Pack it down loosely.
5. Pour water through funnel until beaker is filled to 50 mL mark. Time it. Record how long this takes in chart below.
6. Dump soil sample in trash can, and pour water down drain in sink.
7. Repeat using other samples.
8. Rank the materials from slowest to fastest. Record them on the chart below.

	Rock	**Sand**	**Mud**	**Clay**
Time to Filter 50 mL				

Remember: How fast the water moves through the sample is related to the amount of oxygen that flows through the sample.

9. Which material dries out most quickly? ____________________

10. Which material dries out most slowly? ____________________

11. How does particle size relate to the speed with which the water flows through the samples?

____

____

____

12. Would clay make a good aquifer? ____________________

Why or why not? ____________________________________

____

____

13. What materials would hold groundwater above them? __________

____

14. What material would make the best aquifer? ____________________

Why? ____

____

____

____

____

Practice

Use the list below to complete the following statements.

aquifer	**geysers**	**Old Faithful**	**sinkhole**
artesian well	**groundwater**	**ponds**	**soft water**
calcium carbonate	**hard**	**resistance**	**spring**
caverns	**lakes**	**saturated**	**water table**
caves	**limestone**		

1. Water that soaks into the ground is called ________________ .

2. The ground is ________________ when it has as much water as it can hold.

3. The level below which all the pores of the ground are saturated forms the ________________ .

4. Water moves more slowly underground than above ground because of the ________________ between the rocks and the water.

5. Layers of rock found underground that have large pores through which water can easily move form a(n) ________________ .

6. Sometimes pressure in an aquifer is great enough so that the water will flow to the surface on its own when a well is dug. This upward flow of water forms a(n) ________________ .

7. A ________________ forms when water under pressure reaches the surface through a natural opening in Earth.

8. Springs that have hot water spouting out of them at intervals are ______________________ .

9. ______________________ is a famous geyser in Yellowstone National Park that erupts about once every hour.

10. Groundwater dissolves ______________________ and carries it away, leaving ______________________ and ______________________ underground.

11. When the roof of an underground cave or cavern collapses, a ______________________ is formed.

12. Rainwater that falls and does not have any dissolved minerals in it is called ______________________ .

13. When rainwater filters through the ground, it dissolves ______________________ and becomes ______________________ water.

14. Sinkholes that fill with water become ______________________ or ______________________ .

Practice

Write **True** *if the statement is correct. Write* **False** *of the statement is* not *correct.*

________ 1. All rocks found underground hold the same amount of water.

________ 2. The rocks beneath the ground have small spaces called pores between them.

________ 3. The spaces between the rocks underground can hold water.

________ 4. Groundwater moves faster than water moving on the surface of Earth.

________ 5. You must dig a well deep enough so that it goes below the water table if you hope to have water flow up into it.

________ 6. Water always flows out of a well under its own pressure.

________ 7. The larger the spaces between the rocks, the more slowly the water moves underground.

________ 8. Most aquifers are made of mud and clay and other closely packed rock and soil.

________ 9. Water that comes to the surface in the form of a spring flows from a natural opening in the rocks.

________ 10. Old Faithful is a spring.

________ 11. Hot water flows constantly from Old Faithful.

________ 12. Groundwater dissolves minerals like limestone and carries them away, leaving caves and caverns underground.

________ 13. A sinkhole is an underground cave that fills with water.

________ 14. Rainwater is hard water.

________ 15. Hard water contains dissolved minerals.

Practice

Use the list below to complete the following statements.

30,000	**Okefenokee**
Atlantic Ocean	**"Old Folks at Home"**
Everglades	**phosphates**
Green Swamp	**saltwater intrusion**
Gulf of Mexico	**sawgrass**
Lake Okeechobee	**St. Johns River**
Land of the Trembling Earth	**Suwannee**
nitrates	**swamps**
northerly	**U. S. Army Corps of Engineers**

1. Florida has over ____________________ bodies of fresh water.

2. Navigation of Florida's fresh water is controlled by the ____________________ .

3. Florida's largest lake is ____________________ .

4. Lake Okeechobee is connected by a waterway to both the ____________________ and the ____________________ .

5. Because of its low elevation, plentiful rainfall, and humid climate, Florida has many ____________________ and marshes.

6. Florida's largest marsh is the ____________________ , located just south of Lake Okeechobee.

7. The Everglades is a combination of ____________________ and water.

8. The ________________ Swamp is found along the Suwannee River.

9. *Okefenokee* is a Native American name which means ________________ .

10. The largest river system located entirely in Florida is the ________________ .

11. The St. Johns River begins near Ft. Pierce and flows about 300 miles in a ________________ direction to Mayport.

12. The ________________ River which flows out of the Okefenokee Swamp was made famous by Stephen Foster's song, ________________ .

13. The Hillsborough, Withlacoochee, Oklawaha, and Peace rivers all flow out of the ________________ .

14. When rainfall is low, there is a danger that salt water will fill up the freshwater aquifer, causing ________________ .

15. ________________ and ________________ that are dumped into the freshwater systems of Florida are a major cause of water pollution.

Practice

Use reference materials or the Internet to locate and label the following **freshwater systems** *on the map of Florida below.*

Apalachicola River	Peace River
Everglades	St. Johns River
Hillsborough River	Suwannee River
Lake Okeechobee	Withlacoochee River
Okefenokee Swamp	

Practice

Use the list below to write the correct term for each definition on the line provided.

aquifer	groundwater	precipitation
condensation	hydrologic cycle	transpiration
dew point	pollution	water vapor
evaporation		

________________________ 1. underground water that supplies wells and springs

________________________ 2. contamination of the environment with waste

________________________ 3. the temperature at which water vapor condenses

________________________ 4. water in a gaseous state

________________________ 5. rock layer filled with water

________________________ 6. the changing of a liquid to a gas

________________________ 7. the changing of a gas to a liquid

________________________ 8. rain, snow, sleet, or hail

________________________ 9. process of water evaporating from the leaves of plants

________________________ 10. the movement of water from the oceans and freshwater sources to the land and air and then back to the oceans; also called the water cycle

Practice

Use the list below to write the correct term for each definition on the line provided.

clouds	**nitrates**	**runoff**	**soft water**
geyser	**phosphates**	**saturation**	**water cycle**
hard water	**pollutant**		

________________ 1. a fountain of hot water erupting periodically

________________ 2. substance that causes harm to the environment

________________ 3. the water entering a river or stream after a rainfall

________________ 4. water that contains large amounts of dissolved minerals (magnesium and calcium carbonate)

________________ 5. condensed water vapor

________________ 6. water that does not contain dissolved minerals

________________ 7. pollutants often found in soap detergents or fertilizers that seep into water

________________ 8. pollutants from fertilizers or waste products of animals that seep into water

________________ 9. a condition in which a substance cannot hold any more water

________________ 10. the movement of water from the oceans and freshwater sources to the land and air and then back to the oceans; also called hydrologic cycle

Practice

Circle the letter of the correct answer.

1. ____________ is the changing of a liquid to a gas.
   a. Evaporation
   b. Precipitation
   c. Saturation
   d. Transpiration

2. ____________ is the changing of a gas to a liquid.
   a. Evaporation
   b. Condensation
   c. Saturation
   d. Precipitation

3. Rain, snow, sleet, and hail are forms of ____________ .
   a. groundwater
   b. condensation
   c. transpiration
   d. precipitation

4. A rock layer filled with water is a(n) ____________ .
   a. aquifer
   b. groundwater
   c. water cycle
   d. sinkhole

5. ____________ are condensed water vapor.
   a. Clouds
   b. Pollutants
   c. Springs
   d. Phosphates

6. ____________ is underground water that supplies wells and springs.
   a. Pollution
   b. Condensation
   c. Hydrologic cycle
   d. Groundwater

7. The contamination of the environment with waste is called ___________ .

   a. pollution
   b. runoff
   c. transpiration
   d. groundwater

8. The temperature at which water vapor condenses is the ___________ .

   a. aquifer
   b. dew point
   c. runoff
   d. water cycle

9. Water in a gaseous state is ___________ .

   a. groundwater
   b. hard water
   c. soft water
   d. water vapor

10. All of Earth's water is called the ___________ .

   a. water cycle
   b. hydrologic cycle
   c. dew point
   d. hydrosphere

11. A formation of hot water erupting periodically from the ground is called a(n) ___________ .

   a. water cycle
   b. artesian well
   c. aquifer
   d. geyser

12. The water entering a river or stream during and after a rainfall is ___________ .

   a. soft water
   b. runoff
   c. hard water
   d. condensation

13. A depression in a region where soluble rock has been removed by groundwater is called a ________ .

    a. swamp
    b. hydrologic cycle
    c. runoff
    d. sinkhole

14. Water that contains large amounts of magnesium and calcium carbonate is ________ .

    a. soft water
    b. saltwater intrusion
    c. transpiration
    d. hard water

15. Rainwater that does not contain dissolved minerals is ________ .

    a. saltwater intrusion
    b. transpiration
    c. soft water
    d. hard water

16. The process by which water evaporates from the leaves of plants is called ________ .

    a. condensation
    b. transpiration
    c. evaporation
    d. precipitation

17. Among pollutants often found in soap detergents or fertilizers are ________ .

    a. phosphates
    b. aquifers
    c. nitrates
    d. runoffs

18. __________ are pollutants from fertilizers or the waste product of animals that seep into the water.

a. Phosphates
b. Runoffs
c. Nitrates
d. Water vapors

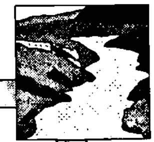
19. __________ occurs when salt water moves into the freshwater aquifer.

a. Condensation
b. Evaporation
c. Pollution
d. Saltwater intrusion

20. Another name for the water cycle is the __________ cycle.

a. hydrologic
b. hydrosphere
c. condensation
d. evaporation

Unit 11: Rivers



Vocabulary

Study the vocabulary words and definitions below.

channel .... a waterway formed by runoff on steep surfaces of mountains

delta .... large amounts of sediment deposited at the mouth of a large river

deposition .... sediment deposited in new locations by running water

floodplains .... flat areas on both sides of a river where sediments have been deposited when the river overflows

load .... particles of soil and rock that a river carries

mature river .... a river with many tributaries where water flow may be both slow and fast and there are no rapids or waterfalls

meander .... a curve or loop-like bend in the course of river or stream (noun); to follow a winding course (verb)

mouth .... point where a river joins a larger body of water such as a lake or ocean

old river .... a slowly flowing river that has a wide floodplain and is curved and winding

oxbow lakes .... U-shaped lakes formed when a meander is cut off from the rest of the river

river .... a large flow of water formed when tributaries join

riverbanks .... the sides of a river

riverbed .... the bottom of a river channel

sediment .... pieces of rock and soil deposited by a river

source .... the beginning of a river

stream .... a body of water that flows in only one direction

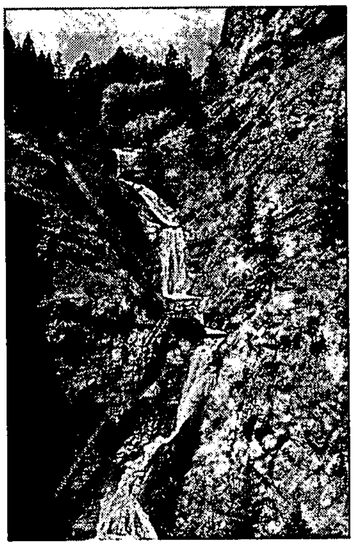
tributaries .... smaller streams flowing into a larger stream or body of water

young river .... a river found in mountainous areas; its water flows very fast and often has rapids and waterfalls

Introduction

As water moves along the earth, it erodes or carves out pathways on the surface. These pathways form many of our **river** systems—with all of their parts that we know as **tributaries, meanders**, and **streams**. As with rocks, rivers have characteristics that help us to unravel more of the mysteries of Earth. The development of a river passes through several stages—young, mature, and old. The physical characteristics of a river are a good gauge to use in determining the age of an area. Understanding the characteristics of our rivers helps us to better understand the topography of our environment.

Development of Rivers



Most rivers have their **source**, or beginning, in the mountains. Water from rain and melting snow trickles downhill. At first, this water does not have a permanent path or **channel**. Eventually, enough trickles meet to cut a channel and a small *stream* is formed. River systems begin where runoff trickles downhill, following the same path over and over.

As a result of gravity, water moves downhill and gradually cuts a channel. The water flowing in the stream carves a V-shaped valley in the land. As water cuts deeper paths, it moves faster. Small streams meet to form *tributaries* which flow into a main river. The main river eventually empties into a large body of water, such as a lake or ocean. The place where the river joins a lake or ocean is called its **mouth**.

This network of streams and tributaries is called a *drainage system* because it drains an area of its runoff. Many drainage systems have a treelike pattern. Small currents and streams resemble small twigs and branches. Larger tributaries form the main branches, while the main river is the trunk.

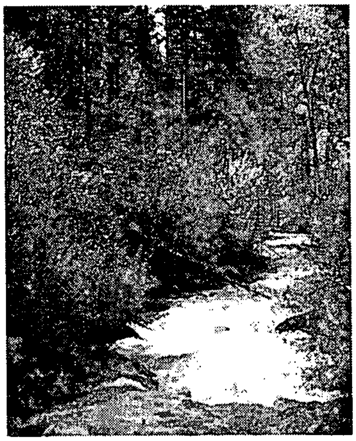
All rivers are not the same age. You can tell the approximate age of a river by its characteristics. Some characteristics of a river at different stages are listed below.

A young river
- has a V-shaped valley
- is usually found in the mountains
- has very fast flowing water
- cuts downward, making a deep valley
- often has rapids and waterfalls
- erodes the land very quickly
- carries large particles as it erodes the land

A mature river
- has been developing for thousands of years
- has formed a wider valley
- has valley walls that are farther from the river
- no longer has rapids or waterfalls
- has both slow and fast moving water in different areas
- has many tributaries
- develops a flat **floodplain** on both sides of the channel

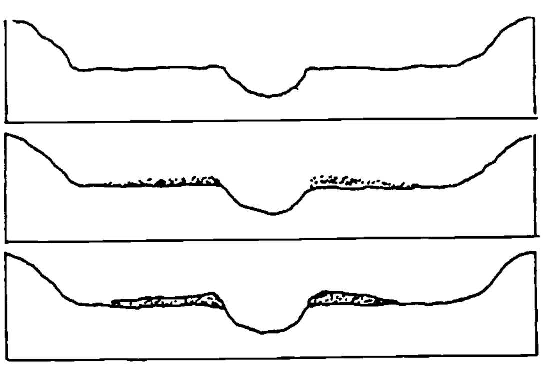
An old river
- has a floodplain several times wider than the channel
- has a valley floor that is flat and wide (U-shaped)
- is curved and winding with many loops called meanders
- has slower waters
- has a very wide floodplain
- carries small particles as it erodes the land

Erosion and Deposition



The fast flow of a young river carries large amounts of soil and rocks. Old rivers, on the other hand, move more slowly and carry smaller particles of soil and rock. The particles of soil and rock that a stream or river carries are called its **load**. Rivers deposit the soil and rock particles, or **deposition**, in new locations. Rivers that carry a lot of soil and rocks appear muddy.

Deltas are formed at the mouth of rivers that empty into quiet bodies of water. As the river flows into a lake or an ocean, it slows down. It cannot carry as much material at a slower speed, so it deposits much of the material. The fan-shaped deposition is largely fertile top soil. For this reason, deltas make fertile growing areas. The deposits build up above the river's water level and add land to a coastal area. The delta formed at the mouth of the Mississippi River, for example, extends the area hundreds of kilometers into the Gulf of Mexico. In this region, cotton and rice are grown.



A river may deposit its load along the riverbank. Over time levees develop.

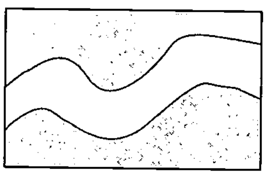
When a river's speed slows down, it can no longer carry as much of a load. Some of this material is then deposited on the bottom of the river channel, which is called the **riverbed**. These deposits are called **sediments**. Levees develop when sediments are deposited on the sides of the river or along the **riverbank**.

Floodplains are flat areas on both sides of the river. When a flood causes a river to overflow, it deposits sediments on the floodplains. These areas are very fertile and are often used for farming.

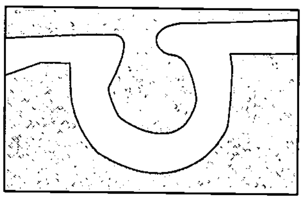
Rivers begin to *meander*, or wander, from side to side across the land. The movement creates curves or loop-like bends in the river known as *meanders*. The river usually erodes or cuts away the bank more when the river curves. The river flows faster on the outside of the curve and cuts away the bank. Sediments are deposited on the inside of the curve, where the river flows more slowly.

Sometimes U-shaped bends are formed as the river winds. Erosion and deposition along the bends can eventually cut part of the bend off from the rest of the river. When this happens, small lakes called **oxbow lakes** form. The diagram below shows the formation of an oxbow lake.

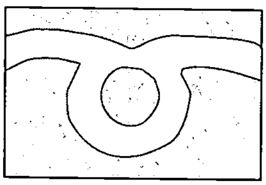
1. meandering river



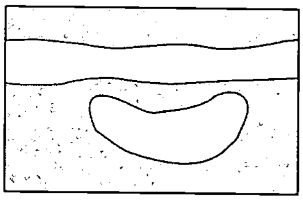
2. U-shaped bend forms



3. sediments deposit



4. lake cut off from river



Summary

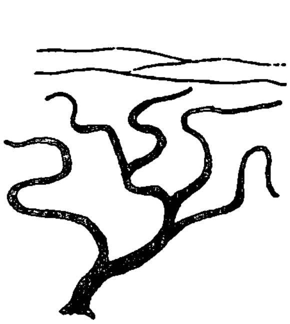
Most rivers are formed as precipitation moves downhill in small streams. The flowing water cuts a channel in the land. Streams flow together to form tributaries, which flow into the main river. At the mouth of the river, the water empties into a larger body of water. The age of a river can be determined by its physical characteristics. Rivers erode the land over which they flow. As rivers move they pick up soil and rocks and deposit the load in new locations. The deposition of soil and rock in the riverbed is called sediment. Along the riverbank, a levee may be formed from the deposition. At the mouth of the river a delta may build up over time, creating fertile growing areas. Rivers may meander across the land. The erosion and depositions in the river curves may result in an oxbow lake.

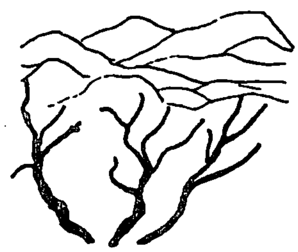
Practice

Label each of the drawings below. Use **young river, mature river,** *or* **old river.**

Characteristics of Rivers

Surface relief





1. ________________ 2. ________________ 3. ________________

Cross-section

4. ________________ 5. ________________ 6. ________________

Practice

Use an **atlas** *of the United States to find the names of the* **major rivers** *that make up the* **Mississippi River System**. *Label the rivers on the map below that make up the Mississippi River System.*

The Mississippi River System

The Mississippi River is an example of an old river. Its source is Lake Itasca in Minnesota, and its mouth is in the Gulf of Mexico. The Mississippi River is the largest river in the United States. The small streams and tributaries that feed into the Mississippi River form a river system that has a treelike pattern.

Lab Activity 1: Researching a River

Purpose	Materials
To identify the major landmarks and features associated with a river system.	• reference materials • maps • Internet access

Use the list of Internet sites below and other reference materials to complete this activity.

Internet Sites:

Wild and Scenic Rivers
http://www.nps.gov/rivers/

Water Resources in the United States
http://water.usgs.gov/

Water Resources of Florida (main office in Tallahassee)
http://fl-water.usgs.gov/

Mississippi River Road Map
http://www.mississippi-river.com/

1. Name of river: ______________________________

2. Source (beginning of river): ______________________________

3. Outlet (where the river flows to): ______________________________

4. Location of source (state, county, country, etc.): ______________________________

____

____

____

5. Describe the watershed of the river (flow pattern). Include states or areas the river flows through, including major cities or lakes:

____

____

____

____

6. Direction the river flows: ______________________

7. Names of tributaries that join the river: ______________

8. Names of any structures that affect the river's flow (dams, levees, etc.):

____

____

9. What is the condition of the water in the river? __________

____

____

10. List any environmental concerns: ________________

____

____

____

____

____

____

Practice

Use the list below to complete the following statements.

branches	faster	Mississippi River	source
channels	fertile	mountains	tributaries
decreases	mature	mouth	young
deltas	meanders		

1. Most rivers begin in the ________________________ .

2. Moving water cuts paths in the earth called

   ________________________ .

3. Small streams flow together to form ________________________ that flow into the main river.

4. As the water cuts deeper paths, the water begins to move

   ________________________ .

5. The place where a river joins a lake or ocean is called its

   ________________________ .

6. The place where a river begins is its ________________________ .

7. ________________________ are deposits of sediment that form at the mouth of a river.

8. As the water flows into a lake or ocean from a river, its speed

   ________________________ .

9. The ______________________ has a large delta that extends hundreds of kilometers into the Gulf of Mexico.

10. The soil found in deltas is very ______________________ .

11. A river system often resembles the ______________________ of a tree.

12. A ______________________ river has a deep V-shaped valley.

13. In a ______________________ river, waterfalls and rapids have disappeared and floodplains have developed.

14. An old river is curved and winding with many loops called ______________________ .

Lab Activity 2: Erosion and Deposition

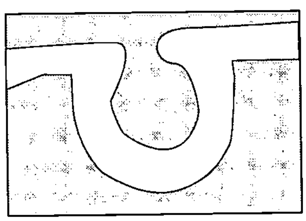
Purpose	**Materials**
Demonstrate erosion and deposition.	• sand (enough to make a steep model of a mountain) • deep pan (4' x 3') • thin water hose or rubber tubing

1. Place sand inside pan.
2. Pile up sand on one end of pan to make a model of a small mountain.
3. Take the hose and place it near the top of the sand mountain.
4. Slowly run a stream of water through the hose so the water flows down the mountain.
5. What happens when the stream of water runs down the mountain?

Practice

The four diagrams below show the stages of an **oxbow lake** *being formed by the* **erosion** *and* **deposition** *of a* **meandering river**. *Place the diagrams in correct order by numbering the boxes from 1 to 4. On the line following the box, write what is happening in each stage using the following phrases:*

sediment deposits
U-shaped bend forms
meandering river
lake cut off from river

A.


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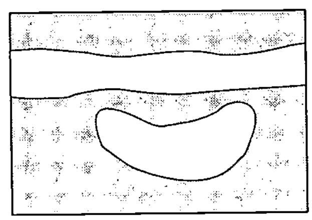
B.


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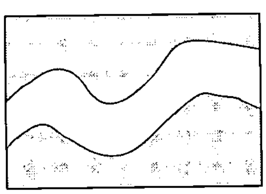

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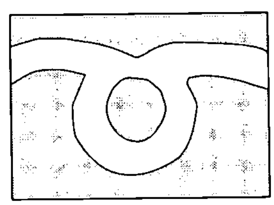
D.


☐ ____________________

Practice

Use the list below to write the correct term for each definition on the line provided.

channel	**meanders**	**river**	**source**
delta	**mouth**	**riverbanks**	**stream**
deposition	**old river**	**riverbed**	**tributaries**
floodplains	**oxbow lakes**	**sediment**	**young river**
load			

____________________ 1. a body of water that flows in only one direction

____________________ 2. a large flow of water formed when tributaries join

____________________ 3. U-shaped lakes formed when a meander is cut off from the rest of the river

____________________ 4. loops formed by a winding river

____________________ 5. smaller streams flowing into larger streams or a body of water

____________________ 6. sides of the river

____________________ 7. sediment deposited by running water

____________________ 8. flat areas on both sides of where a river has once overflowed

____________________ 9. bottom of the river channel

____________________ 10. large amounts of sediment deposited at the mouth of a large river

____________________ 11. point where a river joins a larger body of water

____________________ 12. a slowly flowing river that has a wide floodplain and is curved and winding

____________________ 13. a river found in mountainous areas; its water flows very fast and often has rapids and waterfalls

____________________ 14. the beginning of a river

____________________ 15. particles of soil and rock that a river carries

____________________ 16. pieces of rock and soil deposited by a river

____________________ 17. a waterway formed by runoff on steep surfaces of mountains

Practice

Circle the letter of the correct answer.

1. A river found in mountainous areas and its water flows very quickly is a(n) ____________ .

   a. riverbed
   b. delta
   c. old river
   d. young river

2. A slowly flowing river that has a wide floodplain and is curved and winding is called a(n) ____________ .

   a. old river
   b. floodplain
   c. riverbed
   d. young river

3. The point where a river joins a larger body of water is called its ____________ .

   a. mouth
   b. riverbank
   c. channel
   d. delta

4. Large amounts of sediment deposited at the mouth of a large river form a ____________ .

   a. riverbank
   b. floodplain
   c. delta
   d. channel

5. The ____________ is the bottom of the river.

   a. riverbank
   b. floodplain
   c. riverbed
   d. mouth

6. The flat areas on both sides of where a river has once overflowed are called ___________ .

   a. riverbanks
   b. deltas
   c. floodplains
   d. meanders

7. ___________ are the sides of the river.

   a. Meanders
   b. Riverbanks
   c. Channels
   d. Floodplains

8. Sediment deposited in new locations by running water is called ___________ .

   a. deposition
   b. load
   c. floodplain
   d. source

9. A smaller stream that flows into a larger stream or body of water is a ___________ .

   a. meander
   b. tributary stream
   c. channel
   d. floodplain

10. Curves or loop-like bends formed in the course of a winding river are called ___________ .

    a. meanders
    b. tributary streams
    c. riverbanks
    d. floodplains

11. The beginning of a river is called its ___________ .

    a. source
    b. channel
    c. load
    d. delta

12. Particles of soil and rock that a river carries is its __________ .

    a. deposition
    b. riverbed
    c. load
    d. delta

13. __________ are pieces of rock and soil deposited by a river.

    a. Sources
    b. Channels
    c. Loads
    d. Sediments

14. A waterway formed from runoff on steep surfaces of mountains is a __________ .

    a. river
    b. stream
    c. source
    d. channel

15. A body of water that flows in only one direction is a __________ .

    a. young river
    b. stream
    c. river
    d. channel

16. A __________ is a large flow of water formed when tributaries join.

    a. river
    b. stream
    c. channel
    d. tributary

17. U-shaped lakes that form when a meander is cut off from the rest of the river are called __________ .

    a. meanders
    b. oxbow lakes
    c. channels
    d. floodplains

Unit 12: Glaciers

Vocabulary

Study the vocabulary words and definitions below.

abrading .... the scraping of the bedrock surface as ice moves over it

alpine glacier .... a glacier that forms high in the mountains and moves slowly down the mountain through the valley; also called *valley glacier*

cirque .... the bowl-shaped depression in which snow accumulates; when it overflows, a valley glacier begins

continental glaciers .... very large sheets of ice that form glaciers in the polar regions

drift .... name given to material deposited by glaciers

glacier .... a large mass of moving ice and snow

hanging valley .... small abandoned glacial valley suspended on the mountain above the main glacial valley

horns .... steep, three-sided mountain peaks formed by glaciers

ice age .... a period of time when large ice sheets covered much of the surface of Earth

icebergs .... huge chunks of floating ice that break apart from a glacier when it reaches the sea

interglacial ages .... the periods of time between the ice ages

kettle lakes .... lakes formed by the melting of a huge chunk of ice left behind by a glacier

meltwater .... water resulting from the melting of glacial snow and ice

moraines .... long, thin deposits of earth and stone that mark the sides and front of a glacier

outwash .... layered deposits of rock fragments dropped by glacial meltwater

piedmont glaciers .... glaciers which form at the foot of mountains

plucking .... combination of water freezing in the cracks of rocks and the glacier pulling the rocks along with it

striations .... scratches made by sharp-pointed rocks as a glacier moves over the land

till .... unlayered and unsorted rock material deposited directly by a glacier

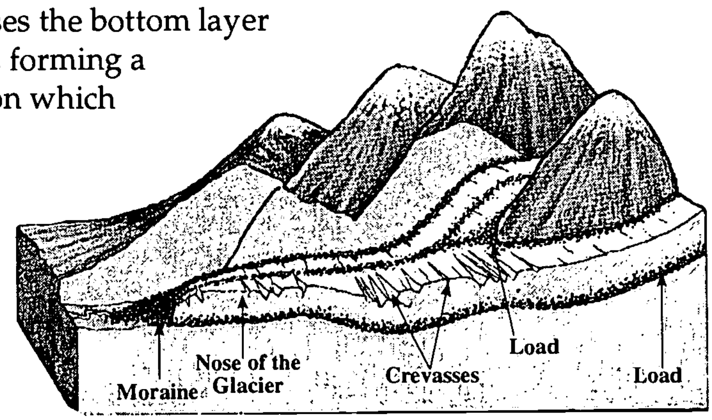
valley glacier .... a glacier that forms high in the mountains and moves slowly down the mountain through the valley; also called *alpine glacier*

Introduction

Many of our most beautiful hills and valleys are the result of years of erosion by ice and snow. During the time when the temperature of Earth was extremely low, massive amounts of snow and ice formed large **glaciers** which moved outward from the poles of Earth. The formation and movement of glaciers is important to the understanding of the **ice ages** and our rock formations as we know them today.

Glaciers

A *glacier* is a huge mass of moving ice and snow. It forms where more snow falls in the winter than melts during the summer. When the snow accumulation builds to about 60 meters, the weight of the snow causes the bottom layer to be squeezed together, forming a sheet of ice. If the land on which the glacier is formed is sloped, the glacier will move down the slope. If it is formed on flat land, it will spread out in all directions.



Types and Formation

There are three types of glaciers: piedmont, alpine, and continental. **Piedmont glaciers** form at the foot of some mountains. These glaciers spread out on the plains and join one another, making a continuous sheet of ice. A second type of glacier that forms high in the mountains is called an **alpine glacier**. Alpine glaciers are also called an **valley glacier**. They usually move downward through river valleys due to the pull of gravity.

The third type of glacier is the continental. **Continental glaciers** are very large sheets of ice that move outward in all directions from a central point. Unlike alpine glaciers, they are not confined to valleys, but cover large areas of land surfaces. They form in the polar regions and are sometimes called *polar ice caps*. The only continental glaciers existing today are found in Greenland and Antarctica.

Types of Glaciers	
piedmont glaciers	form at the foot of some mountains
alpine glaciers	form high in the mountains
continental glaciers	very large sheets of ice that form in the polar regions and move outward in all directions from a central point

Erosion and Movement

Although their movement is not visible, most glaciers are thought to be moving or sliding along the ground. As glaciers move through an area, they completely change the surface of that area by erosion. Glaciers scrape away all loose particles of rock and pile them up in huge mounds, like a bulldozer at work. Glaciers erode by **abrading** and **plucking**.

Abrading is the scraping of the bedrock surface over which the ice moves. The results of this are similar to using a scouring pad on a soiled pot or pan. As the ice moves, it scrapes over rocks, scouring and polishing the surface of rocks beneath it.

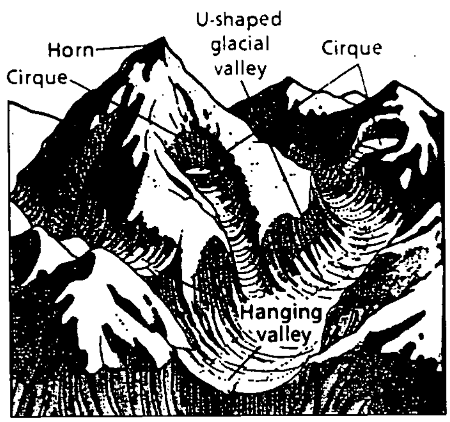
Plucking combines freezing and pulling forces. The sun warms the rocks, ice melts and water runs into cracks in the rocks. When the water freezes again and expands, the rocks break. The rocks become part of the bottom of the moving glacier. In this way, the glacier lifts and carries rocks, sand, gravel, and even large boulders with it. Plucking adds to the scouring power of the glacier.

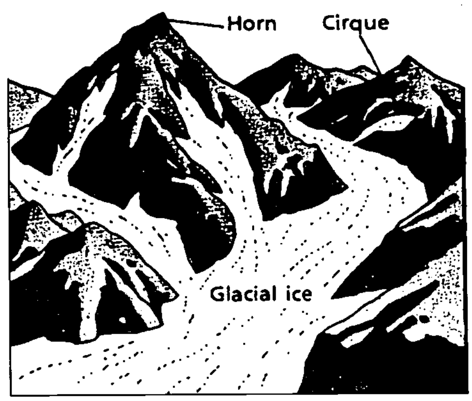
As glacial ice moves, sharp rocks make gouges and scratches called **striations** in the rock beneath it. Glaciers dig into soft rock more deeply than hard rock, leaving step-like irregularities in the land that they pass over.

Valley glaciers begin in a **cirque**, a bowl-shaped depression filled with ice and snow. The glacier that forms in a cirque may actually grow and extend to the mountain's summit. In some places, valley glaciers erode the cirques, forming three-sided peaks called **horns**. The Matterhorn in the Swiss Alps is an example of a horn.

When the cirque overflows, the glacier begins moving down the valley. As a glacier moves through narrow, V-shaped valleys once occupied by a stream or river, it widens, deepens, and straightens the valley. It changes the shape of the V-shaped valley to a U-shaped one.

Just as tributaries join to form rivers, small glaciers join to form larger glaciers. As the smaller glaciers melt and disappear, their valleys no longer erode. The valley of the main glacier continues to erode until it is much lower than the abandoned valley of the smaller glacier. The abandoned valley is left suspended on the mountain high above the main valley floor and is called a **hanging valley**. When the river again flows through the small valleys, waterfalls are created as the river plunges into the deeper valley. The waterfalls of Yosemite National Park in California spill from hanging valleys.





Deposits

Glaciers pick up and deposit rocks and debris as they travel. When a glacier begins to melt, it deposits the rocks it has been carrying. **Drift** is the name given to material deposited by glaciers. The material that the glacier drops first has not yet been sorted by the action of running water. It is a mixture of various sizes of boulders, rocks, sand, and clay called **till**. As the glacier continues to melt, running water called **meltwater** sorts the materials left behind according to size. The material deposited by meltwater is called **outwash**. In outwash, gravity sorts the rock fragments by size and weight. Heavier, larger fragments fall to the bottom.

The glacier may melt so rapidly at the front that it appears to be moving backwards, even though it is actually moving forward. That is, the glacier continues to grow and move forward. While this happens, the end of the glacier farthest from where it forms will melt so that the glacier covers less surface. When this happens, the glacier is said to be retreating. As the glacier recedes, mounds of till are left behind. Long, thin **moraines** are deposits of earth and stone that mark the edges of a glacier. Scientists search for moraines to find the location of glaciers that melted long ago.

Some valley and continental glaciers reach the sea. When this happens, they form cliffs of ice and snow that sometimes break off into the sea and drift. These huge pieces of floating ice are called **icebergs**.

Lakes are also created by glaciers. Sometimes huge blocks of glacial ice covered with sediment are left behind. As this glacial ice melts, it makes a depression in the ground that fills with water and forms **kettle lakes**. Most of Minnesota's lakes were formed in this way. The Great Lakes were also formed by glaciers, but in another way. They formed when the glacial till piled up in low-lying river channels, damming the water in the area. The land areas filled with water, and the Great Lakes were formed.

Today, glaciers can still be seen at high altitudes. Alaska has many glaciers—16 in Glacier Bay alone! In the ice fields of Alberta, Canada, visitors can walk onto glaciers. Scientists continue to study these existing glacier formations and their activities.

Ice Ages

Earth passes through periods of time in which the average temperatures everywhere on the surface of Earth become much lower. During these periods, large continental sheets of ice spread out from the poles. The period of time when this occurs is known as an *ice age*.

During an ice age, some water from the oceans forms glaciers and the sea level drops. Areas of the world that were previously covered by water become land masses. During the last ice age, Great Britain was connected to Europe by dry land.

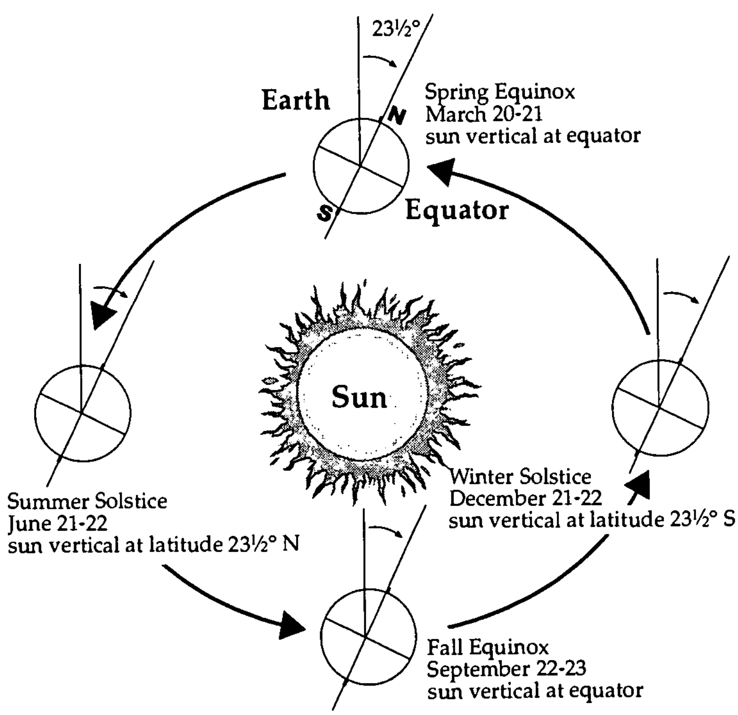
The periods of time between ice ages are called **interglacial ages**. During interglacial ages, the ice melts and the water level of the oceans rises, covering low-lying land areas. Each ice age period has been separated by long periods when the climate was as warm as or warmer than it is today.

Most of the glacial periods occurred during a division of the geologic calendar called the Pleistocene Epoch. From field investigations of deposits, geologists have found evidence that at least three other ice ages have occurred on Earth. There may have been more, but only three are confirmed. The earliest one took place about 600 million years ago, and the second occurred only 200 million years ago.

The most recent ice age in the Pleistocene Epoch is of greatest interest to us. It began about eight million years ago, and the last ice sheet retreated only about 7,000 years ago. We are now in an interglacial period, but scientists predict we will enter into another ice age in a few thousand years.

There is no clear explanation as to what causes the temperature changes that lead to ice ages; however, several theories have been suggested. Some recent theories include the following:

1. The tilt of Earth can vary over thousands of years from 22° to 25°. Its present angle is 23½°. When the tilt is 25°, the poles receive more sunlight, making the poles warmer, which causes the ice to melt. As the ice melts, the oceans rise and landforms sink. When the tilt is at 22°, the poles receive less sunlight, making the poles colder. This causes glaciers to grow and oceans to recede.



2. Every 100,000 years Earth's orbit around the sun changes from an oval to almost a circle. This causes the sun to be farther away during fall, winter, and spring, making these seasons colder. When the decreased tilt and the more circular orbit happen at the same time, an ice age may begin.

3. The amount of energy put out by the sun varies. When the energy from the sun decreases, Earth cools and an ice age begins.

Summary

Piedmont, continental, and alpine or valley glaciers are three types of glaciers. As glaciers move, they completely change the surface of the land by erosion and deposition, forming horns, lakes, hanging valleys, and moraines. Earth has experienced glacial periods known as ice ages. The most recent occurred during the Pleistocene Epoch.

Lab Activity: Erosion by Glaciers

Purpose	Materials
Observe how glaciers erode Earth's surface.	• freezer tray with sand • gravel • one-half block of frozen ice • ruler • bucket

1. Arrange the sand and gravel in the freezer pan.
2. Place the ice block at one end of the tray.
3. Allow it to melt for an hour or two.
4. Refreeze the tray.
5. Repeat step 3.
6. Refreeze the tray.
7. Repeat step 3.
8. Allow the block of ice to completely melt.
9. Record observations made of the changes in the sand and gravel.

   First melt: ____

   ____

   Second melt: ____

   ____

   Complete melt: ____

   ____

Practice

Use the list below to complete the following statements.

60 meters	glacier	icebergs	U
abrading	horns	kettle lakes	V
cirques			

1. A glacier begins to move when snow accumulation builds to about

   ____________________ .

2. A huge mass of moving ice and snow is called a

   ____________________ .

3. Many mountains have three-sided peaks formed by glaciers called

   ____________________ .

4. Lakes formed from huge pieces of ice covered with sediment that were left behind by a glacier are called ____________________ .

5. Valley glaciers begin when bowl-like depressions called

   ____________________ overflow with ice and snow.

6. Glaciers change ____________________-shaped valleys formed by rivers into ____________________-shaped valleys.

7. ____________________ is the scraping of the bedrock surface as ice moves over it.

8. Huge pieces of glaciers that break off and drift in the ocean are called

   ____________________ .

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

alpine	**Greenland**	**piedmont**	**valley**
Antarctica	**hanging valleys**	**plucking**	**waterfalls**
continental	**moraines**	**striations**	
drift	**outwash**	**till**	

1. The first material a glacier drops as it begins to melt is called

   ______________________ .

2. A combination of freezing and pulling forces is called

   ______________________ .

3. The only two continental glaciers that exist today are found in

   ______________________ and ______________________ .

4. When the valley of a main glacier continues to erode and abandoned valleys are left suspended high above the main valley floor, ______________________ are formed that often have beautiful

   ______________________ .

5. The three main types of glaciers are ______________________ or

   ______________________ , ______________________ , and

   ______________________ .

6. Gouges or scratches in the rock beneath the glacier made by sharp rocks being pulled along by the glacier are called

   ______________________ .

7. Material deposited by glaciers is called ______________________ .

8. The first deposits that are sorted are known as ________________ .

9. Sorted glacial deposits from meltwater are called

__________________ .

10. ______________________ are deposits that mark the edge of a glacier.

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

8 million	**22°**	**colder**	**interglacial**
20 million	**23½°**	**glaciers**	**lower**
600 million	**25°**	**Great Britain**	**rises**
7000	**circle**	**ice age**	**three**

1. A period of time when the average temperatures everywhere on Earth become lower and large continental sheets of ice spread out from the poles is called a(n) ____________________ .

2. Warm periods between ice ages are called ____________________ ages.

3. During interglacial ages, the water level of the ocean ____________________ due to the melting of the ____________________ .

4. It is believed that Earth has passed through ____________________ ice ages.

5. The first ice age began ____________________ years ago, the second began ____________________ years ago, and the most recent one began ____________________ years ago.

6. The great ice sheets from the last ice age retreated only about ____________________ years ago.

7. The present angle of the tilt of Earth on its axis is

_______________________ .

8. The tilt of Earth varies from _______________________ to

_______________________ .

9. When Earth is tilted at _______________________ , the poles get less sunlight, making them _______________________ .

10. When the tilt is _______________________ , the poles are warmer.

11. During ice ages, the water level of the oceans becomes

_______________________ .

12. Every 100,000 years, Earth's orbit becomes almost a(n)

_______________________ .

13. We are now in a(n) _______________________ age.

14. During the last ice age, _______________________ was connected to Europe by dry land.

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. We are presently in an ice age.

_________ 2. Earth has gone through three ice ages.

_________ 3. A period of time when the average temperatures on Earth become lower and glaciers form is known as an interglacial age.

_________ 4. The first ice age began about 600 million years ago.

_________ 5. The number of years between ice ages is constant.

_________ 6. The water level of the oceans rises during interglacial ages.

_________ 7. Scientists know exactly what causes ice ages.

_________ 8. The last great sheets of ice from the last ice age disappeared only about 7,000 years ago.

_________ 9. Scientists predict another ice age will occur in a few thousand years.

_________ 10. One theory of why we have ice ages is that the amount of energy we receive from the sun varies.

Practice

Answer the following using complete sentences.

1. Why could the change in the tilt of Earth cause temperatures on Earth to change?

   ____
   ____
   ____
   ____

2. Why would Earth's orbit becoming circular cause a change in temperature?

   ____
   ____
   ____
   ____
   ____

3. Why would the amount of energy Earth gets from the sun affect the temperature of Earth?

   ____
   ____
   ____
   ____
   ____

Practice

Use the list below to write the correct term for each definition on the line provided.

abrading	**horns**	**piedmont glaciers**
cirque	**ice age**	**plucking**
continental glaciers	**icebergs**	**striations**
drift	**interglacial ages**	**till**
glacier	**kettle lakes**	**valley glaciers**
hanging valley	**moraines**	**valley or alpine glaciers**

____________________ 1. small abandoned glacial valley suspended on the mountain high above the main glacial valley

____________________ 2. unsorted and unlayered rock material and other matter deposited directly by a glacier

____________________ 3. huge chunks of floating ice that break apart from a glacier when it reaches the sea

____________________ 4. lakes formed by the melting of a huge chunk of ice left behind by a glacier

____________________ 5. steep three-sided peaks formed by glaciers

____________________ 6. combination of freezing and pulling forces

____________________ 7. a period of time when large ice sheets covered much of the surface of Earth

____________________ 8. glaciers which form at the foot of mountains

____________________ 9. name given to material deposited by glaciers

_______________ 10. long, thin deposits of rock material that mark the edges of a glacier

_______________ 11. the periods of time between the ice ages

_______________ 12. glaciers that move very slowly down the mountain through a valley

_______________ 13. a large mass of moving ice and snow

_______________ 14. the scraping of the bedrock surface as ice moves over it

_______________ 15. the bowl-shaped hollow in which snow accumulates

_______________ 16. scratches made by sharp-pointed rocks

_______________ 17. another name for alpine glaciers

_______________ 18. glaciers formed in the polar regions, some of which are very large sheets of ice

Practice

Circle the letter of the correct answer.

1. A large mass of moving ice and snow is a(n) __________ .

   a. iceberg
   b. moraine
   c. glacier
   d. cirque

2. Glaciers that move very slowly down the mountain through a valley are called __________ .

   a. continental glaciers
   b. valley glaciers
   c. icebergs
   d. piedmont glaciers

3. Glaciers formed in the polar regions by very large sheets of ice are __________ .

   a. horns
   b. alpine glaciers
   c. piedmont glaciers
   d. continental glaciers

4. The name given to material deposited by glaciers is __________ .

   a. cirque
   b. abrading
   c. drift
   d. horns

5. Glaciers which form at the foot of mountains are __________ .

   a. continental glaciers
   b. valley glaciers
   c. piedmont glaciers
   d. alpine glaciers

6. ____________ is the combination of freezing and pulling forces in a glacier.

   a. Cirque
   b. Plucking
   c. Abrading
   d. Striation

7. ____________ is the scraping of the bedrock surface as the ice moves over it.

   a. Striation
   b. Abrading
   c. Plucking
   d. Moraine

8. ____________ are steep three-sided mountain peaks formed by glaciers.

   a. Horns
   b. Striations
   c. Moraines
   d. Icebergs

9. The bowl-shaped hollow in which snow accumulates is called a(n) ____________ .

   a. striation
   b. cirque
   c. horn
   d. iceberg

10. ____________ are scratches made by sharp-pointed rocks as a glacier moves over the land.

   a. Glaciers
   b. Kettle lakes
   c. Striations
   d. Horns

11. Long, thin mounds of rock material that mark the sides and front of a glacier are __________.

    a. moraines
    b. cirques
    c. striations
    d. horns

12. __________ is the unlayered and unsorted rock material and other matter deposited by a glacier.

    a. Moraine
    b. Cirque
    c. Till
    d. Outwash

13. The valley of a tributary that meets the main valley from a considerable height above the main valley is called a __________ valley.

    a. striation
    b. kettle
    c. cirque
    d. hanging

14. Layered deposits of rock fragments dropped by glacial meltwater are called __________.

    a. till
    b. outwash
    c. moraine
    d. horns

15. A period of time when large ice sheets covered much of the surface of Earth is called a(n) __________ age.

    a. hanging
    b. terminal
    c. glacier
    d. ice

16. ___________ lakes are formed by the melting of a huge chunk of ice left behind by a glacier.

a. Striation
b. Iceberg
c. Ground moraine
d. Kettle

17. ___________ are periods of time between ice ages.

a. Interglacial ages
b. Ancient ages
c. Prehistoric ages
d. Alpine ages

18. Huge chunks of floating ice that break apart from a glacier when it reaches the sea are called ___________ .

a. striations
b. icebergs
c. glaciers
d. moraines

Unit 13: Weathering and Erosion

Vocabulary

Study the vocabulary words and definitions below.

caverns .... underground caves formed by running water dissolving limestone over a period of time

chemical weathering .... the change in mineral composition or chemical makeup of a rock by chemical means; also called "decomposition"

clay .... a mineral found in large quantities in the soil; a common soil type found in Florida

dunes .... hills of sand deposited by the wind

erosion .... the movement of weathered rocks and soil from one place to another by wind, water, ice, or gravity

glacier .... a large, moving mass of ice and snow

gravel .... large pieces of rock and mineral in soil

gravity .... the force of attraction between all objects in the universe; an agent of erosion

humus .... the dark-colored material left in soil by the decaying of plants and animals

loam .... type of soil made of sand, silt, and clay

loess .... pieces of silt and clay deposited by wind

mechanical weathering .... the breakdown of rocks into smaller particles by physical means

organic .... material formed from the remains of plants and animals

runoff .... water that flows over Earth's surface

sand .... small particles of rock found in soil

silt .... soil particles that are smaller than sand but larger than clay

soil .... a combination of small pieces of rock and organic material combined with air and water

topsoil .... the upper layer of soil that contains a lot of humus

weathering .... the breaking down of rocks and other materials by chemical or physical means

Introduction

Glaciers, water, wind, and **gravity**—all are forces responsible for **weathering** and **erosion**. Changes resulting from these forces determine the shape of Earth's surface. They create our mountains, valleys, sand **dunes**, and deserts. They determine the type of **soil** that is formed in a particular area. Learning about weathering and erosion gives us clues to understanding our Earth.

Weathering

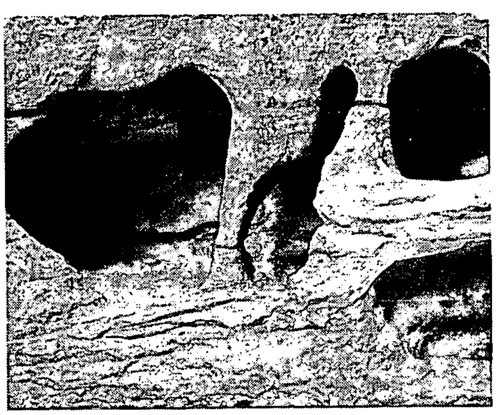

the effects of weathering

Weathering is a slow process that breaks down substances and materials exposed to the atmosphere. Some examples of weathering are peeling paint, rust, and rock fragments. Rocks on Earth's surface are broken down by two types of weathering—mechanical and chemical.

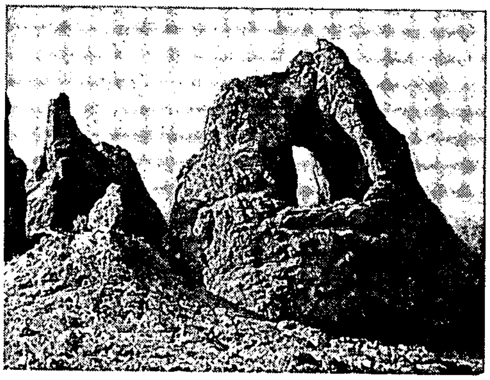
Mechanical Weathering

In **mechanical weathering**, rocks are broken down into smaller fragments. As weathering progresses, the rock fragments become smoother and more rounded. The agents of mechanical weathering are temperature, water, plants, and wind.

Changes in temperature can cause rocks to expand and contract. This can cause particles of rock on the surface to flake off.


weathering caused by water

Water expands as it freezes. If water seeps into cracks in a rock and the temperature falls below freezing, the resulting ice expands in the crack. Eventually this expansion will break the rock into smaller pieces. Plants can also enlarge cracks in rocks as their roots expand and grow into the rock. Small rock particles can be carried by the wind. These windblown particles create a *sand blasting* effect on soft rocks, abrading or wearing away rocks. Many rock formations in desert regions are the result of this abrasion. Landslides are often caused by mechanical weathering.

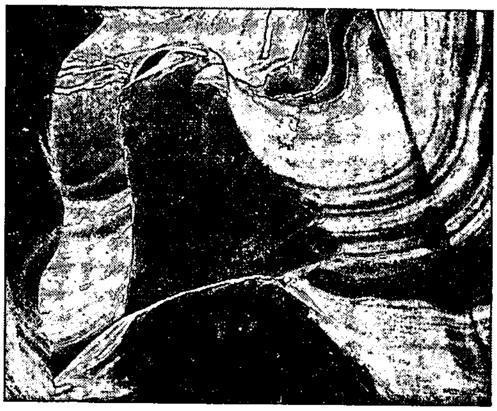


weathering caused by wind

Chemical Weathering

Chemical weathering causes changes in the mineral composition or chemical makeup of the rock. Chemical weathering is sometimes called *decomposition*. The agents of this type of weathering are water, oxygen, and acids. For instance, water can dissolve rocks. These dissolved rocks can form other deposits, such as **clay**, or formations such as stalactites and stalagmites. Another form of chemical weathering involves oxygen. Oxygen in the atmosphere can chemically combine with other compounds. The resulting *rust* is darker and chemically different than the original material.

Acids and other chemicals can also cause changes in rocks. Carbon dioxide can dissolve in water, making it carbonated. This carbonated water can dissolve limestone and feldspar. In addition, acid rain can corrode the surface of rocks. Some plants are capable of growing on rocks. They produce weak acids to *soften* the rock's surface so their roots can attach. Lichens are examples of plants that produce acids and cover rock surfaces.



effects of erosion

Erosion

The surface of Earth is continually being built up and worn down. The breaking down of rocks and other materials by chemical or physical means is called *weathering*. *Erosion* is the movement of these weathered rocks and soil from one place to another. The four main types of erosion are water, wind, ice, and gravity.

Water Erosion

Of all the forces that cause erosion, water is the most important. Water is responsible for changing much of Earth's surface. Below are several ways in which water can erode the surface of Earth:

How Liquid Water Erodes Earth's Surface

1. Rivers are important because they affect large areas. Heavy rains and large amounts of melting snow cause **runoff** water to carry away sediment. The sediment goes into rivers where more material eroded from other areas is carried. Rivers then empty into other rivers, lakes, or oceans. Water carries materials as it moves. Rivers slow down where they empty into large bodies of water. The slowing of the current at the river's mouth causes moving **sand** and other particles to stop moving and fall to the bottom of the stream. The sediment builds up and forms a delta—a wedge-shaped area of sand at the mouth of a river. As more sediment is added to the delta, the path of the river will change.

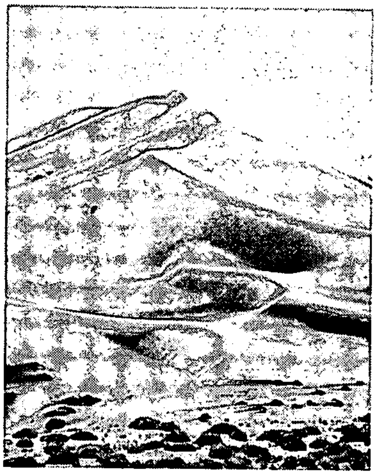
2. Fast-moving water in rivers also wears away the banks, creating canyons and carrying rocks and soil downstream to new locations. The Grand Canyon, formed by the Colorado River, is an example of erosion caused by a fast-moving stream.

3. **Caverns** are caves formed by underground running water dissolving limestone and carrying it away. The Carlsbad Caverns in New Mexico and the Linville Caverns in North Carolina were formed by this type of erosion.

4. When the roof of an underground cave formed by erosion sinks or collapses, a *sinkhole* is formed. Central Florida has many sinkholes.

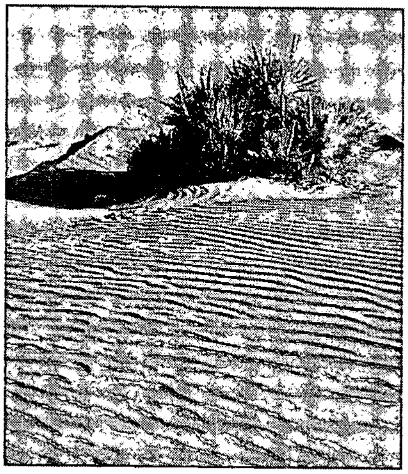
The amount of erosion is determined by several factors. The type of minerals that make up rocks and soil determines how quickly it will erode. Rocks with holes in them or with large spaces between them will soak up the running water, whereas rocks with no openings cause rapid *runoff*. The slope of a surface also determines the amount of erosion. A steep hill will cause more erosion than a gently sloping hill. The amount and type of plants grown in an area also affect the rate of erosion. An area with many plants will erode less quickly than an area with few or no plants. This is why picking sea grasses along sand dunes is often prohibited.

Wind Erosion



Wind erosion occurs mainly in areas where there is very little moisture. Because of this, there are few plants to hold the soil in place. Wind picks up and carries small bits of sand and dust. Wind erosion occurs in deserts, along the beach, and by rivers in dry regions.

Loose particles carried by the wind act like sandpaper, wearing down rocks into flat, sharp forms. Wind erosion depends on the speed of the wind, the length of time that it blows, and the size of the particles being carried. Sand is the heaviest type of particle carried by the wind. It is carried close to the ground and is the first to be deposited by the wind. **Silt** is finer than sand and is carried farther before it is deposited. Dust is the lightest material carried by the wind. It gets into the high air currents and can be carried for hundreds of miles.



When the wind dies down, the materials it has been carrying are deposited. Hills of sand called *sand dunes* are the most common type of wind deposit. They are formed near rocks and bushes and where the wind slows down in desert areas and along shorelines. **Loess** is another type of wind deposit formed of angular pieces of silt and clay that tend to pack together into a dense mass. Loess deposits are usually light in color and may be several meters thick. They form fertile soil. The hilltops and valleys of the Mississippi River are formed from deposits of loess. The presence of grass and shrubs helps to control wind erosion. Roots hold soil and other particles in place.

Ice Erosion

Ice erosion is caused by large sheets of moving ice known as *glaciers*. Glaciers form in areas where winter snowfall is greater than summer melting. The snow piles up, putting pressure on the snow at the bottom. The snow at the bottom of the pile eventually packs tightly and turns into ice. As the ice continues to build up, the pressure causes it to move. As the glacier moves, it tears rocks and soil from the ground similar to the effect of dragging a heavy rake across an unpaved driveway. The glacier also acts like a bulldozer. The front of the glacier piles up material called *till*. When the glacier melts and retreats, it leaves behind the material it was carrying.

Mountain shapes can be changed by glaciers. Glaciers have eroded mountain tops into peaks, such as the Matterhorn in Switzerland, and formed hanging valleys with beautiful waterfalls like those in Yosemite National Park in California. Glaciers can also form lakes. The Great Lakes were formed by glaciers deepening river valleys and damming them to form lakes.

Gravitational Erosion

The gravitational pull of Earth also causes erosion. Sometimes the movement of rocks and soil down a hillside, due to the pull of *gravity*, is very slow. Soil and rock particles may be pulled down a hillside so slowly that it is hardly noticeable. This slow movement which may not even be noticeable is called *slump*. Eventually, this material comes to rest at the bottom of the slope. At other times the combined forces of gravity, water, and steep slopes cause rapid movements. *Landslides* are rapid movements of large amounts of rock caused by excessive rains or earthquake activity. *Mudflows* are also rapid movements that occur after heavy rains. *Avalanches* happen when rapid melting of snow or earthquake activity occurs in heavy layers of snow. Gravitational erosion can cause major structural damage wiping out roads, houses, and sometimes entire towns.

Soil

Soil is a combination of weathered rock and **organic** material with air and water filling the spaces between the soil particles. The type of minerals and organic matter that are contained in the soil determine the type of soil. The organic material in soil, called **humus**, comes from the decaying or breaking down of dead plants and animals. Humus is dark-colored and found in the upper layer of soil called **topsoil**. The humus in the soil makes it fertile and good for growing plants.

Particles of soil vary in size. Large particles of rock and mineral found in the soil are called **gravel**. Weathering causes gravel to break down into smaller pieces called *sand*. Sand is further weathered to produce smaller particles called *silt*. *Clay* is the smallest particle in the soil. It is so small that it must be magnified to see. It packs very tightly to form large clumps so it may be impossible to see the individual particles. **Loam** is a type of soil that is a mixture of sand, silt, and clay. It holds a large amount of water which makes it very good for farming.

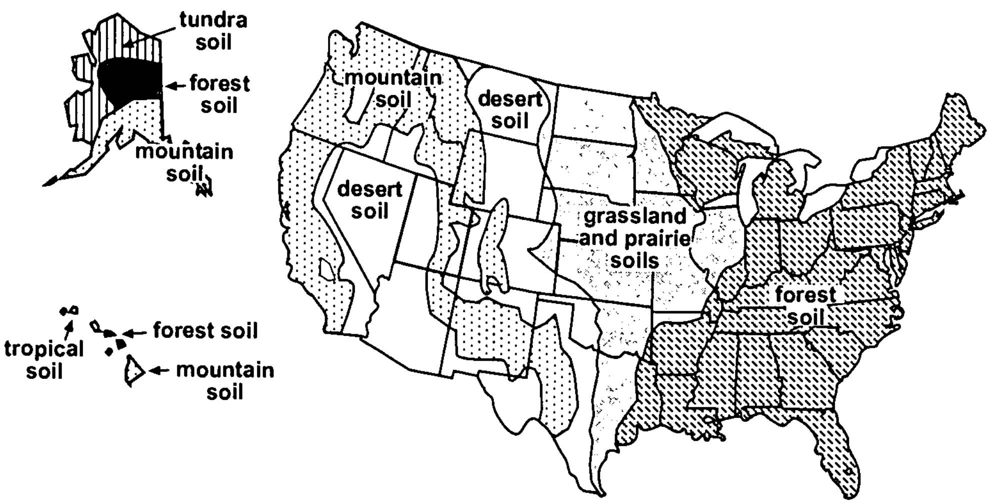
Soil Types and Regions

Soil is classified by its makeup and the region in which it forms. The chart below lists several factors that determine soil types.

Factors Which Determine Soil Types	
time	the amount of time the soil has had to form
climate	the average weather for that region
rocks	the type of rocks present in the area
Earth's surface	the shape of Earth's surface in the area

Forest Soil. The soil in the eastern part of the United States ranges from brownish-gray in the Northeast to a reddish color in the Southeast. Forest soil forms under tree cover, contains very little humus, and requires frequent fertilization because heavy rainfall causes the minerals in the soil to be washed away. The southeastern forest soil is slightly more fertile than northeastern forest soil due to the warmer southern climate, which causes organic matter to decay more quickly.

Soil Regions of the United States



Grasslands and Prairie Soils. The part of the United States from the eastern forest region to the Rocky Mountains has grasslands and prairies. The soil there is rich in humus and receives large amounts of rainfall, which makes it fertile and good for farming.

Desert Soil. The lack of rainfall in the desert regions of the western United States results in soil that is rich in minerals. However, the soil lacks humus due to the limited number of plants.

Mountain Soil. The soil found in the mountain ranges of the western United States, although rich in mineral ores, is dry and made up of pieces of rock. Therefore, it is not a good soil for growing crops.

Tundra Soil. The tundra region of the United States has thin soil. This, combined with the severely cold climate, allows only the growth of mosses and lichens. Alaska is the only region in the United States that has tundra soil.

Tropical Soil. Tropical soil is found in only one part of the United States, the very warm, humid climates of the Hawaiian rain forests. The tropical soil region has excessive rain and heat which causes organic matter to rapidly decay. A thick layer of humus does not form because heavy rain washes it away. However, the plentiful organic matter in this region quickly replaces the humus and minerals needed to keep the rain forests growing.

Soils contain different minerals and nutrients depending on their formation. Sometimes fertilizers are added to soil to enrich it for growing crops. Phosphate, nitrate, and other chemicals may be used in fertilizers. These substances, however, can act as pollutants when applied incorrectly. Organic fertilizers such as manure or compost may be used to increase organic material content. The risk of misuse with these appears to be less than with other fertilizers.

Summary

Mechanical and chemical weathering breaks down rocks and other materials exposed to the atmosphere. Temperature, water, plants, and wind are mechanical weathering agents. The agents of chemical weathering are water, oxygen, and acids. The process of erosion moves weathered materials from one place to another. The four main types of erosion are water, wind, ice, and gravity. Weathered rock becomes part of our soil. Soil types vary depending on the composition and other factors such as age and climate.

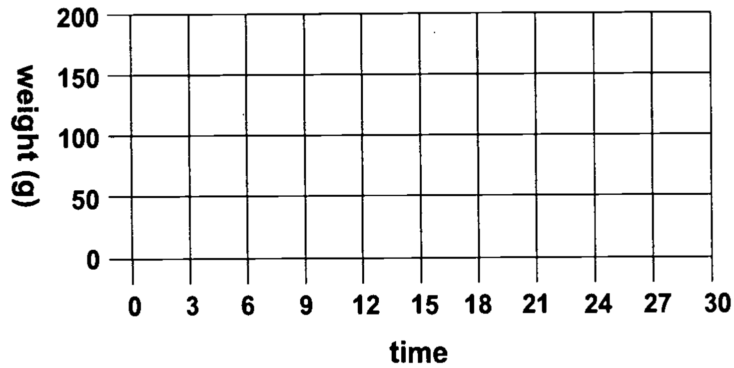
Lab Activity 1: Weathering

Purpose	Materials
Observe the effects of mechanical weathering.	• plastic jar with screw-top lid • pre-soaked marble chips • balance • piece of screen • water

1. Measure out 100 grams of presoaked marble chips.
2. Place marble chips in jar. Fill halfway with water. Secure lid.
3. Shake jar for three minutes.
4. Strain out water using screen.
5. Weigh marble chips.
6. Repeat nine more times for a total of 30 minutes.
7. Record weight in chart below.

Time	Weight of Chips
0	100 g
3	
6	
9	
12	
15	
18	
21	
24	
27	
30	

8. Use the graph below to plot your data from the previous page.



9. Describe the changing appearance of the marble chips from the beginning to the end of the procedure.

____

____

____

10. What type of weathering does this represent? ______________

Why? ______________________________________

____

____

11. Why were the rock chips presoaked? ____________________

____

____

12. How did the mass of the rock chips change through time?

____

____

____

Lab Activity 2: Water Erosion

Purpose	Materials
Observe the effects of erosion by water.	• large baking pan • soil • pitcher • water

1. Take the baking pan and fill it with soil.
2. Smooth the soil so that it is evenly spread.
3. Fill the pitcher with water.
4. Place the edge of the pan and soil on a book to raise one side of the pan.
5. Pour the water slowly over the soil at the higher end of the pan.
6. Record what happens on the lines below.

____

____

____

7. Pour the water more quickly.
8. Record what happens on the lines below.

____

____

____

9. Compare your observations.

Lab Activity 3: Wind Erosion

Purpose	Materials
Observe the effects of erosion by wind.	• small fan or blowdryer (on low) • sand box (3′x 2′)

1. Put the sand in the box.
2. Smooth the sand so that the sand is evenly spread.
3. Turn the fan on.
4. Aim the fan at one end of the box.
5. Record what happens on the lines below.

____

____

____

____

6. Place a large rock or object in the center of the box.
7. Turn on the fan.
8. Record the results below.

____

____

____

____

____

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

abrasion	**gravity**	**temperature**
chemical	**ice**	**water**
decomposition	**mechanical**	**weathering**
erosion	**plants**	**wind**

1. The breaking down of rocks and other materials by physical or chemical means is called ________________________ .

2. The movement of weathered rocks and soil from one place to another is called ________________________ .

3. The two main types of weathering are ________________________ and ________________________ .

4. The agents of mechanical weathering are ________________________ , ________________________ , ________________________ , and wind.

5. Wind blown particles cause the weathering away of rock particles, or ________________________ .

6. Chemical weathering is also called ________________________ .

7. The four main types of mechanical erosion are

_________________________, _________________________,

_________________________ and _________________________.

8. _________________________ is the most important type of erosion.

Practice

Use the list below to complete the following statements.

canyon	**landslides**	**sand**
caverns	**loess**	**sand dunes**
dust	**mudslides**	**silt**
glaciers	**runoff**	**wind**
gravity		

1. ______________________ water caused by heavy rains and melting snow carries soil away.

2. Fast-moving water in rivers forms a ______________________ as it erodes the banks of the river.

3. Caves found underground that are formed by running water dissolving limestone are called ______________________ .

4. The type of erosion that usually occurs in desert areas is ______________________ erosion.

5. Hills of sand deposited by the wind near rocks or bushes are called ______________________ .

6. A type of wind deposit formed by pieces of clay and silt is ______________________ .

7. Types of particles carried by wind are ______________________ , ______________________ , and ______________________ .

8. Large sheets of moving ice and snow that erode Earth's surface are known as ____________________.

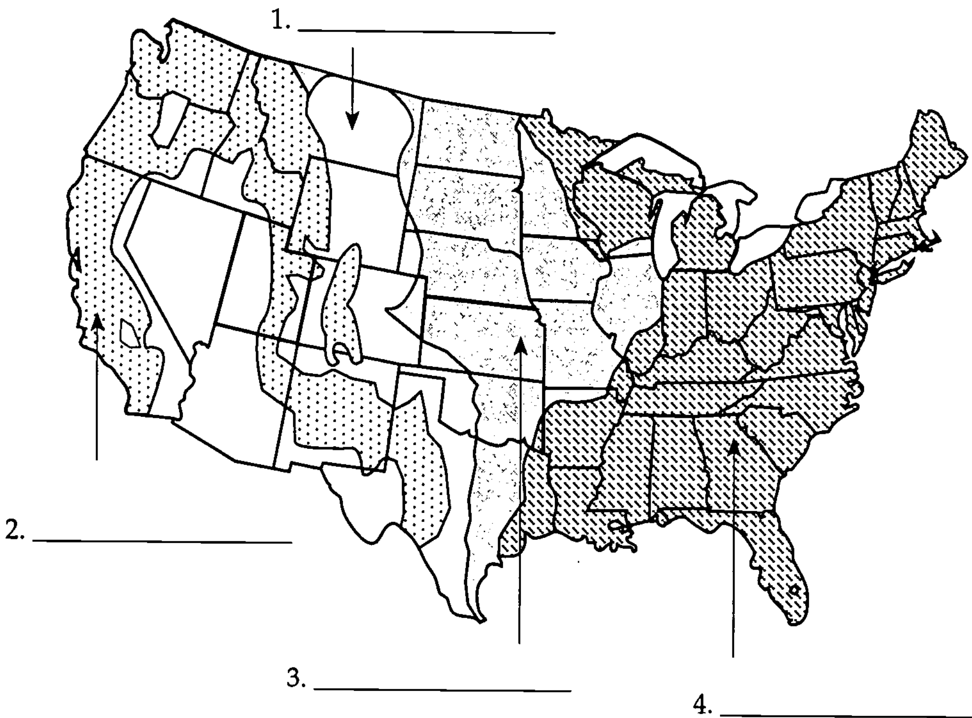
9. The type of erosion caused by the force that pulls objects towards the center of Earth is ____________________.

10. ____________________ and ____________________ are rapid forms of erosion caused by gravity, rain, and earthquakes.

Practice

Label the **soil regions** *on the map below as* **mountain, desert, forest,** *or* **grassland and prairie.**

Soil Regions of the United States



Practice

Write a description of the **type of soil** *found in each area.*

1. desert: ____________________

2. forest: ____________________

3. mountain: ____________________

4. grassland or prairie: ____________________

Practice

Use the list below to write the correct term for each definition on the line provided.

caverns	**gravel**	**loess**	**silt**
clay	**gravity**	**organic**	**soil**
dunes	**humus**	**runoff**	**topsoil**
erosion	**loam**	**sand**	**weathering**
glacier			

______________________ 1. water that flows over Earth's surface

______________________ 2. soil particles that are smaller than sand but larger than clay

______________________ 3. hills of sand deposited by wind

______________________ 4. small particles of rock found in soil

______________________ 5. a mineral found in large quantities in the soil; a common soil type found in Florida

______________________ 6. dark colored material left in soil by the decaying of plants and animals

______________________ 7. a combination of small pieces of rock and organic material combined with air and water

______________________ 8. the upper layer of soil that contains a lot of humus

______________________ 9. large pieces of rock and mineral in soil

______________________ 10. the breaking down of rocks and other materials by chemical or physical means

______________________ 11. a large, moving mass of ice and snow

____________________ 12. material formed from the remains of plants and animals

____________________ 13. pieces of silt and clay deposited by wind

____________________ 14. the movement of rocks and soil from one place to another by wind, water, ice, or gravity

____________________ 15. type of soil made of sand, silt, and clay

____________________ 16. the force of attraction between all objects in the universe

____________________ 17. underground caves formed by running water dissolving limestone over a period of time

Practice

Circle the letter of the correct answer

1. The movement of weathered rocks and soil from one place to another by wind, water, ice, or gravity is __________ .

   a. gravel
   b. humus
   c. erosion
   d. soil

2. Underground caves formed by running water dissolving limestone over a period of time are __________ .

   a. dunes
   b. caverns
   c. humus
   d. loam

3. A large, moving mass of ice and snow is called a __________ .

   a. dune
   b. cavern
   c. runoff
   d. glacier

4. Large pieces of rock and mineral in soil are __________ .

   a. clay
   b. silt
   c. gravel
   d. loam

5. A combination of small pieces of rock and organic material combined with air and water is __________ .

   a. sand
   b. humus
   c. clay
   d. soil

6. ____________ is the dark-colored material left in soil by the decaying of plants and animals.

a. Clay
b. Silt
c. Humus
d. Loam

7. ____________ is a mineral found in large quantities in the soil.

a. Gravel
b. Clay
c. Silt
d. Humus

8. The force of attraction between all objects in the universe is called ____________ .

a. loess
b. gravity
c. runoff
d. weathering

9. ____________ is the small particles of rock found in the soil.

a. Silt
b. Clay
c. Gravel
d. Sand

10. Hills of sand deposited by wind are called ____________ .

a. dunes
b. sand
c. clay
d. silt

11. ____________ is a type of soil made of sand, silt, and clay.

a. Loam
b. Humus
c. Loess
d. Topsoil

12. Pieces of silt and clay deposited by wind are called ___________.

    a. soil
    b. loess
    c. humus
    d. gravel

13. Material formed from the remains of plants and animals is called ___________.

    a. organic
    b. loam
    c. sand
    d. silt

14. Water that flows over Earth's surface is called ___________.

    a. gravel
    b. silt
    c. clay
    d. runoff

15. Soil particles that are smaller than sand but larger than clay are called ___________.

    a. loam
    b. humus
    c. gravel
    d. silt

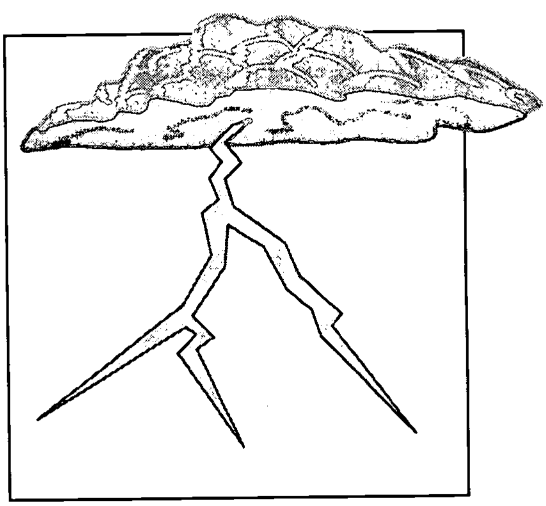
16. The upper layer of soil that contains a lot of humus is ___________.

    a. gravel
    b. silt
    c. topsoil
    d. clay

17. The breaking down of rocks and other materials by chemical or physical means is called ___________.

    a. runoff
    b. erosion
    c. weathering
    d. gravel

Unit 14: The Atmosphere and Weather



Vocabulary

Study the **atmosphere** *and* **climate** *vocabulary words and definitions below.*

atmosphere .... the mixture of gases surrounding Earth

climate .... the weather of an area over a long period of time

continental climate .... type of climate found where there are huge land masses

desert .... dry areas that receive less than 25 cm of rainfall per year

exosphere .... the upper part of the thermosphere; extends into interplanetary space

ionosphere .... the lower part of the thermosphere that contains electrically charged particles called ions

jet stream .... narrow layer of strong winds that blow from west to east just above the troposphere

marine climate .... type of climate found when an area is located near a large body of water

mesosphere .... the coldest layer of the atmosphere, just above the stratosphere

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ozone .... type of oxygen with three oxygen atoms (O_3) found in the upper areas of the stratosphere

polar zone .... area of Earth that extends from the poles to 60° north and south latitude and has a very cold climate

stratosphere .... the layer of Earth's atmosphere above the troposphere; it contains the ozone layer

temperate zone .... the zone of moderate climate with distinct seasonal changes; located between 30° and 60° latitude

thermosphere .... the layer of the atmosphere above the mesosphere where the air is very thin and hot; includes the ionosphere and exosphere

tropical zone .... area of Earth that extends from 30° north latitude to 30° south latitude; above average temperatures and precipitation

troposphere .... the lowest layer of the atmosphere that contains most of Earth's weather

weather .... the day-to-day changes in temperature, humidity, wind, and air pressure

Vocabulary

Study the **solar radiation** *and* **air mass** *vocabulary words and definitions below.*

air masses .... large bodies of air having the same temperature and amount of moisture

barometer .... an instrument used to measure air pressure

cold front .... forms when a mass of cold air meets a mass of warm air and moves beneath it

conduction .... direct transfer of heat energy from one substance to another

convection .... transfer of heat energy by moving air or fluid

convection current .... the vertical movement of air or water caused by differences in temperature

currents .... vertical movements of air or water caused by the uneven heating of Earth

direct rays .... rays of the sun that hit Earth at a 90° angle; they create the greatest amount of heat

front .... the boundary formed when two different masses of air meet

high-pressure system .... system that brings cool, clear skies and dry weather

indirect rays .... rays of the sun that hit Earth at greater than 90°; they produce less heat

low-pressure system .... system that brings cloudy, rainy, and often stormy weather

occluded front .... forms when a cold front overtakes and merges with a warm front

radiation .... process by which the sun's rays reach Earth in the form of waves

stationary front .... forms when two unlike air masses face each other, but neither moves

warm front .... forms when a mass of warm air meets a mass of cold air and moves over it

wind .... horizontal movements of air caused by the uneven heating of Earth

Vocabulary

Study the **wind** *and* **current** *vocabulary terms and definitions below.*

anemometer .... an instrument used to measure wind speed

doldrums .... the area around the equator where air moves straight up and there is very little wind

horse latitudes .... area at about 30° north and south latitude where there is very little wind

land breeze .... cool air blowing from land to sea at night

monsoons .... winds that blow inland during summer bringing rainy weather and that blow out to sea in winter bringing dry weather

polar easterlies .... system of winds that blows cold air from the poles

prevailing westerlies .... wind system formed over large land areas that blows from the west to the east

sea breeze .... cool air that moves from sea to land during the day

trade winds .... system of winds found just north and south of the equator that blows toward the equator from the northeast and southeast

wind vane .... an instrument that tells from which direction the wind is coming

Vocabulary

Study the **storm** *and* **precipitation** *vocabulary terms and definitions below.*

anticyclone .... high-pressure system with winds moving clockwise

blizzard .... a severe snowstorm with high winds

cirrus .... very high, thin, feathery clouds made of ice crystals

cloud .... tiny droplets of water suspended in the air

cumulonimbus .... cumulus clouds that bring rain; also called thunderheads

cumulus .... puffy, white clouds with flat bottoms

cyclone .... a low-pressure system with winds moving in a counterclockwise direction

hurricane .... a large, powerful low-pressure storm system; a cyclone with sustained winds of 75 mph or more

lightning .... a sudden discharge of electricity from clouds

nimbostratus .... a dark, low-lying stratus cloud that contains rain

nimbus .... a cloud that causes rain to fall

precipitation .... moisture that falls to Earth as rain, hail, sleet, or snow

saturated .... a term used when the air has all the moisture it can hold

stratus .... smooth, layered clouds found low in the sky

thunder .... the sound made by lightning

tornado .... a violent, funnel-shaped windstorm

tropical depression .... a storm formed by a large, low-pressure system over water with winds less than 35 mph

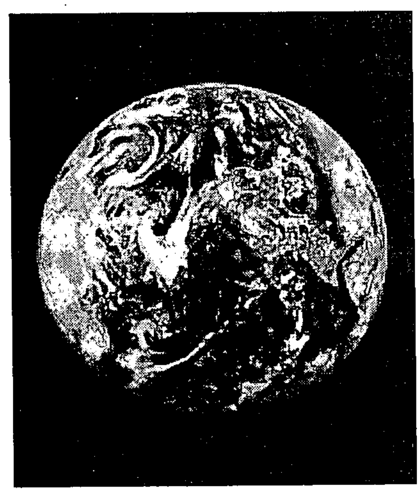
tropical storm .... a storm formed when the winds of a tropical depression are between 35 and 74 mph

waterspout .... a tornado that forms over water

Introduction

Earth is enveloped in layers of gases called the **atmosphere**. These layers are responsible for Earth's **weather** and for protecting us from harmful rays of the sun. Weather affects us daily and is a determining factor in many of our decisions. Air pressure, temperature, winds, and humidity change constantly and can produce dangerous conditions like **hurricanes** and **tornadoes**. The day-to-day weather we experience makes up our **climate**. Some areas have a cold, polar climate while others have a hot and humid tropical climate. Climate and weather influence our daily lives. Studying Earth's weather and climate changes will help us to understand how to prepare for or prevent dangerous weather conditions and cope with our ever changing environment.

Atmosphere

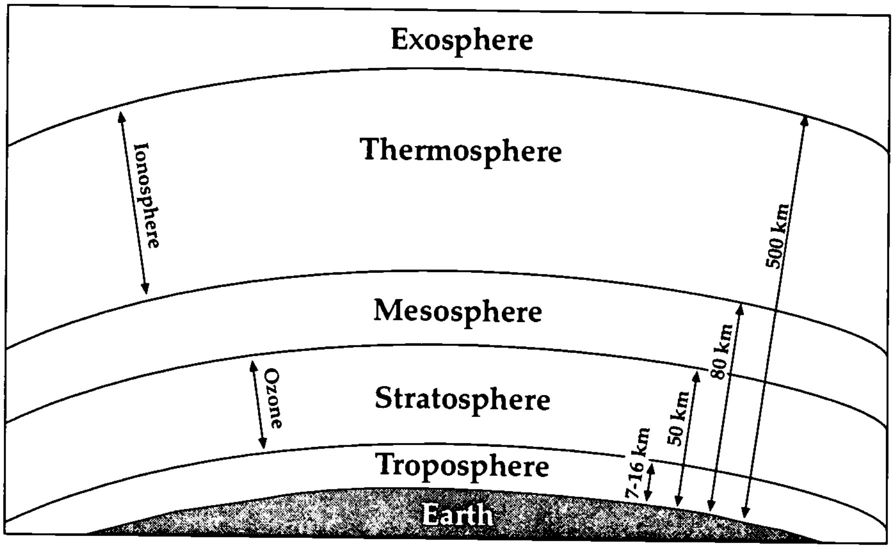

Earth

Earth is surrounded by a mixture of gases called the *atmosphere.* The atmosphere is divided into four layers, based on differences in temperature and gases present. The layer of the atmosphere closest to Earth is the **troposphere**. This is the layer in which we live, and it contains most of our weather. The troposphere extends upwards from the surface of Earth for about 10 kilometers. The temperature decreases farther up in the troposphere.

Just above the troposphere is a narrow layer of strong winds that blow from west to east called the **jet stream**. Planes flying eastward use the jet stream to increase their air speed.

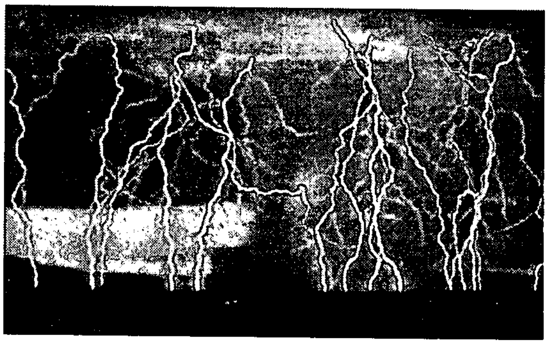
The layer of air above the troposphere is the **stratosphere**. This layer extends to about 50 kilometers above Earth's surface: The air in the lower areas of the stratosphere is very cold, but the air in the upper layers is about the same as it is at sea level.

This warmer temperature is due to the **ozone** present there. Ozone is a gas with three oxygen atoms (O_3), rather than two oxygen atoms (O_2) present in the air we breathe. Ozone absorbs the sun's ultraviolet rays and heats up the atmosphere. It also shields Earth and keeps ultraviolet rays from reaching Earth's surface. Ultraviolet rays can cause blindness and skin cancer.



For these reasons, it is important that the ozone layer of Earth not be destroyed. Chemicals known as chlorofluorocarbons (CFCs) that are used in aerosol (spray) cans can destroy the ozone layer. Federal laws have been passed which regulate the use of aerosol cans.

Most of the ozone on Earth is in this layer of the stratosphere; however, some of it is found in lower layers. When **lightning** strikes, ozone is formed. You can smell the presence of ozone when lightning strikes. It has a clean, sharp smell.



lightning striking

Above the stratosphere lies the **mesosphere**, where the temperature is colder. It is, in fact, the coldest part of the atmosphere. This layer extends to about 80 kilometers above the Earth.

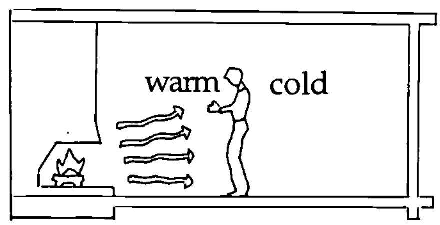
Beyond the mesosphere is the **thermosphere**, which is divided into two parts, the **ionosphere** and the **exosphere**. The ionosphere extends to about 500-700 kilometers. The exosphere is the last layer of the atmosphere and extends for thousands of kilometers upward into interplanetary space.

The thermosphere is very hot because of absorption of the sun's energy. The first part of the thermosphere, the ionosphere, is a layer of electrically charged particles. These particles are bombarded by energy from space. They become electrically-charged particles called *ions* and *free electrons*. These are useful for communication because they reflect radio waves.

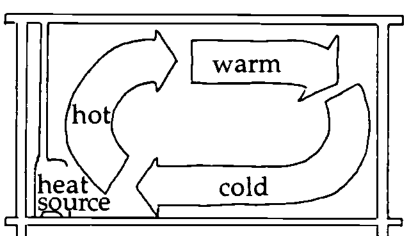
The last layer of the thermosphere and atmosphere is the exosphere. Here, the atmosphere is very thin. In other words, atoms and ions are very far apart. Some gases escape into space.

The Effect of Solar Radiation

Earth receives its heat from the sun. The sun's energy is spread through the atmosphere in three ways—**radiation**, **convection**, and **conduction**. Radiant energy from the sun reaches Earth in the form of waves by a process called *radiation*. These light waves are absorbed by Earth and returned to the atmosphere as heat. As air molecules absorb heat, they begin to move farther and farther apart. Warm air is therefore less dense, or lighter, and rises.



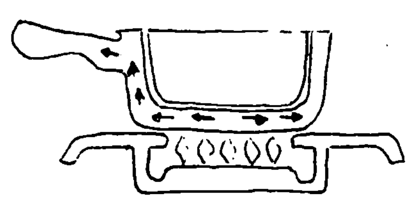
Radiation



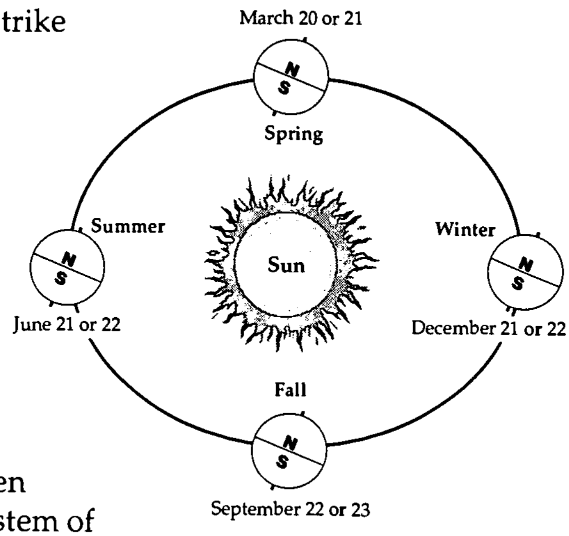
Convection

Convection is the process through which heat is transferred by moving air or water. As the warm air rises, denser, heavier, and colder air moves in to replace it. This movement creates a **convection current**. Convection currents cause a constant exchange of air until the surface is evenly heated. Most of the heat in the atmosphere is transferred by convection currents.

The direct transfer of heat energy through contact is called *conduction*. When cool air above Earth's surface comes into contact with the warm ground, the air is heated. Air temperatures closer to the ground are generally warmer than those higher up. Conduction plays only a minor role in heating the atmosphere because land and water are poor conductors of heat.


Conduction

The angle at which the sun's rays strike Earth varies because Earth is a sphere that rotates on its axis. The sun's rays produce the most heat when they strike Earth at a 90° angle. We call these rays **direct rays**. The area near the equator gets most of the direct rays of the sun. The rays that strike Earth on both sides of the equator hit at an angle that is greater than 90° and are called **indirect rays**. This creates an uneven heating of Earth which causes a system of air currents and winds to be formed. Vertical movements of air are called **currents**, and horizontal movements of air are called **wind**.



High and Low Air Pressure

L

low pressure

The uneven heating of Earth also causes changes in air pressure. When lighter, warm air rises, it creates an area of low pressure. The winds of a **low-pressure system** move upward, spiraling towards the system's center in a counterclockwise direction in the Northern Hemisphere and clockwise in the Southern Hemisphere. Low-pressure systems generally bring cloudy, rainy weather that is often accompanied by storms.

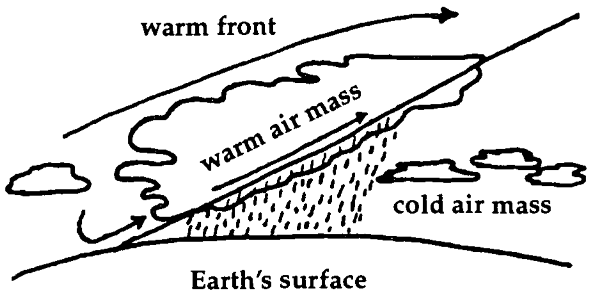
H

high pressure

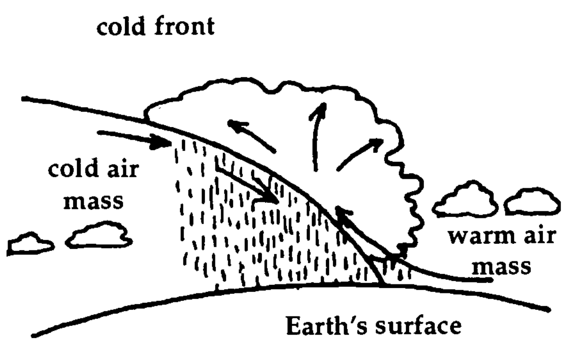
The heavier, cooler air in the upper atmosphere sinks, creating an area of high pressure. The winds of a **high-pressure system** move downward, spiraling outward in a clockwise direction in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. High-pressure systems bring cool, clear skies and dry weather. Differences between air pressure also cause winds. Air will move from an area of high pressure into an area of low pressure. The strength of the wind will depend on the amount of difference in pressure between the two systems. Air pressure systems cause changes in weather and are measured by a **barometer**.

Fronts

Large bodies of air having the same temperature and amount of moisture are called **air masses.** Some air masses form over continents and others form over the oceans. Those forming over the oceans have more moisture in them than the ones forming over land. When two different types of air masses meet, a boundary called a **front** forms. Fronts usually have stormy or unstable weather. There are four types of fronts: warm, cold, stationary, and occluded.



Warm Front. A **warm front** ( ) forms when a mass of warm air meets a mass of cold air. The warm air gradually moves up and over the colder air causing **precipitation** and **clouds** ahead of the warm front. High **cirrus** clouds form and are followed by **stratus** clouds, causing the barometer to fall, and **nimbostratus** clouds producing rain or snow falls for a long period of time. A warm front is indicated by a line with half circles on it.



Cold Front. A **cold front** ( ) forms when a cold air mass pushes a warm air mass in front of it. The cold air wedges under the warm air and lifts it up at a sharp angle, causing the formation of **cumulus** and **cumulonimbus** clouds, which produce thunderstorms and hard rains. Cold fronts generally move through an area quite rapidly, with cool, clear weather following. Cold fronts are indicated by a line with triangles facing the direction the front is moving.

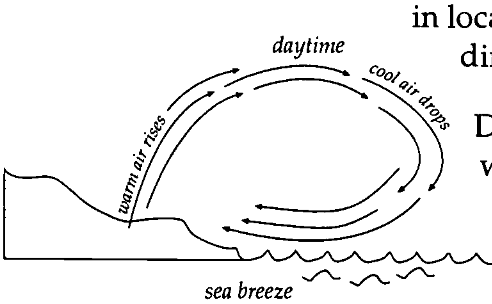
Stationary Front. A **stationary front** ( ) forms when two unlike air masses face each other, but there is very little movement of air. The weather associated with a stationary front is similar to a warm front. Eventually one front or the other moves, forming either a warm or a cold front. The symbol for this front is a line with half circles on one side and triangles on the other.

Occluded Front. An **occluded front** (▲▲▲▲) forms when a cold front overtakes and merges with a warm front. It is characterized by a combination of weather from both fronts. An occluded front is indicated by a line with alternating half circles and triangles on the same side of the line.

Winds

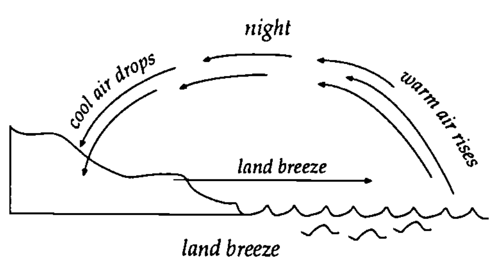
The differences in air pressure caused by the uneven heating of Earth by the sun result in winds. We use a **wind vane** to indicate the direction from which the wind is blowing. An **anemometer** is used to measure wind speed.

There are different types of wind systems. Local wind systems are caused by the specific conditions of a local area. The surface features of a particular area affect the amount of heat absorbed by the sun. Land absorbs the heat of the sun faster than water does, but it also loses heat faster than the water. This causes an uneven heating of the air and results in local winds. Winds are named for the direction from which they come.



During the day, land near a large body of water heats up faster than the water. The warm air above the land rises and the cool air from the body of water moving inland to replace it creates a **sea breeze**.

At night, the land cools faster than nearby bodies of water. Eventually air above the water will become warmer than that above the land and will rise, causing the cooler air from land to move in and replace it. This movement of air from land to sea is called a **land breeze**.



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Wind Systems

The unequal heating and rotation of Earth also creates global wind systems, or belts. The air above the equator is warmer than the air above the polar regions. Warmer air rises and travels towards the poles where it cools and becomes heavier. This cool, heavy air then moves back towards the equator where it is again warmed and rises. This warming and cooling process combines with Earth's rotation to form convection currents that create global winds. There are several wind systems on Earth's surface. They are as follows:

Doldrums. The **doldrums** are a windless zone at the equator. The air seems to be motionless, but actually it is constantly being heated and forced straight up. This causes very little wind or no wind at all except during storms. In the days of sailing ships, many ships were caught in the doldrums and lost.

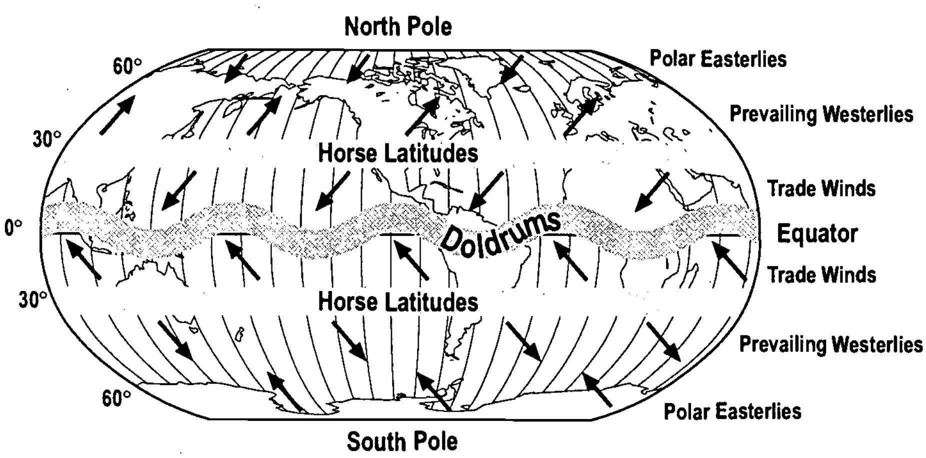
Trade Winds. The wind belt known for the **trade winds** is found just north and south of the equator. In these areas, wind is fairly constant. North of the equator the winds blow from the northeast, and south of the equator they blow from the southeast. Early sailors depended on these winds to get from one continent to another in order to trade, and called them trade winds.

Horse Latitudes. Just north and south of the trade winds at about 30° latitude are two narrow regions known as the **horse latitudes**. This is where the air moving from the equator cools and sinks. It is characterized by clear weather and very little rainfall. There is also very little wind in this area. If ships were caught in this region, they sometimes had to throw horses overboard when they were unable to feed them, giving the area its name.

Prevailing Westerlies. North and south of the horse latitudes are another wide belt of winds known as the **prevailing westerlies**, named for the direction from which they blow. These winds form in areas of Earth where there are large areas of land. The air over the land heats up and rises, then cools and sinks again, creating a wind belt.

Polar Easterlies. The belt known as the **polar easterlies** extends from 65° north and south latitude to the poles. These winds come from the east and blow cold winds away from the polar areas.

Sometimes winds that blow are seasonal. Winds that blow in one direction one season and in an opposite direction in another season are called **monsoons**. During a monsoon, the land becomes hotter than the water, causing winds that blow in from the ocean which bring warm, moist air, producing a rainy season during the summer. In the winter, the land cools more quickly, causing the winds to blow from the land to the oceans, which creates a dry season. A monsoon is actually a very large, long-lasting land and sea breeze.

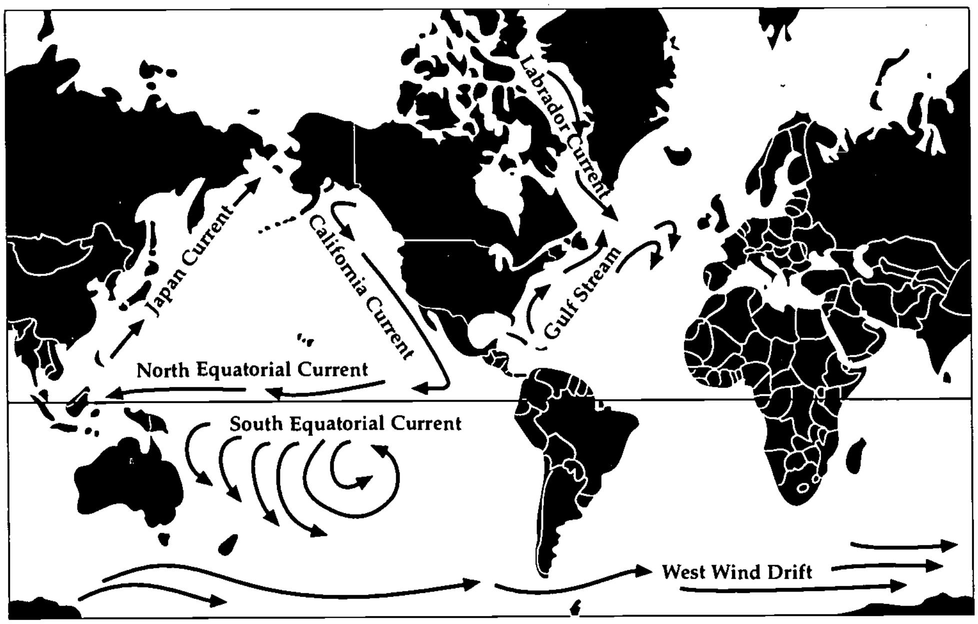


Wind Belts

Currents

A *current* is a moving, streaming, or plowing body of water or air. Ocean currents are sometimes called the *rivers of the ocean*. Like the rivers on the land, ocean currents flow in nearly the same direction.

The ocean has many currents. These currents are caused by the forces of the sun's heat, Earth's rotation, and the blowing winds.



Ocean Currents

Changes in the water temperature cause currents. Differences in water temperature start water movement called convection currents. Because the equator of Earth receives direct sun rays, the waters near the equator are warmer than the waters near the north or south pole. Warm water from the equator is pushed toward the poles by winds and Earth's rotation. This warm current transfers its warmth to the lands it flows by and to the cool waters around the poles. The colder water is heavier, so it sinks and moves back to the equator.

Ocean currents affect the climate of the continents they flow past. Currents that originate near the equator are warm. The warmth of these currents is transferred to the land and to the cool northern waters. The Gulf Stream is a warm current that helps moderate the winters of the British Isles and Norway and keeps them relatively warm for their latitudes. The Gulf

Stream warms our eastern coast of the United States. The Japan Current is also a warm current. It brings a mild climate to parts of British Columbia and Alaska.

Alaskan waters are near the North Pole and nearer to either pole the water cools. Colder, heavier polar waters sink under warm currents and move back toward the equator. The California Current is a colder current that affects the western coast of the United States.

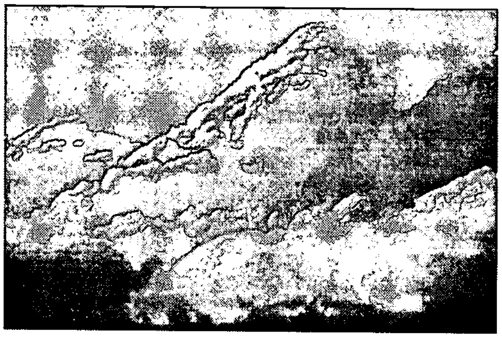
The dense fog of London is an example of the way currents affect the land masses. This heavy fog is caused when the warm, moist air from the Gulf Stream meets the colder air from the Labrador Current.

Storms

There are many different types of storms that occur on the surface of Earth. They range in severity from minor inconvenience to major disaster.

When two fronts collide, rainstorms and thunderstorms form. A *rainstorm* or steady rainfall that lasts for hours forms when a warm front meets a cold front. There is not usually much danger in a rainstorm except for flooding if the storm lasts long enough.

Thunderstorms form when a cold front meets a warm front. As warm air rises, it cools and condenses, forming *cumulonimbus* clouds. These clouds cause heavy rains along with **thunder** and lightning. During thunderstorms, electrical charges build up in the clouds. *Lightning* is the sudden discharge of electricity from the clouds. *Thunder* is the sound made by lightning. It is usually heard a few seconds after the lightning is seen because sound travels slower than light.

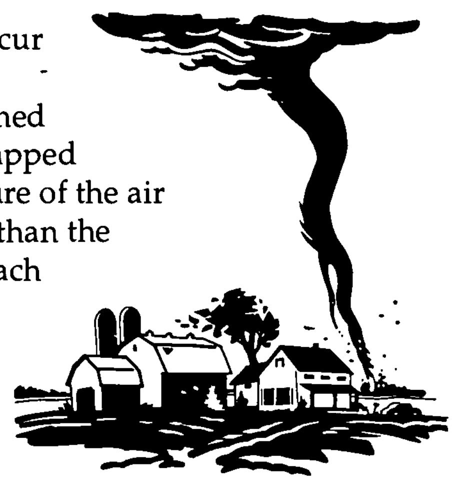


Blizzards occur during the winter months. Blizzards combine high winds, below freezing temperatures, and blowing powdery snow. Winds often range from 30 to 45 miles per hour (mph). These severe weather conditions can be dangerous to people and animals.

Low-pressure areas that contain warm air rising in a counterclockwise circular motion are called **cyclones**. The low-pressure areas usually cause rainy, stormy weather. High-pressure areas that have cool, dry air moving downward in a clockwise motion are called **anticyclones**. They bring clear, dry, fair weather. Cyclones and anticyclones move in opposite directions in the Southern Hemisphere. These systems can be either mild or severe.

A *hurricane* is a large, powerful cyclone. Hurricanes start out as low-pressure areas over the ocean in summer or early fall. As the system builds, it forms a spiral motion and contains a large amount of moisture. When wind speed is less than 35 mph, the storm is called a **tropical depression**. If the storm builds to a wind speed of 35 to 74 mph, it is called a **tropical storm**. When sustained winds reach 75 mph or more, a hurricane is born. Hurricane winds can reach over 200 mph; however, most of the damage from hurricanes comes from the flooding caused by the heavy rains associated with the storm.

A *tornado* is a violent, funnel-shaped windstorm that can occur along with thunderstorms or hurricanes. Tornadoes are formed when a mass of warm air is trapped between two masses of cold air. The pressure of the air in the center of the tornado is much lower than the surrounding air, causing winds that can reach 300 mph. The path of a tornado is much smaller than that of a hurricane, but because of its extremely high winds, it can do more damage to the area it strikes. A tornado that forms over the ocean is called a **waterspout**.



Safety Precautions

Storms can cause severe damage. Many safety precautions can be taken to prevent injury and lessen damage.

Rainstorms and thunderstorms rarely cause severe damage, with the exception of flooding. However, if lightning occurs, take the precautions listed on the following page:

Lightning Safety Precautions

1. Stay indoors.
2. Unplug electrical appliances to prevent damage.
3. If outdoors, stay away from tall objects like trees and towers. Also, avoid metal objects like golf clubs and aluminum baseball bats.

Getting struck by lightning can result in burns, loss of hearing, nervous system problems, and death. Lightning is a problem in Florida—especially during the summer and fall.

Hurricanes develop in tropical waters usually between June and November. These storms affect Florida and cause damage from wind and water. Hurricanes cause large-scale destruction and often leave areas without power and telephone service. Therefore, make sure that you have water, nonperishable food, candles, flashlights, a portable radio, batteries, and other items you may need.

A *hurricane watch* means that a hurricane may threaten within 24 hours. *Hurricane warnings* indicate that one is expected to strike within 24 hours. When a warning is issued, take the following precautions:

Hurricane Warning Safety Precautions

1. Leave low-lying areas.
2. Secure boats, outdoor objects, and windows.
3. Fill your car with gas.
4. Leave mobile homes for sturdier shelter.
5. Listen to weather service bulletins.
6. Leave your home for shelter, if advised by authorities.

After the hurricane has completely passed, stay away from heavily damaged areas, flooded areas, and loose wires, and cooperate with emergency officials. Do not mistake the *eye* of the hurricane for the *end*. The eye is a calm area at the center of a hurricane. After it passes, the storm will continue.

Tornadoes can be spawned by hurricanes or occur singly over land or water. Remain indoors or seek shelter in low-lying areas, if outdoors. If inside, open a window a few inches on the side of the house away from the storm, and take shelter in a small interior area like a hallway, closet, or bathroom.

Blizzards are not a common occurrence in Florida. But if you should be where they occur, it is important to stay indoors, if possible. Frostbite and disorientation are common problems. People in northern areas watch weather bulletins and stay close to home as a precaution.

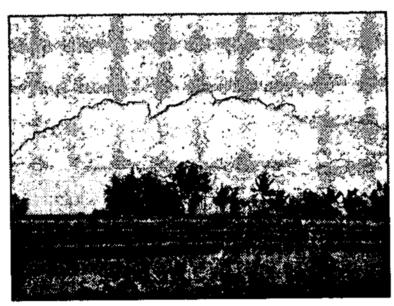
Danger to human life can be lessened by taking appropriate precautions when warnings are issued. It is important to pay attention to signs of severe weather.

Clouds

Clouds are tiny droplets of water suspended in the air. Clouds form when the air becomes **saturated** (has all of the moisture that it can hold). The droplets of water cling to particles of dust, salt, smoke, or even volcanic ash found in the atmosphere and form clouds.

cirrus clouds

There are three basic types of clouds. They are classified according to their shape and the altitude at which they are formed. There are three basic types:



cumulus clouds

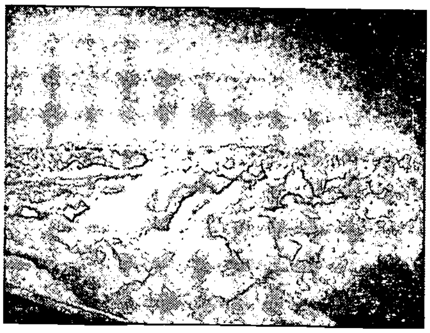
Cirrus. Cirrus clouds are thin, feathery clouds that form at very high altitudes. They are made of ice crystals and indicate that snow or rain may be coming in the next few hours.

Cumulus. Cumulus clouds are puffy with flat bottoms. They look like puffs of cotton in the sky. They form in the middle altitudes and usually indicate fair weather.

stratus clouds

Stratus. Stratus clouds are the gray, smooth, layered clouds that lie low in the sky. They block out the sun and usually bring rain or drizzle. Stratus clouds that form close to the ground are called fog.

Another term used to describe clouds is **nimbus**, which means *rain*. *Nimbostratus* clouds are low, black, layered clouds that cause long periods of rain. *Cumulonimbus* clouds are often called thunderheads because they are the clouds that cause thunderstorms.



Clouds shield against the heat of the sun. Since clouds are made of droplets of water, more light is reflected off them. As a result there are lower temperatures during the day than if there were no clouds. At night, clouds act as blankets that insulate Earth and keep it warmer. Heat waves radiated by the sun that enter the atmosphere are short waves. As they bounce off the surface of Earth, they become longer. These longer waves cannot pass through the cloud layer and therefore bounce back to Earth's surface, maintaining warmer nighttime temperatures than if there were no clouds. Clouds blanket Earth in much the same way a blanket keeps a person warm on a cool night. Cloud cover can keep crops from freezing when the temperatures unexpectedly drop below freezing.

Precipitation

When clouds form, water droplets may grow larger and larger until they are so heavy that they can no longer remain suspended in the air. Water falls to the ground in one or more forms called *precipitation*. There are several types of precipitation. The type of precipitation formed depends on the weather conditions and temperatures.

Rain is the most common type of precipitation. It forms when the temperature of air below the clouds is above freezing and droplets of water fall from the clouds. If the rain falls in very tiny drops, it is called *drizzle* or *mist*.

When the temperature in the clouds is below freezing and the temperature of the air below the clouds is also freezing, crystals of ice called *snowflakes* form. Each snowflake is unique, but all of them have six points.

Sleet forms when raindrops fall through a layer of air that is below freezing, causing the rain to freeze as it falls to Earth. Sleet also forms when snow melts on its way down and then freezes again; sleet will only fall in the winter. Freezing rain forms when conditions on the ground are cold enough to freeze the rain when it lands.

A damaging form of precipitation is *hail*. It can destroy entire crops as well as damage cars and other property. Hail or hailstones are chunks or balls of ice formed in cumulonimbus clouds. A hailstone is formed when a water droplet freezes on a small crystal of ice. Updrafts in the cloud toss the ice balls up in the cloud and then a layer of water freezes on the ice ball. This continues until the hailstone is finally heavy enough to fall to Earth. The average hailstone is about the size of a pea, but sometimes they can get as large as baseballs.

Climates

Weather encompasses the day-to-day changes in the temperature, humidity, wind, and air pressure. *Climate* is the average of conditions that make up an area's weather over a long period of time. Weather changes from day to day, whereas climate remains the same.

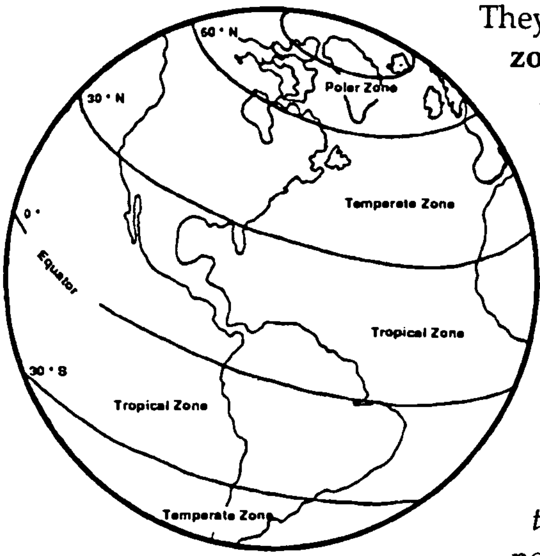
Factors Influencing Climate

An area's climate is influenced by many factors. Some of these include latitude, elevation, and nearness to a major body of water.

The latitude or distance north or south of the equator is a factor in determining the climate of an area. Areas near the equator receive the direct rays of the sun and have warm climates. Likewise, the areas farther from the equator get more indirect rays and are cooler, with the coldest areas being at the poles.

Elevation, or height above sea level, is also a factor in determining the climate of an area. The higher the elevation, the colder the climate. Even high mountains near the equator can have snow-capped peaks. Mountains near coastal regions are also important in forming **deserts**. When the moist winds from the ocean rise and meet the mountain range, they drop their moisture in the form of rain on the side of the mountains nearest the ocean or in the form of snow on the mountains. The air that passes to the other side of the mountains is now dry, and the climate on that side of the mountains will also be dry.

A major body of water near land may have a great influence on the climate. Land near large bodies of water may be humid or moist. Since large bodies of water heat up and cool off much more slowly than land, these areas do not have the extreme temperature changes of large land areas.



climate zones

There are three main climate zones on Earth. They are the **polar zone**, the **temperate zone**, and the **tropical zone**. The *polar* zone begins at each pole and extends to about 60° north or south latitude. Here, the average temperatures remain below freezing and there is little precipitation. Between 60° and 30° latitude on each hemisphere is a region called the *temperate* zone, which has a variance of temperatures and an average amount of precipitation. The *tropical* zone extends from about 30° north latitude to 30° south latitude. It has above-average temperatures and precipitation.

Within these zones there are other climatic types. *Deserts* are areas that receive less than 25 centimeters of rainfall a year. They are usually located along the western border of a large land mass with a range of coastal mountains.

Marine climates are found near large bodies of water. Temperatures in this type of climate do not vary much because the water cools off and heats up much more slowly than the land does. There is also less seasonal change in these areas.

Continental climates are found where there are huge land masses. They are greatly affected by air masses that move in from both polar and tropical regions. They have noticeable seasonal changes and severe temperature changes. Mountain regions located in continental areas also show distinct climatic changes. Higher up in the mountain regions, the climate becomes more like that found in the polar regions.

Summary

Heat and energy are transferred from the sun by Earth's atmosphere through convection, radiation, and conduction. Uneven heating of Earth causes changes in air pressure and air currents. These changes along with the Earth's rotation produce local wind systems and global wind systems.

Blowing winds, the sun's heat, and the Earth's rotation combine to create the oceans' many water currents.

Air masses of different types meet and form warm, cold, stationary, or occluded fronts. Colliding fronts cause many different types of storms. In the event of severe storms such as hurricanes and tornadoes, safety precautions should be used to prevent injury or property damage.

When moist air is cooled, water vapor condenses around tiny specks of dust, smoke, or salt to form droplets. Huge numbers of droplets form clouds. When these water droplets get too heavy, they fall to the ground in some form of precipitation—rain, sleet, hail, or snow. Three basic types of clouds insulate Earth and help shield it from the sun's heat.

Climate is the average weather of an area over a long period of time. Factors such as latitude, elevation, and nearness to water affect climate. Earth's atmosphere has four layers. Each layer has different temperatures and gases present.

Practice

Use the list below to complete the following statements.

10	**exosphere**	**oxygen**	**thermosphere**
aerosol cans	**ionosphere**	**ozone**	**troposphere**
atmosphere	**jet stream**	**skin cancer**	**ultraviolet rays**
blindness	**mesosphere**	**stratosphere**	

1. The blanket of air that surrounds Earth is the ____________________ .

2. The layer of the atmosphere closest to Earth that contains our weather is the ____________________ .

3. The troposphere extends for about ____________________ kilometers.

4. A narrow band of winds that blow from west to east, just above the troposphere, in which airplanes sometimes fly, is called the ____________________ .

5. The ____________________ is the layer above the troposphere.

6. The upper layer of the stratosphere is about the same temperature as Earth at sea level because of the presence of ____________________ .

7. Ozone heats the atmosphere by absorbing the sun's ____________________ .

8. Ultraviolet rays from the sun can cause ______________________ and ______________________.

9. CFCs used in ______________________ destroy the ozone layer.

10. The coldest part of the atmosphere is the ______________________.

11. Beyond the mesosphere is the ______________________, which extends to 500-700 kilometers and is very hot.

12. Within the thermosphere, the part that contains electrically charged particles is called the ______________________.

13. The last layer of the atmosphere extends for thousands of kilometers into space and is called the ______________________.

14. Ozone is a gas that contains three atoms of ______________________ per molecule instead of two atoms, as does the gas that we breathe.

Practice

Complete the chart below. Beside each layer of the **atmosphere**, *record the* **distance** *each extends into* **space**, *and list the important* **characteristics** *of each.*

Layer	Distance	Characteristics
1. troposphere		
2. stratosphere		
3. mesosphere		
4. thermosphere		
a. ionosphere		
b. exosphere		

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Practice

Answer the following using complete sentences.

1. How does ozone differ from the oxygen we breathe?

2. How does ozone smell?

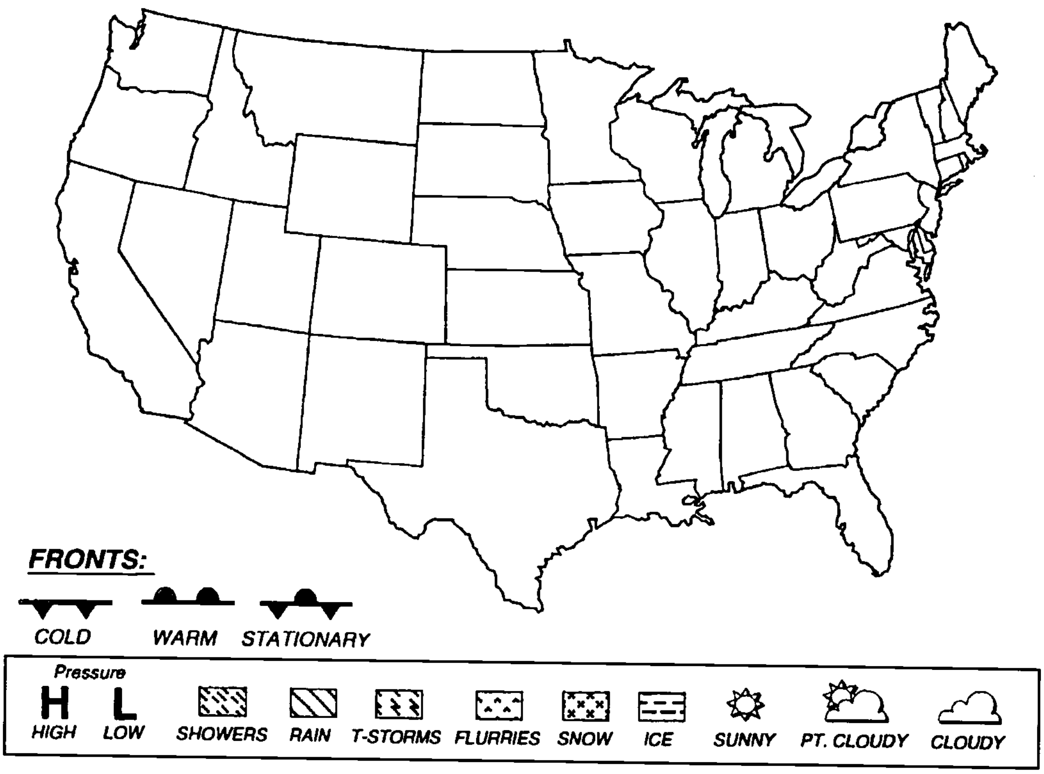
3. When can you smell ozone?

4. How does the ozone layer protect us?

5. What can be done to stop people from destroying the ozone layer?

Practice

Use data from the newspaper to construct a **weather map** *for a particular day. Use your knowledge of* **air masses** *to predict the weather for the* **southeast region**.



Practice

Use the list below to complete the following statements.

convection current	heat	radiation
counterclockwise	indirect rays	sun
currents	low-pressure	wind
direct rays		

1. Earth gets its heat from the ________________ .

2. The process by which the sun's energy reaches Earth in the form of waves is called ________________.

3. Light waves are absorbed by Earth and returned to the atmosphere as ________________ .

4. A ________________ is formed when warm air rises and cold air rushes in to take its place.

5. Rays of the sun that hit Earth at a 90° angle are called ________________ .

6. Rays that strike Earth at an angle of greater than 90° are called ________________ .

7. ________________ are vertical movements of air.

8. Horizontal movements of air are called ________________ .

9. Air that is heated is less dense; it rises and forms a

_________________________ area.

10. The winds of a low-pressure area move _________________________

in the Northern Hemisphere.

Practice

Use the list below to complete the following statements.

air mass	**high-**	**occluded**
barometer	**high pressure area**	**stationary**
cold	**low-**	**warm**
front		

1. Cloudy, rainy weather is caused by a ________________ pressure system.

2. Cool air that is heavy sinks and creates a ________________ .

3. Cool, clear skies with dry weather accompany a ________________ pressure area.

4. A ________________ is used to measure air pressure.

5. A large body of air having the same amount of moisture and temperature is called a(n) ________________ .

6. A boundary called a ________________ forms when two different types of air masses meet.

7. After a(n) ________________ front, the weather is usually cool and clear.

8. A(n) ________________ front forms when two fronts meet but neither moves for a period of time.

9. A(n) ________________________ front brings rain or snow that lasts for a long period of time.

10. When a cold front overtakes and merges with a warm front, a(n) ________________________ front forms.

Practice

Match the **front** *with the correct* **symbol**. *Write the letter on line provided.*

______ 1. Warm Front

______ 2. Cold Front

______ 3. Occluded Front

______ 4. Stationary Front

A. 

B. 

C. 

D. 

Lab Activity 1: The Earth's Rotation Creates Winds and Currents

Purpose	Materials
Observe the effects of rotation on water.	• bowl • water • lazy Susan tray or rotating piano stool

1. Place a bowl of water on a lazy Susan tray or a rotating piano stool.
2. Gently spin in a counterclockwise direction.
3. Let the water become still.
4. Rotate in the opposite direction.
5. What did you see happen when the water was spun counterclockwise?

   ____

   ____

   ____

6. What did you see happen to the water when it was rotated in the opposite direction?

   ____

   ____

   ____

7. How did the water movement change? ____________________

   ____

   ____

Lab Activity 2: Water Currents

Purpose

Observe water currents that result from heating water.

Materials

- ice cubes
- rectangular pan
- water
- food coloring
- Bunsen burner

1. Place ice cubes in the center of a rectangular pan.

2. Fill pan with water.

3. Put an immersion heater just below the surface of the water on one side of the pan. (A Bunsen burner can be used. Make sure to heat one side of the pan, not the center.)

4. Add several drops of food coloring close to the heated side.

5. Continue to heat until you can see the movement of the color.

6. In what direction does the colored water move? ____________

7. Does the clear water move? ____________

8. Does the colored water stay at the top? ____________

9. What climate zone does the ice represent? ____________

10. What climate zone does the heater represent? ____________

11. Considering what you have observed, in what direction do you think the ocean currents should move?

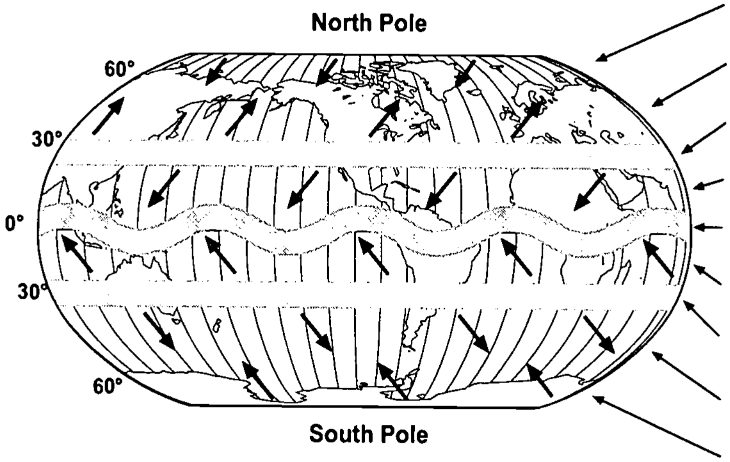
____

____

____

Practice

Label the **major wind systems** *on Earth. Write* **North, South, East,** *or* **West** *on each line in the chart to show the direction of the* **major air movements**. *The arrows indicate the direction of the movement.*



1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________

10.-15.

Wind		
Direction of movement for latitudes:	Northern Hemisphere	Southern Hemisphere
60° - 90°		
30° - 60°		
0° - 30°		

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Practice

Match each definition with the correct term. Write the letter on the line provided.

______	1. instrument used to indicate from which direction the wind is coming	A. anemometer
______	2. instrument used to measure the speed of the wind	B. doldrums
______	3. breeze formed when the air on land warms and rises and cooler wind from the ocean rushes in to replace it	C. horse latitudes
______	4. breeze that blows at night when cool air from the land moves out to sea replacing the warmer air found there	D. land breeze
______	5. system of wind found just north and south of the equator where there is a steady wind flow that early sailors depended on	E. monsoons
______	6. seasonal winds that bring rainy weather in the summer and dry weather in the winter	F. polar easterlies
______	7. area around the equator where there is little or no wind	G. prevailing westerlies
______	8. system of winds found in the areas of Earth where there are large land masses; these winds blow from the west	H. sea breeze
______	9. narrow band near 30° latitude with very little wind	I. trade winds
______	10. system of winds that extends from the poles to 65° north and south latitude that blow cold winds from an easterly direction	J. wind vane

Practice

Use the **hurricane tracking map** *on the next page to* **plot** *the* **paths** *of hurricanes* **Bonnie** *and* **Andrew**. *Then answer the questions below with a short answer.*

Hurricane Bonnie			**Hurricane Andrew**		
Date	Position at 6:00 a.m.		Date	Position at 6:00 a.m.	
1998	Latitude	Longitude	1992	Latitude	Longitude
Aug. 22	21.8° N	68.7° W	Sept. 20	20.7° N	60.0° W
23	23.8° N	71.3° W	21	23.9° N	63.3° W
24	25.2° N	72.1° W	22	25.6° N	67.0° W
25	27.8° N	73.8° W	23	25.5° N	72.5° W
26	31.7° N	77.3° W	24	25.4° N	79.3° W
27	34.5° N	77.5° W	25	26.6° N	86.7° W
28	36.2° N	75.1° W	26	29.2° N	91.3° W
29	39.2° N	69.6° W	27	32.1° N	90.5° W
30	44.3° N	57.0° W	28	35.4° N	84.0° W

1. Where did Bonnie hit land? ______________________

2. Where did Andrew hit land? ______________________

3. In which general directions do hurricanes move? __________

4. Where do most of the hurricanes form that affect Florida?

   ____

5. Which areas of the United States are most affected by hurricanes?

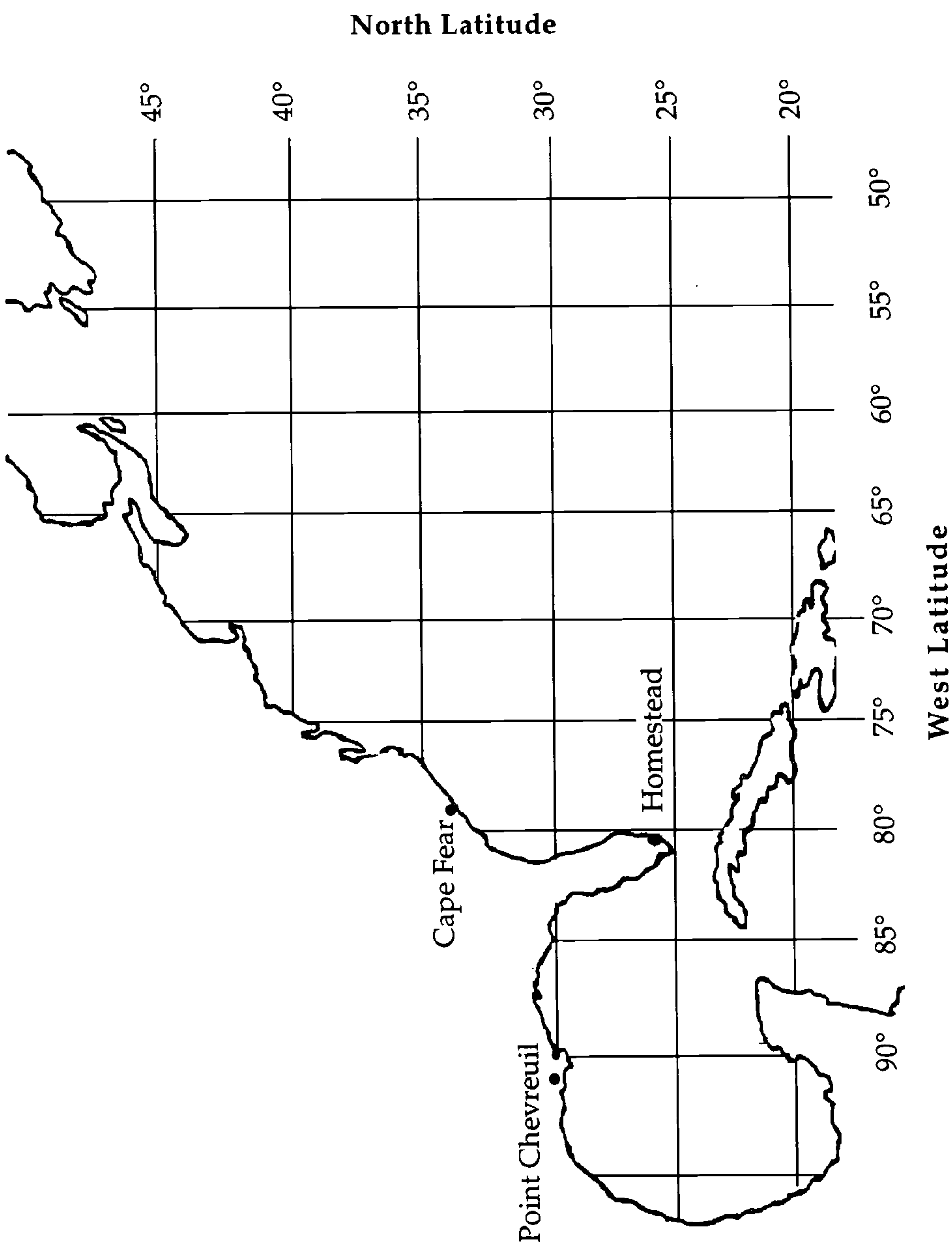
   ____

6. What causes the most damage from a hurricane, wind or water?

   ____

Practice

Use the information on the previous page to **plot** *the* **paths** *of* **hurricanes Bonnie** *and* **Andrew** *on the map below.*



Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

75	**cyclones**	**thunder**
200	**hurricane**	**tornado**
anticyclones	**lightning**	**tropical depression**
blizzard	**opposite**	**tropical storm**
cumulonimbus	**rainstorm**	**waterspout**

1. A storm formed when two fronts meet that causes steady rainfall lasting for hours is called a ____________________ .

2. A snowstorm with strong winds is called a ____________________ .

3. Thunderstorms are caused by the formation of ____________________ clouds.

4. A sudden discharge of electricity from the clouds is called ____________________ .

5. ____________________ is the sound made by lightning.

6. Low-pressure areas that contain warm air rising in a counterclockwise circular motion are called ____________________ .

7. High-pressure areas that have cool, dry air moving downward in a clockwise motion are called ____________________ .

8. High- and low-pressure systems move in ________________ directions in the Southern Hemisphere.

9. A large powerful cyclone that begins as a low-pressure system over the ocean in summer or early fall is called a ________________.

10. A low-pressure system with winds less than 35 mph is called a(n) ________________.

11. A large, low-pressure system with winds from 35 to 74 mph is a ________________.

12. A hurricane is formed when sustained winds reach ________________ mph. Hurricane winds can reach speeds of over ________________ mph.

13. A violent, funnel-shaped windstorm with winds that reach 300 mph is a ________________.

14. A ________________ is a tornado that forms over the ocean.

15. The path of a ________________ is smaller than that of a ________________, but because of the high winds it can do more damage.

Practice

Answer the following using complete sentences.

1. What danger exists in thunderstorms? ______________________

____

____

2. What should you do if you are caught outside during a thunderstorm?

____

____

____

3. What are three precautions to take in the event of a hurricane?

____

____

____

4. What is the difference between a hurricane watch and a hurricane warning?

____

____

____

5. Where should you seek shelter indoors during a tornado?

____

____

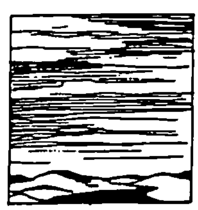
Practice

Match each description with the correct **type of cloud**. *Write the letter on the line provided.*

______	1.	thin, feathery clouds found at high altitudes	A. cirrus
______	2.	clouds that contain rain	B. cumulonimbus
______	3.	gray, smooth, layered clouds found low in the sky	C. cumulus
______	4.	clouds that cause thunderstorms	D. nimbostratus
______	5.	puffy clouds with flat bottoms found at middle altitudes	E. nimbus
______	6.	low-lying, black, layered clouds that bring long periods of rain	F. stratus

Label the three basic **types of clouds**:

7. ______________



8. ______________

9. ______________

Practice

Complete the chart below for **five** *consecutive days.*

Cloud Observation Chart

Date and time of day	Direction of wind	Type of cloud observed	Description of clouds observed (puffy? wispy? dark? flat? etc.)	Weather conditions at the time
	north			
	east			
	south			
	west			
	north			
	east			
	south			
	west			
	north			
	east			
	south			
	west			
	north			
	east			
	south			
	west			
	north			
	east			
	south			
	west			

Practice

Match each definition with the correct term. Write the letter on the line provided.

______ 1. moisture that falls to Earth as rain, hail, sleet, or snow

______ 2. condensation on particles of dust, smoke, or salt

______ 3. temperature of the air below the clouds is above 32° F

______ 4. six-pointed crystals of ice that fall when the temperature of both the clouds and the land is below freezing

______ 5. rain that falls in very tiny droplets

______ 6. rain that freezes after it hits the ground

______ 7. snow melts and freezes again on its way down

______ 8. the most damaging form of precipitation

A. cloud

B. drizzle or mist

C. freezing rain

D. hailstones

E. precipitation

F. rain

G. sleet

H. snowflakes

Practice

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. Water droplets must condense on particles such as dust or smoke in order to form clouds.

_________ 2. Precipitation forms when water droplets become so heavy that they can no longer stay suspended in the air.

_________ 3. Snow is the most common type of precipitation.

_________ 4. Rain that forms very large droplets is called drizzle or mist.

_________ 5. In order for snowflakes to form, both the temperature of the clouds and the temperature of the air must be below freezing.

_________ 6. Snowflakes can have four, five, or six points.

_________ 7. Sleet and freezing rain are the same thing.

_________ 8. Sleet only falls in the winter.

_________ 9. The form of precipitation that causes the most damage is sleet.

_________ 10. Hailstones are formed in cumulonimbus clouds.

_________ 11. Hailstones are usually the size of golf balls.

_________ 12. Hailstones move up and down in the clouds several times, forming new layers of ice until they are finally heavy enough to fall.

_________ 13. Snow that melts on its way down and refreezes is called sleet.

_________ 14. The type of precipitation that falls is only determined by the temperature on the ground where it falls.

Practice

Answer the following using complete sentences.

1. What three factors influence the climate of an area? ______________

    ____

    ____

2. Why are areas near the equator warmer? ____________________

    ____

3. How do mountains near coastal regions help in the formation of deserts?

    ____

    ____

    ____

4. Describe the temperature and precipitation in each of the three major climate zones. Fill in the chart below.

Zone	Temperature	Precipitation

5. Describe the following climate types.

Desert: ____

____

____

____

____

____

Marine climate: ____

____

____

____

____

____

Continental climate: ____

____

____

____

____

____

____

Practice

Use the list below to write the correct **atmosphere** *and* **climate** *term for each definition on the line provided. One or more terms will be used more than once.*

atmosphere	**jet stream**	**stratosphere**
climate	**marine climate**	**temperate zone**
continental climate	**mesosphere**	**thermosphere**
desert	**ozone**	**troposphere**
exosphere	**polar zone**	**weather**
ionosphere		

__________________________ 1. type of climate found where there are huge land masses

__________________________ 2. type of climate found when an area is located near a large body of water

__________________________ 3. day-to-day changes in temperature, humidity, wind, and air pressure

__________________________ 4. the blanket of air surrounding Earth

__________________________ 5. the part of the thermosphere that contains electrically charged particles called ions

__________________________ 6. the zone of moderate climate with distinct seasonal changes located between 30° and 60° latitude

__________________________ 7. coldest layer of the atmosphere, just above the stratosphere

__________________________ 8. dry areas that receive less than 25 cm of rainfall per year

__________________________ 9. area of Earth that extends from the poles to 60° north and south latitude and has a very cold climate

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______________________ 10. the weather of an area over a long period of time

______________________ 11. the layer of the atmosphere above the mesosphere where the air is very thin and hot

______________________ 12. type of oxygen with three oxygen atoms (O_3) found in the upper areas of the stratosphere

______________________ 13. the layer of air closest to Earth

______________________ 14. the upper part of the thermosphere

______________________ 15. the lowest layer of the atmosphere that contains most of our weather

______________________ 16. the layer of Earth's atmosphere that contains ozone

______________________ 17. narrow band of winds that blow from west to east just above the troposphere

Practice

Use the list below to write the correct **solar radiation** *and* **air mass** *term for each definition on the line provided.*

air masses	**currents**	**occluded front**
barometer	**direct rays**	**radiation**
cold front	**front**	**stationary front**
conduction	**high-pressure system**	**warm front**
convection	**indirect rays**	**wind**
convection current	**low-pressure system**	

________________________ 1. front that forms when two unlike air masses face each other, but neither moves

________________________ 2. process by which the sun's rays reach Earth in the form of waves

________________________ 3. front that forms when a cold front overtakes and merges with a warm front

________________________ 4. system that brings cloudy, rainy, and often stormy weather

________________________ 5. rays of the sun that hit Earth at greater than 90°; they produce less heat

________________________ 6. system that brings cool, clear skies and dry weather

________________________ 7. the boundary formed when two different masses of air meet

________________________ 8. rays of the sun that hit Earth at a 90° angle; they create the greatest amount of heat

_______________ 9. vertical movements of air or water caused by the uneven heating of Earth

_______________ 10. vertical movement of air or water caused by differences in temperature

_______________ 11. front formed when a mass of cold air meets a mass of warm air and moves beneath it

_______________ 12. an instrument used to measure air pressure

_______________ 13. large bodies of air having the same temperature and amount of moisture

_______________ 14. front that forms when a mass of warm air meets a mass of cold air and moves over it

_______________ 15. horizontal movements of air caused by the uneven heating of Earth

_______________ 16. direct transfer of heat energy from one substance to another

_______________ 17. transfer of heat energy by moving air or fluid

Practice

Use the list below to write the correct **wind** *and* **current** *term for each definition on the line provided.*

anemometer	**monsoons**	**sea breeze**
doldrums	**polar easterlies**	**trade winds**
horse latitudes	**prevailing westerlies**	**wind vane**
land breeze		

______________________ 1. an instrument used to measure wind speed

______________________ 2. area at about 30° north and south latitude where there is very little wind

______________________ 3. the area around the equator where air moves straight up and there is very little wind

______________________ 4. system of winds that blows cold air from the poles

______________________ 5. cool air that moves from sea to land during the day

______________________ 6. cool air blowing from land to sea at night

______________________ 7. system of winds found just north and south of the equator that blows toward the equator from the northeast and southeast

______________________ 8. winds that blow inland during summer bringing rainy weather and that blow out to sea in winter bringing dry weather

______________________ 9. an instrument that tells from which direction the wind is coming

______________________ 10. wind system formed over large land areas that blow from the west to the east

Practice

Use the list below to write the correct **storm** *and* **precipitation** *term for each definition on the line provided.*

anticyclone	**hurricane**	**stratus**
blizzard	**lightning**	**thunder**
cirrus	**nimbostratus**	**tornado**
cloud	**nimbus**	**tropical depression**
cumulonimbus	**precipitation**	**tropical storm**
cumulus	**saturated**	**waterspout**
cyclone		

________________________ 1. a large, powerful low-pressure storm system; a cyclone with sustained winds of 75 mph or more

________________________ 2. puffy, white clouds with flat bottoms

________________________ 3. high-pressure system with winds moving clockwise

________________________ 4. a cloud that causes rain to fall

________________________ 5. a sudden discharge of electricity from clouds

________________________ 6. a severe snowstorm with high winds

________________________ 7. a term used when the air has all the moisture it can hold

________________________ 8. tiny droplets of water suspended in the air

________________________ 9. very high, thin, feathery clouds made of ice crystals

________________________ 10. a low-pressure system with winds moving in a counterclockwise direction

_______________ 11. smooth, layered clouds found low in the sky

_______________ 12. a dark, low-lying stratus cloud that contains rain

_______________ 13. the sound made by lightning

_______________ 14. cumulus clouds that bring rain; also called thunderheads

_______________ 15. moisture that falls to Earth as rain, hail, sleet, or snow

_______________ 16. a tornado that forms over water

_______________ 17. a violent, funnel-shaped windstorm

_______________ 18. a storm formed when the winds of a tropical depression are between 35 and 74 mph

_______________ 19. a storm formed by a large, low-pressure system over water with winds less than 35 mph

Practice

Circle the letter of the **atmosphere** *and* **climate** *term that correctly completes each statement below.*

1. A dry area that receives less than 25 cm of rainfall per year is a(n) ____________ .

   a. equinox
   b. ozone
   c. polar zone
   d. desert

2. The upper part of the thermosphere is called the ____________ .

   a. ionosphere
   b. jet stream
   c. exosphere
   d. mesosphere

3. The coldest layer of the atmosphere, just above the stratosphere is called the ____________ .

   a. exosphere
   b. ozone
   c. polar zone
   d. mesosphere

4. The ____________ is the lower part of the thermosphere that contains electrically charged particles called ions.

   a. ozone
   b. mesosphere
   c. exosphere
   d. ionosphere

5. The ____________ is a layer of Earth's atmosphere above the troposphere; it contains the ozone layer.

   a. thermosphere
   b. temperate zone
   c. stratosphere
   d. tropical zone

6. The layer of the atmosphere above the mesosphere where the air is very thin and hot is called the ___________ .

   a. tropical zone
   b. thermosphere
   c. ionosphere
   d. troposphere

7. The day-to-day changes in temperature, humidity, wind, and air pressure are called ___________ .

   a. temperate zones
   b. tropical zones
   c. weather
   d. marine climates

8. The ___________ is mixture of gases surrounding Earth.

   a. equinox
   b. polar zone
   c. tropical zone
   d. atmosphere

9. The ___________ is a narrow layer of strong winds that blow from west to east just above the troposphere.

   a. mesosphere
   b. jet stream
   c. polar zone
   d. ozone

10. The weather of an area over a long period of time is called the ___________ .

    a. climate
    b. seasons
    c. solstice
    d. tropical

11. The type of climate found when an area is located near a large body of water is called ___________ .

    a. seasons
    b. continental climate
    c. tropical zone
    d. marine climate

12. The type of climate found where there are huge land masses is called ___________ .

a. continental climate
b. marine climate
c. tropical zone
d. seasons

13. The zone of moderate climate with distinct seasonal changes located between 30° and 60° latitude is a ___________ .

a. polar zone
b. temperate zone
c. tropical zone
d. solstice

14. The type of oxygen with three oxygen atoms (O_3) found in the upper areas of the stratosphere is called ___________ .

a. ozone
b. seasons
c. climate
d. solstice

15. The ___________ is the layer of air closest to Earth.

a. troposphere
b. temperate
c. thermosphere
d. mesosphere

16. The area of Earth that extends from the poles to 60° north and south latitude and has very cold climate is called the ___________ .

a. temperate zone
b. stratosphere
c. tropical zone
d. polar zone

17. The lowest layer of the atmosphere that contains most of our weather is called the ___________ .

a. stratosphere
b. polar zone
c. troposphere
d. temperate zone

Practice

Circle the letter next to the **solar radiation** *and* **air mass** *term that correctly completes each statement below.*

1. An instrument used to measure air pressure is a ____________ .

   a. barometer
   b. convection current
   c. direct ray
   d. current

2. The vertical movement of air or water caused by differences in temperature is a ____________ .

   a. current
   b. front
   c. direct ray
   d. convection current

3. Rays of the sun that hit Earth at a 90° angle are called ____________ .

   a. fronts
   b. indirect rays
   c. high-pressure systems
   d. direct rays

4. A system that brings cool, clear skies and dry weather is a(n) ____________ .

   a. low-pressure system
   b. indirect ray
   c. high-pressure system
   d. stationary front

5. A system that brings cloudy, rainy, and often stormy weather is a(n) ____________ .

   a. stationary front
   b. occluded front
   c. convection current
   d. low-pressure system

6. The process by which the sun's rays reach Earth in the form of waves is called ____________ .

   a. wind
   b. warm front
   c. radiation
   d. stationary front

7. Large bodies of air having the same temperature and amount of moisture are ____________ .

   a. currents
   b. convection currents
   c. warm fronts
   d. air masses

8. A front formed when a mass of cold air meets a mass of warm air and moves beneath it is a ____________ .

   a. cold front
   b. current
   c. front
   d. direct ray

9. Vertical movements of air caused by the uneven heating of the Earth are ____________ .

   a. fronts
   b. direct rays
   c. currents
   d. indirect rays

10. The boundary formed when two different masses of air meet is a(n) ____________ .

   a. occluded front
   b. low-pressure system
   c. high-pressure system
   d. front

11. The rays of the sun that hit Earth at more than 90° and produce less heat are called ____________ .

   a. radiation
   b. low-pressure systems
   c. occluded fronts
   d. indirect rays

12. A front that forms when a cold front overtakes and merges with a warm front is a(n) ___________ .

    a. occluded front
    b. stationary front
    c. low-pressure system
    d. warm front

13. A front that forms when two unlike air masses face each other, but neither moves is a(n) ___________ .

    a. warm front
    b. high-pressure system
    c. stationary front
    d. occluded front

14. The horizontal movements of air caused by the uneven heating of Earth are called ___________ .

    a. stationary front
    b. radiation
    c. occluded front
    d. wind

15. A front that forms when a mass of warm air meets a mass of cold air and moves over it is a(n) ___________ .

    a. occluded front
    b. warm front
    c. stationary front
    d. low-pressure system

16. The transfer of heat energy by moving air or fluid is ___________ .

    a. convection
    b. current
    c. conduction
    d. radiation

17. The direct transfer of heat energy from one substance to another is ___________ .

    a. radiation
    b. conduction
    c. current
    d. convection

Practice

Circle the letter next to the **wind** *and* **current** *term that correctly completes each statement below.*

1. A system of winds that blows cold air from the poles is called ____________ .

   a. sea breezes
   b. prevailing westerlies
   c. polar easterlies
   d. horse latitudes

2. Cool air blowing from land to sea at night is a ____________ .

   a. monsoon
   b. trade wind
   c. land breeze
   d. sea breeze

3. The area around the equator where air moves straight up and there is very little wind is called ____________ .

   a. monsoons
   b. doldrums
   c. land breezes
   d. horse latitudes

4. An instrument used to measure wind speed is a(n) ____________ .

   a. sea breeze
   b. land breeze
   c. anemometer
   d. wind vane

5. The area at about 30° north and south latitude where there is very little wind is the ____________ .

   a. horse latitudes
   b. monsoons
   c. prevailing westerlies
   d. trade winds

6. Winds that blow inland during summer bringing rainy weather and that blow out to sea in winter bringing dry weather are called ___________ .

   a. sea breezes
   b. monsoons
   c. polar easterlies
   d. trade winds

7. An instrument that tells from which direction the wind is coming is a(n) ___________ .

   a. anemometer
   b. land breeze
   c. monsoon
   d. wind vane

8. A wind system formed over large land areas that blows from the west to the east is the ___________ .

   a. polar easterlies
   b. monsoons
   c. trade winds
   d. prevailing westerlies

9. Cool air that moves from sea to land during the day is a ___________ .

   a. sea breeze
   b. land breeze
   c. doldrum
   d. trade wind

10. A system of winds just found north and south of the equator that blows toward the equator from the northeast and southeast is the ___________ .

    a. trade winds
    b. polar easterlies
    c. doldrums
    d. prevailing westerlies

Practice

Circle the letter next to the **storm** *and* **precipitation** *term that correctly completes each statement below.*

1. Tiny droplets of water suspended in the air are ______________ .

   a. clouds
   b. blizzards
   c. hurricanes
   d. cyclones

2. A high-pressure system with winds moving clockwise is a(n) ______________ .

   a. anticyclone
   b. cyclone
   c. tornado
   d. hurricane

3. ______________ clouds are clouds that bring rain—they are also called thunderheads.

   a. Cumulus
   b. Cumulonimbus
   c. Hurricanes
   d. Cyclones

4. Moisture that falls to Earth as rain, hail, sleet, or snow is ______________ .

   a. saturated
   b. thunder
   c. stratus
   d. precipitation

5. A sudden discharge of electricity from clouds is called ______________ .

   a. thunder
   b. precipitation
   c. waterspout
   d. lightning

6. A severe snowstorm with high winds is a ____________ .

   a. tornado
   b. blizzard
   c. cloud
   d. tropical depression

7. Any type of low-pressure system with winds moving in a counterclockwise direction is a ____________ .

   a. hurricane
   b. tropical storm
   c. tropical depression
   d. cyclone

8. Very high, thin, feathery clouds made of ice crystals are ____________ .

   a. cumulus
   b. stratus
   c. cirrus
   d. nimbostratus

9. Puffy, white clouds with flat bottoms are ____________ .

   a. cumulus
   b. stratus
   c. cirrus
   d. nimbostratus

10. A large, powerful low-pressure storm system is a ____________ .

    a. blizzard
    b. cyclone
    c. hurricane
    d. tornado

11. A storm formed when the winds of a tropical depression are between 35 and 74 mph is a ____________ .

    a. tornado
    b. tropical storm
    c. blizzard
    d. cyclone

12. The sound made by lightning is ____________ .

a. cyclone
b. tornado
c. thunder
d. nimbus

13. A dark, low-lying stratus cloud that contains rain is called ____________ .

a. nimbostratus
b. precipitation
c. nimbus
d. stratus

14. Smooth, layered clouds found low in the sky are called ____________ .

a. tornados
b. nimbus
c. stratus
d. cumulus

15. A cloud that causes rain to fall is called ____________ .

a. precipitation
b. stratus
c. cirrus
d. nimbus

16. A tornado that forms over water is a ____________ .

a. tropical depression
b. blizzard
c. cyclone
d. waterspout

17. A term used when the air has all the moisture it can hold is ____________ .

a. stratus
b. tornado
c. thunder
d. saturated

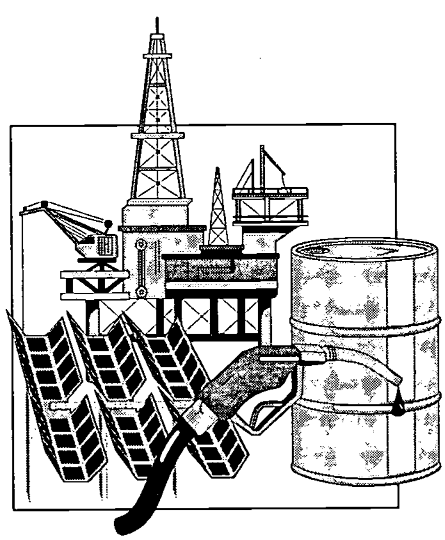
18. A storm formed by a large, low-pressure system over water with winds less than 35 mph is a ________.

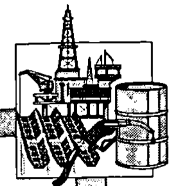
a. tropical storm
b. blizzard
c. tropical depression
d. tornado

19. A violent, funnel-shaped windstorm is a ________.

a. hurricane
b. tropical storm
c. tornado
d. cyclone

Unit 15: Energy Sources





Vocabulary

Study the vocabulary words and definitions below.

anthracite .... the final stage in the formation of coal; it is very hard and burns cleanly

biomass fuel .... a burnable fuel made from plant and animal material
Examples: wood and peat

bituminous .... the third stage in the formation of coal; it is soft and gives off a lot of heat when burned

coal .... fossil fuel that comes from plants that lived millions of years ago

conserve .... to save natural resources for the future

electricity .... the type of energy produced by using natural resources such as water, wind, and fossil fuels to power a generator

energy .... the ability to do work or move objects

fossil fuel .... fuel made from decayed plants and animals that lived millions of years ago preserved below Earth's crust
Examples: coal, oil, natural gas

geothermal energy .... energy produced by the heat from inside Earth's crust

hydroelectricity .... electricity produced by falling water

lignite .... the second stage in the formation of coal; it is moist and still has bits of woody tissue in it

methane .... natural gas used in stoves and for heating homes

natural gas .... a fossil fuel in its gaseous state found along with oil deposits

natural resources .... materials found on or inside Earth's crust that people can use

nonrenewable .... materials that are used up faster than they can be replaced in nature or can be used only once

nuclear energy .... energy produced by splitting the nucleus of the uranium atom

oil shale .... sedimentary rock with oil trapped between its layers

peat .... the first stage of the formation of coal; formed from decomposed plants

petroleum or **oil** .... liquid fossil fuel formed from plants and animals that lived in the sea

renewable .... materials that can be replaced in nature at a rate close to their rate of use or used over again

solar cells .... a device used to collect energy from the sun and transform it into electricity

solar collectors .... large panels that collect solar energy that will be used to heat water, etc.

solar energy .... energy from the sun

tidal power .... the energy from the two-way flow of the tides used to produce electricity

wind power .... energy of the wind used to create electricity

Introduction

It is a well known fact that nothing lasts forever. Our **energy** resources are no exception. We need energy to power our cars and factories, heat our schools and homes, refine metals, make steel, and to do many of the things that we take for granted. Because the price of **petroleum** or **oil** tends to increase and their supply is limited, we are trying to find other methods for producing energy. **Coal**, gas, oil, wind, water, the sun, the tides, and nuclear reactions are but a few of Earth's energy resources. Some are **renewable** and some are not. If we understand these resources, and whether they are renewable or **nonrenewable**, we can make informed decisions about producing and using energy.

Sources of Energy

Energy is the ability to do work. We get energy from our **natural resources**. Some energy is used directly, such as burning **natural gas** to cook. Many times we change a natural resource into another form of energy, such as **electricity**. Electricity is produced by a generator. A generator uses energy from coal, gas, oil, wind, uranium, steam, tides, or falling water to turn the blades of a large wheel called a *turbine*. The turbine turns the coils in the generator to produce electricity.

Our major sources of energy include the sun, moving water and wind, tides, **fossil fuels**, nuclear reactions, plant and animal materials, and heat inside Earth's crust.

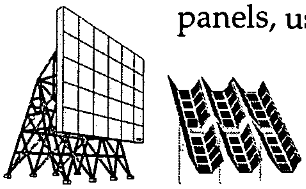
Types of Energy

Coal is one of the fossil fuels.

Some of the energy we use comes from natural resources which can be used over and over again, such as water and wind. Other resources, such as soil and forests, can be replaced within a relatively short period of time. These resources are said to be *renewable*; they can be replaced or used over again. Other resources, such as fossil fuels, are *nonrenewable*. Fossil fuels—oil, gas, and coal—take millions of years to form. They can be used up faster than they can be replaced in nature or used only once. We must **conserve** our use of nonrenewable resources so that they do not run out in the foreseeable future.

Renewable Resources

Solar Energy. Energy from the sun is called **solar energy**. Many homes and buildings are heated by using **solar collectors**. Solar collectors are panels, usually put on the roof of a house, to collect heat to use for hot water, cooking, washing, and heating swimming pools. Solar energy can also be converted to electricity through the use of **solar cells**. Using solar cells is expensive. They are not used very often, except in spacecrafts.


solar panels

The *advantages* of using solar energy include the following:

1. It is a renewable resource because there is a continuous supply of sunshine.

2. Solar energy does not pollute the atmosphere, land, or water.

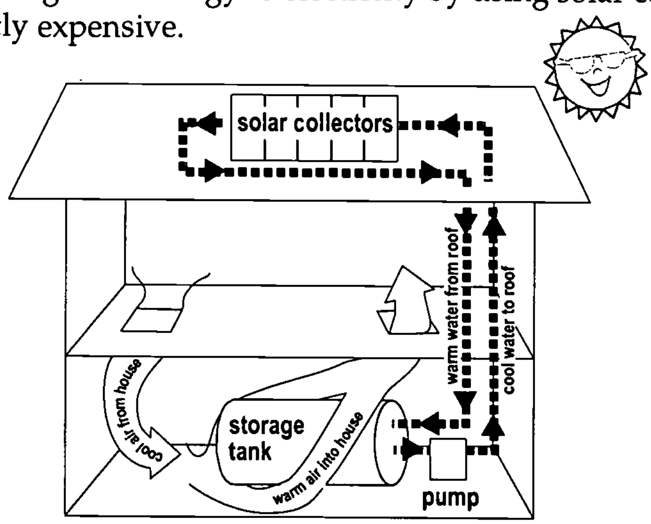
The *disadvantages* of solar energy include the following:

1. It cannot be collected at night.

2. It can only be used in areas that receive a lot of sunshine.

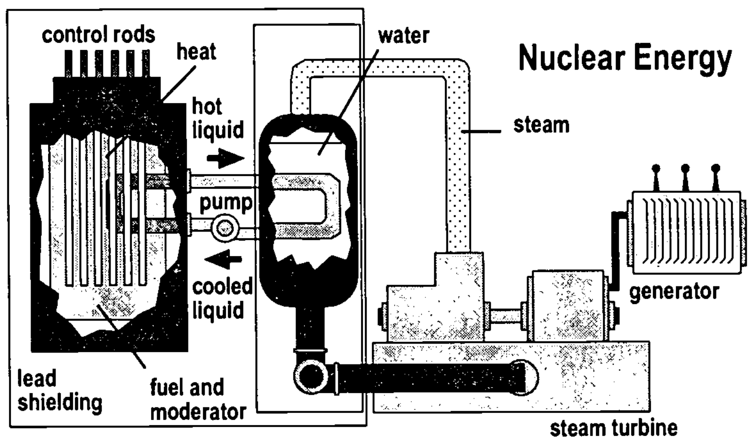
3. It is impractical for large buildings because too many solar panels would be required.

4. Converting solar energy to electricity by using solar cells is currently expensive.

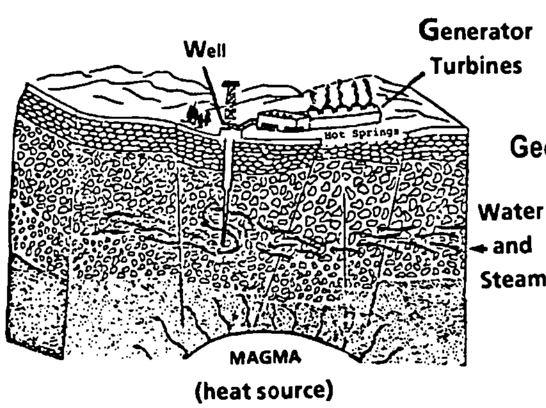


How Solar Energy Can Warm Our Homes

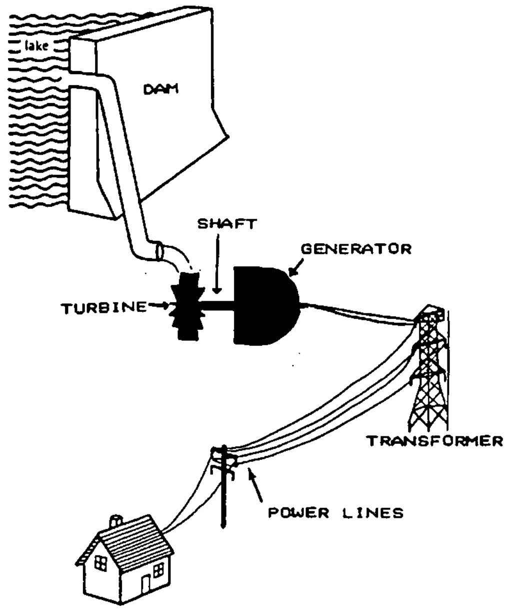
Nuclear Energy. **Nuclear energy** is produced by splitting the nucleus or center of the uranium atom. When the atom splits, a great deal of energy is released as heat. This heat energy is then used to turn water into steam. Then, the steam turns the turbines of generators that produce electricity. A major disadvantage of nuclear energy is that it produces radioactive wastes that can destroy cells and change or destroy genetic material. These wastes may leak from storage facilities. The leaked wastes may contaminate the soil or groundwater. In extreme instances, cores may *melt down*. That is, they may become so hot due to faulty power plant operation that they may melt through the floor and shielding.



Geothermal Energy. **Geothermal energy** uses the heat from inside Earth's crust. Wells are drilled into hot water deposits in Earth. The water then escapes to the surface as steam. The steam is then used to run generators to make electricity. Sometimes the hot water comes to the surface naturally in hot springs and geysers. In Iceland, most homes get their hot water from hot springs and geysers. Geothermal energy is renewable; however, even if all of the geothermal energy available were used, it could only provide a very small amount of the energy we need.



Water Power. Water is one of the major sources of electricity in the United States. Water power produces electricity called **hydroelectricity**. To harness the power of water, a dam is built on a river to control the flow of the water. The flow of the water turns the turbines of generators that produce electricity. Hydroelectric power has many advantages. It is renewable and relatively inexpensive, and does not pollute the atmosphere. One disadvantage is that many times rivers are not located where the power is needed.



Hydroelectric Power

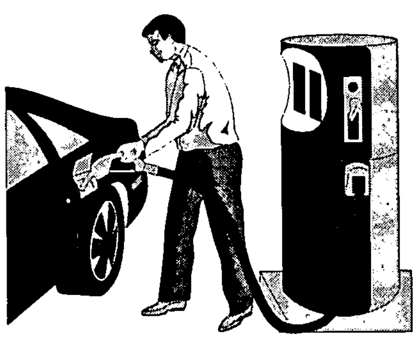
Wind Power. The energy of the wind, or **wind power**, can be turned into electrical energy through the use of windmills. Windmills can be used to pump water or grind grain. Prior to the industrial revolution of the 1800s, windmills were very common, but many have been replaced by electric and fossil fuel-operated motors. The recent energy shortages have brought about an increase in new, modern types of windmills that do not require fuels in order to perform the work desired. Because the wind is not predictable in most areas of the world, it is not a widely used resource. Wind is a renewable resource.

Tidal Power. The energy from the two-way flow of the tides through narrow passages can also be used to generate electricity. **Tidal power** is not a widely used source of energy because there are only a few areas in the world with usable tidal conditions. Tides are a renewable resource. Experimental tidal power plants have been built in Canada, near the Bay of Fundy, where the vertical difference in low and high tides is 13.6 meters (44.6 feet).

Biomass Fuels. **Biomass fuels** are combustible fuels made from plant and animal materials. Some plants can be converted into alcohol and burned for fuel. Wood can also be burned to create heat. Biomass fuels are a renewable resource. Burning garbage is being considered as an alternative to some biomass fuels.

Nonrenewable Resources

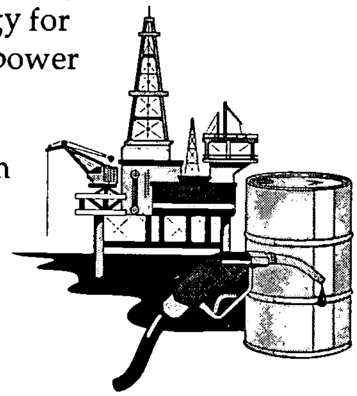
Fossil Fuels. Fossil fuels include coal, oil or petroleum, natural gas, and **oil shale.** Fossil fuels come from plants and animals that died millions of years ago and were preserved in Earth's crust. Over the years, these remains were chemically changed to produce our fossil fuels. Since millions of years are required to form deposits of fossil fuels, they are nonrenewable resources. These fuels are currently our most important source of energy for industry, transportation, and for use in our homes. Since they are nonrenewable, they must be conserved.



The largest deposits of coal and shale are found in North America. Because they are usually buried, it takes considerable effort (strip mining or shaft mining) to extract this fuel. New reserves of oil and gas are being discovered, but many environmental considerations must be weighed before drilling and recovery can begin.

Coal comes from plants that died millions of years ago. These dead plants are covered with more dead plants and turn into **peat.** Heat, pressure, and time eventually turn peat into different coal.

The next stage in coal formation is the production of **lignite** or brown coal. It contains bits of woody tissue but retains some moisture; therefore, it does not burn well. **Bituminous**, or soft coal, is the next stage in coal formation. Bituminous coal gives off a lot of heat when burned and is abundant. The last stage of coal formation is the production of **anthracite**. It is the hardest type of coal and burns the most cleanly, but it is very scarce. Coal is used to provide energy for trains and ships and for generating electricity in power plants and factories.



Petroleum or oil is a liquid fossil fuel formed from plants and animals that lived in shallow coastal waters. Oil is used as a lubricant and to make gasoline, plastics, synthetic fabrics, medicine, building materials, kerosene, wax, and asphalt.

Shale is a sedimentary rock that has oil trapped between its layers. It is plentiful, but it is difficult and expensive to remove the oil from the rock. However, shale oils may be used in the near future.

Natural gas is usually found along with oil. It is the only fossil fuel that can be used as it comes from Earth, without having to be processed first. **Methane** is the most common natural gas. It is used in gas stoves and to heat homes.

Fossil fuels have some *disadvantages*, however. They include the following:

Disadvantages of Fossil Fuels

1. Fossil fuels are nonrenewable (once used up they cannot be replaced).
2. Many fossil fuels contain traces of sulfur, which causes pollution when burned. If spilled or in contact with living organisms, many fossil fuels are extremely toxic and damaging.
3. It is expensive and often difficult to remove the fossil fuels from Earth's surface.

Use of Natural Resources

It is crucial that the use of natural resources be carefully planned and monitored. Fossil fuels and mineral supplies are continually decreasing, and the world's population continues to rise. Without safeguards and regulations, uncontrolled burning of wood and coal can pollute the air. Inorganic materials from industries and some pesticides can pollute our waters, and nuclear energy pollutants may become a danger to mankind.

Efforts at conservation include recycling and the use of alternative energy sources. Coal is more plentiful than petroleum, so the United States is using more coal for energy production every year. Minerals, such as aluminum, can be recycled. Some minerals are found in ocean water, and in the future, these may be used more extensively.

Some of Earth's energy resources are renewable; others are nonrenewable. Several nonrenewable energy sources are being rapidly exhausted. The wise use and conservation of natural resources is necessary to ensure that these resources remain available for future generations.

Summary

Our natural resources supply the energy needed to do work or move objects. Types of energy include solar energy, nuclear energy, geothermal energy, water power, wind power, tidal power, biomass fuel, and fossil fuels. Some of the sources of energy are renewable, and others are nonrenewable. Our natural resources must be conserved to safeguard the supply for our future.

Lab Activity: Solar Energy

Purpose

Determine what type of materials should be used to collect and store solar energy.

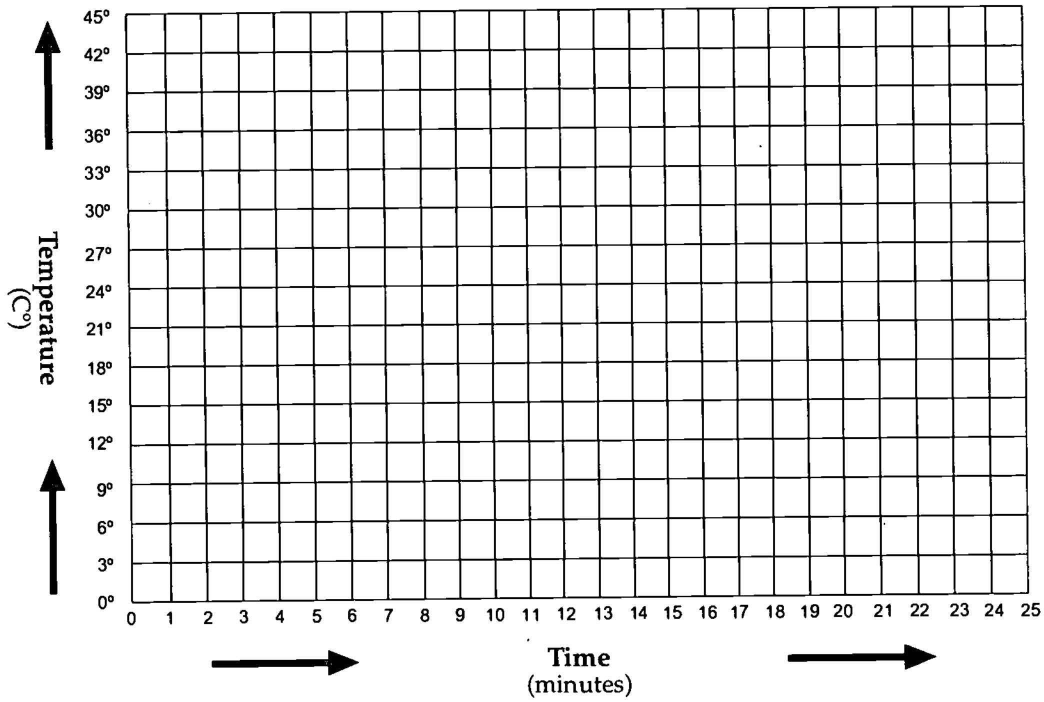
Materials

- 4 empty aluminum beverage cans, pop tops and labels removed
- 4 thermometers
- black paint
- silver or metallic paint
- 2 clear cellophane squares
- 2 rubber bands
- graph paper
- lamp
- red, blue, green, and black markers

1. Paint two of the cans black. Paint two with the metallic paint. Let dry.
2. Fill all 4 cans ⅓ full with water and insert thermometers into cans.
3. Cover 1 black can and 1 aluminum can with clear cellophane and secure with rubber bands.
4. Place all 4 cans equal distance from light source (10 to 20 centimeters from lamp with 100 watt bulb).
5. Use the graph on the next page to record the temperature in C° for each can. Take a measurement every minute for 25 minutes. Turn lamp off after 15 minutes.
6. Use the table below as a key to make a graph of the results.

Can	Color	Cellophane	Markers
A	aluminum	no	red
B	aluminum	yes	blue
C	black	no	green
D	black	yes	black

Temperature Graph



7. Place the cans in order from largest to smallest temperature changes.

8. Which can gained heat the fastest? ______________________

9. Which can held heat the longest? ______________________

10. Which can lost heat the fastest? ______________________

11. Is there a relationship between fast "warmers" and fast "coolers"?

____

If so, what is it? ______________________________

____

12. Why do asphalt parking lots and streets become very hot on a sunny day while concrete sidewalks remain relatively cool?

____

____

13. How does the color of material affect the material's ability to absorb energy?

____

____

14. What materials would you use to make a solar collector?

____

____

15. What materials would you use to store solar energy?

____

____

Practice

Answer the following using complete sentences.

1. What is energy? ______________________________

____

2. Where do we get most of our energy? ______________________________

____

3. Name eight major sources of energy. ______________________________

____

____

____

____

4. How is electricity produced from other energy sources?

____

____

____

____

5. List three renewable natural resources from which we can get energy.

____

____

____

6. List three nonrenewable natural resources from which we can get energy.

____

____

7. List two advantages of solar energy. ____________________

____

____

8. List three disadvantages of solar energy. ________________

____

____

____

9. How is nuclear energy released to create electricity? __________

____

____

____

____

10. How can geothermal energy be used to produce electricity?

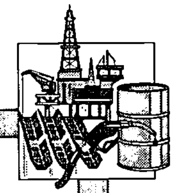
____

____

____

____

____



11. What is electricity produced from water called?

12. Name three advantages of water power.

13. What is one disadvantage of hydroelectric power?

14. For what purpose are windmills used?

15. What is the main disadvantage of wind power?

16. Why is tidal power not a widely used resource?

17. What is biomass fuel? ______

18. Name two ways biomass fuel can be used as energy sources.

19. What is our most important source of energy? ______

20. Name four types of fossil fuels. ______

Practice

Place an **R** *on the line if the natural resource listed is* **renewable**. *Place an* **N** *on the line if it is* **nonrenewable**.

_________ 1. fossil fuels

_________ 2. forests

_________ 3. gold and silver

_________ 4. cotton

_________ 5. nylon

_________ 6. diamonds, rubies, and emeralds

_________ 7. aluminum

_________ 8. paper

_________ 9. hydroelectricity

_________ 10. farmland used for grazing animals

_________ 11. plastic

_________ 12. minerals from Earth

_________ 13. plants

_________ 14. wind power

_________ 15. iron and steel

Name three **natural resources** *that can be* **recycled**, *or used over and over again.*

16. ____

17. ____

18. ____

Practice

Complete each statement below with the correct answer.

1. Fossil fuels come from ______________________________

   ______________________________________ .

2. Petroleum is formed from ______________________________

   ______________________________________ .

3. Six uses of petroleum are ______________________________

   ____

   ____

   ______________________________________ .

4. Coal comes from ______________________________

   ____

   ______________________________________ .

5. The first stage in the development of coal is ______________

   ____

   ______________________________________ .

6. The second stage in the production of coal is the formation of

   ______________________, which does not burn well.

7. The type of coal that produces a lot of heat and is very abundant is

   called ______________________________ .

8. The hardest type of coal is called ____________________.

9. Two uses of coal are ____________________

____

____

____

____________________.

10. Natural gas is usually found ____________________

____

____________________.

11. The type of natural gas we use in stoves and to heat our homes is

____________________.

12. The type of fossil fuel that is the most difficult and expensive to remove from Earth is ____________________.

13. Shale is ____________________.

14. Three disadvantages of fossil fuels are ____________________

____

____

____

____

____________________.

Practice

Use the list below to write the correct term for each definition on the line provided.

anthracite	**fossil fuel**	**natural resources**
biomass fuel	**hydroelectricity**	**nonrenewable**
bituminous	**lignite**	**petroleum or oil**
conserve	**methane**	**renewable**

____________________ 1. liquid fossil fuel

____________________ 2. electricity produced by falling water

____________________ 3. natural gas used in gas stoves

____________________ 4. the second stage in the formation of coal; it is moist and still has bits of woody tissue in it

____________________ 5. resources found in Earth

____________________ 6. fuel made from decayed plants and animals preserved below Earth's crust

____________________ 7. materials that can be replaced in nature at a rate close to their rate of use or used over again

____________________ 8. materials that are used up faster than they can be replaced in nature or can be used only once

____________________ 9. soft coal that gives off a lot of heat when burned

____________________ 10. a burnable fuel made from plant and animal material

_________________________ 11. the final stage in the formation of coal; it is very hard and burns cleanly

_________________________ 12. to protect or preserve natural resources for the future

Practice

Use the list below to write the correct term for each definition on the line provided.

coal	nuclear energy	solar collectors
electricity	oil shale	solar energy
energy	peat	tidal power
geothermal energy	solar cell	wind power
natural gas		

_______________ 1. energy produced by splitting the nucleus of the uranium atom

_______________ 2. energy from the sun

_______________ 3. energy produced by the heat from inside Earth's crust

_______________ 4. fossil fuel that comes from plants that lived millions of years ago

_______________ 5. the ability to do work or move objects

_______________ 6. the type of energy produced by using natural resources such as water, wind, and fossil fuels to power a generator

_______________ 7. a fossil fuel in its gaseous state found along with oil deposits

_______________ 8. sedimentary rock with oil trapped between its layers

_______________ 9. the first stage of the formation of coal; formed from decomposed plants

_______________ 10. large panels that collect solar energy that will be used to heat water, etc.

_______________ 11. a device used to collect energy from the sun and transform it into electricity

________________________ 12. the energy from the two-way flow of the tides used to produce electricity

________________________ 13. energy of the wind used to create electricity

Practice

Circle the letter of the correct answer.

1. Materials found on or inside Earth's crust that people can use are called ____________ .

    a. renewable resources
    b. nonrenewable resources
    c. fossil fuels
    d. natural resources

2. Fuel made from decayed plants and animals that lived millions of years ago preserved below Earth's crust are ____________ .

    a. fossil fuels
    b. nuclear energy
    c. renewable
    d. petroleums

3. ____________ materials can be replaced or used again.

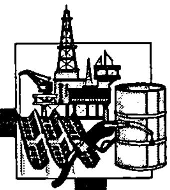
    a. Renewable
    b. Petroleum
    c. Methane
    d. Nonrenewable

4. ____________ materials can be used up faster than they can be replaced in nature or used only once.

    a. Petroleum
    b. Methane
    c. Renewable
    d. Nonrenewable

5. A liquid fossil fuel formed from plants and animals that lived in shallow coastal waters is called ____________ .

    a. methane
    b. hydrocarbon
    c. petroleum
    d. renewable



6. ___________ is a fossil fuel in its gaseous state found along with oil deposits.

   a. Peat
   b. Bituminous
   c. Petroleum
   d. Natural gas

7. ___________ is a natural gas used in home heating and gas stoves.

   a. Anthracite
   b. Bituminous
   c. Petroleum
   d. Methane

8. ___________ is a fossil fuel that comes from plants that lived millions of years ago.

   a. Uranium
   b. Biomass fuel
   c. Coal
   d. Natural gas

9. ___________ is the second stage in the formation of coal. It is moist and still has bits of woody tissue in it.

   a. Biomass fuel
   b. Methane
   c. Bituminous
   d. Lignite

10. ___________ is soft coal that gives off a lot of heat when burned.

    a. Natural gas
    b. Oil shale
    c. Anthracite
    d. Bituminous

11. ___________ is the final stage in the formation of coal. It is very hard and burns cleanly.

    a. Anthracite
    b. Methane
    c. Bituminous
    d. Lignite

12. To __________ is to preserve natural resources for the future.

a. renew
b. energize
c. conserve
d. anthracite

13. __________ is energy from the sun.

a. Geothermal energy
b. Nuclear energy
c. Wind power
d. Solar energy

14. __________ is energy produced by splitting the nucleus of the uranium atom.

a. Geothermal energy
b. Nuclear energy
c. Wind power
d. Solar energy

15. __________ is energy produced by the heat from inside Earth's crust.

a. Solar energy
b. Nuclear energy
c. Wind power
d. Geothermal energy

16. __________ is an energy source made from plant and animal material.

a. Anthracite
b. Lignite
c. Coal
d. Biomass fuel

17. __________ is the type of energy produced from natural resources such as water, wind, and fossil fuels by using a generator.

a. Solar energy
b. Hydroelectricity
c. Electricity
d. Nuclear energy

18. __________ is the ability to do work or move objects.

a. Energy
b. Geothermal energy
c. Solar energy
d. Nuclear energy

19. Electricity produced by falling water is called __________ .

a. geothermal energy
b. nuclear energy
c. hydroelectricity
d. methane

20. __________ is sedimentary rock with oil trapped between its layers.

a. Oil shale
b. Methane
c. Bituminous
d. Lignite

21. __________ is the first stage of the formation of coal and is formed from decomposed plants.

a. Peat
b. Lignite
c. Anthracite
d. Bituminous

22. Devices used to collect energy from the sun and transform it into electricity are __________ .

a. solar collectors
b. oil shale
c. peat
d. solar cells

23. Large panels that collect solar energy that will be used to heat water are __________ .

a. nuclear energy
b. solar collectors
c. tidal power
d. solar cells

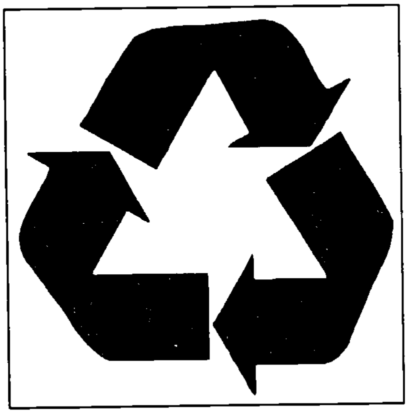
24. The energy from the two-way flow of the tides used to produce electricity is __________.

   a. solar cells
   b. nuclear energy
   c. wind power
   d. tidal power

25. The energy of the wind used to create electricity is __________.

   a. tidal power
   b. wind power
   c. geothermal energy
   d. nuclear energy

Unit 16: Our Environment



Vocabulary

Study the vocabulary words and definitions below.

acid rain .... rain that contains sulfuric acid; forms as a result of the mixture of air pollutants with moisture in the atmosphere

conservation .... measures taken to save natural resources for future use

environment .... all of the things that make up your surroundings

fossil fuels .... fuels made from decayed plants and animals that lived millions of years ago preserved below Earth's crust
Examples: coal, oil, natural gas

hydrocarbons .... unburned particles of fuel that contain hydrogen and carbon; fossil fuels produce hydrocarbons

litter .... waste materials found along roadsides and other public places

nitrates .... pollutants found in fertilizers and detergents made of nitrogen compounds

pesticides .... chemicals used to kill insects

phosphates .... pollutants found in fertilizers and detergents made of phosphorus compounds pollutants .... substances in the air, water, and land that are harmful to living things

pollution .... a change in the air, water, or land that is harmful or unpleasant to living things

recycling .... processing materials so they can be used again

smog .... a pollutant that contains nitrogen, sulfur, and hydrocarbons; creates a brown haze and unpleasant odor

temperature inversion .... occurs when a layer of cool air gets trapped under a layer of warm air and acts like a lid, keeping pollutants near the ground

thermal pollution .... the unnatural heating of waters

Introduction

Earth science combines several fields of science to study Earth and the space around it. Geologists study the surface and interior of Earth. Oceanographers study the ocean. Meteorologists study the weather, and astronomers study the universe. Land, water, air, and space are very closely related—what happens to one affects all of the others.

We must use what we know about Earth to improve and safeguard our living conditions, such as the exploration of land for building our homes, observation of air and ocean influences to predict floods and storms, and examination of photographs of geological structures from space to explore new sources of valuable metal deposits. We must depend on Earth science to help us find new resources and to help us to learn to protect and use our Earth wisely.

Protecting the Environment

The **environment** is very delicate. Special care must be taken of the environment if it is going to continue to provide an atmosphere that will support life and all of the natural resources people need to live. Some of these resources, such as minerals, ores, and **fossil fuels**, cannot be replaced. They are said to be nonrenewable. Others, such as the forests, soil, air, and water, can be replaced at a rate close to their rate of use and are renewable. People must learn to use resources wisely and conserve or preserve natural resources for future use.

Pollution is a change in the air, water, or land that can be harmful or unpleasant to living things and the environment. Pollution upsets the balance of nature, and if not controlled, causes severe environmental problems. These problems could eventually lead to the extinction of entire populations.

There are several measures society can take to help preserve the balance of nature. One way is to make people aware of the problems of pollution and the need for **conservation**. This can be accomplished through television and newspaper stories, local campaigns to clean up the environment, and education.

Society can help create laws to force large corporations and factories to stop polluting the environment and to stop overusing the natural resources. Laws are also important to keep individuals from burning trash, improperly dumping garbage, and littering. Regulations, such as those requiring licenses to hunt and fish, and placing limits on the numbers of animals killed, are also important.

Conducting scientific research to help keep nature in balance is another measure of preservation. Some of the projects scientists are working on to accomplish this include the following:

- finding new sources for food
- trying to learn how to control the weather so unusable land can be made usable
- looking for ways to get usable minerals and natural resources from the ocean
- trying to find easier and less expensive ways to get fresh water from ocean water
- trying to find less expensive and easier ways to get the oil out of shale
- looking for new sources of energy
- looking for new ways to stop and clean up the harmful effects of pollution
- exploring space to possibly find new resources, answers to problems on Earth, and perhaps a new place for people to live.

Air Pollution

Unwanted, harmful substances in the air are **pollutants**. Air can become polluted. The amount of air pollution varies depending on the conditions in a particular location. Air pollutants especially harmful to human health are **hydrocarbons**, sulfur oxides, particulates, carbon monoxide, and nitrogen oxides. What are these pollutants, and where do they come from?

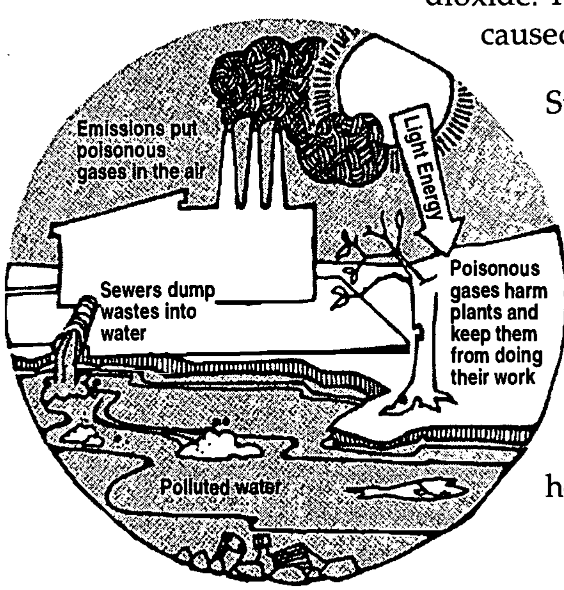
Hydrocarbons. Hydrocarbons are compounds of hydrogen and carbon. Hydrocarbons come from spilled or unburned particles of gasoline. Automobiles that do not have proper fuel settings or pollution control devices may produce hydrocarbons.

Carbon monoxide. Carbon monoxide is another dangerous gas produced by the incomplete burning of fuels. It is colorless and odorless. Its fumes can cause people to become very ill or die. The exhaust from automobiles, gas heaters, and charcoal grills produces carbon monoxide. Therefore, it is important not to operate a car or grill indoors because carbon monoxide poisoning could result.

Sulfur oxides. Fossil fuels, coal and oil, contain small amounts of sulfur. When the fuels are burned, the sulfur is released and combines with oxygen in the air to form sulfur oxides. Sulfur oxides irritate the eyes, nose, throat, and lungs. If sulfur oxides combine with moisture in the atmosphere, a powerful acid called "sulfuric acid" forms. This acid then falls to Earth in rain or snow. This sulfuric acid damages plant leaves, stains the paint on buildings, and causes lung damage.

When sulfuric acid combines with rain, **acid rain** is formed. Acid rain kills fish, damages crops, and pollutes our water supplies. In Florida, the natural limestone rock helps neutralize the sulfuric acid in groundwater so acid rain is not a serious problem. The northern United States is not as fortunate; there, rock is granite and does not buffer the sulfuric acid as limestone does.

Nitrogen oxides. At very high temperatures, nitrogen and oxygen gases in the atmosphere react with each other and form nitric oxide. This gas forms in car engines and comes out of exhaust pipes. Nitric oxide then reacts with oxygen in the air and forms another compound, nitrogen dioxide. The brown haze over many cities is caused by nitrogen dioxide.



Sunlight causes a chemical reaction between nitrogen oxide, sulfur oxide, and hydrocarbon gases. This reaction produces a fog-like pollutant called **smog**. Smog got its name from the words smoke and fog. Most smog seems to come from the burning of fossil fuels. Smog usually occurs in areas with a lot of industry or heavy traffic. Smog creates an

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unpleasant odor, a brown haze in the air, and causes the burning of eyes and inflammation of the lungs.

The condition of the air is dependent on other factors besides pollutants. The amount of pollution in an area also depends on geographical features in the area. Very windy areas seldom have much pollution because the wind carries the pollutants away. On the other hand, areas in valleys or with mountains on one side are more likely to have pollution problems because the pollution cannot escape. Weather conditions also have an effect on pollution. Moisture dissolves some pollutants in the air; however, as that moisture becomes a form of *precipitation*, it can pollute the land and waters instead.

Sometimes air pollution is made worse when a layer of cool air gets trapped under a layer of warm air. The warm air acts like a lid and keeps the pollutants near the ground. This effect is called a **temperature inversion** and can create dangerously high levels of pollution. When this occurs, people have to be warned to stay indoors until the weather clears.

Particulates. Particulates are tiny particles of dust, soot, ash, and oil. Burning diesel fuels, coal, oil, and wood gives off particulates. People may experience chest pains or coughing as a result. Particulates can cause lung diseases such as bronchitis, asthma, emphysema, and cancer.

Controlling Air Pollution

Efforts have been made to control air pollution. Laws were passed requiring that unleaded gas be used in new cars in an effort to stop one type of air pollution. Some other important solutions to the problem include the following:

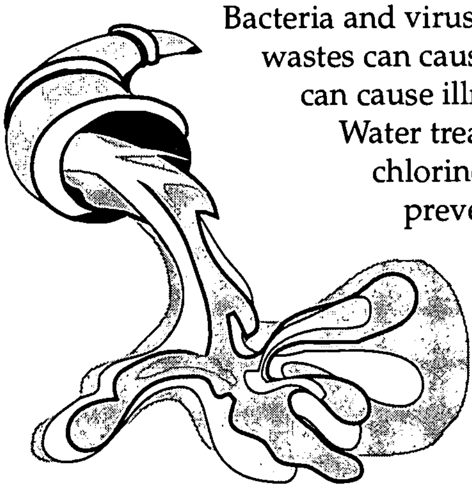
- Laws have been passed, such as the 1970 Clean Air Act, that require industry not exceed safe levels of pollutants. This law is scheduled to be reviewed every five years.
- Warning systems have been installed in areas with high pollution rates.
- More greenery has been planted in cities to reduce the amount of carbon dioxide and increase the amount of oxygen.

- Pollution control devices have been installed on cars.
- Laws have been passed to prohibit the burning of garbage and leaves in residential and other restricted areas.

Every individual can do his or her part to help reduce air pollution. Actions such as car pooling, using public transportation, and making sure our cars are in proper working order can help solve the problem of air pollution.

Water Pollution

Water is one of our most important natural resources. We use fresh water to drink, grow food, produce energy, and manufacture products for transportation and recreation. Both the water on the surface of Earth and the groundwater beneath Earth's surface need to be kept free from pollution. As with air, there are many ways that water can be polluted.



Bacteria and viruses from untreated sewage and animal wastes can cause pollution of the water supplies. This can cause illness and diseases such as typhoid. Water treatment plants and the addition of chlorine to the water are common methods of preventing this type of pollution.

Water can also be polluted by chemicals from industrial plants, sewage systems, mines, and households. **Phosphates** and **nitrates** found in fertilizers, detergents, and cleaning supplies cause algae and pond weeds in lakes to multiply very rapidly, using up all of the available nutrients. When large numbers of these plants die, bacteria that decompose them exhaust the oxygen supply. Many other organisms, such as fish, will then die because of a lack of oxygen. **Pesticides** and other poisonous chemicals pollute waters, killing plant life and fish.

The unnatural heating of waters is called **thermal pollution**. Electric power plants that use both fossil fuels and nuclear fuels produce a lot of heat. Power plants use water to condense steam. When the water is returned to the lakes and rivers, it is warmer than before. This upsets the balance of nature. Some organisms cannot live at these higher temperatures. Thermal pollution also disrupts the breeding cycles of some fish. Some people argue that thermal pollution can be beneficial in winter—providing refuge from the cold for manatees, for instance. Manatees congregate in the winter near power plants, such as St. Marks and Crystal River, to take advantage of the warmer waters.

Too much sediment buildup in waterways can create pollution problems. Sand and soil settle to the bottom of rivers and lakes, gradually filling them. These sediments cover up the food supply of fish, causing them to die. Sediment buildup also smothers nonmoving organisms such as oysters and clams and clogs animals' gills, suffocating them. Dredging may then be necessary to open the waterway. Disturbing the bottom by dredging causes other problems such as destroying the nutrients in the sediments and altering the water flow.

Another pollution concern for all bodies of water is the oil spill. Major spills result from tanker collisions in the oceans. These oil spills from tankers spoil our beaches, pollute our ocean water, and cause birds and fish to die. Many cleaning methods are used to remove the oil.

Some of these methods create other types of pollution, however. Burning the oil releases hydrocarbons into the atmosphere. Adding chemicals to breakdown oil introduces other substances into an already stressed environment. Scraping up or collecting oily debris contributes to the problem of waste disposal and scarce landfills. The benefits of cleaning methods must be considered along with their risks and disadvantages.

Cleaning Up an Oil-Tainted Shore

Rocky beaches

1. Heaviest concentrations of oil are removed with pumps, vacuum trucks, and skimmer boats (in shallows near the shore).

2. Workers using buckets, scoops, and absorbents, which attract oil but not water, remove as much crude as possible.

3. High-pressure hoses wash oil back into the water where the oil is trapped by oil booms and vacuumed into trucks.

4. Chemical dispersants are applied where wave action can quickly disperse crude oil.

Sandy beaches

1. Workers collect oil with scoops, shovels, rakes, etc.

2. Heavy equipment is used to push oily sand into wave zones for natural cleansing action.

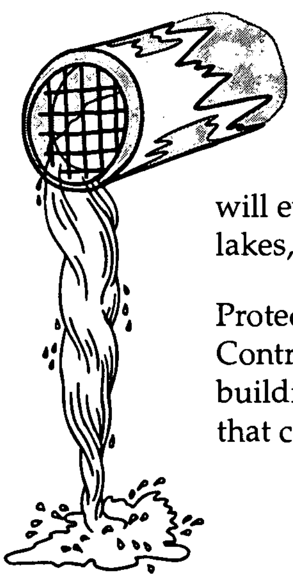
3. Tractors with raking equipment are used to separate tar balls and clumps of oily sand from the beach.

Muddy shoreline

1. Mud flats and beaches are very sensitive environments, easily damaged by people and equipment.

2. Low-pressure washing with hoses may be used to push oil into open water for skimming.

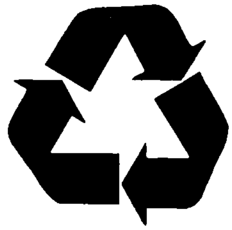
3. Oil-fouled plants are cut and removed if animal life is endangered.



One of the main forms of pollution of groundwater comes from the dumping of chemical wastes—especially radioactive wastes. When it rains, some of the dangerous chemicals seep down into the water table. These chemicals will eventually be pumped up into wells or enter streams, lakes, or oceans as part of the groundwater.

Protective measures must be taken to keep water pure. Controlling chemical use by farmers and industry and building waste treatment plants are examples of things that can be done to help reduce water pollution.

Land Resources



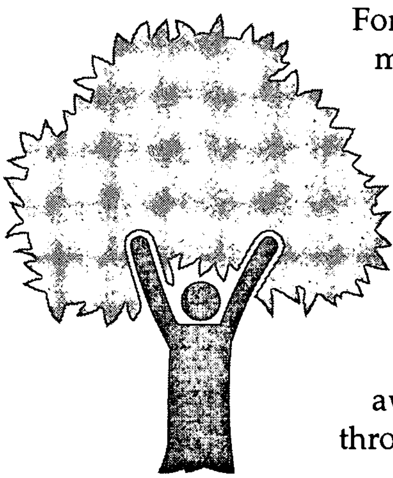
recycle

Natural resources found on land must also be conserved and protected from pollution. One of the most noticeable forms of pollution on land is **litter**. To help control litter, laws can be passed to place fines on littering. **Recycling**, which refers to processing materials so they can be used again, can also help to solve the litter problem. Glass bottles, aluminum cans, plastic, and paper are common forms of litter and can all be recycled.

Wastes in landfills, dumps, and septic tanks can cause pollution, if not disposed of properly. The creation of waste management companies and urban sewage treatment plants has helped to eliminate some pollution from these sources.

Chemicals from industry, buried radioactive wastes, and pesticides pollute the land when they enter the soil. Plants grown in this soil may contain these dangerous chemicals. These chemicals are then passed on to people and animals who eat the plants.

Land resources must not only be protected from pollution, they must also be conserved so that there are enough resources for future generations. Crops must be rotated and fertilizers added to keep farm land productive. Some land that is unsuitable for farming because it is too hilly can be terraced or contoured. Land too dry to grow crops can be irrigated in order to become productive. Land used for grazing must be carefully controlled to allow the vegetation to grow back before it is used again.

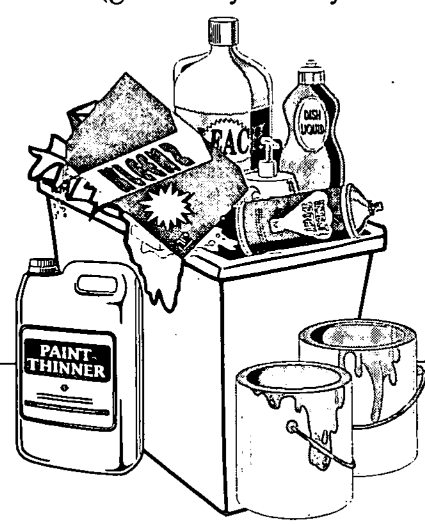


Forests are another valuable land resource. Trees must be replanted to replace the ones cut down. Since trees prevent erosion, foresters must be careful not to cut down too many trees in a particular place at any given time.

Practicing conservation and controlling pollution of natural resources will allow people to enjoy the gifts of nature for many years to come. It is important that we become aware of the destructive nature of items that we throw away every day. Some of these items require special disposal methods. Many communities have established hazardous-waste collection sites or other alternatives. Below is a chart of the toxic trash that should be separated from other trash.

Toxic Trash List

- **ammonia**
- **automotive fluids and body filler** for repairing auto body dents and holes
- **batteries** that are disposable or rechargeable (NiCad) batteries
- **caustic cleaners** such as oven cleaners and lye
- **cosmetics** such as fingernail polish and removers
- **electrical devices** with mercury switches
- **florescent light bulbs and their ballasts**
- **fuel** such as charcoal lighter
- **glue, rubber cement, and thinners**
- **herbicides** and their containers (don't rinse)
- **insect sprays, powders, strips, repellants, and their containers** (don't rinse)
- **liquid correction paper and thinner**
- **mothballs**
- **motor-oil cans** (don't rinse)
- **paint, polishers, dyes, and paint thinners** (give away what you don't use; latex paint can be dried out and disposed of in trash)
- **photographic chemicals**
- **pool chemicals**
- **solvents and spot removers**
- **spray cans**
- **wood preservatives** such as sanding sealer and water sealer
- **and anything labeled "dispose of carefully"**



Careers in Earth Science

There are a great number of career opportunities related to the field of Earth science. Some careers require a college degree, but others require vocational and on-the-job training instead. Listed below are brief descriptions of careers in Earth science and the amount of education needed.

Careers in Earth Science		
Career	**Description**	**Education**
seismologist	scientist who studies earthquakes	college degree
geology technician	person who assists a geologist by recording data, assisting in the lab running equipment, and making maps	two-year degree
paleontologist	scientist who traces the development of Earth by studying fossils	geology degree plus a masters or doctorate in paleontology
air pollution inspector	Inspects factories, tests samples for pollution, and suggest ways to clean-up pollution	college degree
soil scientist	tests soil, determines what would best grow in it, and suggests ways to make it more productive	college degree
waste water plant operator	tests samples, records data, and runs tests on plant samples	trade school or community college
weather observer	records weather information and sends information to weather stations	1 or 2 years of trade school or community college
surveyor assistant	assists in taking measurements, land clearing, and collecting map data	high school plus on-the-job training
cartographer	draws maps	two years of technical training
coal inspector	inspects and reports on the quality of coal	high school plus on-the-job training

Summary

Protecting our environment and natural resources is extremely important for the future of Earth. Controlling pollution of air, land, and water is one part of the effort. Each of us has a responsibility as a caretaker of the environment. Many different kinds of scientists are working on solutions to today's problems.

Practice

Follow the steps below to conduct an **environmental survey** *of your neighborhood.*

> ### Environmental Influences
>
> Human beings are agents of change, and the rate at which they are changing the environment increases rapidly as their population increases. Only recently have people become aware of their impact on the atmosphere, water, and the crust of Earth.

1. Look over the survey on the next page. General categories for the ways people change the environment are listed on the left side of the page. Across the top are the various areas of the environment that may be affected by the processes and materials which people use.

2. Walk or ride through your neighborhood—at least a 10-block square—taking the survey with you.

3. Place a check in the last column to the right after each type of environmental influence found in your neighborhood. For example, if new houses are being built, put a check (√) after houses.

4. Find the area being influenced in the column headings at the top of the chart. Put an (**L**) in the left half of the box if the influence is large, or (**S**) in the left half of the box if the influence is small. In the right half of the box, put a (**+**) if the effect is good; put a (**-**) if the effect is bad.

KEY
(√) Influence found
(L) Large influence
(S) Small influence
(+) Good influence
(-) Bad influence

Ex.—Large, negative influence $\boxed{L}\boxed{-}$

Environmental Aspects

Environmental Influences	health	scenery	recreation	temperature	air	water	other	influence
Construction:								
houses								
roads								
shore structures								
commercial								
Traffic:								
streets								
highways								
Chemicals:								
fertilization								
weed control								
insect control								
Waste Disposal:								
litter								
dumps								
sewage								
Other:								

Practice

Answer the following using complete sentences.

1. List three ways in which road construction using concrete pavement changes the environment.

____

____

____

2. What other ways could people travel which would have fewer adverse effects on the environment?

____

____

____

____

3. How does an automobile affect the atmosphere? ____________

____

____

____

____

4. If there is smog in your community, what is its source? ________

____

____

____

5. What resources are used in local construction?

____

____

6. What resources are lost to humans when cities move into the surrounding countryside?

____

____

____

7. Describe some solutions to the problems above.

____

____

____

____

____

____

____

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

________ 8. Human influence can be recognized on your local environment.

________ 9. The chart on page 527 does not permit the estimation of a negative impact on an environment.

________ 10. The public can suggest ways to improve and protect the environment.

Practice

Answer the following using complete sentences.

1. Name three ways society can help preserve the balance of nature.

____

____

____

2. Name five ways scientists are trying to maintain the balance of nature.

____

____

____

____

3. Name three ways laws can help stop the pollution and depletion of natural resources.

____

____

____

4. Name three ways people can be made aware of the problems of pollution and the necessity of conservation.

____

____

____

Lab Activity: Water Pollution

Purpose	Materials	
Create and clean up an oil spill.	• aluminum pie plate • new or used motor oil • pieces of nylon net • pieces of nylon stocking • pieces of cardboard • pieces of string • pieces of straw	• salad oil • plastic bowl • cotton balls • spoon • detergent • eyedropper

Thirty miles from the shore of Santa Barbara, an oil production platform pulled up a worn-out drill. Oil and gas began escaping into the water. Blow out! Before the leak could be stopped, 700,000 gallons of oil were released. What can be done to clean up the spill?

1. Obtain an aluminum pie plate or similar container. Pour about one inch of water in the plate.

2. Use an eyedropper to place 15 to 20 drops of salad oil on the surface of the water.

3. The problem you face is the same as that faced by the people of Santa Barbara. How can you clean up the oil with the tools at hand? Select any of the materials available and use them to clean up the oil slick. Use a watch with a second hand to determine the amount of time it takes you to clean up the spill. Use the Data Chart on the next page to record your results.

4. Repeat the simulation by adding salad oil to new water. Try at least three different techniques and materials and record the results.

5. Up to this point you have been using a light oil. Now perform the same procedures using a heavier oil—in this case, motor oil. Record your results in the Data Chart on the next page.

6. You have been very lucky. The weather during your oil recovery operations has been fair and calm. Many oil spills occur in stormy weather. To simulate rough weather, carefully make waves in your model ocean. You can make waves by *gently* blowing over the surface or moving a card through the water. Get new water and repeat two of the techniques with heavy oil and rough water. Record your data in the Data Chart below.

7. Select the method you feel works best and modify it as follows. After you have added 15 to 20 drops of heavy oil, add 5 to 10 drops of detergent. Stir the water to mix the oil and detergent. Then proceed to remove the oil and soap mixture with the technique you selected. Record your results in the Data Chart below.

8. Clean up your lab station. Place the used oil in the container provided by your teacher. Wash the equipment with detergent and store.

Data Chart

	Material	Time taken to clean spill	Estimate percent of oil cleaned up	Comments: (e.g., messy, left with oily straw)
Light Oil				
Heavy Oil				
Heavy oil and rough water				
Heavy oil plus detergent				

523

9. Which method most rapidly cleaned up the oil spill?

____

10. Which method was most effective with light oil? ______________

____

Was the same method most effective with heavy oil? ______________

If not, which method was most effective with the heavy oil?

____

11. The first activities following an oil spill involve attempts to contain the spill. Containment keeps the spill from spreading. Which of the materials provided helped to contain an oil spill?

____

____

Ocean spills are often contained by placing booms. A boom is a barrier or fence of some type. Floating logs, foam, and rubber tubes have been tried. Under what weather conditions would booms work best?

____

____

12. Most of the oil removal techniques which use the materials provided remove the oil by *absorption*. The oil is absorbed by other substances like straw, sawdust, etc. The oil-soaked material is then removed from the water. Which of the techniques removed oil by absorption?

____

____

Some people say that these techniques simply move the oil spill from the water to the land. What do you suppose they mean?

____

____

13. What effect did the detergent have on your oil spill? ____________

____

____

____

Did the detergent make your cleanup technique more effective or less effective? Please explain.

____

____

____

14. Fire is another technique often used to remove oil spills. The oil spill is ignited and allowed to burn. Where does the oil from the water go when it is burned?

____

____

15. What factors affect the cleaning up of oil spills in the ocean?

____

____

____

____

16. Once the oil reaches the beach, other problems occur. What is one technique you might use to remove oil from beach sands?

____

____

____

Which animals are likely to be most affected by oil on the beach?

____

____

17. Who should be responsible for cleaning up the spills? ____________

____

____

18. Some bacteria will use oil as their only food source. Ocean scientists would like to be able to plant these bacteria in oil spills. For these bacteria to be successful in cleaning up spills, the bacteria have to pass several tests. Some of the tests are listed below.

Rank these **tests** *in* **order of importance** *from 1 to 5. In the blank next to the test, write in the order number. The most important test to consider would be number 1, etc.*

______ The cost of the bacteria.

______ The bacteria will eat the oil quickly.

______ The bacteria will eat the oil thoroughly.

______ The bacteria will produce no harmful by-products.

______ The bacteria will disappear when their job is done.

Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

acid rain	**fog**	**pollutants**
automobile exhaust	**fossil fuels**	**smoke**
automobiles	**hydrocarbons**	**sulfuric acid**
carbon monoxide	**industry**	**sulfur oxides**
charcoal grills	**nitrogen oxides**	**temperature inversion**

1. ________________ are substances in the air, land, and water that are harmful to living things.

2. Four types of air pollution are ________________, ________________, ________________, and ________________.

3. Unburned particles of fuel that contain hydrogen and carbon are called ________________.

4. Most hydrocarbons come from ________________ that are not properly maintained.

5. The sulfur found in ________________ is a major cause of pollution.

6. Sulfur combines with oxygen and moisture in the atmosphere to form ________________.

7. Sulfuric acid in the atmosphere combines with rain to form ________________.

8. Smog is a chemical reaction between ____________________, ____________________, and ____________________.

9. The word smog came from combining the words ____________________ and ____________________.

10. ____________________ is a dangerous gas produced by the incomplete burning of fuels.

11. ____________________ and ____________________ are two sources of carbon monoxide.

12. A ____________________ is a layer of cool air trapped under a layer of warm air that keeps pollutants near the ground.

13. The 1970 Clean Air Act has helped reduce the levels of pollutants produced by ____________________.

Practice

Answer the following using complete sentences.

1. What are four uses for fresh water? ____________________

   ____

   ____

   ____

2. Where do bacteria and viruses that pollute water come from?

   ____

   ____

3. How can bacteria and viruses be prevented from polluting our water supplies?

   ____

   ____

4. What effect do phosphates and nitrates have on our water supplies?

   ____

   ____

   ____

   ____

5. How is thermal pollution caused? ____________________

   ____

   ____

6. How does thermal pollution affect the fish and other organisms?

____

____

____

7. How can sediment buildup cause pollution? ______________

____

____

8. How do oil spills cause pollution? ______________

____

____

9. How can dumping chemical wastes pollute groundwater?

____

____

____

10. Name four ways that we can help prevent water pollution.

____

____

____

____

____

Practice

Answer the following using complete sentences.

1. What is one of the most noticeable forms of pollution of the land?

____

____

2. Name two ways littering can be controlled. _______________

____

____

____

____

3. What is recycling? _______________________________

____

____

4. Name at least three kinds of items that can be recycled. ________

____

____

5. How do chemicals from industry and radioactive wastes pollute the land?

____

____

____

6. What else must be done for land resources besides protecting them from pollution?

____

____

7. Name four ways land can be made more productive. ______________

____

____

____

____

____

____

____

8. How can forest land be protected? ______________________

____

____

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____

____

____

Practice

Use your school library or the career information in your guidance center to find the following information about **three careers** *in* **Earth science** *that interest you.*

1. Give a detailed description of exactly what the worker does. Use a separate sheet of paper, if needed.

    ____

    ____

    ____

    ____

2. Does the career require you to live in a specific part of the country or world? (Example: An oceanographer must live near the ocean.)

    ____

3. How much does the job pay per year? ______________________

4. Is the job primarily in government, private industry, or a college or university?

    ____

5. What type of education or special training is necessary?

    ____

    ____

6. What special skills are necessary? (Example: the ability to draw for a career in map making).

    ____

    ____

Practice

Use the list below to write the correct term for each definition on the line provided.

acid precipitation	**litter**	**pollution**
conservation	**nitrates**	**recycling**
environment	**pesticides**	**smog**
fossil fuels	**phosphates**	**temperature inversion**
hydrocarbons	**pollutants**	**thermal pollution**

________________________ 1. measures taken to save natural resources for future use

________________________ 2. processing materials so they can be used again

________________________ 3. a pollutant that contains sulfur, nitrogen, and hydrocarbons; creates a brown haze and unpleasant odor

________________________ 4. rain or snow that contains sulfuric acid

________________________ 5. all of the things that make up your surroundings

________________________ 6. a change in the air, water, or land that is harmful or unpleasant to living things

________________________ 7. substances in the air, water, and land that are harmful to living things

________________________ 8. fuels made from decayed plants and animals that lived millions of years ago

________________________ 9. chemicals used to kill insects

________________________ 10. pollutants found in fertilizers and detergents made of phosphorus compounds

_________________________ 11. unburned particles of fuel that contain hydrogen and carbon

_________________________ 12. waste materials found along roadsides and other public places

_________________________ 13. the unnatural heating of waters

_________________________ 14. occurs when a layer of cool air gets trapped under a layer of warm air that acts like a lid, keeping pollutants near the ground

_________________________ 15. pollutants found in fertilizers and detergents made of nitrogen compounds

Practice

Circle the letter of the correct answer.

1. __________ is a pollutant that contains nitrogen, sulfur, and hydrocarbons. It creates a brown haze and unpleasant odor.

   a. Smog
   b. Phosphate
   c. Pesticide
   d. Hydrocarbon

2. __________ is a change in the air, water, or land that is harmful or unpleasant to living things.

   a. Acid rain
   b. Smog
   c. Pollution
   d. Littering

3. __________ are chemicals used to kill insects.

   a. Hydrocarbons
   b. Phosphates
   c. Nitrates
   d. Pesticides

4. __________ are pollutants found in fertilizers and detergents made of nitrogen compounds.

   a. Fossil fuels
   b. Hydrocarbons
   c. Nitrates
   d. Phosphates

5. __________ are unburned particles of fuel that contain hydrogen and carbon.

   a. Fossil fuels
   b. Pesticides
   c. Hydrocarbons
   d. Nitrates

6. Taking measures to save natural resources for future use is called __________ .

   a. recycling
   b. conservation
   c. temperature inversion
   d. thermal pollution

7. Rain that contains sulfuric acid is __________ .

   a. smog
   b. acid rain
   c. thermal pollution
   d. litter

8. Your __________ is all of the things that make up your surroundings.

   a. litter
   b. smog
   c. environment
   d. conservation

9. Fuels made from plants and animals that lived millions of years ago are __________ .

   a. smog
   b. pesticides
   c. hydrocarbons
   d. fossil fuels

10. Waste materials dropped along roadsides and other public places are __________ .

    a. pesticides
    b. litter
    c. nitrates
    d. phosphates

11. __________ are pollutants found in fertilizers and detergents made of phosphorus compounds.

    a. Nitrates
    b. Fossil fuels
    c. Hydrocarbons
    d. Phosphates

12. ____________ are substances in the air, water, and land that are harmful to living things.

a. Acid rain
b. Fossil fuels
c. Nitrates
d. Pollutants

13. Processing used materials so they can be used again is called ____________ .

a. recycling
b. conservation
c. littering
d. temperature inversion

14. The unnatural heating of waters is ____________ .

a. pollution
b. recycling
c. smog
d. thermal pollution

15. ____________ occurs when a layer of cool air gets trapped under a layer of warm air that acts like a lid, keeping pollutants near the ground.

a. Acid rain
b. Littering
c. Recycling
d. Temperature inversion

Appendices

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References

Alexander, Peter, et al. *Earth Science*. Morristown, NJ: Silver, Burdette, and Ginn, 1987.

Barnes-Svarsey, Patricia, ed. *The New York Public Library Science Desk Reference*. New York: Stonesong Press Incorporated and the New York Public Library, 1995.

Bledsoe, Lucy Jane. *General Science*. Paramus, NY: Globe Fearon Educational Publisher, 1994.

DiSpezio, Michael, et al. *Science Insights: Exploring Earth and Space*. New York: Addison-Wesley, 1996.

Florida Department of Education. *Florida Course Descriptions*. Tallahassee, FL: State of Florida, 1998.

Florida Department of Education. *Florida Curriculum Framework: Science*. Tallahassee, FL: State of Florida, 1996.

Fonk, Robert H. and Linda B. Knight. *Earth Science*. New York: Holt, Rinehart, and Winston, 1994.

Hesser, Date T. and Susan S. Leach. *Focus on Earth Science*. Columbus, OH: Merrill, 1989.

Namowitz, Samuel N. and Nancy E. Spaulding. *Earth Science*. Lexington, MA: D. C. Heath, 1994.

Otto, James H. and Albert Towle. *Modern Biology*. New York: Holt, Rinehart, and Winston, 1985.

Pasachoff, Jay M., Naomi and Timothy M. Cooney. *Earth Science*. Glenview, IL: Scott Foresman, 1986.

Ramsey, William L., et al. *Modern Earth Science*. New York: Holt, Rinehart, and Winston, 1998.

Stevenson, L. Harold and Bruce Wyman, eds. *The Facts on File Dictionary of Environmental Science*. New York: Facts on File, 1991.

Tarbuck, Edward J. and Frederick K. Litgens. *Earth Science*. Columbus, OH: Merrill, 1985.

White, Jo Ann, ed. *The New American Desk Encyclopedia*. New York: Penguin Putnam, 1997.

Production Software

Adobe PageMaker 6.5. Mountain View, CA: Adobe Systems.

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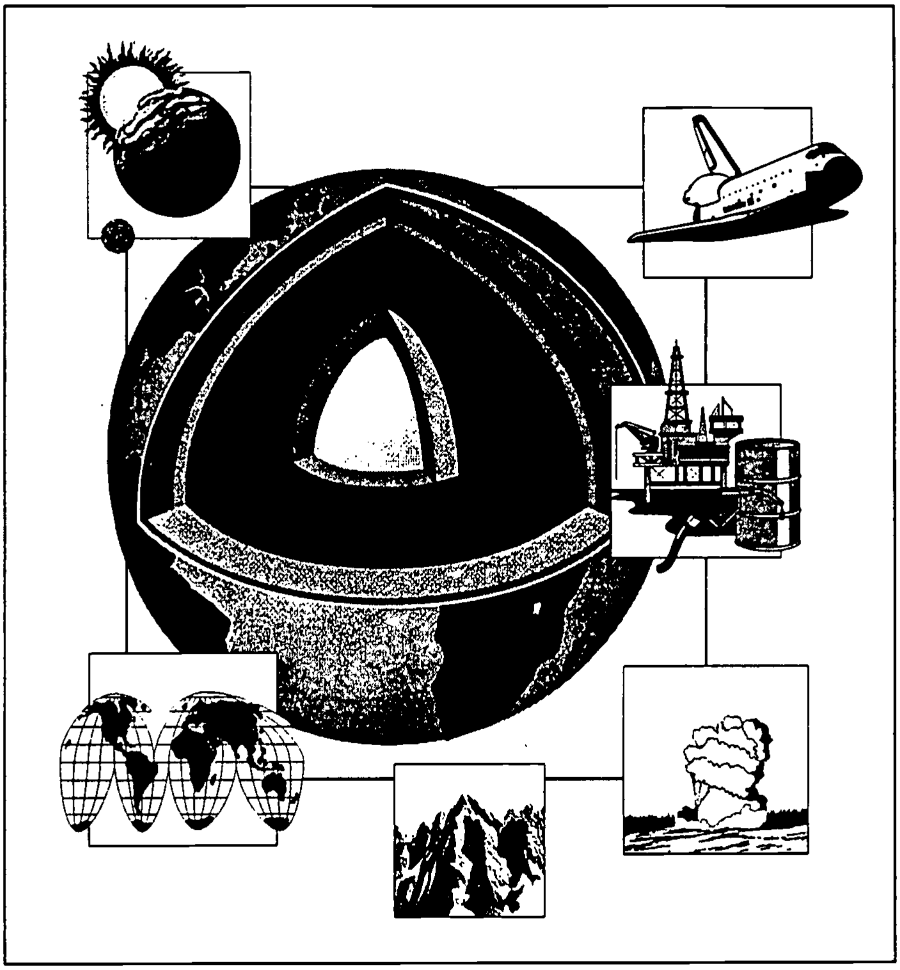
Parallel Alternative Strategies for Students

Teacher's Guide

Earth/Space Science

Course No. 2001310



1999

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Parallel Alternative Strategies for Students

PASS Book Evaluation Form

PASS Volume Title: ______________________ Date: __________

Your Name: ______________________ Your Position: __________

School: ______________________

School Address: ______________________

____

Directions: *We are asking for your assistance in clarifying the benefits of using the PASS book as a supplementary text. After using the PASS book with your students, please respond to all the statements in the space provided; use additional sheets if needed. Check the appropriate response using the scale below. Then, remove this page, fold so the address is facing out, attach postage, and mail. Thank you for your assistance in this evaluation.*

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Content					
1. The content provides appropriate modifications, accommodations, and/or alternate learning strategies for students with special needs.	❑	❑	❑	❑	❑
2. The content is at an appropriate readability level.	❑	❑	❑	❑	❑
3. The content is up-to-date.	❑	❑	❑	❑	❑
4. The content is accurate.	❑	❑	❑	❑	❑
5. The content avoids ethnic and gender bias.	❑	❑	❑	❑	❑
Presentation					
6. The writing style enhances learning.	❑	❑	❑	❑	❑
7. The text format and graphic design enhance learning.	❑	❑	❑	❑	❑
8. The practice/application activities are worded to encourage expected response.	❑	❑	❑	❑	❑
9. Key words are defined.	❑	❑	❑	❑	❑
10. Information is clearly displayed on charts/graphs.	❑	❑	❑	❑	❑
Student Benefits					
11. The content increases comprehension of course content.	❑	❑	❑	❑	❑
12. The content improves daily grades and/or tests scores.	❑	❑	❑	❑	❑
13. The content increases mastery of the standards in the course.	❑	❑	❑	❑	❑

Usage

The simplified texts of *PASS* are designed to be used as an additional resource to the state-adopted text(s). Please check the ways you have used the *PASS* books. Feel free to add to the list:

- ❑ additional resource for the basic text
- ❑ pre-teaching tool (advance organizer)
- ❑ post-teaching tool (review)
- ❑ alternative homework assignment
- ❑ alternative to a book report
- ❑ extra credit
- ❑ make-up work
- ❑ outside assignment
- ❑ individual contract
- ❑ self-help modules
- ❑ independent activity for drill and practice
- ❑ general resource material for small or large groups
- ❑ assessment of student learning
- ❑ other uses: ______________________

Overall

Strengths:

Limitations:

Other comments:

***Directions:** Check each box that is applicable.*

I have daily access at school to:	❑ A computer	❑ A printer	❑ The Internet	❑ A CD-ROM drive
All of my students have daily access at school to:	❑ A computer	❑ A printer	❑ The Internet	❑ A CD-ROM drive
I would find it useful to have PASS on:	❑ The Internet	❑ CD-ROM	❑ Mac	❑ PC/IBM

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Place Stamp Here
Post Office Will Not Deliver Without Postage

Arlene Duncan, Program Director
BISCS Clearinghouse
Turlington Building, Room 628
325 West Gaines Street
Tallahassee, FL 32399-0400

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Earth/Space Science

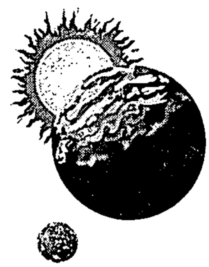
Teacher's Guide

Course No. 2001310

Bureau of Instructional Support and Community Services
Division of Public Schools and Community Education
Florida Department of Education

1999

This product was developed by Leon County Schools, Exceptional Student Education Department, through the Curriculum Improvement Project, funded by the State of Florida, Department of Education, Division of Public Schools and Community Education, Bureau of Instructional Support and Community Services, through federal assistance under the Individuals with Disabilities Education Act (IDEA), Part B.



Earth/Space Science

Teacher's Guide

Course No. 2001310

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Foreword

Parallel Alternative Strategies for Students (PASS) books are content-centered packages of supplemental readings, activities, and methods that have been adapted for students who have disabilities and other students with diverse learning needs. *PASS* materials are used by regular education teachers and exceptional education teachers to help these students succeed in regular education content courses. They have also been used effectively in alternative settings such as juvenile justice educational programs and second chance schools, and in dropout prevention and other special programs that include students with diverse learning needs.

The content in *PASS* differs from standard textbooks and workbooks in several ways: simplified text; smaller units of study; reduced vocabulary level; increased frequency of drill and practice; concise directions; less cluttered format; and presentation of skills in small, sequential steps.

PASS materials are not intended to provide a comprehensive presentation of any course. They are designed to *supplement* state-adopted textbooks and other instructional materials. *PASS* may be used in a variety of ways to augment the curriculum for students with disabilities and other students with diverse learning needs who require additional support or accommodations in textbooks and curriculum. Some ways to incorporate this text into the existing program are as

- a resource to supplement the basic text
- a pre-teaching tool (advance organizer)
- a post-teaching tool (review)
- an alternative homework assignment
- an alternative to a book report
- extra credit work
- make-up work
- an outside assignment
- part of an individual contract
- self-help modules
- an independent activity for drill and practice
- general resource material for small or large groups
- an assessment of student learning

The initial work on *PASS* materials was done in Florida through Project IMPRESS, an Education of the Handicapped Act (EHA), Part B, project funded to Leon County Schools from 1981–1984. Four sets of modified content materials called *Parallel Alternate Curriculum* (*PAC*) were disseminated as parts two through five of *A Resource Manual for the Development and Evaluation of Special Programs for Exceptional Students, Volume V-F: An Interactive Model Program for Exceptional Secondary Students*. Project IMPRESS patterned the *PACs* after curriculum materials developed at the Child Service Demonstration Center at Arizona State University in cooperation with Mesa, Arizona, Public Schools.

A series of 19 *PASS* volumes was developed by teams of regular and special educators from Florida school districts who volunteered to participate in the EHA, Part B, Special Project, Improvement of Secondary Curriculum for Exceptional Students (later called the Curriculum Improvement Project). This project was funded by the Florida Department of Education, Bureau of Education for Exceptional Students, to Leon County Schools during the 1984 through 1988 school years. Regular education subject area teachers and exceptional education teachers worked cooperatively to write, pilot, review, and validate the curriculum packages developed for the selected courses.

Beginning in 1989 the Curriculum Improvement Project contracted with Evaluation Systems Design, Inc., to design a revision process for the 19 *PASS* volumes. First, a statewide survey was disseminated to teachers and administrators in the 67 school districts to assess the use of and satisfaction with the *PASS* volumes. Teams of experts in instructional design and teachers in the content area and in exceptional education then carefully reviewed and revised each *PASS* volume according to the instructional design principles recommended in the recent research literature. Subsequent revisions have been made to bring the *PASS* materials into alignment with the Sunshine State Standards.

The *PASS* volumes provide some of the text accommodations necessary for students with diverse learning needs to have successful classroom experiences and to achieve mastery of the Sunshine State Standards. To increase student learning, these materials may be used in conjunction with additional resources that offer visual and auditory stimuli, including computer software, videotapes, audiotapes, and laser videodiscs.

User's Guide

The *Earth/Space Science PASS* and accompanying *Teacher's Guide* are supplementary resources for teachers who are teaching science to secondary students with disabilities and other students with diverse learning needs. The content of the *Earth/Space Science PASS* book is based on the *Florida Curriculum Frameworks* and correlates to the Sunshine State Standards.

The Sunshine State Standards are made up of *strands*, *standards*, and *benchmarks*. A *strand* is the most general type of information and represents a category of knowledge. A *standard* is a description of general expectations regarding knowledge and skill development. A *benchmark* is the most specific level of information and is a statement of expectations about student knowledge and skills. Sunshine State Standards correlation information for *Earth/Space Science*, course number 2001310, is given in a matrix in appendix E.

The *Earth/Space Science PASS* is divided into 16 units of study that correspond to the science strands. The student book focuses on readings and lab activities that help students meet benchmark requirements as identified in the course description. It is suggested that expectations for student performance be shared with the students before instruction begins.

Each unit in the *Teacher's Guide* includes the following components:

- **Overview:** Each unit contains a general description and summary of the unit. (The summary is also in the student book.)

- **Suggestions for Enrichment:** Each unit contains activities that may be used to encourage, to interest, and to motivate students by relating concepts to real-world experiences and prior knowledge.

- **Unit Assessments:** Each unit contains an assessment with which to measure student performance.

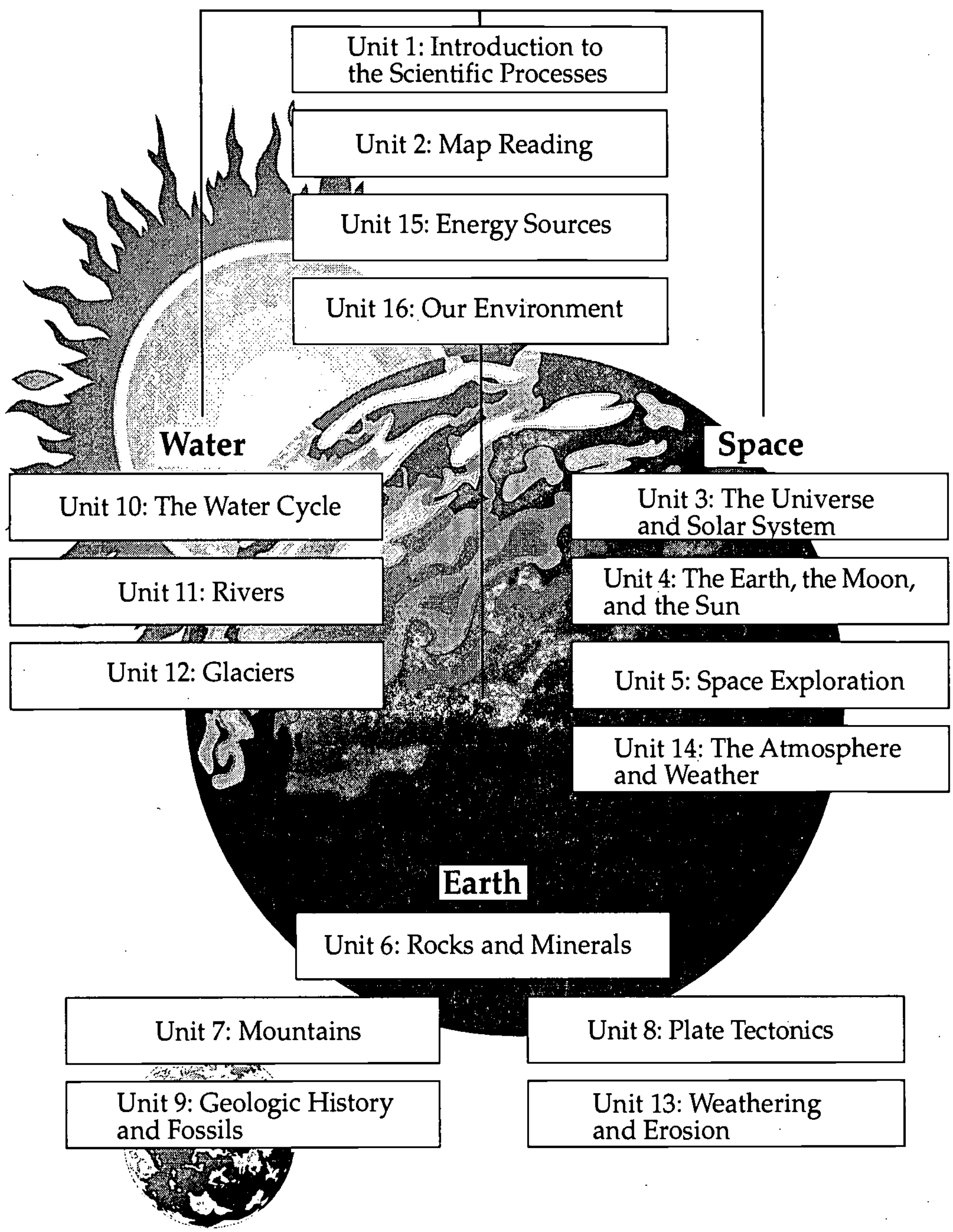
- **Keys:** Each unit contains an answer key for each practice and lab activity in the student book and for the unit assessments in the *Teacher's Guide*.

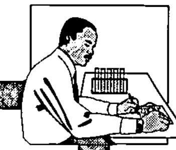
The appendices contain the following components:

- **Appendix A** describes instructional strategies adapted from the Florida Curriculum Frameworks for meeting the needs of students with disabilities and other students with diverse learning needs.
- **Appendix B** lists teaching suggestions for helping students achieve mastery of the Sunshine State Standards and Benchmarks.
- **Appendix C** contains suggestions for specific strategies to facilitate inclusion of students with disabilities and other students with diverse learning needs. These strategies may be tailored to meet the individual needs of students.
- **Appendix D** lists suggested Internet sites for each unit.
- **Appendix E** contains a chart that correlates relevant benchmarks from the Sunshine State Standards with course requirements for *Earth/Space Science*. These course requirements describe the knowledge and skills the students will have once the course has been successfully completed. The chart may be used in a plan book to record dates as the benchmarks are addressed.
- **Appendix F** lists reference materials and software used to produce *Earth/Space Science*.

Earth/Space Science is designed to correlate classroom practices with the Florida Curriculum Frameworks. No one text can adequately meet all the needs of all students—this *PASS* is no exception. *PASS* is designed for use with other instructional materials and strategies to aid comprehension, provide reinforcement, and assist students in attaining the subject area benchmarks and standards.

Earth/Space Science





Unit 1: Introduction to the Scientific Processes

Overview

The scope of this unit includes introductory instruction in basic science skills and methods to ensure safety and accuracy. Review safety rules and have students sign the Lab Safety Contract on page 3 of Teacher's Guide. Require mastery (90–100 percent) on safety quiz before participation in lab activities (student book page 19).

The sharing of scientific information requires that scientists be able to obtain and report their findings in an efficient and consistent manner. When answering questions, scientists use the five steps of the scientific method—(1) identifying the problem, (2) gathering information on the problem, (3) forming a hypothesis, (4) testing the hypothesis (experiment), and (5) drawing conclusions and reporting the results. Scientists must also have very specific equipment or apparatus to make accurate measurements and to handle materials properly. Just as scientists have specific rules and procedures for operating in the laboratory, we too must follow safety rules to make our experiences in the science laboratory safe and rewarding.

Suggestions for Enrichment

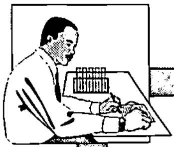
1. Assign the safety cartoon for group discussion on page 20 of student book.

2. Role-play dangerous situations so students will know what to do. For example: clothes on fire—use a blanket or stop, drop, and roll; chemicals in the eyes—use eye wash or the safety shower; electrical fire—use sand or a fire extinguisher.

3. Develop a student-generated emergency plan in case of a lab accident.

4. Set up a display of lab equipment that will be used during the year and provide instruction for its use, cleaning, and storage.

5. Stress the need for mastery of scientific measurement, scientific process, and laboratory safety as necessary to understand the scientific enterprise.



6. Demonstrate the scientific method. Example: light a small candle, let it burn for a moment, then cover it with a glass or bottle. Observe the result. Ask students what happened and record observations (data). The demonstration may need to be repeated to get more data.

   Form a hypothesis—collect students' ideas on the board and focus on one or two.

   Design a simple experiment to test the hypothesis—introduce the idea of a control to isolate *one variable*.

7. Have students analyze newspaper articles about scientific research. Point out the difference between science and pseudoscience (i.e., astronomy *vs.* astrology) and compare the two based on what science is to the students.

8. Discuss the concept of Earth/space science.

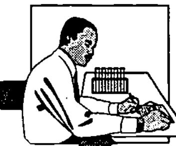
9. Divide the students into groups and assign each group a component of Earth/space science. Have the students collect articles, make a drawing, or prepare a bulletin board to share with the class.

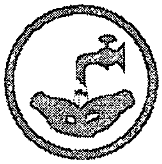
10. Introduce students to the Internet. Use a simple scavenger hunt to teach searching skills.

11. Use the Internet to research a current scientific discovery.

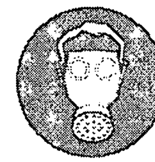
12. Discuss how Earth/space science can be considered an integrated science. For example, one cannot discuss weather scientifically without understanding something about the atmosphere, the oceans, and mathematical models. Show the interrelationships.

13. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.





Lab Safety Contract



I,________________________________, have read and do understand the safety rules of the science laboratory and agree to follow them at **all** times. I will follow all instructions given by the teacher and behave responsibly in the science laboratory.

____

Date

____

Student's Signature

____

Parent's Signature

____

Teacher's Signature

Safety Guidelines

1. Read and follow all directions while working in the laboratory.
2. Wear protective gear, such as aprons, at all times. Wear goggles when working with dangerous or hot chemicals, or any time your teacher instructs you to do so.
3. NEVER taste or directly inhale chemicals. Test the smell of a substance by wafting or fanning some of the odor to your nose with your hand. Your teacher can show you how.
4. DO NOT bring food or drink into the lab.
5. Wash hands thoroughly after each lab.
6. DO NOT rub eyes or put hands in mouth.
7. Dress in a way that helps you work safely and efficiently in the lab. Tie your hair back. Wear cotton—it doesn't catch fire as easily as nylon or polyester. Always keep your shoes on while in the lab. Roll up long or loose sleeves.
8. DO NOT look directly down into the mouth of a filled test tube. DO NOT point the mouth of a filled test tube at another student. Liquid can splash into eyes.
9. DO NOT perform any experiments unless the instructor is in the room.
10. Report ALL minor and major accidents to your instructor. Remain calm and do not alarm others by shouting or running.
11. Know the location of the safety shower, eye wash, and fire blanket. Know how to use these important pieces of safety equipment.
12. Turn off gas burners and the gas outlets when no one is using them. NEVER leave a lit burner unattended.
13. Use tongs or gloves to handle hot objects.
14. DO NOT look directly at the sun, with or without equipment, as it may damage your eyes.
15. Keep lab tables clean and neat to prevent accidents. Wipe all areas at the end of the lab.
16. MAKE SAFETY A HABIT!

Unit Assessment

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

________ 1. An experiment may have only one variable factor.

________ 2. Experiments always prove the hypothesis to be correct.

________ 3. A good hypothesis can be tested.

________ 4. A hypothesis only deals with known or existing facts.

________ 5. A hypothesis explains the relationship among observed facts.

________ 6. A fact is something about which we have no doubts.

________ 7. Careful observation is an important step in scientific study.

________ 8. Data is usually numerical.

________ 9. Logical reasoning has no part in a scientific experiment.

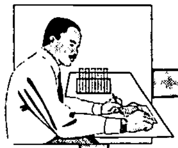
________ 10. If you get positive results from your experiment the first time, it is okay to stop and report your results.

________ 11. It is best to keep the results of your experiment a secret so that no one may steal your ideas.

________ 12. Observation is done only with the eyes.

________ 13. A theory can be disproved if new discoveries are made.

________ 14. The experiment is a part of the last step of the scientific method.



Circle the letter of the correct answer.

15. When working in the laboratory, a teacher should be present ____________ .

    a. at the beginning of class
    b. at the end of class
    c. during the experiment
    d. at all times

16. If an accident occurs in the laboratory, you should ____________ .

    a. remain calm and not alarm others
    b. run and shout for the teacher as loudly as you can
    c. telephone 911
    d. begin CPR technique as soon as possible

17. Looking directly into the sun with or without equipment may ____________ .

    a. cause you to see spots
    b. cause retinitis pigmentosa
    c. damage your eyes
    d. increase your visual acuity

18. To test the smell of a substance, ____________ .

    a. put your nose directly over the substance
    b. fan some of the odor to your nose with your hand
    c. sniff the substance through a piece of tubing or a straw
    d. enclose the substance in a box and sniff through an opening in the box

19. Dispose of all waste materials in ____________ .

    a. radioactive waste containers
    b. toxic waste containers
    c. proper containers
    d. metal containers only

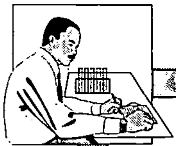
20. Wearing safety goggles ___________.
    a. protects your eyes from the Bunsen burner flame
    b. protects your eyes from radioactive rays
    c. protects your eyes from materials that may splash
    d. protects your eyes from the sun

21. Wearing loose-fitting clothes ___________.
    a. could knock over equipment
    b. is comfortable while doing experiments
    c. is preferable to wearing tight-fitting clothes
    d. keeps the work area safe

22. Washing hands ___________.
    a. keeps toxic materials in your mouth
    b. should be done thoroughly after each lab
    c. prevents chemicals from leaving the bloodstream
    d. should be done after looking at each chemical substance

23. To handle hot objects, you should ___________.
    a. use asbestos towels
    b. use tongs or gloves
    c. leave them in the ring-stand and move the ring-stand
    d. leave them alone and call the teacher

24. You should know the location of ___________.
    a. fire blankets
    b. first aid kits
    c. fire extinguishers
    d. all of the above



Use the list below to complete the following statements. One or more terms will be used more than once.

charts	**gathering information**	**senses**
controlled	**graphs**	**tables**
equipment	**hypothesis**	**tested**
experiments	**identify the problem**	**theory**
fact	**observations**	**time**
first	**records**	

25. The ______________________ step of the scientific method is to ______________________ .

26. Careful ________________ are important in ________________ .

27. Two ways of collecting information are using the ______________ and using scientific ______________________ .

28. A ______________________ is an idea that has been proven by ______________________ .

29. Careful and confirmed ______________ can become scientific facts.

30. The third step of the scientific method is to form a ______________ .

31. A ______________ that cannot be ______________ is of no value.

32. A ______________________ experiment is one where all the factors are the same except for the one being tested.

33. Make careful observations and keep accurate ______________ of the results using ______________ , ______________ , and ____________ .

34. A ______________________ is a hypothesis that has withstood the test of ______________________ .

Keys

Practice (p. 15)

1. False
2. False
3. True
4. True
5. True
6. True
7. True
8. False
9. False
10. False
11. False
12. True
13. False

Practice (p. 16)

1. Bunsen burner
2. eyedropper
3. beaker
4. thermometer
5. funnel
6. graduated cylinder
7. balance
8. test tube
9. compass

Practice (pp. 17-18)

1. b
2. a
3. d
4. c
5. c
6. d
7. a
8. d
9. c
10. b

Practice (p. 19)

1. True
2. False
3. False
4. True
5. True
6. True
7. True
8. True
9. False
10. True

Practice (p. 20)

Correct answers will be determined by the teacher.

Practice (p. 21)

Correct answers will be determined by the teacher.

Practice (p. 22)

1. variable factor
2. thermometer
3. control group
4. hypothesis
5. eyedropper
6. experiment
7. observation
8. graduated cylinder
9. conclusion
10. Bunsen burner

Practice (p. 23)

1. fact
2. data
3. theory
4. test tube
5. scientific method
6. controlled experiment
7. experimental group
8. apparatus
9. beaker
10. balance

Keys

Practice (pp. 24-26)

1. a
2. b
3. a
4. b
5. a
6. d
7. a
8. a
9. a
10. c
11. b
12. d

Unit Assessment (pp. 5-8TG)

1. False
2. False
3. True
4. False
5. True
6. True
7. True
8. True
9. False
10. False
11. False
12. False
13. True
14. False
15. d
16. a
17. c
18. b
19. c
20. c
21. a
22. b
23. b
24. d
25. first; identify the problem
26. observations; gathering information
27. senses; equipment
28. fact; experiments
29. observations
30. hypothesis
31. hypothesis; tested
32. controlled
33. records; charts; graphs; tables
34. theory; time

Unit 2: Map Reading

Overview

The scope of this unit includes different types of maps used in Earth/space science including road maps, topographic maps, and weather maps. Longitude, latitude, and map symbols are also included.

Different types of maps show different features of Earth and have different uses. Each type has advantages and disadvantages. Legends and scales help us interpret maps. Parallels and meridians are imaginary lines that measure distances in degrees of latitude and longitude. Special maps, such as topographic and weather maps, give special types of information.

Suggestions for Enrichment

1. Stimulate discussion on maps—Why do we use maps? Why is a flat map not very accurate for large areas? How do we use maps? How do you make a map? How do you map something you can't see?

2. Show examples of the different types of maps. Discuss advantages, disadvantages, and uses.

3. Discuss navigation and use of longitude and latitude to find position. Investigate the way early sailors used a sextant to locate their position.

4. Compare longitude and latitude to LORAN (*lo*ng-*ra*nge-*n*avigation) numbers used by fishermen or the grid on a street map.

5. Discuss the use of topographic maps and why elevation might be important to know.

6. Discuss what is necessary to make a weather map and how to predict areas of severe weather, and introduce meteorology.

7. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Circle the letter of the correct answer.

1. A contour line represents __________ .

   a. a hill
   b. a valley
   c. a lake
   d. points of equal elevation

2. Each symbol on the map is explained in the __________ .

   a. scale
   b. legend
   c. index
   d. title

3. A map which shows surface features of the area is a(n) __________ .

   a. topographic map
   b. Mercator projection map
   c. equal-area projection map
   d. polar projection map

4. Lines of latitude are called __________ .

   a. meridians
   b. parallels
   c. contour lines
   d. longitude

5. The prime meridian is __________ longitude.

   a. 180°
   b. 90°
   c. 0°
   d. 45°

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6. The line that is on the opposite side of Earth from the prime meridian is the ___________ .

   a. equator
   b. International Date Line
   c. meridian
   d. 90° parallel

7. A spherical or round model of Earth is a ___________ .

   a. map projection
   b. topographic map
   c. relief map
   d. globe

8. An imaginary line halfway between the poles is the ___________ .

   a. equator
   b. prime meridian
   c. International Date Line
   d. Tropic of Cancer

9. Lines that run from the north to the south poles are called ___________ or lines of longitude.

   a. parallels
   b. latitude
   c. meridians
   d. topographic lines

10. A drawing of Earth that is flat is called a ___________ .

    a. globe
    b. topographic map
    c. relief map
    d. map projection

11. Lines on a map that represent areas of equal temperature are called ___________ .

    a. isobars
    b. isotherms
    c. contour intervals
    d. contour lines

12. The comparison of the distance on a map to the actual distance on Earth's surface is the __________ of a map.

    a. relief
    b. legend
    c. scale
    d. elevation

13. A scientist who studies and predicts the weather is called a __________ .

    a. geologist
    b. paleontologist
    c. biologist
    d. meteorologist

14. The imaginary line of 0° longitude that runs through Greenwich, England is the __________ .

    a. International Date Line
    b. equator
    c. parallel
    d. prime meridian

15. A map that has both lines of latitude and longitude running parallel to each other that is good for navigation, but is distorted at the polar regions, is a(n) __________ .

    a. equal-area projection map
    b. Mercator projection map
    c. polar projection map
    d. topographic map

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 16. The most accurate model of Earth is the globe.

_________ 17. Places on Earth can be located exactly if their latitude and longitude are known.

_________ 18. The date changes when you cross the prime meridian.

_________ 19. A polar projection map gives a distorted view of the polar regions.

_________ 20. Mercator projection maps are the most useful for navigation purposes.

_________ 21. The scale explains the symbols used on a map.

_________ 22. The equator is the line that divides east and west longitude.

_________ 23. Earth can be divided into 24 sections, called time zones, that are each 15° of longitude wide.

_________ 24. Latitude and longitude are measured in degrees because Earth is circular, and degrees are used to measure circles.

_________ 25. Contour lines are used to show elevation on a flat map.

_________ 26. Contour lines of different elevations often cross each other.

_________ 27. Contour lines form a V that points downstream when they cross a river.

_________ 28. Weather maps are made by putting information about the weather on a map in the form of symbols.

_________ 29. Meteorologists' weather predictions are usually 100 percent accurate.

_________ 30. Tracking a hurricane on a map helps give us an idea what direction a hurricane **might** go.

Answer the following using complete sentences.

31. Explain the use of a topographic map. ______________________

____

____

____

____

____

____

32. Explain the use of a weather map. ______________________

____

____

____

____

____

____

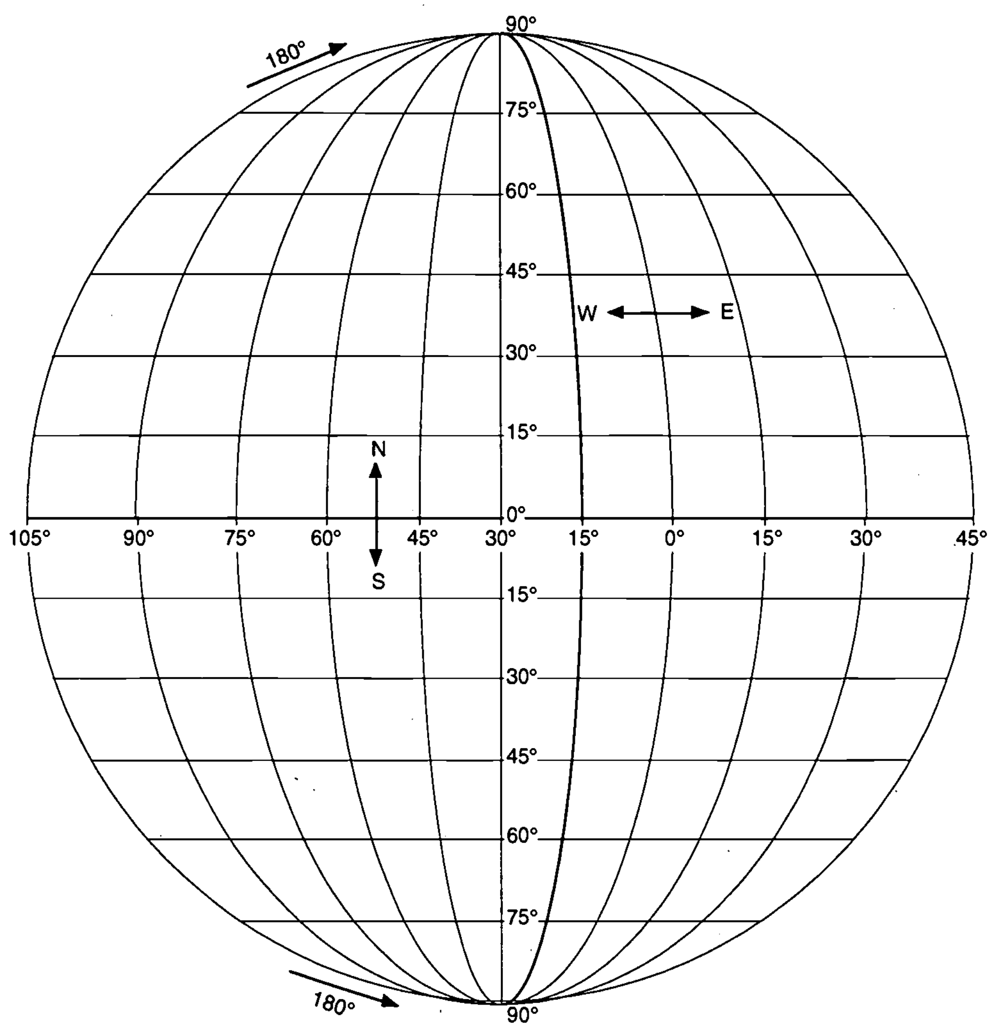
Locate the following **continents** *on a globe or map. Record the* **locations** *giving the range of both the latitude and longitude at which the boundaries may be found. Be sure to give* **North** *or* **South** *with* **latitude** *and* **East** *or* **West** *with* **longitude**.

(Example: Longitude 17°E–17°W, Latitude 32°N–32°S)

Continent	Latitude	Longitude
33. Africa		
34. North America		
35. South America		
36. Asia		
37. Europe		
38. Australia		
39. Antarctica		

Write the following terms in their correct **location** *on the map.*

equator	**longitude line**
International Date Line	**prime meridian**
latitude line	



Keys

Practice (pp. 40-41)

Correct answers will be determined by the teacher.

Practice (p. 42)

Correct answers will be determined by the teacher.

Practice (p. 43)

Answers will include the following information:

1. a flat drawing or model of the surface of Earth
2. a spherical or round model of Earth
3. places closely correspond to where they are on Earth
4. a drawing of Earth on a flat piece of paper
5. put in textbooks, hung on walls, projected on screens
6. It distorts the size and shape of land masses.

Practice (p. 44)

1. C
2. A
3. B
4. A
5. B
6. A
7. B
8. C
9. A
10. C

Practice (p. 45)

City	Latitude	Longitude
1. San Francisco	38° N	122° W
2. Los Angeles	35° N	120° W
3. Salt Lake City	42° N	112° W
4. Denver	39° N	105° W
5. Chicago	42° N	88° W
6. St. Louis	37.5° N	91° W
7. Houston	30° N	95° W
8. New Orleans	30° N	89° W
9. Philadelphia	40° N	75° W
10. Miami	27° N	80° W

Practice (p. 46)

1. North America
2. Australia
3. South America
4. Africa
5. Europe

Practice (p. 47)

Correct answers will be determined by the teacher.

Practice (p. 48)

1. J
2. L
3. K
4. F
5. H
6. I
7. E
8. G
9. M
10. A
11. C
12. B
13. D

Keys

Practice (p. 49)

1. lake
2. river
3. southwest
4. hill
5. 500 meters
6. 300 meters
7. 500 meters
8. 450 meters

Practice (p. 50)

Correct answers will be determined by the teacher.

Practice (p. 51)

Answers will include the following information:

1. a flat map that shows the surface features of the land
2. hills, plains, mountains, lakes, or rivers
3. railroads, cities, dams, and roads
4. elevation
5. contour lines
6. the difference in elevation between two contour lines
7. how much variation there is in the elevation of the land
8. hills or mountains
9. coastal areas or plains

Practice (p. 52)

1. time zone
2. relief
3. map
4. legend
5. isobars
6. polar projection
7. meteorologist
8. Mercator projection map
9. International Date Line
10. equator
11. elevation

Practice (p. 53)

1. map projection
2. contour interval
3. meridians
4. contour lines
5. parallels
6. equal-area projection map
7. prime meridian
8. globe
9. topographic map
10. isotherms
11. longitude

Practice (pp. 54-58)

1. a
2. c
3. b
4. a
5. c
6. d
7. d
8. a
9. d
10. d
11. d
12. d
13. d
14. b
15. a
16. d
17. d
18. a
19. d
20. a
21. d
22. c
23. b
24. d

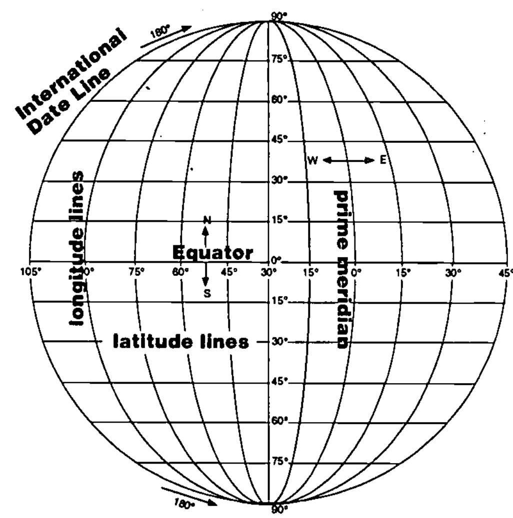
Keys

Unit Assessment (pp. 13-19TG)

1. d
2. b
3. a
4. b
5. c
6. b
7. d
8. a
9. c
10. d
11. b
12. c
13. d
14. d
15. b
16. True
17. True
18. False
19. False
20. True
21. False
22. False
23. True
24. True
25. True
26. False
27. False
28. True
29. False
30. True
31. to show the surface features of an area including elevation and relief
32. to check weather conditions in different areas

Continent	Latitude	Longitude
33. Africa	36° N 36° S	17° W 53° E
34. North America	83° N 7° S	168° W 53° E
35. South America	12° N 57° S	81° W 35° E
36. Asia	81° N 1° S	60° W 170° E
37. Europe	81° N 36° S	10° W 60° E
38. Australia	12.5° N 44° S	115° W 155° E
39. Antarctica	60° N 90° S	Antarctic Circle

40.-44.



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Unit 3: The Universe and Solar System

Overview

The scope of this unit includes the origin and composition of the universe and the solar system.

The nine planets—along with comets, meteoroids, asteroids, and other celestial objects—make up Earth's vast neighborhood. The planets and other heavenly bodies have at least one thing in common. They all share gravitational forces with the sun, forming a large system—the solar system. With the help of space probes, cameras, and other data-gathering equipment placed above Earth's atmosphere, scientists are able to find out more and more about our celestial neighborhood. These scientific studies are making our world seem smaller than we once imagined it to be and the universe more accessible.

Suggestions for Enrichment

1. Discuss space as an area containing subsystems vs. an empty area.
2. Review the theories of the formation of the solar system.
3. Compare the *Big Bang* theory to a loaf of raisin bread rising—all subsystems are moving away from each other in all directions.
4. Discuss open and closed systems in space—open systems will continue to expand until too far apart to function—there is no end; and closed systems will expand until a certain point is reached, then will contract back together—like a rubber band stretching and contracting.
5. Compare each component of the universe in regard to composition, size, and characteristics.
6. Assign each component of the universe to a group for research and class presentation.
7. Have students make models of constellations or pinhole viewers.

8. Have students make drawings of the planets comparing size and physical features.

9. Visit a planetarium.

10. Organize a night viewing to identify constellations.

11. Set up a telescope.

12. Have students research two constellations and their mythology.

13. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Circle the letter of the correct answer.

1. An object in the sky that looks like a shooting star is a ____________.
   a. comet
   b. planet
   c. star
   d. meteor

2. Planets reflect the light of ____________.
   a. the moon
   b. another planet
   c. the sun
   d. a comet

3. The sun is called a ____________.
   a. red giant
   b. yellow dwarf
   c. blue star
   d. shooting star

4. Halley's comet is seen every____________ years.
   a. 50
   b. 75
   c. 80
   d. 76

5. The name of a constellation found in the Zodiac is ____________.
   a. the Big Dipper
   b. the Little Dipper
   c. Aquarius
   d. Draco

6. The planet closest to the sun is ___________.

   a. Earth
   b. Pluto
   c. Mercury
   d. Venus

7. The planet Earth is a part of ___________.

   a. an elliptical galaxy
   b. a spiral galaxy
   c. the Milky Way
   d. both b and c

8. The moon is a ___________.

   a. planet
   b. satellite
   c. star
   d. meteor

9. Asteroids are fragments of rock and metal and many are found between ___________.

   a. Mars and Jupiter
   b. Earth and Mars
   c. Sun and Mercury
   d. Uranus and Neptune

10. The fragments of a meteor that hit Earth are called ___________.

   a. asteroids
   b. stars
   c. moons
   d. meteorites

Match each definition with the correct term. Write the letter on the line provided.

______ 11. disk-shaped and looks like a pinwheel; our solar system is part of this type of galaxy

______ 12. millions or billions of stars in a system

______ 13. hot, bright bodies of gas

______ 14. bodies that revolve around a sun and reflect its light

______ 15. a small number of stars that appears to form a shape or image

______ 16. spherical to disklike; contain very little dust or gas

______ 17. name of a constellation

______ 18. a very big star

______ 19. a medium-sized star

______ 20. a mass of dust and ice with a gaseous tail that orbits the sun

A. Big Dipper

B. comets

C. constellation

D. elliptical galaxies

E. galaxy

F. planets

G. red giant

H. spiral galaxies

I. stars

J. yellow dwarf

Use the list below to write the correct term for each definition on the line provided.

Aries	**constellation**	**Milky Way**	**planets**
asteroids	**galaxy**	**moon**	**star**
comet	**meteors**	**orbit**	**Zodiac**

______________ 21. millions or billions of stars in a system that may form a spiral or elliptical system

______________ 22. a hot mass of gas constantly exploding and giving off light and heat

______________ 23. bodies that revolve around a sun and reflect its light

______________ 24. a mass of dust and ice with a bright gaseous tail that orbits the sun

______________ 25. fragments of rocky material from space that sometimes enter Earth's atmosphere and burn as they fall

______________ 26. a small number of stars that appears to form a shape or image in the sky

______________ 27. a path of an object revolving around another object

______________ 28. one of the 12 signs of the Zodiac

______________ 29. Earth is located in this galaxy

______________ 30. a satellite that orbits a planet; Earth has one

______________ 31. twelve constellations that appear in a belt across the sky

______________ 32. fragments of rock and metal that orbit the sun

Use the list below to complete the following statements.

15	Earth	nebulae	size
20	galaxies	nebular	solar systems
Big Bang	Jupiter	Neptune	space
brightness	Mars	planets	temperature
constellation	Mercury	Pluto	Uranus
Dust Cloud	meteor	Saturn	Venus

33. The theory that most scientists accept for the beginning of the universe is called the ______________________ .

34. The universe is said to have begun between ______________________ and ______________________ billion years ago.

35. The theory that most scientists accept for the beginning of the solar system is called the ______________________ theory.

36. This theory is also known as the ______________________ theory.

37. The universe system is made up of ______________________ , ______________________ , ______________________ , ______________________ , and all energy and all matter.

38. Stars are different in ______________________ , ______________________ , and ______________________ .

39. A small number of stars that appears to form a shape or image is called a ______________________ .

40. ______________________ do not undergo fusion like stars, but reflect the light of the sun.

41. When a meteoroid enters Earth's atmosphere and begins to burn, it is called a ______________________ .

42. The nine planets of our solar system are as follows:

______________________ , ______________________ ,

______________________ , ______________________ ,

______________________ , ______________________ ,

______________________ , ______________________ ,

and ______________________ .

Keys

Lab Activity (pp. 71-73)

2. Distance from the sun:

Mercury	1 cm
Venus	2 cm
Earth	3 cm
Mars	4.5 cm
Jupiter	15.5 cm
Saturn	28.5 cm
Uranus	57.5 cm
Neptune	89.7 cm
Pluto	118 cm

3.-7. Correct answers will be determined by the teacher.

8. Mercury, Venus, Mars, and Jupiter
9. Mercury and Venus
10. a broken-up planet or trapped debris
11. after the asteroid belt with the exception of Pluto
12. closest to sun and farthest away (Pluto)

Practice (pp. 74-75)

Sentences will include the following information:

1. Big Bang theory
2. approximately 15 to 20 billion years ago
3. packed together in a single body
4. It formed a giant cloud that moved away from the center of the explosion.
5. Cosmic material cooled and condensed into solid bodies.
6. The stars continue to form and die.
7. a nebula
8. the Dust Cloud theory
9. A star larger than the sun came very close to the sun, which caused explosions. The gases from these explosions condensed to form the planets.
10. galaxies, solar systems, nebulae, and space—all matter and all energy

Practice (p. 76)

Answers will vary.

Practice (p. 77)

Answer will include the following heavenly bodies but the characteristics of each will vary.

1. Mercury
2. Venus
3. Earth
4. Mars
5. asteroid belt
6. Jupiter
7. Saturn
8. Uranus
9. Neptune
10. Pluto

Practice (pp. 78-79)

1. comet
2. planets
3. stars
4. meteors
5. galaxy
6. elliptical galaxies
7. spiral galaxies
8. constellation
9. satellite
10. orbit
11. nebula
12. solar system
13. theory
14. universe
15. asteroids
16. stellar equilibrium

Keys

Practice (pp. 80-82)

1. d
2. d
3. d
4. b
5. b
6. c
7. a
8. b
9. d
10. d
11. a
12. b
13. d
14. a
15. d

Unit Assessment (pp. 27-32TG)

1. d
2. c
3. b
4. d
5. c
6. c
7. d
8. b
9. a
10. d
11. H
12. E
13. I
14. F
15. C
16. D
17. A
18. G
19. J
20. B
21. galaxy
22. star
23. planets
24. comet
25. meteors
26. constellation
27. orbit
28. Aries
29. Milky Way
30. moon
31. Zodiac
32. asteroids
33. Big Bang
34. 15; 20
35. nebular (or Dust Cloud)
36. Dust Cloud (or nebular)
37. galaxies; solar systems; nebulae; space
38. size; brightness; temperature
39. constellation
40. Planets
41. meteor
42. Mercury; Venus; Earth; Mars; Jupiter; Saturn; Uranus; Neptune; Pluto

Unit 4: The Earth, the Moon, and the Sun

Overview

The scope of this unit includes the relative positions of the sun, Earth, and moon and changes associated with them.

Our moon is very different from Earth. While the moon rotates on its axis and revolves around Earth, Earth revolves around the sun. These three heavenly bodies create different shadows as they change positions. At certain times these shadows result in eclipses—lunar, solar, or total. As the moon rotates and revolves, different portions of the lighted side are visible from Earth. As a result, the moon appears to change its shape, or go through phases. The moon's gravitational pull on Earth (as well as the sun's) causes our changing ocean tides.

Suggestions for Enrichment

1. Have students use the Internet to research early theories about the moon. Have students discuss their findings.
2. Compare the moon to Earth in regards to atmosphere and topography.
3. Have students observe the surface of the moon using maps or a telescope.
4. Stimulate discussion with questions such as—Why did the Apollo 11 mission choose to land on a maria?
5. Have students research the Apollo missions and discuss what new discoveries were made.
6. Discuss the environment on the moon. Have students analyze what aspects of the lunar environment need to be considered to invent a device for supporting life on the moon. Ask students to develop a design or sketch of the product.
7. Have students diagram the positions of the sun, Earth, and moon during lunar and solar eclipses.

8. Discuss the phases of the moon. Why do they change?

9. Ask students to observe the phases of the moon.

10. Have students chart lunar activity over the course of a month to determine the length of a lunar month.

11. Relate the tides to the gravitational pull of the moon and its position.

12. Have students plot the tides on a graph to determine the tidal cycle and the number of high and low tides in a particular area.

13. Have students learn to read tidal charts and predict tides.

14. Discuss the uses of known tidal patterns—navigation, military landings, and fishing.

15. Have students chart sunrise and sunset times for each day and compute number of daylight hours.

16. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Match each definition with the correct term. Write the letter on the line provided.

______ 1. the rise and fall of the oceans

______ 2. gases that surround Earth

______ 3. the path of an object revolving around another object

______ 4. bowl-shaped depressions on a moon or planet

______ 5. the movement of Earth around the sun

______ 6. totally shaded cone-shaped shadow

______ 7. oval-shaped path of one object revolving around another

______ 8. spinning of Earth on its axis

______ 9. tide when sun, moon, and Earth are all in a straight line

______ 10. light areas on the moon

______ 11. blocking of light when the moon is between Earth and the sun

______ 12. dark areas on the moon

______ 13. blocking of light when Earth is between the sun and the moon

______ 14. partly shaded shadow caused by an eclipse

A. atmosphere

B. craters

C. elliptical orbit

D. highland areas

E. lunar eclipse

F. maria

G. orbit

H. penumbra

I. revolve

J. rotate

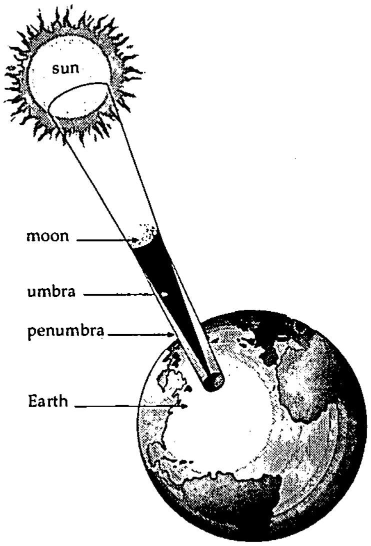
K. solar eclipse

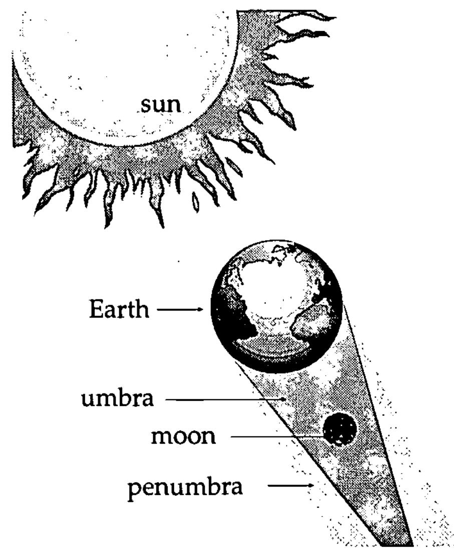
L. spring tide

M. tides

N. umbra

Label the following diagrams as a **solar** *or* **lunar eclipse**.





15. ____________________ eclipse   16. ____________________ eclipse

Match the name of the **moon phase** *to the correct shape. Write the letter on the line provided.*

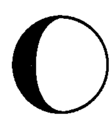
______ 17. full moon

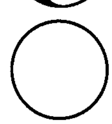
______ 18. gibbous moon

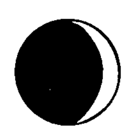
______ 19. new moon

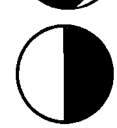
______ 20. crescent moon

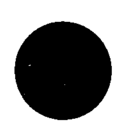
______ 21. quarter moon

A. 

B. 

C. 

D. 

E. 

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 22. Earth is the fourth planet from the sun.

_________ 23. There is an atmosphere on the moon.

_________ 24. The moon is lifeless and dry.

_________ 25. A gibbous moon occurs just before and after a new moon.

_________ 26. We always see the same side of the moon from Earth.

_________ 27. It takes 24 hours for the moon to rotate.

_________ 28. The moon revolves around Earth once every month.

_________ 29. It takes 29½ days for the moon to go through its phases.

_________ 30. The maria are tall mountains on the moon.

_________ 31. Spring tides only occur in the spring.

_________ 32. The surface of the moon is smooth and flat.

_________ 33. It is very cold and very hot on the moon.

_________ 34. There is only one high tide and one low tide over a 24-hour period of time.

_________ 35. Tides are caused by the moon alone.

_________ 36. When Earth is between the sun and the moon, we have a solar eclipse.

Circle the letter of the correct answer.

37. The four divisions of the year characterized by changes in temperature, weather, and the number of hours of daylight are called ___________ .

    a. seasons
    b. weather
    c. climate
    d. atmosphere

38. The seasons are caused by ___________ .

    a. the speed of Earth rotating
    b. the closeness to the sun
    c. the tilt of Earth on its axis
    d. the number of hours of daylight and darkness

39. When it is summer in the Northern hemisphere, it is ___________ in the Southern hemisphere.

    a. summer
    b. winter
    c. fall
    d. spring

40. The summer solstice is ___________ .

    a. the first day of summer
    b. the shortest day of the year
    c. the first day of spring
    d. the time of the year when day and night are equal

41. When the number of hours of daylight and darkness are equal in both hemispheres, it is called a(n) ___________ .

    a. summer solstice
    b. equinox
    c. winter solstice
    d. holiday

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42. The equinox marks the first day of ____________.

a. summer
b. winter
c. spring and fall
d. summer and winter

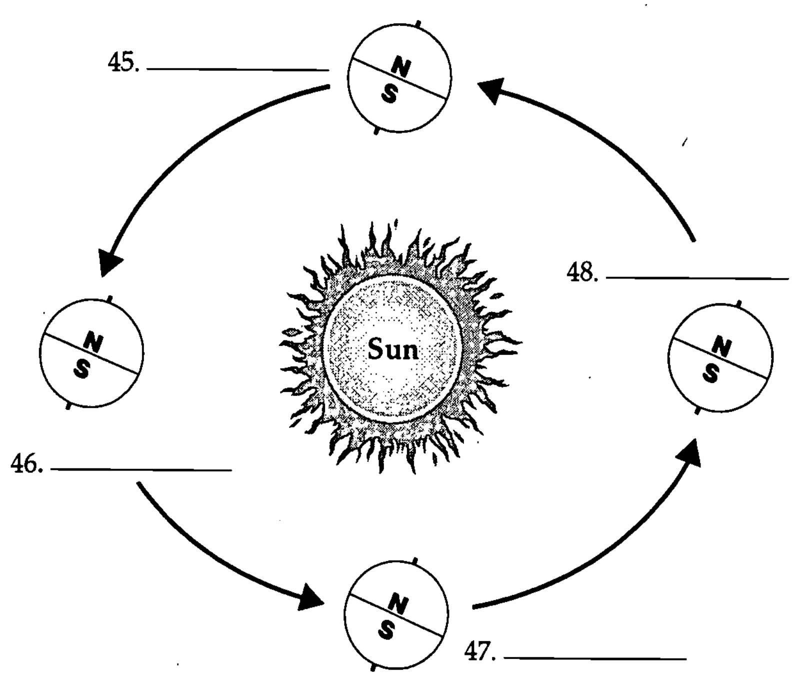
43. The equator has ____________.

a. equal days and nights all year long
b. long days in the summer and short days in the winter
c. long days in the winter and short days in the summer
d. 24 hours of darkness in the winter and 24 hours of daylight in the summer

44. The area(s) of Earth that have the biggest change in the number of hours of daylight and darkness during the year are ____________.

a. the equator
b. the temperate zones
c. the tropical zones
d. the poles

Label the **seasons** *for the Northern Hemisphere on the diagram below.*



Keys

Practice (pp. 97-98)

Sentences will include the following information:

1. atmosphere; water
2. No; there is no atmosphere and no water.
3. It does not have a strong enough gravitational pull.
4. It doesn't have an atmosphere to protect it from extreme temperatures.
5. the light and dark areas of the highlands and maria form shapes that look like faces
6. There is no water in them.
7. light-colored areas with high mountains
8. craters; meteors
9. from a few inches to over 500 miles
10. no weathering because of no atmosphere

Practice (pp. 99-100)

1. shadows
2. umbra
3. penumbra
4. solar eclipse
5. total
6. corona
7. partial; total
8. partial eclipse
9. lunar eclipse
10. three or four hours
11. lunar; solar
12. lunar

Practice (p. 101)

1. sun
2. Earth
3. umbra
4. moon
5. penumbra
6. lunar
7. sun
8. moon
9. penumbra
10. umbra
11. Earth
12. solar

Practice (p. 102)

Correct answers will be determined by the teacher.

Practice (p. 103)

1. C
2. D
3. B
4. E
5. A
6. F

Practice (p. 104)

1. D
2. B
3. A
4. F
5. C
6. E

Practice (p. 105)

1. crescent .... this moon occurs just before and after the new moon
2. full moon .... the moon is on the opposite side of Earth from the sun
3. gibbous .... this moon occurs just before and just after the full

Keys

4. new moon .... the moon is between Earth and the sun
5. quarter .... this moon occurs when it is halfway between a new moon and full moon

Practice (pp. 106-107)

Correct answers will be determined by the teacher.

Practice (pp. 108-109)

Sentences will include the following information:

1. the movement of ocean water caused by the gravitational attraction of sun and moon
2. 2; 2 (usually)
3. moon; because it is so much closer
4. spring tides
5. full moon and new moon
6. first- and third-quarter moon
7. higher than average high tides and lower than average low tides
8. sun and moon are at right (90°) angles
9. against each other
10. spring tide
11. 10:50 p.m.
12. Both Earth and moon are moving in orbit. It takes Earth 50 minutes to catch up to the moon.

Practice (pp. 110-111)

Sentences will include the following information:

1. differences in temperature; differences in weather; differences in the number of hours of light
2. the tilt of Earth on its axis
3. with the north pole towards the sun
4. with the north pole away from the sun and the south pole towards the sun
5. No. They are opposite because when one pole is pointed towards the sun, the other is pointed away.
6. during spring and fall
7. summer solstice
8. The day that has the greatest number of hours of sunlight.
9. equinox
10. spring and fall
11. at the equator
12. the north and south poles
13. summer; winter; spring; fall

Practice (pp. 112-113)

1. craters
2. solstice
3. seasons
4. equinox
5. neap tide
6. revolve
7. lunar month
8. orbit
9. lunar eclipse
10. phases
11. rotate
12. maria
13. tides
14. spring tide
15. solar eclipse
16. highland areas
17. elliptical orbit

Practice (pp. 114-117)

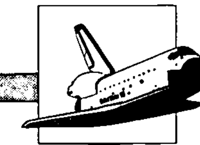
1. d
2. a
3. a
4. c
5. c
6. d
7. c

Keys

8. d
9. c
10. d
11. d
12. d
13. a
14. c
15. d
16. b
17. c

Unit Assessment (pp. 37-41TG)

1. M
2. A
3. G
4. B
5. I
6. N
7. C
8. J
9. L
10. D
11. K
12. F
13. E
14. H
15. solar
16. lunar
17. B
18. A
19. E
20. C
21. D
22. False (fourth) or (Earth)
23. False (an atmosphere) or (moon)
24. True
25. False (new) or (gibbous)
26. True
27. False (24 hours) or (moon)
28. True
29. True
30. False (maria are lunar seas or plains)
31. False (only occur in the spring)
32. False (is smooth and flat)
33. True
34. False (one high tide and one low tide)
35. False (moon alone)
36. False (solar eclipse) or (when Earth is between the sun and the moon)
37. a
38. c
39. b
40. a
41. b
42. c
43. a
44. d
45. spring
46. summer
47. fall
48. winter



Unit 5: Space Exploration

Overview

The scope of this unit scans the development of astronomy—from the early astronomers to instruments currently used in collecting information about space. Research questions about NASA's project are provided.

People have been interested in studying the sky and celestial bodies since the earliest times. Observations have been recorded since 500 B.C. Our ideas about the universe changed as discoveries were made by scientists such as Copernicus and Galileo. Today, through research conducted by NASA using sophisticated technology, scientists can gather firsthand information. Astronauts travel safely in space shuttles and collect data from space stations. More distant parts of the universe can be studied with probes and satellites. The technological advances in communication and other areas have benefited us in many ways.

Suggestions for Enrichment

1. Discuss observations about space.

2. Have students use knowledge about science fiction books or movies to discuss what it would really take for humans to leave Earth and live on another planet or in outer space.

3. Discuss the origins of astronomy, early views and superstitions, early astronomers, the clergy's influence, and the current developments of astronomy.

4. Stimulate discussion with such questions as—How do we know about space?

5. Discuss the instruments used in astronomy.

6. Have students build or examine simple telescopes.

7. Discuss NASA's contributions to astronomy and mankind.

8. Have students use current events to research the technology of space exploration such as the Hubble Space Telescope and the space shuttle.

9. Have students use the Internet to research events in the exploration of space. Discuss specific space missions or satellites and why they were helpful to the exploration of space and future discoveries.

10. Discuss the advantages and disadvantages of the space program.

11. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Use the list below to complete the following statements.

astronomer	**Kepler**	**Ranger**
astronomy	**Lunar Orbiter**	**satellites**
communication satellites	**lunar probes**	**Surveyor**
Copernicus	**moon**	**transfer**

1. The Greeks are credited with many of the early discoveries in the area of ________________________ .

2. Ptolemy (2^{nd} century A.D.) was a Greek ________________________ who supported the view that Earth was the stationary center of the universe.

3. The Polish astronomer ________________________ (1473–1543) proposed that Earth was a planet and revolved around the sun—the center of the universe.

4. In the early 1600s, the German astronomer, ________________________ , proposed three laws that described the movement of the planets.

5. The ________________________ is the most studied celestial object.

6. ________________________ are specially designed to be launched into space to take pictures of the moon.

7. Three of the space probes sent into space to take pictures of the moon in preparation for the Apollo 11 were the ________________________ , ________________________ , and ________________________ .

8. ______________ have been used to pave the way for our travel into space.

9. ______________ are used for the transmission of telephone, educational, medical, and other types of communication.

10. Technology ______________ from space research has had a great impact on many areas of our life.

Circle the letter of the correct answer.

11. One who studies astronomy or makes observations of celestial phenomena is called a(n) __________ .

    a. philosopher
    b. astrologer
    c. astronomer
    d. astronaut

12. A person who flies in a rocket or space shuttle is called a(n) __________ .

    a. philosopher
    b. astrologer
    c. astronomer
    d. astronaut

13. A spacecraft designed to orbit a celestial body without landing on its surface is a(n) __________ .

    a. satellite
    b. orbiter
    c. space station
    d. space shuttle

14. Communication over a distance is called ____________.

   a. telecommunication
   b. telescope
   c. television
   d. telephone

15. A satellite that receives, amplifies, and relays signals is called a(n) ____________.

   a. weather satellite
   b. TV satellite
   c. artificial satellite
   d. communication satellite

16. A reusable spacecraft that carries astronauts into space and returns them to Earth is called a ____________.

   a. space probe
   b. space shuttle
   c. space station
   d. space detector

17. An instrument that concentrates signals from space to view objects is called a ____________.

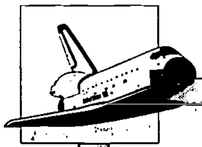
   a. telescope
   b. space shuttle
   c. space station
   d. space detector

18. A structure that provides living quarters in space, equipped with all the necessary instruments to work and live, is called a ____________.

   a. space probe
   b. space shuttle
   c. space station
   d. space detector

19. The load that is carried by a spacecraft is called its ____________.

   a. orbiter
   b. detector
   c. payload
   d. truckload



20. The abbreviation NASA stands for ________ .

    a. National Association for Space and Astronauts
    b. National Aeronautics and Space Administration
    c. National Association of Sociology and Astronomy
    d. New Adventures in Space and Air

Answer the following using complete sentences.

21. Although there have been objections by some to the amount of money spent on space research, many technological advances have resulted. List and discuss at least three benefits that space research and NASA's technologies have provided.

22. Communication has also been affected by the transferal of technologies. List and discuss at least three ways that the research in communication has benefited our everyday lives.

Keys

Practice (pp. 131-132)

Correct answers will be determined by the teacher.

Practice (p. 133)

1. False
2. True
3. True
4. False
5. True
6. True
7. False
8. True
9. True
10. False
11. False

Practice (p. 134)

1. D
2. G
3. B
4. E
5. A
6. C
7. F

Practice (p. 135)

1. G
2. H
3. B
4. F
5. A
6. E
7. D
8. C

Practice (pp. 136-137)

1. Probes
2. weather stations
3. Weather satellites
4. satellite system
5. Transmitters
6. orbiter
7. NASA
8. Space stations
9. telescopes
10. planetary probes
11. taxpayers
12. funds

Practice (pp. 138-139)

1. communication satellite
2. artificial
3. astronaut
4. cosmic rays
5. telecommunication
6. transmitter
7. detector
8. space shuttle
9. space stations
10. satellite
11. space probes
12. NASA

Lab Activity (pp. 140-141)

Correct answers will be determined by the teacher.

Practice (pp. 142-144)

1. d
2. a
3. a
4. d
5. c
6. a
7. c
8. c
9. d
10. d
11. a
12. a
13. b
14. d
15. c
16. b

Keys

Unit Assessment (pp. 49-52TG)

1. astronomy
2. astronomer
3. Copernicus
4. Kepler
5. moon
6. Lunar probes
7. Ranger; Lunar Orbiter; Surveyor
8. Satellites
9. Communication satellites
10. transfer
11. c
12. d
13. b
14. a
15. d
16. b
17. a
18. c
19. c
20. b

Sentences will include the following information:

21. safer space travel; more accurate information about the solar system; and improved command missions (unmanned satellites and probes)
22. worldwide communications (TV and radio); improved ability to more accurately forecast weather; improved warning systems for dangerous storms

Unit 6: Rocks and Minerals

Overview

The scope of this unit includes rocks, minerals, and the rock cycle.

Earth's crust is composed of elements which combine to form minerals. Minerals have five essential characteristics: naturally formed, inorganic, solid, a definite chemical formula, and an orderly arrangement of atoms. Minerals are identified by their physical properties, including luster, color, shape, cleavage, streak, specific gravity, hardness, and certain other tests.

Rocks are composed of one or more minerals. The three major types of rocks are igneous, sedimentary, and metamorphic. Rocks are continually changing from one form to another through the rock cycle.

Florida's rock formations consist of mostly limestone. Key Largo, oolite, and coquina are three of the different types. Florida's other rock formations include dolomite, common clay, kaolin, fuller's earth, and quartz sand. These natural resources are important for the state's economy.

Suggestions for Enrichment

1. Have students look at geologic maps to examine the history of the area in which they live and to determine the age of the rocks in Florida.

2. Stimulate discussion with questions such as—What areas does geology cover? What careers are available in the field? Why are rocks important in Florida?

3. Set up a display of common minerals, labeling the different properties used to identify them.

4. Have students generate a list of minerals and gems. Discuss why some are more valuable than others.

5. Discuss crystal formation.

6. Have students make rock candy.

7. Have students look at evaporating salt water under a microscope and describe what is left when the liquid is gone.

8. Grow *seed* crystals from a kit. Have students observe them under a microscope and create models of the crystalline structure.

9. Have students make crystal models with toothpicks and clay.

10. Have students use the dichotomous key to identify unknown minerals used in labs. (See student book page 171.)

11. Have students choose three rocks of each type (igneous, sedimentary, and metamorphic) to identify.

12. Discuss the importance of maintaining a good, unpolluted source of minerals. (For example, minerals are needed for nutrition, industry, consumer goods, etc.)

13. Have students look at shampoo, soap, and other cosmetics and cleaning supplies in their home and note minerals listed on the ingredients list.

14. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Teacher Preparation for Lab Activities

Some labs will need mineral samples such as galena, pyrite, feldspar, quartz, sulfur, hematite, halite, and calcite. Some labs will need mineral samples labeled with letters.

Lab Activity 4: Mineral Identification—Hydrochloric Acid Test (student book page 170) will need 1.0 molar solution of hydrochloric acid which may be purchased from many chemical supply houses.

Unit Assessment

Match the definition with the correct term. Write the letter on the line provided.

______ 1.	rock made of several layers of sediment cemented together	A. cleavage
______ 2.	igneous or sedimentary rocks that have been changed by heat and pressure	B. fracture
______ 3.	a scientist who studies and identifies minerals	C. gems
______ 4.	the continuous change of rocks from one form to another	D. metamorphic rock
______ 5.	a scale to measure the hardness of a mineral	E. mineral
______ 6.	when a mineral breaks along an uneven, jagged, or curved surface	F. mineralogist
______ 7.	when a mineral breaks along a smooth or flat surface	G. Mohs' scale
______ 8.	rare, precious, or semiprecious minerals	H. rock
______ 9.	an inorganic solid with a definite chemical formula and specific shape	I. rock cycle
______ 10.	a solid material made of one or more minerals	J. sedimentary rock

Place an **I** *on the line if the rock is an* **igneous** *rock, an* **S** *if it is a* **sedimentary** *rock, and an* **M** *if it is* **metamorphic** *rock.*

______ 11. granite

______ 12. marble

______ 13. limestone

______ 14. basalt

______ 15. sandstone

______ 16. pumice

______ 17. slate

______ 18. halite

Name five **common tests** *used to identify minerals.*

19. ______________________________

20. ______________________________

21. ______________________________

22. ______________________________

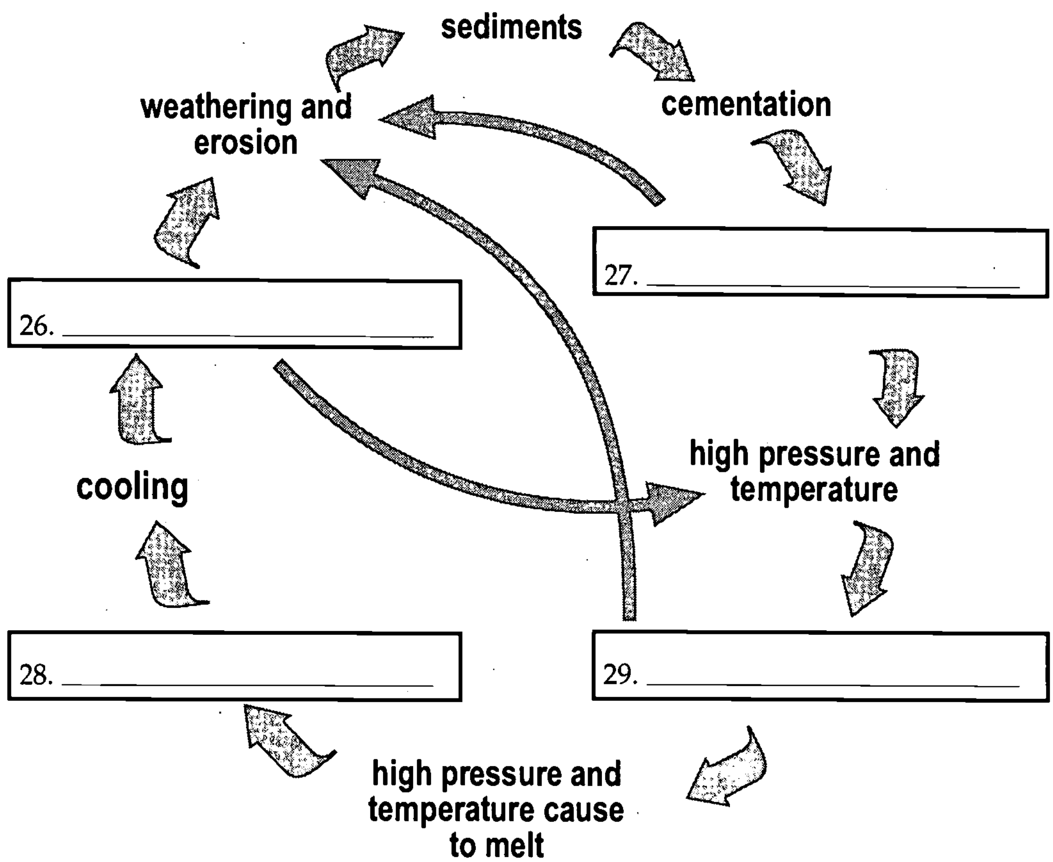
23. ______________________________

Name two **common rocks** *found in Florida.*

24. ______________________________

25. ______________________________

Name the **types of rocks** *on the rock-cycle diagram below.*



Keys

Practice (p. 163)

1. rocks; minerals
2. naturally; inorganic; solid; definite; atoms
3. ores
4. metals
5. gold; copper; silver; aluminum

Practice (p. 164)

1. sulfur; oxygen; phosphorus; nitrogen
2. gems
3. diamonds; emeralds
4. opals; topaz

Lab Activity 1 (p. 165)

Correct answers will be determined by the teacher.

Lab Activity 2 (pp. 166-167)

Correct answers will be determined by the teacher.

Practice (p. 168)

1. hardness
2. luster
3. shape
4. color
5. cleavage
6. streak
7. specific gravity
8. hydrochloric acid
9. cleavage
10. luster

Lab Activity 3 (p. 169)

Correct answers will be determined by the teacher.

Lab Activity 4 (p. 170)

Correct answers will be determined by the teacher.

Lab Activity 5 (pp. 171-172)

Correct answers will be determined by the teacher.

Lab Activity 6 (pp. 173-174)

Correct answers will be determined by the teacher.

Practice (p. 175)

1. True
2. False (texture or shines)
3. True
4. False (All)
5. False (All)
6. True
7. False (cleavage or rough)
8. True
9. True
10. False (fractures or flat)
11. False (Talc or hardest)
12. False (Diamond or softest)
13. True
14. False (All)
15. True

Practice (p. 176)

1. H
2. L
3. G
4. B
5. F
6. K
7. D
8. I
9. A
10. E
11. J
12. C

Keys

Lab Activity 7 (p. 177)

Correct answers will be determined by the teacher.

Lab Activity 8 (pp. 178-179)

Correct answers will be determined by the teacher.

Lab Activity 9 (pp. 180-181)

Correct answers will be determined by the teacher.

Practice (pp. 182-184)

1. no
2. no
3. no
4. yes
5. yes
6. yes
7. no

Sentences will include the following information:

8. Cycle means a series of events or act usually leading back to the starting point.
9. You begin with one kind of rock which can go through a series of changes to other kinds of rocks and eventually end as the kind of rock with which you started.
10. Tremendous heat and pressure must be applied to an igneous rock for it to become a metamorphic rock.
11. Tremendous heat and pressure must be applied to a sedimentary rock for it to become a metamorphic rock.
12. An igneous rock becomes a sedimentary rock as a result of its breakdown which is a result of weathering and erosion caused by wind and water.
13. A metamorphic rock becomes a sedimentary rock which is a result of its breakdown which is a result of weathering and erosion caused by wind and water.
14. A metamorphic rock becomes an igneous rock when high pressure and temperatures cause the original rock to melt, forming magma, which is cooled to form an igneous rock.
15. A sedimentary rock becomes an igneous rock when high pressure and temperatures cause the original rock to melt, forming magma, which is cooled to form an igneous rock.

Practice (pp. 185-186)

Sentences will include the following information:

1. limestone
2. calcium carbonate, $CaCO_3$
3. making roads and concrete, soil conditioner, riprap, building stone
4. coquina, Key Largo, oolite
5. coquina
6. shells and quartz sand grains are cemented together
7. Answers may include: dolomite, common clay, kaolin (china clay) fuller's earth, and others.
8. Large quantities are mined, making this an important industry for the state.
9. Limestone is dissolved underground and carried away, leaving caves and caverns.
10. During periods of drought, the roofs of these underground structures sometimes cave in, forming sinkholes.

Keys

Practice (pp. 187-188)

1. d
2. b
3. a
4. d
5. b
6. c
7. c
8. d
9. a
10. b
11. b
12. d

Practice (p. 189)

1. inorganic
2. ore
3. gems
4. metamorphic rock
5. mineral
6. sediment
7. magma
8. sedimentary rock
9. igneous rock
10. lava

Practice (p. 190)

1. mineralogist
2. rock cycle
3. fracture
4. cleavage
5. rock
6. extrusive
7. Mohs' scale
8. nonmetallic
9. luster
10. intrusive
11. metallic

Practice (pp. 191-194)

1. d
2. a
3. a
4. d
5. c
6. d
7. d
8. c
9. d
10. a
11. d
12. d
13. c
14. a
15. a
16. d
17. a
18. d
19. c
20. b

Unit Assessment (pp. 57-59TG)

1. J
2. D
3. F
4. I
5. G
6. B
7. A
8. C
9. E
10. H
11. I
12. M
13. S
14. I
15. S
16. I
17. M
18. S

Keys

19.-23. Accept any five of the following: color; luster; hardness; shape; cleavage or fracture; specific gravity; streak; acid test; magnetic properties; flame test.

24.-25. Accept any two of the following: Key Largo; limestone; coquina limestone; oolite; dolomite; common clay; kaolin; fuller's earth; quartz; sand.

26. igneous
27. sedimentary
28. magma
29. metamorphic

Unit 7: Mountains

Overview

The scope of this unit includes the different types of mountains and their formation and distinguishes between *old* and *young* mountains.

Mountains are landforms at least 600 meters above the surrounding land. Mountain features include the summit, slopes, and gorges. A series of mountains is a mountain range, and a group of ranges is a mountain system. Mountain formations change over time by weathering. Types of mountains include folded, fault-block, dissected, dome, and volcanic mountains.

Suggestions for Enrichment

1. Compare Florida's topography with that of mountainous areas.
2. Relate mountain formation to upcoming units on earthquakes, volcanoes, and crustal movements.
3. Have students name mountain ranges and locate them on a world map.
4. Have students make models of mountain formations.
5. Use topographic maps to look at relief of mountainous areas.
6. Compare and contrast *old* and *young* mountains.
7. Compare the Appalachians and the Rockies. Compare height, terrain, geologic formations, etc.
8. Have students construct models or drawings of *old* and *young* mountains' features.
9. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. Landforms that are at least 200 meters above the surrounding land are called *mountains*.

_________ 2. A series of mountains parallel to each other is called a *mountain system.*

_________ 3. When a mountain is young, it is usually bigger than an older mountain.

_________ 4. The Appalachian Mountain range is an example of a young mountain system.

_________ 5. Mountains formed as a result of the bending of rocks in Earth's crust are called *folded mountains*.

_________ 6. The types of mountains include summit, slope, and gorge.

_________ 7. Fault-block mountains are formed by the movement of large amounts of rock along a crack in Earth's crust.

_________ 8. The Grand Tetons of Wyoming and the Sierra Nevada Mountain Range of California are examples of mountains formed by faulting.

_________ 9. Dome mountains are formed when rocks are moved by external forces on Earth, creating a dome-shaped mountain.

_________ 10. The Cascades of Washington (which include Mount St. Helens) are active volcanic mountains.

Match each definition with the correct term. Write the letter on the line provided.

______ 11. the breaking down of rocks and other particles by wind, water, and ice

______ 12. a flat area of land over 600 meters above sea level

______ 13. mountains formed by the movement of large amounts of rock along a crack in Earth's crust

______ 14. top of a mountain

______ 15. landforms less than 600 meters high

______ 16. a series of mountains parallel to each other

______ 17. a group of mountain ranges

______ 18. landforms that are at least 600 meters high

______ 19. a flat area of low elevation

______ 20. mountains formed when rocks are pushed up by internal forces within Earth

______ 21. side of a mountain

______ 22. mountains formed by the erosion of a plain or plateau

______ 23. mountains formed by volcanoes

______ 24. a very steep valley between young mountains

A. dissected mountains

B. dome mountains

C. fault-block mountains

D. gorge

E. hills

F. mountain range

G. mountain system

H. mountains

I. plain

J. plateau

K. slope

L. summit

M. volcanic mountains

N. weathering

Use the list below to complete the following statements.

bigger	**Himalayas**	**peaks**	**valleys**
fault-block	**Matterhorn**	**Philippines**	**weathering**
hills	**mountains**	**Rocky Mountains**	

25. Landforms that are at least 600 meters above the surrounding lands are called ____________________ .

26. Landforms that are less than 600 meters are called ________________ .

27. Different types of ____________________ such as wind, water, and ice will wear away mountains.

28. As a glacier moves through a mountain range, it will carve ____________________ and ____________________ .

29. The ____________________ in Switzerland is an example of a peak formed by a glacier.

30. When a mountain is young, it is usually ____________________ than an older mountain.

31. The ____________________ are an example of a young mountain system.

32. The name of the world's largest mountain range is the ____________________ .

33. ______________________ mountains are formed by the movement of large amounts of rock along a crack in Earth's surface.

34. The mountain which became an active volcano and erupted in 1991 is located in the ______________________ .

Keys

Practice (p. 205)

1. dome mountains
2. Black Hills; Adirondacks
3. Dome
4. erosion
5. volcanoes
6. New Zealand
7. Mount St. Helens
8. Grand Tetons of Wyoming
9. bending

Practice (p. 206)

1. faulting
2. Wind; water; ice
3. steep; narrow
4. wide
5. Matterhorn
6. glaciers
7. fold; warp; twist
8. Rockies; Alps

Practice (p. 207)

1. C
2. A
3. E
4. D
5. B
6. dissected
7. dome
8. volcanic
9. fault-block
10. folded

Practice (p. 208)

1. A hill is a landform less than 600 meters and a mountain is a landform that is at least 600 meters high.
2. Old mountain ranges are smaller because wind, water, and ice have helped to break them down.
3. Answers will vary.

Practice (pp. 209-210)

1. plain
2. plateau
3. mountain system
4. volcanic mountains
5. dissected mountains
6. dome mountains
7. folded mountains
8. summit
9. relief
10. mountain range
11. slope
12. mountains
13. hills
14. gorge
15. fault-block mountains
16. glacier
17. weathering

Practice (pp. 211-213)

1. d
2. a
3. a
4. d
5. c
6. d
7. d
8. c
9. d
10. d
11. a
12. b
13. c
14. d
15. b
16. d
17. d

Keys

Unit Assessment (pp. 67-70TG)

1. False
2. False
3. True
4. False
5. True
6. False
7. True
8. True
9. False
10. True
11. N
12. J
13. C
14. L
15. E
16. F
17. G
18. H
19. I
20. B
21. K
22. A
23. M
24. D
25. mountains
26. hills
27. weathering
28. valleys; peaks
29. Matterhorn
30. bigger
31. Rocky Mountains
32. Himalayas
33. Fault-block
34. Philippines

Unit 8: Plate Tectonics

Overview

The scope of this unit includes two violent phenomena in the lithosphere—earthquakes and volcanoes.

Scientists have collected evidence to show that Earth's continents were once one large landmass. Over time the continents separated and drifted to their present locations. By the 1960s, a theory known as plate tectonics suggested that Earth is separated into plates. These plates are still moving, and this movement helps explain volcanoes and earthquakes. The ocean floor has many of the same features as the continents, including mountains and earthquakes, even though there are important differences.

The lithosphere, or solid part of Earth, has three major layers—crust, mantle, and core. The plates of Earth's crust move. This movement along a fault in the crust may cause earthquakes. The pressure beneath the surface of Earth may cause molten rock to flow from an opening in Earth's crust and form a volcano.

Suggestions for Enrichment

1. Discuss the layers of Earth.
2. Discuss earthquake causes and faults.
3. Relate to the release of built-up stress.
4. Ask students to research either the April 18, 1906 or the October 17, 1989, San Francisco earthquakes.
5. Discuss why some minor earthquakes can cause major destruction.
6. Discuss causes and consequences of volcanoes.
7. Ask students to complete research activity on the Ring of Fire.
8. Remind students that Earth is not a solid sphere; it is a solid layer floating on a molten layer.

9. Discuss the concept of resulting fit and other evidence for plate tectonics—fossil evidence, glacial situations, and climate changes.

10. Review the components of plate tectonics.

11. Relate the concept of isostasy to floating a boat in water. For example, if you add cargo (weight) to a canoe, what happens? It goes down. And if you remove weight, it goes up.

12. Discuss ocean floor features. Have students draw a diagram.

13. Discuss ways to measure what you cannot see in the ocean—rope and weight (old way), echo sounding, etc.

14. Relate ocean floor features to movements in Earth's crust.

15. Have students use the Internet (http://quake.wr.usgs.gov/) to track earthquakes and plot their locations on a map to see if the locations indicate plate boundaries.

16. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

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Unit Assessment

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 1. The lithosphere is the rigid or solid part of Earth.

_________ 2. The temperature and pressure of Earth decrease the deeper you go.

_________ 3. The mantle of Earth is made of soil and bedrock which act as Earth's skin.

_________ 4. The ground that you stand upon is called the *soil*.

_________ 5. The boundary line between the crust and the mantle is called the *Moho*.

_________ 6. The outer core or fourth layer of Earth is about 3,800 kilometers thick.

_________ 7. The upward push of the rock layers of Earth causes earthquakes.

_________ 8. The zone inside Earth where the actual break occurs in an earthquake is called a *fault*.

_________ 9. The focus is a break or crack in the surface of Earth's crust.

_________ 10. The place on the crust of Earth's surface directly above the fault is called the *epicenter*.

_________ 11. The energy of the waves that move away from the focus and are felt as shocks of the earthquake is called *seismic wave activity*.

_________ 12. A seismograph is used to measure the force of an earthquake.

_________ 13. The scientists who study the inner structure of Earth are called *seismologists.*

_________ 14. When Earth's pressure is so great that magma is pushed out of a dome mountain and onto Earth's surface, it results in an *eruption.*

_________ 15. Quiet volcanoes have steep, sloping sides.

Use the list below to complete the sentences. One or more terms will be used more than once.

8.6	**explosive**	**lava**	**Richter scale**
ash	**focus**	**magma**	**Ring of Fire**
continents	**Hawaiian Islands**	**mantle**	**seismograph**
crust	**kilometers**	**quiet**	**St. Helens**
dormant			

16. The lithosphere, or crust, is about 6,700 ____________________ in thickness.

17. The crust of Earth is thickest under the ____________________ .

18. The Moho is a boundary line between the ____________________ and the ____________________ .

19. An instrument used to measure the force of an earthquake is called a ____________________ .

20. The zone inside Earth where the actual movement in the rocks occurs is called the ____________________ .

21. When an earthquake is recorded, it is given a number on the

_________________________ .

22. The largest earthquakes ever recorded have Richter magnitudes near

_________________________ .

23. Another name for molten rock under Earth's crust is ______________ .

24. Once the molten rock flows out of the volcano, it is

called _________________________ .

25. An area in the Pacific Ocean where many of the world's active

volcanoes are found is called the _________________________ .

26. The _________________________ are really the tops of volcanoes.

27. A _________________________ volcano is one where the lava oozes out

and spreads over the land.

28. The _________________________ and _________________________ from

the volcano forms fertile land that can be farmed.

29. _________________________ volcanoes are ones where the magma

blasts to the surface.

30. Some volcanoes are _________________________, which means that

they have not erupted within the last 50 years.

31. Mount _________________________ is an active volcano on the Pacific

Coast of the United States which erupted in 1980.

Write **True** *if the statement is correct. Write* **False** *of the statement is* not *correct.*

_________ 32. The German meteorologist Alfred Wegener described his hypothesis of convection currents.

_________ 33. Wegener suggested that at one time all of the continents were one large landmass called *Pangaea*.

_________ 34. Since Wegener's death, more evidence has been found and his theory has been disproved.

_________ 35. The positions of the continents are not permanent.

_________ 36. Plate tectonics suggests that Earth is separated into large sections called *plates*.

_________ 37. The oceanic and crustal plates have separated because of convection currents.

_________ 38. In the 1950s and 1960s, scientists invented new instruments to more accurately study and map the ocean floor.

_________ 39. The area where the land and the ocean water meet is called the continental shelf.

_________ 40. Underwater mountain chains, rising from the basin are called seamounts.

_________ 41. The wide valley which separates two parallel chains of mountains is called a *guyot*.

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Answer the following using complete sentences.

42. Describe Alfred Wegener's theory of continental drift.

____

____

____

____

____

____

____

____

43. What is the theory of plate tectonics?

____

____

____

____

____

____

____

____

____

44. What are some of the differences between the continents and the seafloor?

Keys

Lab Activity 1 (pp. 230-231)

1.-4. Correct answers will be determined by the teacher.
5. Africa and South America
6. There was an uneven breaking of Earth's crust and the continents drifted.

Practice (p. 233)

1. False
2. True
3. True
4. False
5. True
6. False
7. False
8. False
9. False
10. True
11. True

Practice (pp. 234-235)

1. lithosphere
2. crust; mantle; core
3. instruments
4. indirect
5. crust
6. Moho
7. mantle
8. rock
9. outer
10. inner
11. outer
12. crust
13. mantle
14. inner
15. crust

Practice (p. 236)

1. crust
2. Moho
3. mantle
4. outer core
5. inner core

Layers	Thickness	Material
crust	8-67 km	soil; bedrock
mantle	2,800-3,000 km	rock
outer core	2,000 km	melted iron and nickel
inner core	2,800 km	iron mixed with nickel and cobalt

Lab Activity 2 (pp. 237-239)

Correct answers will be determined by the teacher.

Practice (pp. 240)

Correct answers will be determined by the teacher.

Practice (p. 241)

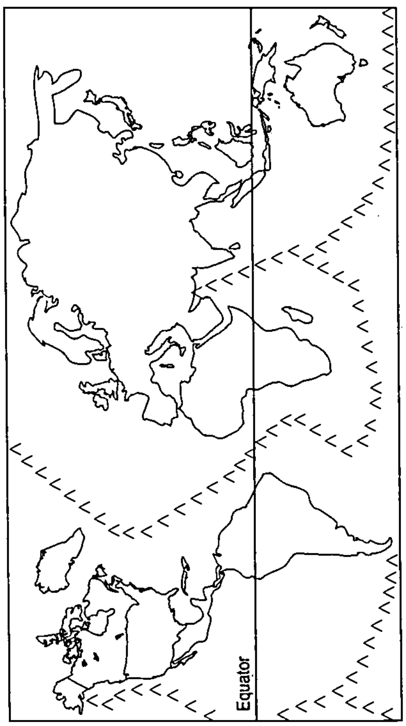
Correct answers will be determined by the teacher.

Practice (p. 242)

1. magma
2. lava
3. rocks; poisonous
4. gentle
5. erupt
6. Ring of Fire
7. mountains
8. blasts
9. inactive
10. erupt
11. Hawaiian

Keys

Practice (p. 243)



Practice (pp. 244-245)

1. volcanoes; earthquakes
2. slope
3. canyons
4. abyssal plains
5. Pacific
6. basin
7. rift
8. shoreline
9. instruments
10. shelf
11. trenches
12. mid-ocean ridges
13. Mid-Atlantic Ridge; Atlantic; Pacific; Indian
14. thinner
15. Marianas Trench; 11,000

Practice (pp. 246-247)

1. plates
2. mid-ocean ridges
3. continents
4. continental shelf
5. abyssal plains
6. canyons
7. continental slope
8. convection currents
9. Pangaea
10. rift
11. trenches
12. continental drift
13. plate tectonics
14. seamounts
15. guyots

Practice (pp. 248-249)

1. earthquake
2. Richter scale
3. seismograph
4. focus
5. volcano
6. epicenter
7. seismic waves
8. magma
9. mantle
10. fault
11. lava
12. Ring of Fire
13. crust
14. core
15. seismologist
16. lithosphere

Practice (pp. 250-254)

1. c
2. d
3. a
4. b
5. b
6. a
7. d

Keys

8. a
9. d
10. a
11. d
12. d
13. b
14. a
15. d
16. b
17. d
18. d
19. a
20. b
21. d
22. a
23. a
24. c
25. d

Unit Assessment (pp. 75-80TG)

1. True
2. False
3. False
4. True
5. True
6. False
7. True
8. False
9. False
10. False
11. True
12. True
13. True
14. True
15. False
16. kilometers
17. continents
18. crust; mantle
19. seismograph
20. focus
21. Richter scale
22. 8.6
23. magma
24. lava
25. Ring of Fire
26. Hawaiian Islands
27. quiet
28. lava; ash
29. Explosive
30. dormant
31. St. Helens
32. False
33. True
34. False
35. True
36. True
37. True
38. True
39. False
40. False
41. False

Sentences will include the following information:

42. all continents were one mass called Pangaea; giant landmass split in two; two masses broke apart and drifted across the ocean floor
43. Earth is separated into large sections called plates—nine large ones and several smaller ones. Plates include continental and ocean crust plates separated because of convection currents.
44. Ocean basins have more volcanoes and earthquakes. Rocks in the ocean basin are different from those on Earth's surface. Ocean basins are made up of basalt and continents of granite. Earth's crust is thinner on the ocean floor than on the surface.

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Unit 9: Geologic History and Fossils

Overview

The scope of this unit includes geologic time—eras, periods, epochs, and geologic dating.

Earth's history is outlined in the geologic time scale. The largest subdivisions are called eras. Each era is divided into periods and the periods into smaller units called epochs. You are living in the Recent Epoch of the Quaternary Period of the Cenozoic Era. Ways to measure geologic time include studying rates of sedimentation, rates of erosion, radioactive decay, and evidence of fossils.

Suggestions for Enrichment

1. Explain the concepts of enormous lengths of time (millions and billions of years) and relative age. These are difficult for some students to comprehend.

2. Discuss age of Earth and divisions of geologic time.

3. Show a video segment of the first part of *Life on Earth*, the PBS series narrated by Richard Attenborough. This segment places all geologic time in the context of a year. For comparison, man appears just seconds before midnight on New Year's Eve (a sobering thought to some).

4. Break geologic time into eras and discuss each.

5. Have students make posters to represent major happenings in each era.

6. Have students write a description of what it would be like to live in each era.

7. Discuss popular science fiction films and cartoons that show man and dinosaurs coexisting in the same time period. Why is this incorrect? What would be more accurate?

8. Ask students to research the Ice Ages.

9. Have students research possible theories for the mass extinction of the dinosaurs at the end of the Mesozoic Era.

10. Introduce the concepts of absolute and relative dating.

    Absolute has an exact age or date. Example: "I am fifteen years old."

    Relative can be placed between other events. Example: "John is older than Mary, but younger than Shawn."

11. Discuss ways to determine the *age* of something.

12. Discuss radioactive decay—half-life.

13. Use a piece of licorice to demonstrate decay. For each half-life, cut and dispose of half of the licorice. Stimulate class discussion with questions: Will you ever completely get rid of all the licorice? Why or why not? How could you determine with how much licorice you started?

14. Stimulate student discussion with questions such as—Why are so few fossils found of soft animals (worms, jellyfish)?

15. Discuss ways that fossils form—casts, imprints, molds, carbonization, preservation, (petrification, freezing, amber).

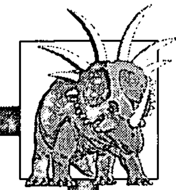
16. Have students make fossils. To prepare plaster of Paris, add plaster to one cup of water until a pudding-like consistency is reached. If it is too runny, the mold will not hold the plaster.

17. Discuss evidence provided by fossils.

18. Show video on paleontology: *T. Rex Uncovered* (NOVA). It discusses problems of reconstructing an organism from fossil remains and different interpretations possible from the same evidence.

19. Invite a paleontologist to discuss the area's geologic history.

20. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.



Unit Assessment

Circle the letter of the correct answer.

1. The largest division of geologic time is a(n) __________ .

   a. epoch
   b. era
   c. period
   d. century

2. The first geologic era of Earth was the __________ .

   a. Paleozoic
   b. Cenozoic
   c. Mesozoic
   d. Proterozoic

3. The correct order of geologic eras of Earth is __________ .

   a. Paleozoic, Mesozoic, Cenozoic, Proterozoic
   b. Proterozoic, Mesozoic, Paleozoic, Cenozoic
   c. Proterozoic, Paleozoic, Mesozoic, Cenozoic
   d. Cenozoic, Mesozoic, Proterozoic, Paleozoic

4. The __________ Era is divided into epochs.

   a. Cenozoic
   b. Mesozoic
   c. Paleozoic
   d. Proterozoic

5. The Proterozoic Era was characterized by __________ .

   a. dinosaurs
   b. man and flowering plants
   c. trilobites and brachiopods
   d. single-celled organisms, algae, and simple invertebrates

6. Paleozoic means ____________ .

   a. Age of Mammals
   b. Ancient Life
   c. Age of Dinosaurs
   d. Middle Life

7. Trilobites, brachiopods, fish, amphibians, reptiles, and cone-bearing trees were the main forms of life during the ____________ Era.

   a. Proterozoic
   b. Mesozoic
   c. Paleozoic
   d. Cenozoic

8. All of the following are characteristics of the Mesozoic Era **except** ____________ .

   a. dinosaurs were dominant
   b. birds and mammals first appeared
   c. most of the major mountain ranges formed
   d. man appeared

9. The Cenozoic Era began ____________ years ago.

   a. 600 million
   b. 4.5 billion
   c. 225 million
   d. 65 million

10. Humans appeared on Earth during the ____________ Era.

    a. Proterozoic
    b. Paleozoic
    c. Mesozoic
    d. Cenozoic

11. Scientists who study Earth are called ____________ .

    a. biologists
    b. botanists
    c. geologists
    d. chemists

12. The **least** accurate method of determining the age of Earth is __________ .

a. rate of sedimentation
b. rate of erosion
c. radioactive decay
d. study of fossils

13. The radioactive element used to tell the age of materials that were once living is __________ .

a. carbon-14
b. uranium
c. cobalt
d. radium

14. The **most** accurate method of determining the age of Earth is __________ .

a. rate of sedimentation
b. rate of erosion
c. radioactive decay
d. study of fossils

15. Earth is about __________ years old.

a. 600 million
b. 225 million
c. 4.5 million
d. 4.5 billion

Give two characteristics of each of the following **eras**:

16. Cenozoic: ______________________________

____

17. Mesozoic: ______________________________

____

18. Paleozoic: ______________________________

____

19. Proterozoic: ______________________________

____

List four ways scientists can measure **geologic time**.

20. ______________________________

21. ______________________________

22. ______________________________

23. ______________________________

Answer the following using complete sentences.

24. What are fossils? ______________________________

____

____

____

25. Explain what is meant by the *rate of sedimentation*.

26. Explain the term *rate of erosion*.

27. Explain the term *radioactive decay*.

Circle the letter of the correct answer.

28. Scientists who look for and study fossils are called ____________ .

    a. geologists
    b. paleontologists
    c. botanists
    d. chemists

29. When an animal species no longer exists on Earth, it is ____________ .

    a. extinct
    b. dead
    c. fossilized
    d. inorganic

30. When the remains of plants and animals are replaced by stone, they are said to be ____________ .

    a. stoned
    b. petrified
    c. casts
    d. molds

31. Entire organisms can be preserved in all of the following ways **except** ____________ .

    a. frozen in ice caps
    b. buried in tar pits
    c. hardened in amber
    d. found as trace fossils

32. When the parts of organisms that are buried in rock decay and dissolve, a cavity called a(n) ____________ forms.

    a. cast
    b. imprint
    c. mold
    d. facies fossil

33. Fossils that divide geologic time into units are called __________ .

a. period fossils
b. index fossils
c. trace fossils
d. petrified fossils

34. Fossils are useful to scientists in all of the following ways **except** to __________ .

a. give clues as to how living things have changed
b. give clues as to how the surface of Earth has changed
c. help to determine the age of sediments
d. tell us the **exact** size, shape, and dietary habits of **all** prehistoric animals

35. If a fossil of a marine animal is found on land, one might conclude that __________ .

a. the land was once covered by water
b. the wind carried it there
c. it arrived there as a result of volcanic eruptions
d. none of the above

36. If a fossil is buried in sedimentary rock, __________ .

a. the age of the fossil can be determined by carbon-14 decay
b. the age of the rock can be determined by carbon-14 decay
c. the fossil will be older than the rock it is buried in
d. it is impossible to determine the age of either the rock or the fossil

37. Most fossils are found in __________ rock.

a. igneous
b. metamorphic
c. sedimentary
d. none of the above

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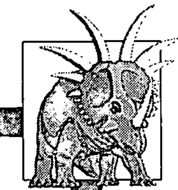

Keys

Lab Activity 1: Part 1 (p. 270)

Age	No. of mm
Cambrian Period	570 mm
Ordovician Period	500 mm
Silurian Period	430 mm
Devonian Period	395 mm
Mississippian Period	345 mm
Pennsylvanian Period	325 mm
Permian Period	280 mm
Triassic Period	225 mm
First mammals	200 mm
Jurassic Period	190 mm
Cretaceous Period	136 mm
Paleocene Epoch	65 mm
Eocene Epoch	54 mm
Oligocene Epoch	38 mm
Miocene Epoch	26 mm
Pliocene Epoch	7 mm
Quaternary Period	2.5 mm
Earliest humans	2 mm

Lab Activity 1: Part 2 (pp. 271-272)

1.-2. Correct answers will be determined by the teacher.

Sentences will include the following information:

3. Humans have existed for a relatively short period of geologic time.
4. Events have occurred very slowly on Earth.
5. The length of a person's life (relative to the geologic time) is so very, very small that it would not be possible to represent it on the timeline.
6. Paleozoic—geologic time lasting from about 570 to 225 million years before present
   Proterozoic—all geologic time before the beginning of the Paleozoic Era; equals about 90 percent of geologic time
   Cenozoic—an era of geologic time that began about 65 million years ago
   Mesozoic—an era of geologic time lasting from about 225 to 65 million before present
7. Proterozoic; Paleozoic; Mesozoic; Cenozoic

Practice (pp. 273-275)

Answers will include the following information:

1. Proterozoic; Paleozoic; Mesozoic; Cenozoic
2. No; depended on revolutions and violent volcanic and crustal movements to occur
3. Not enough is known about it to divide it.
4. It is the only era there is enough known about to subdivide.
5. Proterozoic, it covers 90 percent of all time
6. after the location where the change was discovered
7. at the end of the Paleozoic or beginning of the Mesozoic Era
8. Cambrian; Ordovician; Silurian; Devonian; Mississippian; Pennsylvanian; Permian
9. Cretaceous; Jurassic; Triassic
10.

Periods:	Epochs:
Quaternary	Recent
	Pleistocene
Tertiary	Pliocene
	Miocene
	Oligocene
	Eocene
	Paleocene

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Keys

Practice (p. 276)

Era	Period	Epoch	Life Forms
Cenozoic present to 65 million years ago	Quaternary	Recent	answers may include: large mammals, angiosperms, and humans
		Pleistocene	
	Tertiary	Pliocene	
		Miocene	
		Oligocene	
		Eocene	
		Paleocene	
Mesozoic 65 to 225 million years ago	Cretaceous		answers may include: dinosaurs and other reptiles, mammals, birds, and flowering plants
	Jurassic		
	Triassic		
Paleozoic 225 to 600 million years ago	Permian		answers may include: trilobites, brachiopods, land plants and animals, fish, amphibians, and cone-bearing trees
	Pennsylvanian		
	Mississippian		
	Devonian		
	Silurian		
	Ordovician		
	Cambrian		
Proterozoic 600 million to 3,000 million years ago			answers may include: protozoans, bacteria, algae, sponges, and marine worms

Practice (pp. 277-278)

1. fossils or remains
2. Paleontologists
3. remains
4. imprint or trace
5. sedimentary
6. mold
7. cast
8. trace
9. extinct
10. petrification
11. amber
12. index
13. carbon-14
14. climatic

Lab Activity 2: Part C (pp. 279-281)

5. Correct answers will be determined by the teacher.
6. No. Original organism has changed.
7. Living materials replaced by minerals to form exact duplicate.
8. casts—only structure represented; preservations—entire organism (internal and external) represented

Practice (pp. 282-284)

2a.

Relative Ages of Rock Layers

4 10
(youngest)
3 9
5 8
7
6 2
1
(oldest)

Geologic History: Correct answers will be determined by the teacher.

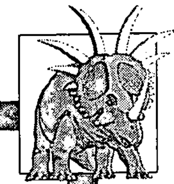
2b.

Relative Ages of Rock Layers

4, 5, 2, 1, 3, 7
(youngest)

8
6
(oldest)

Geologic History: Correct answers will be determined by the teacher.



Keys

2c.

Relative Ages of Rock Layers

7
(youngest)
3

5, 6, 1, 4
2
(oldest)

Geologic History: Correct answers will be determined by the teacher.

2d.

Relative Ages of Rock Layers

2
(youngest)
3

1, 5, 6, 4
(oldest)

Geologic History: Correct answers will be determined by the teacher.

Practice (pp. 285-286)

Sentences will include the following information:

1. Absolute dates tell how many years have passed since an event took place, and relative dates place events in the order that they took place.
2. Rocks on the bottom are the oldest and the ones near the top are the youngest.
3. relative dates
4. No. The rate of erosion varies with the hardness and thickness of the rock and with the amount of precipitation.
5. radioactive decay
6. the time it takes one-half of a sample of the material to decay
7. radioactive form of carbon found in living things
8. carbon-14
9. the remains and imprints of forms of life that once lived on Earth
10. rate of sedimentation; rate of erosion; radioactive decay; fossils

Practice (pp. 287-288)

1. False
2. False
3. True
4. True
5. False
6. False
7. True
8. True
9. True
10. False
11. True
12. False
13. False
14. True
15. False

Practice (pp. 289-290)

1. Cenozoic
2. Mesozoic
3. Proterozoic
4. fossils
5. radioactive decay
6. rate of erosion
7. epoch
8. period
9. Paleozoic
10. era
11. revolutions
12. relative dates
13. rate of sedimentation
14. geologists

Keys

Practice (pp. 291-292)

1. trace fossils
2. absolute dates
3. brachiopods
4. carbon-14
5. extinct
6. geologic time scale
7. half-life
8. law of superposition
9. trilobites
10. cast
11. paleontologists
12. mold
13. petrification
14. index fossils

Practice (pp. 293-297)

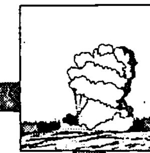
1. c
2. a
3. a
4. d
5. a
6. a
7. d
8. d
9. c
10. d
11. b
12. c
13. d
14. a
15. b
16. a
17. d
18. b
19. c
20. b
21. c
22. d
23. a
24. a
25. a
26. b
27. d

Unit Assessment (pp. 87-93TG)

1. b
2. d
3. c
4. a
5. d
6. b
7. c
8. d
9. d
10. d
11. c
12. b
13. a
14. c
15. d
16. Answers will vary.
17. Answers will vary.
18. Answers will vary.
19. Answers will vary.
20. rate of erosion
21. rate of sedimentation
22. radioactive decay
23. fossils

Sentences will include the following information:

24. remains and imprints of organisms that were once alive
25. amount and type of sediment that was deposited over a long period of time
26. the amount of time it takes for rocks to erode
27. the amount of time it takes for half of the atoms of a sample of radioactive material to decay
28. b
29. a
30. b
31. d
32. c
33. b
34. d
35. a
36. a
37. c



Unit 10: The Water Cycle

Overview

The scope of this unit includes the water cycle and Florida's freshwater system. The importance of water to Florida's unique environments are also stressed.

Earth's water moves in a continuous hydrologic cycle through evaporation, condensation, and precipitation. Seawater makes up over 95 percent of the hydrosphere. Through evaporation in the water cycle, salt water is changed to fresh water. Groundwater is held in rocks, soil, and aquifers. The action of water may form springs, geysers, caves, and sinkholes. Florida has many freshwater bodies that provide recreation and food. We must protect our delicately balanced water resources.

Suggestions for Enrichment

1. Have students identify local bodies of water and their importance.
2. Stimulate class discussion with questions such as—Why is water important? What are the uses of water?
3. Lead a discussion toward the concept that no new water is created; it changes states and is transported.
4. Have students construct models or diagrams to illustrate parts of the freshwater system.
5. Stimulate discussion with questions such as—How can water pollution spread?
6. Discuss changes of state:

   solid $\longrightarrow$ liquid $\longrightarrow$ gas

7. Compare sea water to fresh water.

8. Stimulate discussion with questions such as—Where do *salts* come from?

9. Discuss the ocean as the driving force behind all weather systems.

10. Compare densities of salt water and fresh water.

11. Calculate the salinity of seawater by evaporation.

12. Discuss the components of groundwater: aquifer, water table, springs, and artesian wells.

13. Relate groundwater to the water cycle—the water is moving; it doesn't remain trapped but continues through the cycle.

14. Complete map activity to familiarize students with geography.

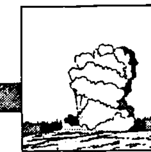
15. Ask students to research local wetland area:

    - Where did the water come from?
    - Where does it go?
    - Where do pollutants come from?

    (See local water management district for help and references.)

16. Visit a sinkhole or follow the development of a sinkhole using newspaper articles.

17. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.



Unit Assessment

Circle the letter of the correct answer.

1. Another name for the water cycle is the ___________ .

   a. hydrosphere
   b. hydrologic cycle
   c. water circle
   d. food cycle

2. The water cycle contains all of the following steps **except** ___________ .

   a. condensation
   b. evaporation
   c. precipitation
   d. transportation

3. The correct order of the steps of the water cycle that produces rain is ___________ .

   a. condensation, evaporation, precipitation
   b. evaporation, precipitation, condensation
   c. precipitation, condensation, evaporation
   d. evaporation, condensation, precipitation

4. Plants give off water from their leaves in a process called ___________ .

   a. evaporation
   b. transpiration
   c. perspiration
   d. condensation

5. Clouds are formed as a result of ___________ .

   a. precipitation
   b. transpiration
   c. condensation
   d. evaporation

6. Rain, sleet, hail, and snow are all forms of____________.

   a. precipitation
   b. condensation
   c. evaporation
   d. transpiration

7. Water that soaks into the ground and eventually returns to the ocean is ____________.

   a. runoff
   b. groundwater
   c. rain
   d. precipitation

8. Water in its gaseous state is called ____________.

   a. clouds
   b. rain
   c. water vapor
   d. precipitation

9. The ____________ is the upper level of the saturated zone of groundwater.

   a. saturation point
   b. runoff
   c. water table
   d. artesian well

10. Layers of rock found underground that have large pores and are filled with water form a(n) ____________.

    a. water table
    b. artesian well
    c. sinkhole
    d. aquifer

11. Water under pressure that reaches the surface through a natural opening in Earth is called a(n) ____________.

    a. artesian well
    b. sinkhole
    c. aquifer
    d. spring

12. Water that does not contain any dissolved minerals is called __________ .

   a. soft water
   b. hard water
   c. fresh water
   d. salt water

13. The largest river system located entirely in Florida is the __________ .

   a. Peace River
   b. Hillsborough River
   c. Suwannee River
   d. St. Johns River

14. All of the following are swamps or marshes **except** the __________ .

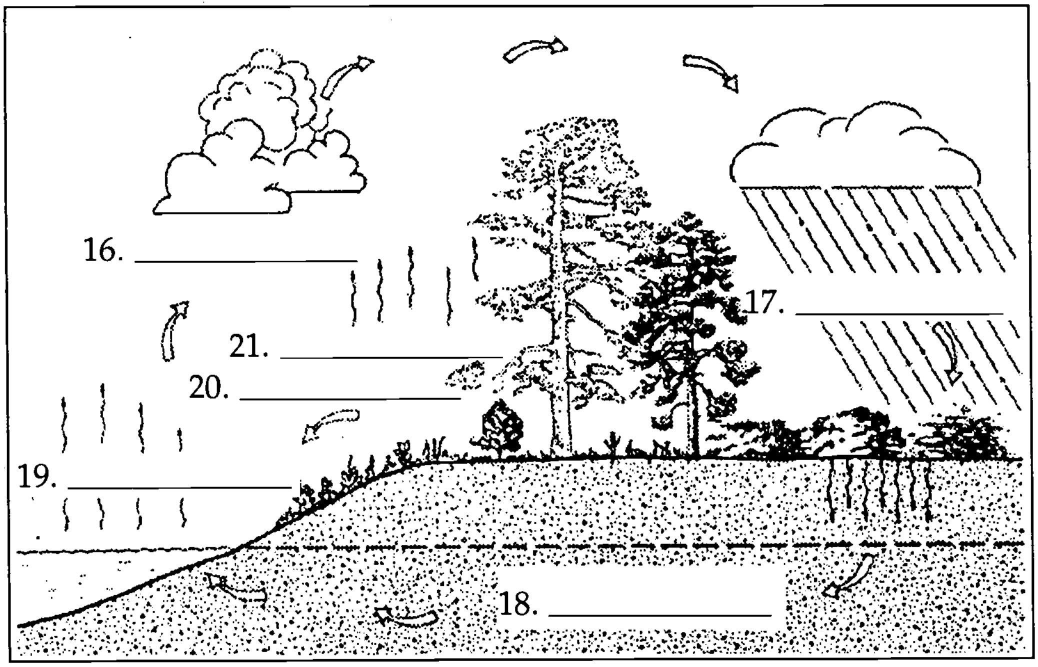
   a. Okefenokee
   b. Everglades
   c. Withlacoochee
   d. Green

15. __________ form when the roof of an underground cavern or cave collapses.

   a. Saltwater intrusion
   b. Sinkholes
   c. Artesian wells
   d. Geysers

Use the following terms to label the **water cycle**.

condensation	**precipitation**
evaporation	**runoff**
groundwater	**transpiration**



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Answer the following using complete sentences.

22. How is the water cycle important to living things?

____

____

____

____

23. What are four examples of Florida's freshwater systems?

____

____

____

____

____

____

24. What are two factors that affect Florida's freshwater systems?

____

____

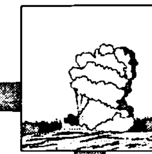
____

____

____

____

____



Keys

Lab Activity 1: Part 1 (p. 311)

5. droplets of water
6. the air
7. no
8. There was no colored water on the outside of the container.

Lab Activity 1: Part 2 (p. 312)

4. It changes to water vapor or steam.
5. Tiny droplets of water have formed on the bottom of the dish.
6. The water droplets came from the container of boiling water.
7. Water vapor (steam) condenses when it comes in contact with the cooler surface of the dish filled with crushed ice.

Practice (p. 313-314)

1. hydrologic cycle or water cycle
2. hydrosphere
3. oceans
4. rivers; streams; springs; ponds; lakes; wetlands
5. polar ice caps.
6. oceans; land; air; oceans
7. water cycle or hydrologic cycle
8. evaporation; condensation; precipitation

Practice (p. 315)

1. water vapor
2. transpiration
3. Animals
4. condensation
5. clouds
6. rain; hail; sleet; snow; dew; fog
7. runoff
8. groundwater

Practice (p. 316)

1. True
2. False
3. False
4. False
5. True
6. True
7. True
8. False
9. True
10. False
11. False
12. True
13. False
14. True
15. False

Lab Activity 2 (p. 317)

4. salt
5. Yes, because salt is left behind as the water continually evaporates, while at the same time salt is constantly being added from the land runoff.
6. Water in the ocean evaporates.
7. salt

Practice (p. 318)

1. 96.5 percent
2. 3.5 percent
3. $NaCl$; Na_2So_4; $MgCl_2$; KCl; $CaCl_2$

Lab Activity 3 (pp. 319-320)

7. Data on chart will vary.
8. rock (gravel)
9. clay
10. the larger the particle size, the more pore space
11. sand and rock (gravel); They have large pores through which water can easily move.

Keys

Lab Activity 4 (pp. 321-322)

8. Data on chart will vary.
9. rock or sand
10. clay
11. The larger the particles, the faster the water flows.
12. No. Doesn't hold or transmit water well.
13. mud and clay
14. rock or sand; holds and transmits water well

Practice (pp. 323-324)

1. groundwater
2. saturated
3. water table
4. resistance
5. aquifer
6. artesian well
7. spring
8. geysers
9. Old Faithful
10. limestone; caves; caverns
11. sinkhole
12. soft water
13. calcium carbonate; hard
14. ponds; lakes

Practice (p. 325)

1. False
2. True
3. True
4. False
5. True
6. False
7. False
8. False
9. True
10. False
11. False
12. True
13. False
14. False
15. True

Practice (pp. 326-327)

1. 30,000
2. U. S. Army Corps of Engineers
3. Lake Okeechobee
4. Atlantic Ocean; Gulf of Mexico
5. swamps
6. Everglades
7. sawgrass
8. Okefenokee
9. Land of the Trembling Earth
10. St. Johns River
11. northerly
12. Suwannee; "Old Folks at Home"
13. Green Swamp
14. saltwater intrusion
15. phosphates; nitrates

Practice (p. 328)

Correct answers will be determined by the teacher.

Practice (p. 329)

1. groundwater
2. pollution
3. dew point
4. water vapor
5. aquifer
6. evaporation
7. condensation
8. precipitation
9. transpiration
10. hydrologic cycle

Practice (p. 330)

1. geyser
2. pollutant
3. runoff
4. hard water
5. clouds
6. soft water
7. phosphates
8. nitrates
9. saturation
10. water cycle

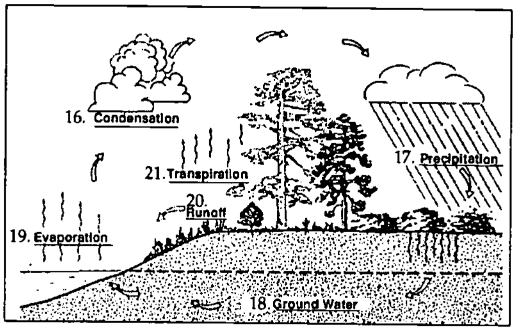
Keys

Practice (pp. 331-334)

1. a
2. b
3. d
4. a
5. a
6. d
7. a
8. b
9. d
10. d
11. d
12. b
13. d
14. d
15. c
16. b
17. a
18. c
19. d
20. a

Unit Assessment (pp. 101-105TG)

1. b
2. d
3. d
4. b
5. c
6. a
7. b
8. c
9. c
10. d
11. d
12. a
13. d
14. c
15. b



Sentences will include the following information:

22. It maintains a constant supply of water for all plants and animals.
23. Accept any four of the following: lakes, groundwater, rivers, aquifer, swamps, sinkholes, canals, artesian springs.
24. Accept any two of the following: amount of rainfall, salt water intrusion, pollution, acid rain.

Unit 11: Rivers

Overview

The scope of this unit includes the formation of river systems and the characteristics representative of each stage of development.

Most rivers are formed as precipitation moves downhill in small streams. The flowing water cuts a channel in the land. Streams flow together to form tributaries, which flow into the main river. At the mouth of the river, the water empties into a larger body of water. The age of a river can be determined by its physical characteristics. Rivers erode the land over which they flow. As rivers move they pick up soil and rocks and deposit the load in new locations. The deposition of soil and rocks in the riverbed is called sediment. Along the river's bank, a levee may be formed from the deposition. At the mouth of the river, a delta may build up over time, creating fertile growing areas. Rivers may meander across the land. The erosion and depositions in the river curves may result in an oxbow lake.

Suggestions for Enrichment

1. Familiarize the students with rivers and streams.
2. Discuss local rivers—uses, characteristics, sources, and ages.
3. Have students map a local river—include tributaries and streams as well as geography of area it passes through.
4. Have students use road maps or atlases to identify major river systems in different areas.
5. Have students trace Lewis and Clark's expedition, following the rivers on which they traveled west.
6. Stimulate discussion with questions such as—Why were rivers used as one of the earliest means of transportation?
7. Discuss characteristics of young, mature, and old rivers.

8. Have students make models of various stages of river development.

9. Have students look at geography of areas along the floodplain or delta of a river using topographic maps.

10. Discuss formations that show evidence of past rivers—oxbow lakes, flat plains, wide channels, etc.

11. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Circle the letter of the correct answer.

1. The beginning of a river is its ___________.

   a. mouth
   b. source
   c. delta
   d. floodplain

2. The main river of a river system could be compared to the ___________ of a tree.

   a. twigs
   b. small branch
   c. trunk
   d. large branch

3. As the waters from a river slow and empty into a lake or ocean, they deposit much of the sediment they are carrying and form a ___________.

   a. floodplain
   b. oxbow lake
   c. meander
   d. delta

4. A young river has all of the following characteristics **except** ___________.

   a. meanders
   b. deep V-shaped valleys
   c. rapids and waterfalls
   d. fast-flowing water

5. The largest river in the United States is the ___________.

   a. Missouri River
   b. Mississippi River
   c. Colorado River
   d. Ohio River

6. The place where a river joins a lake or ocean is called the ___________.

   a. source
   b. mouth
   c. oxbow lake
   d. riverbank

7. The correct order of a river system is ___________.

   a. oxbow, river, ocean
   b. ocean, tributary, river
   c. tributary, river, ocean
   d. river, ocean, tributary

8. Young rivers are usually found in ___________.

   a. a desert
   b. plains
   c. a forest
   d. the mountains

9. Meanders are found on ___________.

   a. mature rivers
   b. young rivers
   c. old rivers
   d. all rivers

10. Particles of soil and rock that a river carries are its ___________.

    a. sediment
    b. load
    c. floodplain
    d. riverbed

11. Sediments deposited in new locations by running water are ___________.

    a. depositions
    b. erosion
    c. weathering
    d. oxbow lakes

12. Flat areas located on both sides of a river that are very good for farming are called ___________.

    a. deltas
    b. riverbanks
    c. riverbeds
    d. floodplains

13. ___________ are formed when erosion and deposition along a meander eventually cuts the bend off from the rest of the river.

    a. oxbow lakes
    b. deltas
    c. meanders
    d. floodplains

14. The bottom of a river is called a ___________.

    a. riverbank
    b. riverbed
    c. delta
    d. floodplain

15. Pieces of rock and soil that are deposited by a river are called ___________.

    a. its load
    b. mud
    c. riverbank
    d. sediment

Match the **river characteristic** *with its stage of* **river development**. *Answers will be used more than once.*

______ 16. V-shaped valley

______ 17. very wide floodplain

______ 18. flat floodplain on both sides of channel

______ 19. slowest moving waters

______ 20. carries large particles

______ 21. has rapids and waterfalls

______ 22. wider, U-shaped valley

______ 23. curved and meandering

______ 24. has been developing for thousand of years

______ 25. erodes land very quickly

A. young river

B. mature river

C. old river

Answer the following using complete sentences.

26. Name three formations caused by the erosion and deposition of a river.

____

____

____

____

____

27. Describe why a river system is similar to a branching tree.

____

____

____

____

____

____

____

____

____

____

28. Draw or describe the way an oxbow lake forms.

Keys

Practice (p. 344)

1. old river
2. young river
3. mature river
4. mature river
5. old river
6. young river

Practice (p. 345)

Correct answers will be determined by the teacher.

Lab Activity 1 (p. 346-347)

Correct answers will be determined by the teacher.

Practice (pp. 348-349)

1. mountains
2. channels
3. tributaries
4. faster
5. mouth
6. source
7. Deltas
8. decreases
9. Mississippi River
10. fertile
11. branches
12. young
13. mature
14. meanders

Lab Activity 2 (p. 350)

Correct answers will be determined by the teacher.

Practice (p. 351)

1. C—meandering river
2. A—U-shaped bend forms
3. D—sediments deposit
4. B—lake cut off from a river

Practice (pp. 352-353)

1. stream
2. river
3. oxbow lakes
4. meanders
5. tributaries
6. riverbanks
7. deposition
8. floodplains
9. riverbed
10. delta
11. mouth
12. old river
13. young river
14. source
15. load
16. sediment
17. channel

Practice (pp. 354-356)

1. d
2. a
3. a
4. c
5. c
6. c
7. b
8. a
9. b
10. a
11. a
12. c
13. d
14. d
15. b
16. a
17. b

Keys

Unit Assessment (pp. 113-118TG)

1. b
2. c
3. d
4. a
5. b
6. b
7. c
8. d
9. c
10. b
11. a
12. d
13. a
14. b
15. d
16. A
17. C
18. B
19. C
20. A
21. A
22. B
23. C
24. B
25. A

Sentences will include the following information:

26. floodplains; deltas; oxbow lakes
27. The small streams are like the small branches on a tree, the tributaries are like the larger branches, and the main river is similar to the trunk of a tree.
28. A river meanders, a U-shaped bend forms, sediments deposit, and the lake is cut off from the river. (Also accept drawings.)

Unit 12: Glaciers

Overview

The scope of this unit includes the different types of glaciers, the conditions under which they were formed, and the ice ages.

Piedmont, continental, and alpine or valley glaciers are three types of glaciers. As glaciers move, they completely change the surface of the land by erosion and deposition, forming horns, lakes, hanging valleys, and moraines. Earth has experienced glacial periods known as ice ages. The most recent occurred during the Pleistocene epoch.

Suggestions for Enrichment

1. Use visual materials to aid in understanding the concepts. (Students are generally unfamiliar with these topics.)
2. Look at polar environments; compare environment to that of a desert.
3. Discuss glacier types, the conditions necessary for their formation, and their characteristic features.
4. Have students draw a diagram of the different glacier types.
5. Have students make 3-D models of glacial features.
6. Use topographic maps to locate glacial areas and remains.
7. Draw maps to show the extent of glacial coverage during the Ice Ages versus today.
8. Use a globe to explain the orbit and the tilt theories of the causes of glaciers.
9. Draw contours on map to represent the change in sea level associated with ice ages.

10. Stimulate discussion with questions such as—What areas would be exposed if we were in an ice age? What would happen if all the ice on Earth today melted?

11. Have students research the changes in animals and plants due to glacial conditions.

12. Have students develop hypotheses about how the topography of the Midwest was shaped and what sort of life forms might have been around 16,000 years ago, and then draw conclusions about the effects of glaciers on the topography (paying special attention to features such as the Great Lakes). Have students use the URL to the Illinois State Museum's exhibit entitled "The Midwest U.S. 16,000 Years Ago" (http://www.museum.state.il.us/exhibits/larson) and explore the site using the graphical aids and text to either support or refute their hypotheses. (Please note all Web-site addresses are subject to change.)

13. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Circle the letter of the correct answer.

1. A huge mass of moving ice and snow is a(n) ____________ .

    a. iceberg
    b. moraine
    c. hanging valley
    d. glacier

2. All of the following are theories as to what caused the Ice Ages **except** ____________ .

    a. Earth was bombarded by meteor showers
    b. the amount of energy put out by the sun changed
    c. the orbit of Earth became circular
    d. the tilt of Earth on its axis changed

3. The first material a glacier drops that has not yet been sorted by water is called ____________ .

    a. moraine
    b. drift
    c. till
    d. meltwater

4. When a glacier appears to be moving backwards because it is melting so rapidly at the front, it is said to be ____________ .

    a. retreating
    b. reversing
    c. striating
    d. melting

5. Waterfalls are often found flowing from ____________ .

    a. cirques
    b. hanging valleys
    c. moraines
    d. horns

6. Steep three-sided mountain peaks created by glaciers are called __________.

   a. icebergs
   b. horns
   c. moraines
   d. cirques

7. Earth has had at least __________ ice ages.

   a. four
   b. three
   c. one
   d. two

8. When the glacial ice melts, the water level of the oceans __________.

   a. rises
   b. falls
   c. does not change
   d. rises and falls

9. The scraping of the bedrock surface over which the glacier moves is called __________.

   a. plucking
   b. striating
   c. abrading
   d. retreating

10. Kettle lakes that were formed by glaciers can be found in __________.

   a. Yosemite National Park
   b. the Great Lakes
   c. the Matterhorn
   d. Minnesota

11. The process whereby rocks are loosened and lifted to become part of a glacier is called ________ .

   a. striations
   b. plucking
   c. retreating
   d. abrading

12. Earth is presently tilted on its axis at ________ .

   a. 25½°
   b. 28°
   c. 23½°
   d. 22°

13. The only two continental glaciers in existence today are Antarctica and ________ .

   a. Iceland
   b. Greenland
   c. Alaska
   d. Siberia

14. Valley glaciers begin in a bowl-like depression called a ________ .

   a. hanging valley
   b. cirque
   c. horn
   d. till

15. As glaciers move through an area, they ________ .

   a. have little effect on the area
   b. completely change the surface of the area
   c. partially change the surface of the area
   d. make no changes in the area

16. A glacier that forms in polar regions and spreads out in all directions from a central point is a(n) ________ glacier.

   a. piedmont
   b. valley
   c. alpine
   d. continental

17. The last ice age began about ____________ years ago.

    a. 200 million
    b. 7 thousand
    c. 600 million
    d. 8 million

18. Periods between ice ages are called ____________ .

    a. eras
    b. glacial ages
    c. interglacial ages
    d. centuries

19. Periods of time when the average temperatures on Earth become lower and large sheets of ice form at the polar regions are called ____________ .

    a. earthquakes
    b. interglacial ages
    c. eras
    d. ice ages

20. Gouges and scratches made in Earth's surface by sharp rocks being moved with the glacier are called ____________ .

    a faults
    b. striations
    c. moraines
    d. hanging valleys

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 21. Continental glaciers move down the valley of a mountain.

_________ 22. A cirque is a bowl-shaped depression where the snow accumulates and the glacier begins.

_________ 23. Scientists know exactly why we have ice ages.

_________ 24. Glaciers greatly change the land surfaces that they pass over.

_________ 25. The level of the ocean water rises during ice ages.

_________ 26. There are many more continental glaciers than valley glaciers.

_________ 27. The last ice age ended about 7,000 years ago.

_________ 28. Glaciers work by abrading and plucking forces.

_________ 29. Scientists predict that another ice age will occur within a few thousand years.

_________ 30. The tilt of Earth on its axis can cause changes in Earth's temperatures.

Answer the following using complete sentences.

31. How is a valley glacier is formed?

32. What are the effects of glaciers melting on the seas?

33. What are two ways glaciers change the surface of Earth?

34. What are the different types of deposits left by glaciers? Explain.

Keys

Lab Activity (p. 367)

Correct answers will be determined by the teacher.

Practice (p. 368)

1. 60 meters
2. glacier
3. horns
4. kettle lakes
5. cirques
6. V; U
7. Abrading
8. icebergs

Practice (pp. 369-370)

1. till
2. plucking
3. Greenland; Antarctica
4. hanging valleys; waterfalls
5. alpine; valley; piedmont; continental
6. striations
7. drift
8. till
9. outwash
10. Moraines

Practice (pp. 371-372)

1. ice age
2. interglacial
3. rises; glaciers
4. three
5. 600 million; 20 million; 8 million
6. 7,000
7. 23½°
8. 22°; 25°
9. 22°; colder
10. 25°
11. lower
12. circle
13. interglacial
14. Great Britain

Practice (p. 373)

1. False
2. True
3. False
4. True
5. False
6. True
7. False
8. True
9. True
10. True

Practice (p. 374)

Sentences will include the following information:

1. When tilted at 22°, the poles receive less sunlight, making them colder.
2. Earth would be farther away from the sun during fall, winter, and spring, making these seasons colder.
3. If Earth gets less energy, it would become colder.

Practice (pp. 375-376)

1. hanging valley
2. till
3. icebergs
4. kettle lakes
5. horns
6. plucking
7. ice age
8. piedmont glaciers
9. drift
10. moraines
11. interglacial ages
12. valley or alpine glaciers
13. glacier
14. abrading
15. cirque
16. striations
17. valley glaciers
18. continental glaciers

Keys

Practice (pp. 377-380)

1. c
2. b
3. d
4. c
5. c
6. b
7. b
8. a
9. b
10. c
11. a
12. c
13. d
14. b
15. d
16. d
17. a
18. b

Unit Assessment (pp. 123-128TG)

1. d
2. a
3. c
4. a
5. b
6. b
7. b
8. a
9. c
10. d
11. b
12. c
13. b
14. b
15. b
16. d
17. d
18. c
19. d
20. b
21. False
22. True
23. False
24. True
25. False
26. False
27. True
28. True
29. True
30. True

Sentences will include the following information:

31. Snow accumulates in a bowl-shaped depression high in the mountains. When it is over 60 meters high, it moves down the valley to form a glacier.
32. As the glacier melts, the level of the seas rise.
33. Answers should include descriptions of abrading and plucking.
34. Answers should include a description of drift. They should distinguish between unsorted/till and sorted/outwash. Moraines may also be mentioned.

Unit 13: Weathering and Erosion

Overview

The scope of this unit includes weathering and erosion. The agents responsible for each are explained and examples are given. A discussion of these forces includes the topic of soil formation.

Mechanical and chemical weathering breaks down rocks and other materials exposed to the atmosphere. Temperature, water, plants, and wind are mechanical weathering agents. The agents of chemical weathering are water, oxygen, and acids. The process of erosion moves weathered materials from one place to another. The four main types of erosion are water, wind, ice, and gravity. Weathered rock becomes part of our soil. Soil types vary depending on the composition and other factors such as age and climate.

Suggestions for Enrichment

1. Discuss examples of change on Earth's surface.
2. Stimulate class discussion with questions such as—How does the environment effect objects and rocks? What are the agents of change on Earth's surface?
3. Locate examples of weathering and erosion on the school campus. Examples—rust, potholes, cracked sidewalks, crumbling bricks, and rocks.
4. Stimulate discussion with questions such as—What results from the activities of weathering and erosion?
5. Discuss formation of sediments and soils and what the factors are that determine soil type.
6. Test soil samples—many simple kits used to test soil fertility are available from science supply houses or garden stores. Have students compare the difference in soil types and composition in a limited area.

7. Have students research soil types; complete United States map or create Florida or regional map of soil types.

8. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Circle the letter of the correct answer.

1. The breaking down of rocks and other materials by chemical or physical means is called ______ .

   a erosion
   b. weathering
   c. glaciation
   d. decaying

2. The movement of weathered rocks and soil from one place to another by wind, water, ice, or gravity is ______ .

   a weathering
   b. glaciation
   c. erosion
   d. decaying

3. The type of erosion that is the most important is ______ .

   a water
   b. wind
   c. ice
   d gravity

4. All of the following are examples of water erosion **except** ______ .

   a. runoff water carrying soil away
   b. formation of sand dunes
   c. formation of canyons
   d. formation of sinkholes

5. When the roof of an underground cave collapses, a ______ is formed.

   a. canyon
   b. cavern
   c. loess
   d. sinkhole

6. ____________ does **not** affect the amount of erosion that is caused by water.

   a. The slope of Earth's surface
   b. The type of rock
   c. The number or type of plants growing
   d. The number of hours of daylight

7. The smallest particles that can be carried by the wind is ____________.

   a. rock
   b. dust
   c. sand
   d. silt

8. A type of wind deposit formed of silt and clay packed together is called ____________.

   a. loess
   b. a sand dune
   c. topsoil
   d. humus

9. Wind erosion is **not** likely to occur ____________.

   a. in a desert
   b. in a forest
   c. along the beach
   d. along a river in a dry area

10. Ice erosion is caused by ____________.

    a. freezing rains
    b. glaciers
    c. landslides
    d. snowstorms

11. Erosion that pulls objects towards the center of Earth is caused by ____________.

    a. wind
    b. water
    c. ice
    d. gravity

12. Organic material found in the soil is called ___________ .

   a. clay
   b. humus
   c. sand
   d. silt

13. The largest particles of rock and minerals found in the soil are called ___________ .

   a. silt
   b. sand
   c. clay
   d. gravel

14. A type of soil that is a mixture of clay, silt, and sand is ___________ .

   a. loam
   b. topsoil
   c. humus
   d. loess

15. The breakdown of dead plants and animals is called ___________ .

   a. organic
   b. decay
   c. humus
   d. loam

16. The area in the eastern United States where the soil has little humus and requires frequent fertilization is ___________ .

   a. grassland or prairie
   b. desert
   c. forest
   d. mountain

17. The area in the western United States where the soil has very little water and plant life, but is rich in minerals, is ___________ .

   a. tundra
   b. desert
   c. prairie
   d. forest

18. The area in the central United States where soil is very fertile is ____________.

    a. desert
    b. tundra
    c. mountain
    d. grassland or prairie

19. An area where the soil is thin and the climate is so cold that only lichens and mosses grow is ____________.

    a. grassland or prairie
    b. tundra
    c. desert
    d. mountain

20. An area in the western United States where the soil is made mostly of rock and contains mineral ores is ____________.

    a. prairie
    b. grassland
    c. desert
    d. mountain

Match the example to the correct **type of erosion**. *Write the letter on the line provided. Answers will be used more than once.*

______ 21. the Grand Canyon was formed this way

______ 22. erosion caused by glaciers

______ 23. forms deposits called *loess*

______ 24. causes landslides

______ 25. forms a V-shaped valley

______ 26. forms a U-shaped valley

______ 27. forms caverns in Earth

______ 28. wears rocks down to flat, sharp edges

______ 29. forms kettle lakes

______ 30. mountain shapes like the Matterhorn are changed by this

______ 31. forms hills of sand called *sand dunes*

______ 32. created the Carlsbad and Linville canyons

A. gravity erosion

B. ice erosion

C. water erosion

D. wind erosion

Keys

Lab Activity 1 (pp. 392-393)

Correct answers will be determined by the teacher.

Lab Activity 2 (p. 394)

Correct answers will be determined by the teacher.

Lab Activity 3 (p. 395)

Correct answers will be determined by the teacher.

Practice (pp. 396-397)

1. weathering
2. erosion
3. mechanical; chemical
4. temperature; water; plants
5. abrasion
6. decomposition
7. water; wind; ice; gravity
8. Water

Practice (pp. 398-399)

1. Runoff
2. canyon
3. caverns
4. wind
5. sand dunes
6. loess
7. sand; silt; dust
8. glaciers
9. gravity
10. Landslides; mudslides

Practice (p. 400)

1. desert
2. mountain
3. grassland and prairie
4. forest

Practice (pp. 401)

Answers will include the following information:

1. rich in minerals; lacks humus; dry
2. contains little humus; needs fertilization
3. rich in minerals; dry; rocky
4. rich in humus; fertile

Practice (pp. 402-403)

1. runoff
2. silt
3. dunes
4. sand
5. clay
6. humus
7. soil
8. topsoil
9. gravel
10. weathering
11. glacier
12. organic
13. loess
14. erosion
15. loam
16. gravity
17. caverns

Practice (pp. 404-406)

1. c
2. b
3. d
4. c
5. d
6. c
7. b
8. b
9. d
10. a
11. a
12. b
13. a

Keys

14. d
15. d
16. c
17. c

Unit Assessment (pp. 133-137TG)

1. b
2. c
3. a
4. b
5. d
6. d
7. b
8. a
9. b
10. b
11. d
12. b
13. d
14. a
15. b
16. c
17. b
18. d
19. b
20. d
21. C
22. B
23. D
24. A
25. C
26. B
27. C
28. D
29. B
30. B
31. D
32. C

Unit 14: The Atmosphere and Weather

Overview

The scope of this unit relates factors such as solar radiation, air masses, winds, and sea currents to the weather. The components and function of the atmosphere are discussed and the connection between weather and climate is explored.

Heat and energy are transferred from the sun by Earth's atmosphere through convection, radiation, and conduction. Uneven heating of Earth causes changes in air pressure and air currents. These changes, along with Earth's rotation, produce local wind systems and global wind systems. Blowing winds, the sun's heat, and Earth's rotation combine to create the oceans' many water currents.

Air masses of different types meet and form warm, cold, stationary, or occluded fronts. Colliding fronts cause many different types of storms. In the event of severe storms such as hurricanes and tornadoes, safety precautions should be used to prevent injury or property damage.

When moist air is cooled, water vapor condenses around tiny specks of dust, smoke, or salt to form droplets. Huge numbers of droplets form clouds. When these water droplets get too heavy, they fall to the ground in some form of precipitation—rain, sleet, hail, or snow. Three basic types of clouds insulate Earth and help shield it from the sun's heat.

Climate is the average weather of an area over a long period of time. Factors such as latitude, elevation, and nearness to water affect climate. Earth's atmosphere has four layers. Each layer has different temperatures and gases present.

Suggestions for Enrichment

1. Discuss the effect of solar radiation on heating the atmosphere.

2. Demonstrate the three mechanisms of heating: radiation using a heat lamp; convection using a convection oven or blow dryer; and conduction using a hot metal spoon in a pan.

3. Introduce the concept of air masses.

4. Cover high and low pressure and associated weather.
5. Discuss the movement of these air masses as fronts and relate this to associated weather patterns.
6. Relate the origin of winds to the mechanisms of heat transfer.
7. Cover land and sea breezes and how they affect coastal weather.
8. Discuss wind belts or global wind patterns.
9. Explain wind origins and the relationship to early travel.
10. Discuss origins and causes of currents.
11. Stimulate discussion on the effects of currents on land masses. For example: The climate of the United States East Coast is influenced by the Gulf Stream.
12. Discuss weather patterns and storms.
13. Relate the components which are necessary for formation of the weather patterns.
14. Identify characteristics and safety precautions associated with each storm.
15. Track the movement of a current tropical storm or hurricane.
16. Make observations of cloud types over the course of several days and identify different types.
17. Relate cloud cover to temperature. For example: A clear night is much colder than a cloudy one.
18. Discuss precipitation.
19. Compare the types of precipitation and the methods of formation.
20. Differentiate between climate and weather.

21. Divide the globe into different zones; discuss the impact of climate on weather patterns.

22. Use a world map to color code different climate zones. Include other subdivisions including tundra, forest, and prairie.

23. Relate climate to geographic location. Compare similar latitudes with different climates.

24. Discuss the different layers of the atmosphere and the characteristics of each.

25. Ask students to research the ozone layer and the *hole* over Antarctica.

26. Have students research different theories on the phenomenon of global warming. Ask students to determine the probability of its occurring within the next decade and then defend their induction.

27. Have students access online weather information and collect weather data daily to enter into a student-designed database/ spreadsheet. Have students use the collected data to predict the next day's weather.

28. Invite a local television weather person to class to explain forecasting.

29. Have students use the Internet and tell what the weather may be like for the next week, including temperature as well as any precipitation, for such cities as the following: Los Angeles, Lexington, Nashville, Dallas, New York City, and Miami. Next, have students use the Internet to find what the forecast for the day is in such places as Paris, France; Rome, Italy; Athens, Greece; Berlin, Germany; and Tokyo, Japan.

30. Ask students to describe the relationship between altitude and weather and then abstract that relationship to two other elements.

31. Discuss the belief that some people hold that weather and climate affect people's personality. Ask students to describe something they have noticed about the relationship between weather or climate and personality or mood. Then have the students make a prediction, gather information, and describe the extent to which it agrees with the prediction.

32. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Circle the letter of the correct answer.

1. Earth receives its heat from the sun by a process called ________.

   a. radiation
   b. reflection
   c. transmission
   d. absorption

2. The rays of sunlight that Earth receives are ________.

   a. direct rays
   b. indirect rays
   c. both direct and indirect rays
   d. convection rays

3. Horizontal movements of air are called ________.

   a. currents
   b. convection currents
   c. wind
   d. air pressure

4. A low-pressure system does **not** ________.

   a. contain warm air that is rising
   b. move counterclockwise in the Northern Hemisphere
   c. bring cloudy, rainy weather often accompanied by storms
   d. contain heavy, dense air

5. Air pressure is measured with a ________.

   a. wind vane
   b. barometer
   c. thermometer
   d. anemometer

6. The boundary formed when two different types of air masses meet is called a(n) ____________.

   a. air mass
   b. low-pressure system
   c. cyclone
   d. front

7. A front formed when a mass of warm air meets a mass of cold air and gradually moves up over the cold air causing rain or snow to fall for a long period of time is a ____________.

   a. cold front
   b. occluded front
   c. stationary front
   d. warm front

8. The type of front that forms when two unlike masses of air face each other, but there is very little movement until one finally takes over the other, is a(n) ____________.

   a. warm front
   b. cold front
   c. stationary front
   d. occluded front

9. An instrument used to tell the direction of the wind is a(n) ____________.

   a. anemometer
   b. wind vane
   c. thermometer
   d. barometer

10. A breeze that blows during the day in coastal areas because the land heats faster than the water is called a ____________.

   a. land breeze
   b. sea breeze
   c. monsoon
   d. trade wind

11. The area around the equator where there is very little movement of the air is called the ___________ .

    a. doldrums
    b. trade winds
    c. horse latitudes
    d. prevailing westerlies

12. A wide belt of winds found north and south of the horse latitudes that form in areas where there are large land masses is called the ___________ .

    a. doldrums
    b. trade winds
    c. prevailing westerlies
    d. polar easterlies

13. Seasonal winds that blow inland during the summer, bringing rainy weather, and blow out to sea in winter, bringing dry weather, are called ___________ .

    a. trade winds
    b. prevailing westerlies
    c. sea breezes
    d. monsoons

14. Storms caused by cumulonimbus clouds and accompanied by thunder and lightning area called ___________ .

    a. blizzards
    b. thunderstorms
    c. tropical storms
    d. cyclones

15. A low-pressure system with warm air rising in a counterclockwise direction in the Northern Hemisphere is also called a(n) ___________ .

    a. anticyclone
    b. cyclone
    c. tornado
    d. thunderstorm

16. A large powerful cyclone with sustained winds reaching over 75 mph is a ____________ .

    a. tropical depression
    b. tropical storm
    c. hurricane
    d. tornado

17. The type of storm that usually does the **least** damage is a ____________ .

    a. tornado
    b. hurricane
    c. blizzard
    d. rainstorm

18. Puffy clouds with flat bottoms found at middle altitudes on nice days are called ____________ .

    a. cirrus
    b. cumulus
    c. stratus
    d. cumulonimbus

19. ____________ clouds have rain accompanying them.

    a. cirrus
    b. nimbostratus
    c. stratus
    d. cumulus

20. Clouds do all of the following **except** ____________ .

    a. shield against the heat of the sun
    b. insulate Earth and keep it warm at night
    c. absorb all of the sun's ultraviolet rays
    d. hold tiny droplets of water condensed on a dust particle

21. Moisture that falls to the ground as hail, rain, sleet, or snow is called ____________ .

    a. evaporation
    b. transportation
    c. condensation
    d. precipitation

22. When both the temperature of the clouds and the temperature of the air beneath them are below freezing, ____________ forms.

    a. snow
    b. rain
    c. sleet
    d. freezing rain

23. Precipitation in the form of chunks or balls of ice is ____________ .

    a. snow
    b. freezing rain
    c. sleet
    d. hailstones

24. A stratus cloud lying near the ground is called ____________ .

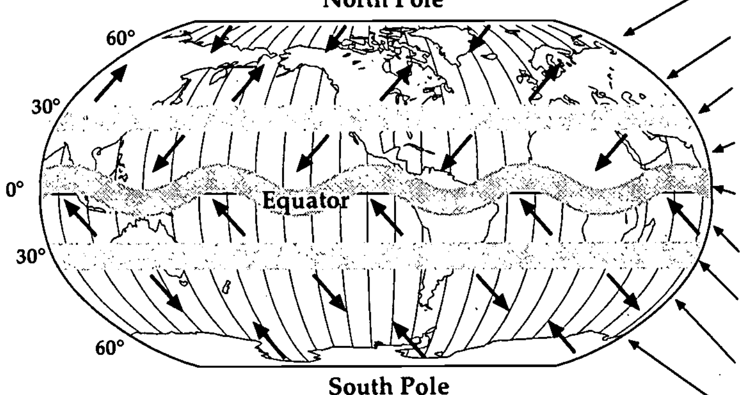
    a. dew
    b. fog
    c. cirrus cloud
    d. nimbus cloud

25. The most common form of precipitation is ____________ .

    a. rain
    b. sleet
    c. snow
    d. hail

Label the **wind belts** *on the map of Earth below. One or more terms will be used more than once.*

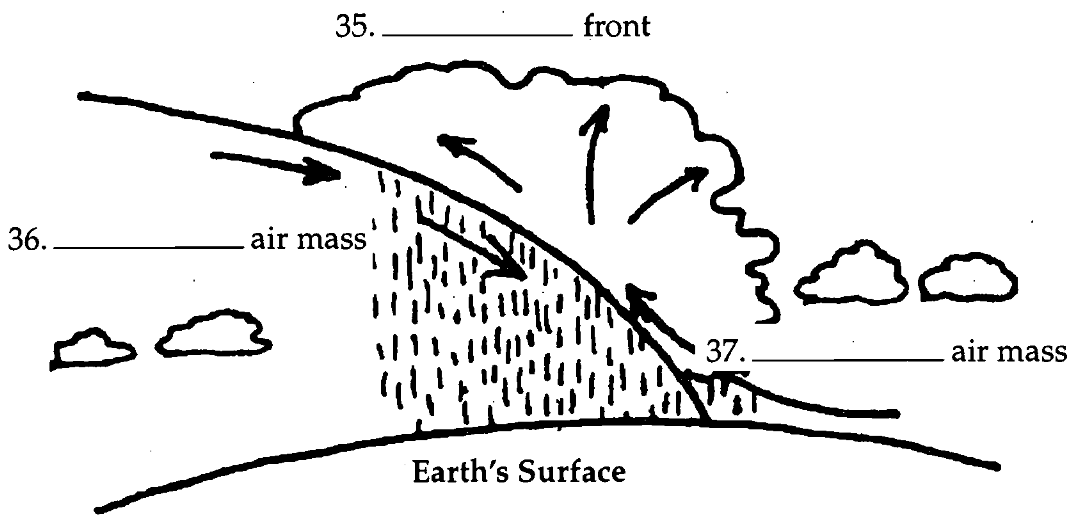
doldrums	**prevailing westerlies**
horse latitudes	**trade winds**
polar easterlies	

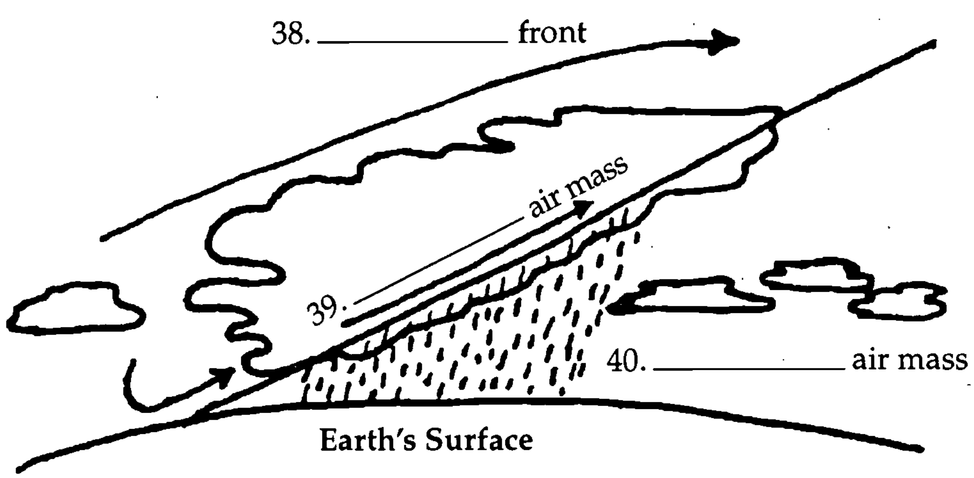


26. ____________________
27. ____________________
28. ____________________
29. ____________________
30. ____________________
31. ____________________
32. ____________________
33. ____________________
34. ____________________

Wind Belts

Label the **fronts** *and* **air masses** *shown below. Write* **cold** *or* **warm** *on the lines provided.*





Match the type of **front** *with the correct* **symbol**. *Write the letter on the line provided.*

______ 41. warm front

______ 42. cold front

______ 43. occluded front

______ 44. stationary front

A. 

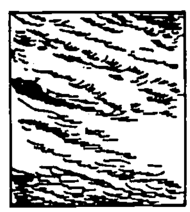
B. 

C. 

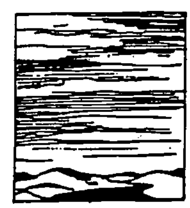
D. 

Label the clouds **cirrus**, **cumulus**, *and* **stratus**.

45. ____________



46. ____________



47. ____________

Circle the letter of the correct answer.

48. Day-to-day changes in temperature, humidity, wind, and air pressure make up our____________.

    a. climate
    b. seasons
    c. weather
    d. relative humidity

49. The climate of an area is influenced by all of the following **except** ____________.

a. its distance north or south of the equator
b. its height above sea level
c. its closeness to a major body of water
d. its time of year

50. The climate zone that lies between 60° and the poles and has an average temperature below freezing is the ____________.

a. temperate zone
b. polar zone
c. tropical zone
d. desert

51 Deserts are usually found ____________.

a. between a mountain range and an ocean
b. between a mountain range and an island
c. near the east coast of a continent
d. on the side of a mountain range that is farthest away from the ocean on large continents

52. A type of climate where an area is located near a large body of water is a ____________.

a. continental climate
b. marine climate
c. desert climate
d. temperate climate

53. The layer of the atmosphere that contains the ozone is the ____________.

a. troposphere
b. mesosphere
c. stratosphere
d. exosphere

54. Ozone has all of the following characteristics **except** ____________ .

    a. three atoms of oxygen per molecule instead of two
    b. absorbs the sun's ultraviolet rays
    c. odorless when formed
    d. protects us against skin cancer and blindness

55. The layer of strong winds found just above the troposphere is the ____________ .

    a. ionosphere
    b. mesosphere
    c. ozone layer
    d. jet stream

56. The layer of the atmosphere that contains most of our weather and that we live in is the ____________ .

    a. stratosphere
    b. ionosphere
    c. troposphere
    d. exosphere

57. The ozone layer ____________ .

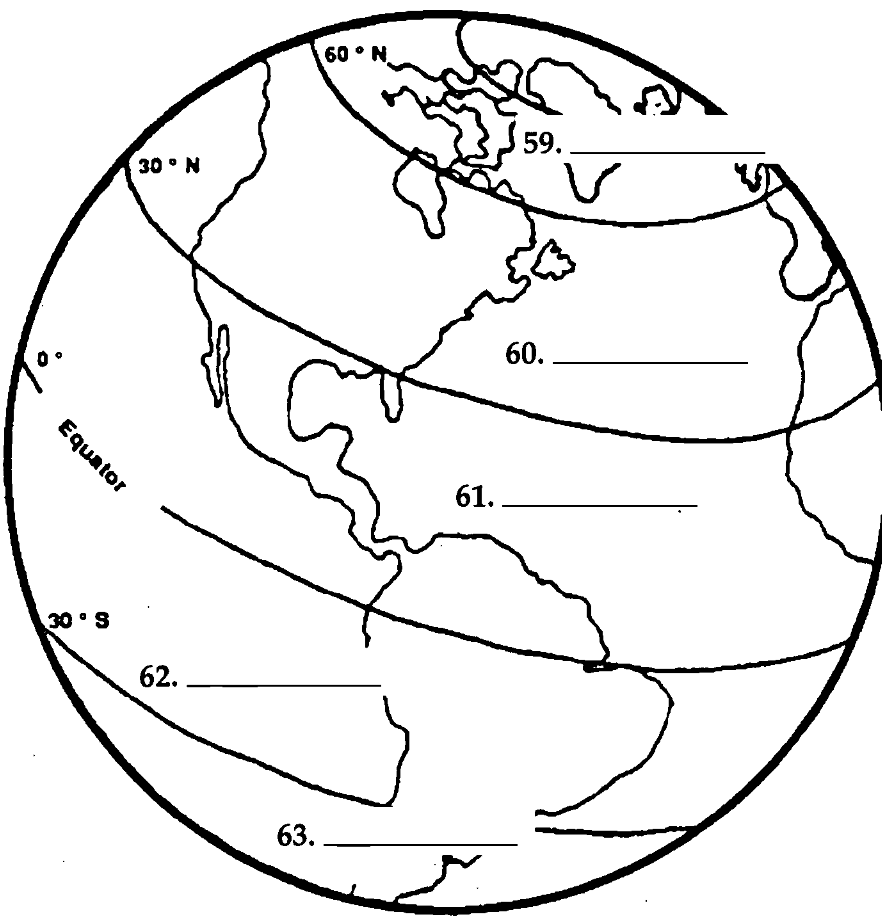
    a. increases the temperature of the upper layer of the stratosphere
    b. decreases the temperature of the upper layer of the stratosphere
    c. has no effect on the temperature of the stratosphere
    d. is capable of destroying the stratosphere

58. Earth's atmosphere ____________ .

    a. has three layers
    b. extends for only about 50 kilometers
    c. extends for thousands of kilometers
    d. is composed mostly of ozone

Use the list below to label the **climate zones** *on the diagram.*

temperate	**polar**	**tropical**



Answer the following using short answers.

64. What are the four layers of the atmosphere in order from the closest to Earth to the farthest away? Give one characteristic of each layer.

	Layers	Characteristic
Closest	____________________	____________________
	____________________	____________________
	____________________	____________________
Farthest	____________________	____________________

65. Why is the ozone layer important? ____________________

____

____

____

____

____

66. Describe the climate zone in which we live.

____

____

____

____

____

____________________ ____________________

Keys

Practice (pp. 434-435)

1. atmosphere
2. troposphere
3. 10
4. jet stream
5. stratosphere
6. ozone
7. ultraviolet rays
8. blindness; skin cancer
9. aerosol cans
10. mesosphere
11. thermosphere
12. ionosphere
13. exosphere
14. oxygen

Practice (p. 436)

	Distance	Characteristics
1.	10 km	humankind lives there; contains most of the weather; temperature drops as you go higher; jet stream is just above it
2.	50 km	lower part is cold; upper part is same temperature as at sea level due to ozone layer
3.	80 km	coldest part of the atmosphere
4a.	500-700 km	very hot because nitrogen and oxygen absorb sun's energy; has electrically-charged particles
4b.	>1,000 kms	last layer of atmosphere; very thin; some gases escape into space

Practice (p. 437)

Sentences will include the following information:

1. It has three atoms of oxygen instead of two.
2. It has a clean, sharp smell.
3. Ozone can be smelled when lightning strikes.
4. It shields Earth from the ultraviolet rays of the sun.
5. Stop producing and using aerosol cans; pass laws.

Practice (p. 438)

Correct answers will be determined by the teacher.

Practice (pp. 439-440)

1. sun
2. radiation
3. heat
4. convection current
5. direct rays
6. indirect rays
7. Currents
8. wind
9. low-pressure
10. counterclockwise

Practice (pp. 441-442)

1. low-
2. high-pressure area
3. high-
4. barometer
5. air mass
6. front
7. cold
8. stationary
9. warm
10. occluded

Keys

Practice (p. 443)

1. B
2. A
3. C
4. D

Lab Activity 1 (p. 444)

1.-4. Correct procedure will be determined by the teacher.
5. The water moved clockwise.
6. The water moved counterclockwise.
7. The direction of the spin is changed.

Lab Activity 2 (p. 445)

1.-5. Correct procedure will be determined by the teacher.
6. across the top, then cools and drops
7. yes, across the bottom
8. no
9. polar zone
10. equatorial zone
11. away from the equator, then circle to the polar zone, and back again

Practice (p. 446)

1. polar easterlies
2. prevailing westerlies
3. horse latitudes
4. trade winds
5. doldrums
6. trade winds
7. horse latitudes
8. prevailing westerlies
9. polar easterlies

10.-15.

Northern	Southern
west	west
east	east
west	west

Practice (p. 447)

1. J
2. A
3. H
4. D
5. I
6. E
7. B
8. G
9. C
10. F

Practice (p. 448)

1. Cape Fear
2. Homestead and Point Chevreuil
3. water to land (east to west)
4. Tropical Caribbean
5. Gulf Coast and southeastern Atlantic Coast
6. water

Practice (p. 449)

Correct answers will be determined by the teacher.

Practice (pp. 450-451)

1. rainstorm
2. blizzard
3. cumulonimbus
4. lightning
5. Thunder
6. cyclones
7. anticyclones
8. opposite
9. hurricane
10. tropical depression
11. tropical storm
12. 75; 200
13. tornado
14. waterspout
15. tornado; hurricane

Keys

Practice (p. 452)

Sentences will include the following information:

1. flooding and lightning
2. Stay away from tall objects and avoid metal objects such as golf clubs and baseball bats.
3. Answers may vary, but will include: leave low lying areas; secure boats and outdoor objects; fill car with gas; listen to weather service bulletins.
4. A hurricane watch means that a hurricane may threaten within 24 hours. Hurricane warnings indicate that one is expected to strike within 24 hours.
5. Seek shelter in a small interior area such as a hallway, closet, or bathroom.

Practice (p. 453)

1. A
2. E
3. F
4. B
5. C
6. D
7. cirrus
8. stratus
9. cumulus

Practice (p. 454)

Correct answers will be determined by the teacher.

Practice (p. 455)

1. E
2. A
3. F
4. H
5. B
6. C
7. G
8. D

Practice (p. 456)

1. True
2. True
3. False
4. False
5. True
6. False
7. False
8. True
9. False
10. True
11. False
12. True
13. True
14. False

Practice (pp. 457-458)

Sentences will include the following information:

1. latitude, elevation, proximity to water
2. sun's rays strike directly
3. Air loses moisture as it crosses mountains, becoming dry.
4. Answers will be determined by teacher.
5. Desert: less than 25 cm rain; wide-ranging temperatures
   Marine: less seasonal and temperature changes
   Continental: large seasonal and temperature changes

Practice (pp. 459-460)

1. continental climate
2. marine climate
3. weather
4. atmosphere

Keys

5. ionosphere
6. temperate zone
7. mesosphere
8. desert
9. polar zone
10. climate
11. thermosphere
12. ozone
13. troposphere
14. exosphere
15. troposphere
16. stratosphere
17. jet stream

Practice (pp. 461-462)

1. stationary front
2. radiation
3. occluded front
4. low-pressure system
5. indirect rays
6. high-pressure system
7. front
8. direct rays
9. currents
10. convection current
11. cold front
12. barometer
13. air masses
14. warm front
15. wind
16. conduction
17. convection

Practice (p. 463)

1. anemometer
2. horse latitudes
3. doldrums
4. polar easterlies
5. sea breeze
6. land breeze
7. trade winds
8. monsoons
9. wind vane
10. prevailing westerlies

Practice (pp. 464-465)

1. hurricane
2. cumulus
3. anticyclone
4. nimbus
5. lightning
6. blizzard
7. saturated
8. cloud
9. cirrus
10. cyclone
11. stratus
12. nimbostratus
13. thunder
14. cumulonimbus
15. precipitation
16. waterspout
17. tornado
18. tropical storm
19. tropical depression

Practice (pp. 466-468)

1. d
2. c
3. d
4. d
5. c
6. b
7. c
8. d
9. b
10. a
11. d
12. a
13. b
14. a
15. a
16. d
17. c

Keys

Practice (pp. 469-471)

1. a
2. d
3. d
4. c
5. d
6. c
7. d
8. a
9. c
10. d
11. d
12. a
13. c
14. d
15. b
16. a
17. b

Practice (pp. 472-473)

1. c
2. c
3. b
4. c
5. a
6. b
7. d
8. d
9. a
10. a

Practice (pp. 474-477)

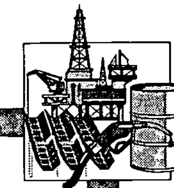
1. a
2. a
3. b
4. d
5. d
6. b
7. d
8. c
9. a
10. c
11. b
12. c
13. a
14. c
15. d
16. d
17. d
18. c
19. c

Unit Assessment (pp. 145-156TG)

1. a
2. c
3. c
4. d
5. b
6. d
7. d
8. c
9. b
10. b
11. a
12. c
13. d
14. b
15. b
16. c
17. d
18. b
19. b
20. c
21. d
22. a
23. d
24. b
25. a
26. polar easterlies
27. prevailing westerlies
28. horse latitudes
29. trade winds
30. doldrums
31. trade winds
32. horse latitudes
33. prevailing westerlies
34. polar easterlies

Keys

35. cold
36. cold
37. warm
38. warm
39. warm
40. cold
41. D
42. B
43. A
44. C
45. cumulus
46. cirrus
47. stratus
48. c
49. d
50. b
51. d
52. b
53. c
54. c
55. d
56. c
57. a
58. c
59. polar
60. temperate
61. tropical
62. tropical
63. temperate
64. Layers: troposphere; stratosphere; mesosphere; thermosphere
    Characteristics may vary, correct answers will be determined by the teacher.
65. absorbs ultraviolet rays and helps heat the atmosphere
66. Temperate—descriptions may vary based on location. (May be *tropical* instead of *temperate* for South Florida.)



Unit 15: Energy Sources

Overview

The scope of this unit includes the identification of energy sources and their uses. Many different types of energy sources or fuels are briefly discussed.

Our natural resources supply the energy needed to do work or move objects. Types of energy include solar energy, nuclear energy, geothermal energy, water power, wind power, tidal power, biomass fuel, and fossil fuels. Some of the sources of energy are renewable, and others are nonrenewable. Our natural resources must be conserved to safeguard the supply for our future.

Suggestions for Enrichment

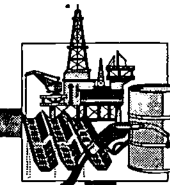
1. Identify energy sources—both conventional and experimental.
2. Classify each energy source as renewable or nonrenewable.
3. Compare the advantages and disadvantages of each resource.
4. Review energy sources individually covering uses, availability, etc.
5. Assign group teaching project(s) involving student research, construction of model or diagram, and oral presentations.
6. Use current events and situations to relate use to area. For example: coal power plant, nuclear power plant, oil spill, gas leak, etc.
7. Discuss fossil fuels and the use of natural resources. Include the long-term effects of the use of fossil fuels and their effects on other resources.
8. Discuss the need for the development of new resources or new technologies to utilize these resources efficiently.

9. Ask students to identify their position on whether nuclear reactors should be used near large cities and support their opinion. Next, have students decide where would be the best place to put a nuclear power plant in their city.

10. Have students use the Internet (http://www.energy.ca.gov/education/story/story-html/story.html) to research the processes and conditions involved in the formation of fossil fuels.

11. Have students use the Internet (http://www.scorecard.org/ranking/) to research and analyze an issue related to the use of natural resources. Ask students to record data so they can graph the top 10 polluting chemicals, the top 10 polluting industries, and the top 10 polluting counties in Florida. Have students devise a plan to educate the community or write letters to these industries.

12. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.



Unit Assessment

Match each definition with the correct term. Write the letter on the line provided.

_______ 1. liquid fossil fuel made from plants and animals that lived in the shallow coastal waters millions of years ago

_______ 2. replaced or used again

_______ 3. fuel made from decayed plants and animals that lived millions of years ago

_______ 4. used only once

_______ 5. soft coal

_______ 6. natural gas

_______ 7. hard coal

_______ 8. sedimentary rock with oil trapped between its layers

_______ 9. a burnable fuel made from plant and animal material

_______ 10. electricity produced by falling water

_______ 11. to save resources for the future

_______ 12. material found in Earth's crust that people can use

_______ 13. energy produced by the heat from inside Earth's crust

A. anthracite

B. biomass fuel

C. bituminous

D. conserve

E. fossil fuel

F. geothermal energy

G. hydroelectricity

H. methane

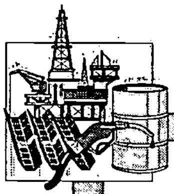
I. natural resources

J. nonrenewable

K. oil shale

L. petroleum or oil

M. renewable



Answer the following using short answers.

14. What is solar energy? ______________________

____

15. What is one advantage of solar energy? ______________________

____

16. What is one disadvantage of solar energy? ______________________

____

17. Name two things from producing energy that can pollute the air.

____

18. Name two things from producing energy that can pollute our water.

____

____

19. How can minerals and fossil fuels be preserved? ______________________

____

____

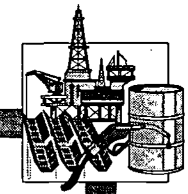
20. What are two ways to solve the problem of decreasing fossil fuels and mineral availability?

____

____

____

____



Circle the letter of the correct answer.

21. The type of energy used by a dam to produce electricity is called ___________ .

    a. solar energy
    b. water power
    c. wind power
    d. fossil fuel

22. The source of energy that we depend on most is called ___________ .

    a. fossil fuels
    b. nuclear energy
    c. water power
    d. tidal energy

23. The type of energy produced by the heat inside Earth's crust is called ___________ .

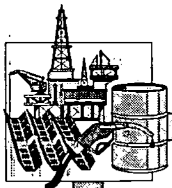
    a. hydroelectric power
    b. geothermal energy
    c. solar energy
    d. wind power

24. The type of energy produced by splitting the nucleus of a uranium atom is called ___________ .

    a. solar energy
    b. fossil fuel
    c. biomass fuel
    d. nuclear energy

25. Energy of the wind used to create electricity is called ___________ .

    a. solar energy
    b. nuclear energy
    c. tidal energy
    d. wind power



26. A dam and a high tide can produce ____________ .

    a. tidal energy
    b. solar energy
    c. fossil fuels
    d. steam

27. The form of water produced when water is heated to its boiling point is called ____________ .

    a. steam
    b. wind
    c. electricity
    d. coal

28. An energy source made from living materials such as wood is ____________ .

    a. coal
    b. steam
    c. biomass fuel
    d. electricity

29. A fossil fuel that is difficult and expensive to get out of the rock it is found in is ____________ .

    a. coal
    b. oil
    c. natural gas
    d. oil shale

30. Energy from the sun is called ____________ .

    a. wind power
    b. geothermal energy
    c. tidal power
    d. solar energy

Write **True** *if the statement is correct. Write* **False** *if the statement is* not *correct.*

_________ 31. Nuclear energy is a fossil fuel.

_________ 32. Methane is a natural gas.

_________ 33. Anthracite is soft coal.

_________ 34. Methane is use in heating homes.

_________ 35. Quartz is used in splitting the atom.

_________ 36. Iceland uses geothermal energy.

_________ 37. Windmills were used to produce electricity.

_________ 38. Coal is a fossil fuel.

_________ 39. Petroleum is used to make gasoline.

_________ 40. Bituminous is hard coal.

Keys

Lab Activity (pp. 492-494)

Correct answers will be determined by the teacher.

Practice (pp. 495-498)

Sentences will include the following information:

1. the ability to do work or move objects
2. from our natural resources
3. solar energy; nuclear energy; moving water; tidal power; fossil fuels; geothermal energy; wind; biomass fuel
4. The energy from coal, gas, oil, wind, uranium, steam, tides, and falling water is used to turn the blades of a turbine that turns the coils of the generator to produce electricity.
5. Accept any three: soil or forests; water, wind, or sunlight; tides or geothermal energy.
6. coal or natural gas; uranium; petroleum or oil
7. It is renewable; it does not cause pollution.
8. It cannot be collected at night; it can only be used in areas that get a lot of sun; it is expensive to convert to electricity.
9. The atom is split and a great deal of energy is released as heat which is used to boil water to create steam. Steam is used to turn the turbine of a generator to produce electricity.
10. Wells are drilled into hot water deposits in the ground and steam is brought to the surface that turns the turbines of a generator to produce electricity.
11. hydroelectricity
12. It is renewable; it is inexpensive; it does not pollute the atmosphere.
13. The rivers are not always where the power is needed.
14. to make electricity and to pump water or grind grain
15. The wind is not predictable.
16. There are only a few places in the world with the right tidal conditions to use it.
17. energy from plant and animal materials
18. Plants can be converted to alcohol that is burned; wood is burned as fuel.
19. fossil fuels
20. coal; natural gas; petroleum or oil; oil shale

Practice (p. 499)

1. N
2. R
3. N
4. R
5. N
6. N
7. N
8. R
9. R
10. R
11. N
12. N
13. R
14. R
15. N

16.-18. Answers will vary. Examples may include the following: aluminum, metal, plastic, glass.

Keys

Practice (pp. 500-501)

Answers will include the following:

1. plants and animals that died millions of years ago
2. plants and animals that lived in the sea
3. Accept any six: lubricant; gasoline; plastic; synthetics; kerosene; wax; building materials; medicine; asphalt.
4. plants that died millions of years ago
5. peat
6. lignite
7. bituminous
8. anthracite
9. to provide energy for ships and trains; to make electricity in factories
10. next to deposits of oil
11. methane
12. oil shale
13. sedimentary rock
14. they are nonrenewable; they contain traces of sulfur which causes pollution when they are burned; it is often expensive and difficult to remove from Earth's surface

Practice (pp. 502-503)

1. petroleum or oil
2. hydroelectricity
3. methane
4. lignite
5. natural resources
6. fossil fuel
7. renewable
8. nonrenewable
9. bituminous
10. biomass fuel
11. anthracite
12. conserve

Practice (pp. 504-505)

1. nuclear energy
2. solar energy
3. geothermal energy
4. coal
5. energy
6. electricity
7. natural gas
8. oil shale
9. peat
10. solar collectors
11. solar cells
12. tidal power
13. wind power

Practice (pp. 506-510)

1. d
2. a
3. a
4. d
5. c
6. d
7. d
8. c
9. d
10. d
11. a
12. c
13. d
14. b
15. d
16. d
17. c
18. a
19. c
20. a
21. a
22. d
23. b
24. d
25. b

Keys

Unit Assessment (pp. 165-169TG)

1. L
2. M
3. E
4. J
5. C
6. H
7. A
8. K
9. B
10. G
11. D
12. I
13. F

14.-20. Correct answers will be determined by the teacher.

21. b
22. a
23. b
24. d
25. d
26. a
27. a
28. c
29. d
30. d
31. False
32. True
33. False
34. True
35. False
36. True
37. True
38. True
39. True
40. False

Unit 16: Our Environment

Overview

The scope of this unit includes the interaction between the different areas of Earth science as they relate to problems of environmental quality. The unit also includes career opportunities in the field of Earth science.

Protecting our environment and natural resources is extremely important for the future of Earth. Controlling pollution of air, land, and water is one part of the effort. Each of us has a responsibility as a caretaker of the environment. Many different kinds of scientists are working on solutions to today's environmental problems.

Suggestions for Enrichment

1. Review the areas of Earth science—geology, hydrology, meteorology, and astronomy.
2. Discuss the areas of Earth science that involve the knowledge of all other areas of Earth science.
3. Discuss the time of human life on Earth as compared to Earth's vast history and how we have permanently altered our environment. Discuss the implications of an environmental crisis as it exists in the context of Earth's history.
4. Introduce the concept of environmental science and environmental quality—use current events and newspapers to locate topics for discussion.
5. Look at the local concerns in the areas of environmental conservation and environmental impact—groundwater, landfills, oil spills, etc. Ask students to choose a problem and develop a plan to solve the problem.
6. Have students research environmental laws and local and state representatives' record on environmental legislation in your area.
7. Discuss the ways that one person can make a difference in the environmental quality of his or her area.
8. Institute a recycling drive.

9. Have students make recycled paper by placing two cups of used, ripped-up paper into a blender with one cup of water and blending until smooth. Next, pour mixture onto a 10″ x 12″ framed window screen over a sink or newspaper. Let dry overnight.

10. Have students write letters of concern about environmental development to the city or county commission.

11. Discuss the different types of pollution.

12. Have students research pollutants and their sources, and possible methods of controlling them or cleaning up.

13. Have students write an editorial about a specific type of pollution.

14. Follow up the oil spill Lab on page 531 with a discussion on the problems associated with cleanups.

15. Conduct optional lab sessions on air and water pollution.

16. Check the availability of kits that make testing for air and water pollution simple and affordable. These activities encourage students to become concerned about their surroundings and to find ways to make them better.

17. Order lab kits Lab-AIDS—a science supply source: A Qualitative Introduction to Water Pollution Kit; A Qualitative Introduction to Air Pollution Kit; and The Effects of Phosphates and Nitrates on Water Supply Kit.

18. Discuss scientific issues in the news. Have students draw editorial cartoons about a scientific issue to reflect their view on the issue.

19. Discuss environmental issues in the news and what may be the most important scientific discoveries needed today.

20. Have students race against time or other students to find science-related items in the newspaper. Examples: a product that uses petroleum, an article about energy, a job requiring computer skills, and article about an environmental problem.

21. See Appendices A, B, C, and D for further instructional strategies, teaching suggestions, accommodations/modifications, and related Internet sites.

Unit Assessment

Match each **pollution** *example to the* **type of pollution**. *Answers will be used more than once. An example may also have more than one answer. Write the correct letter or letters on the line provided.*

_____ 1. litter

_____ 2. phosphates and nitrates

_____ 3. hydrocarbons

_____ 4. smog

_____ 5. thermal pollution

_____ 6. acid rain

_____ 7. carbon monoxide

_____ 8. pesticides

_____ 9. sediment buildup

_____ 10. sulfur

_____ 11. lead additives to gasoline

_____ 12. oil spills by tankers

_____ 13. buried radioactive wastes

_____ 14. bacteria and viruses

_____ 15. soot, ashes, and smoke

A. water pollution

B. air pollution

C. land pollution

00 732

Match each definition with the correct term. Write the letter on the line provided.

______ 16. measures taken to save natural resources for future use

______ 17. all of the things that make up your surroundings

______ 18. unburned particles of fuels that contain hydrogen and carbon

______ 19. pollutants found in fertilizers and detergents

______ 20. substances in the air, water, and land that are harmful to living things

______ 21. processing materials so that they can be used again

______ 22. a pollutant that contains nitrogen, sulfur, and hydrocarbons which creates a brown haze and unpleasant odor

______ 23. when a layer of cool air gets trapped under a layer of warm air and acts like a lid keeping the pollutants near the ground

______ 24. an unnatural heating of water

______ 25. rain that contains sulfuric acid

A. acid rain

B. conservation

C. environment

D. hydrocarbons

E. phosphates and nitrates

F. pollutants

G. recycling

H. smog

I. temperature inversion

J. thermal pollution

Answer the following using complete sentences.

26. What are three things that society can do to help preserve the balance of nature?

____

____

____

____

____

____

____

____

____

____

27. What are three renewable natural resources? ____________

____

____

____

28. What are three nonrenewable natural resources? ____________

____

____

____

29. What are three things that can be recycled? ______________________

____

____

____

____

____

30. What are five careers associated with Earth science?

____

____

____

____

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____

____

____

____

____

Keys

Practice (pp. 526-527)

Correct answers will be determined by the teacher.

Practice (pp. 528-529)

1.-7. Correct answers will be determined by the teacher.
8. True
9. False
10. True

Practice (p. 530)

Sentences will include the following information:

1. Make people aware of the problems of pollution. Create laws to stop pollution. Conduct scientific research.
2. Accept any five: find new sources for food; control weather; find ways to get resources from the ocean; find ways to get oil out of shale; find news ways to desalt ocean water; find new sources of energy; look for ways to stop pollution; space exploration.
3. Accept any three: laws create regulations for factories; control burning of trash; dumping of garbage and littering; licenses and regulations on fishing and hunting.
4. Accept any three: television documentaries; local campaigns; newspapers; education.

Lab Activity (pp. 531-535)

Correct answers will be determined by the teacher.

Practice (pp. 536-537)

1. Pollutants
2. Accept any four: hydrocarbons; sulfur oxides; nitrogen oxides; carbon monoxide; smoke.
3. hydrocarbons
4. automobiles
5. fossil fuels
6. sulfuric acid
7. acid rain
8. nitrogen oxides; sulfur oxides; hydrocarbons
9. smoke; fog
10. carbon monoxide
11. automobile exhaust; charcoal grills
12. temperature inversion
13. industry

Practice (pp. 538-539)

Sentences will include the following information:

1. Accept any four: to drink; grow food; produce energy; manufacture products; transportation; recreation.
2. untreated sewage and animal waste products
3. building water treatment plants and chlorinating water
4. Phosphates and nitrates cause algae and pond weeds to grow rapidly and take over the lake, causing fish and other organisms to die from lack of oxygen.
5. from unnatural heating of waters by power plants
6. Some organisms cannot live at higher temperatures, and it interrupts the breeding cycle of some fish.
7. They cover up the food supply of fish, causing them to die.

Keys

8. Oil spills cause birds and fish to get trapped in them and die, and it pollutes beaches.
9. Rain washes chemicals down into the water table where they will eventually enter lakes or streams or be pumped into wells by man.
10. build water treatment plants; chlorinate; control chemical use and dumping by farmers and industry; keep tankers from dumping oil

Practice (pp. 540-541)

Sentences will include the following information:

1. litter
2. Pass laws to fine people for littering. Recycle wastes such as cans and bottles.
3. Processing used materials so they can be used again.
4. soda and beer cans; soda bottles; paper
5. They enter the soil and plants that grow in the soil absorb the chemicals, then animals eat the plants.
6. Conserve them through wise use.
7. add fertilizers; terrace and contour hilly land; irrigate land; control grazing of lands
8. replant it; control the cutting down of trees to prevent erosion

Practice (p. 542)

Correct answers to be determined by the teacher.

Practice (pp. 543-544)

1. conservation
2. recycling
3. smog
4. acid precipitation
5. environment
6. pollution
7. pollutants
8. fossil fuels
9. pesticides
10. phosphates
11. hydrocarbons
12. litter
13. thermal pollution
14. temperature inversion
15. nitrates

Practice (pp. 545-547)

1. a
2. c
3. d
4. c
5. c
6. b
7. b
8. c
9. d
10. b
11. d
12. d
13. a
14. d
15. d

Unit Assessment (pp. 177-180TG)

1. C, A
2. A
3. B
4. B
5. A
6. C, A
7. B
8. C, A
9. A
10. B
11. B
12. A, C

Keys

13. A, C
14. A
15. B
16. B
17. C
18. D
19. E
20. F
21. G
22. H
23. I
24. J
25. A

Sentences will include the following information:

26. Make people aware of the problems. Create laws to force people and factories to stop polluting. Conduct scientific research.
27. Accept any three: air; water; soil; forests.
28. minerals; ores; fossil fuels
29. aluminum cans; glass; paper
30. Answers will vary.

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Appendices

Instructional Strategies

Classrooms include a diverse population of students. The educator's challenge is to structure the learning environment and instructional material so that each student can benefit from his or her unique strengths. Instructional strategies adapted from the Florida Curriculum Frameworks are provided on the following pages as examples that you might use, adapt, and refine to best meet the needs of your students and instructional plans.

Cooperative Learning Strategies—to promote individual responsibility and positive group interdependence for a given task.

Jigsawing: each student becomes an "expert" on a topic and shares his or her knowledge so eventually all group members know the content.

Divide students into groups and assign each group member a numbered section or a part of the material being studied. Have each student meet with the students from the other groups who have the same number. Next, have these new groups study the material and plan how to teach the material to members of their original groups. Then have students return to their original groups and teach their area of expertise to the other group members.

Corners: each student learns about a topic and shares that learning with the class (similar to jigsawing).

Assign small groups of students to different corners of the room to examine and discuss particular topics from various points of view. Have corner teams discuss conclusions, determine the best way to present their findings to the class, and practice their presentation.

Think, Pair, and Share: students develop their own ideas and build on the ideas of other learners.

Have students reflect on a topic and then pair up to discuss, review, and revise their ideas. Then have the students share their ideas with the class.

Debate: students participate in organized presentations of various viewpoints.

Have students form teams to research and develop their viewpoints on a particular topic or issue. Provide structure in which students can articulate their viewpoints.

Brainstorming—to elicit ideas from a group.

Have students contribute ideas about a topic. Accept all contributions without initial comment. After a list of ideas is finalized, have students categorize, prioritize, and defend their contributions.

Free Writing—to express ideas in writing.

Allow students to reflect on a topic, then have them respond in writing to a prompt, a quotation, or a question. It is important that they keep writing whatever comes to mind. They should not self-edit as they write.

K–W–L (Know–Want to Know–Learned)—to provide structure for students to recall what they know about a topic, decide what they want to know, and then after an activity, list what they have learned and what they still want or need to learn.

Before engaging in an activity, list on the board under the heading "What We Know" all the information students know or think they know about a topic. Then list all the information the students want to know about a topic under, "What We Want to Know." As students work, ask them to keep in mind the information under the last list. After completing the activity, have students confirm the accuracy of what was listed and identify what they learned, contrasting it with what they wanted to know.

Learning Log—to follow-up K–W–L with structured writing.

During different stages of a learning process, have students respond in written form under three columns:

"What I Think"
"What I Learned"
"How My Thinking Has Changed"

Interviews—to gather information and report.

Have students prepare a set of questions in interview format. After conducting the interview, have students present their findings to the class.

Dialogue Journals—to provide a way to hold private conversations with the teacher or share ideas and receive feedback through writing (this activity can be conducted by e-mail).

Have students write on topics on a regular basis. Respond in conversational writing to their writings with advice, comments, and observations.

Continuums—to indicate the relationships among words or phrases.

Using a selected topic, have students place words or phrases on the continuum to indicate a relationship or degree.

Mini-Museums—to create a focal point.

Have students work in groups to create exhibits that represent, for example, a display of several electrical experiments that demonstrate concepts related to electricity.

Models—to represent a concept in simplified form.

Have students create a product, like the model of an atom, or a representation of an abstract idea, like a model of weather systems.

Reflective Thinking—to reflect on what was learned after a lesson.

Have students write in their journals about a concept or skill they have learned, comment on the learning process, note questions they still have, and describe their interest in further exploration of the concept or skill. Or have students fill out a questionnaire addressing such questions as: Why did you study this? Can you relate it to real life?

Problem Solving—to apply knowledge to solve problems.

Have students determine a problem, define it, ask a question about it, and then identify possible solutions to research. Have them choose a solution and test it. Finally, have students determine if the problem has been solved.

Predict, Observe, Explain—to predict what will happen in a given situation when a change is made.

Ask students to predict what will happen in a given situation when some change is made. Have students observe what happens when the change is made and discuss the differences between their predictions and the results.

Literature, History, and Storytelling—to bring history to life through the eyes of a historian, storyteller, or author, revealing the social context of a particular period in history.

Have students locate books, brochures, and tapes relevant to science. Assign students to prepare reports on the life and times of scientists during specific periods of history. Ask students to write their own observations and insights afterwards.

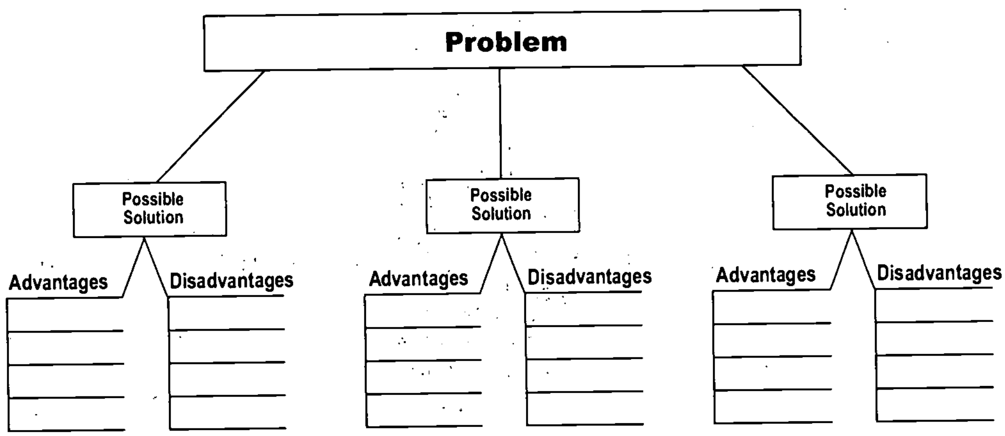
Laboratory Investigation—to involve students with their environment.

Have students propose a question, develop a hypothesis, explore methods of investigating the question, choose one of the methods, then conduct research and draw conclusions based on the information gathered. Ask students to report the results orally, in writing, or with a picture or diagram.

Graphic Organizers—to transfer abstract concepts and processes into visual representations.

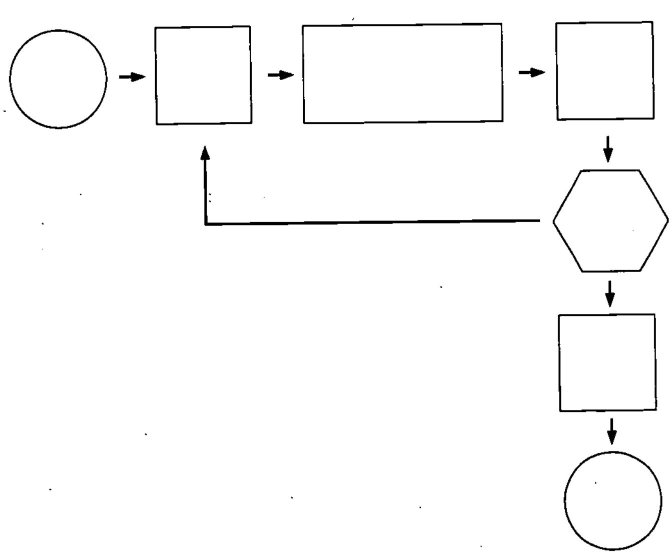
Consequence Diagram/Decision Trees: illustrates real or possible outcomes of different actions.

Have students visually depict outcomes for a given problem by charting various decisions and their possible consequences.



Flowchart: depicts a sequence of events, actions, roles, or decisions.

Have students structure a sequential flow of events, actions, roles, or decisions graphically on paper.



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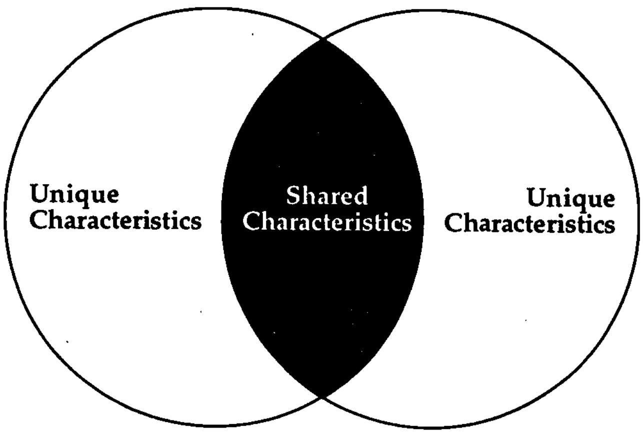
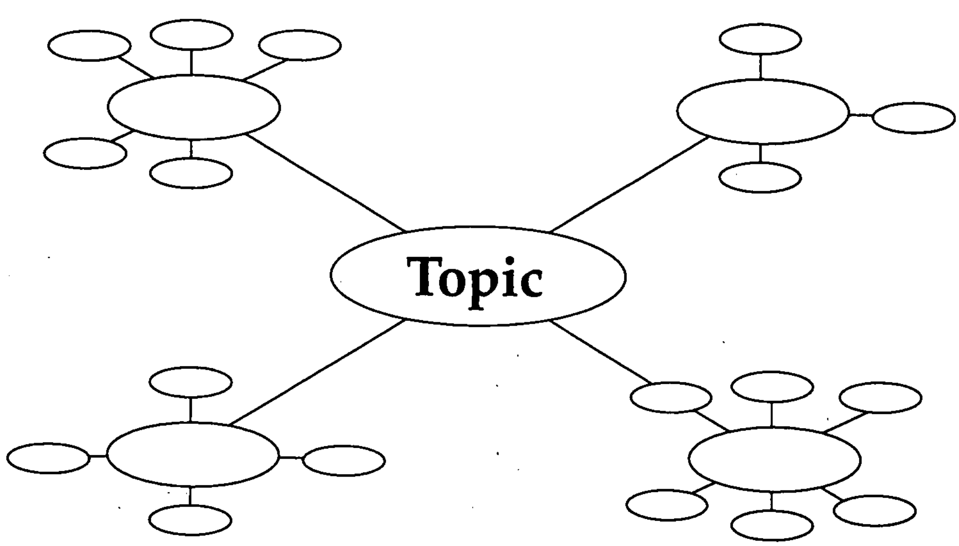
Venn Diagram: creates a visual analysis of the similarities and differences among, for example, two concepts, objects, events, or people.

Have students use two overlapping circles to list unique characteristics of two items or concepts (one in the left part of the circle and one in the right); in the middle have them list shared characteristics.



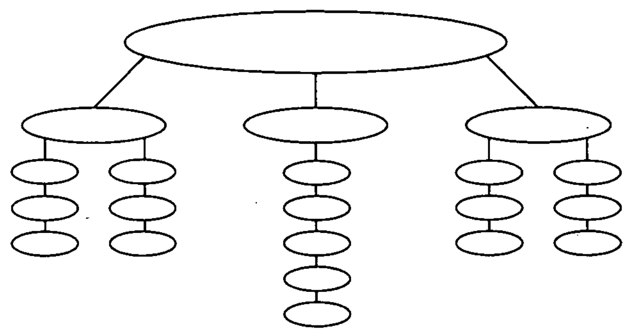
Webbing: provides a picture of how words or phrases connect to a topic.

Have students list topics and build a weblike structure of words and phrases.



Concept Mapping: shows relationships among concepts.

Have students select a main idea and identify a set of concepts associated with the main idea. Next, have students rank the concepts in related groups from the most general to most specific. Then have students link related concepts with verbs or short phrases.



Portfolio—to capture the extent of students' learning within the context of the instruction.

Elements of a portfolio can be stored in a variety of ways; for example, they can be photographed, scanned into a computer, or videotaped. Possible elements of a portfolio could include the following selected student products.

Written Presentations	Media Presentations
• expressive (diaries, journals, writing logs) • transactional (letters, surveys, reports, essays)	• films • slides • photo essays • print media • computer programs • videotapes • audiotapes
Representations	**Visual and Graphic Arts**
• maps • graphs • dioramas • models • mock-ups • displays • bulletin boards • charts • replicas	• storyboards • drawings • posters • sculpture • cartoons • mobiles

Learning Cycle—to engage in exploratory investigations, construct meanings from findings, propose tentative explanations and solutions, and relate concepts to their lives.

Have students explore a concept, behavior, or skill with a hands-on experience and then explain their exploration. Through discussion, have students expand the concept or behavior by applying it to other situations.

Field Experience—to use the community as a laboratory for observation, study, and participation.

Before the visit, plan and structure the field experience with the students. Engage in follow-up activities after the trip.

Teaching Suggestions

The standards and benchmarks of the Sunshine State Standards are the heart of the curriculum frameworks and reflect Florida's efforts to reform and enhance education. The following pages provide samples of ways in which students could demonstrate achievements of specific benchmarks through the study of Earth/Space Science.

The Nature of Matter

1. Have students determine the density of common solids, liquids, and gases, compare their values, and report findings. (SC.A.1.4.2.a)

2. Have students grow crystals, observe them under a microscope, and work with others to create models of the crystalline structure. (SC.A.1.4.5.a)

Energy

Have students design, conduct, and report on an experiment to determine the effect of several variables on home or school use of electricity. (SC.B.1.4.1.a)

Force and Motion

Have students calculate and report the acceleration and motion of several different objects when released from the same position. (SC.C.2.4.1.a)

Processes That Shape the Earth

1. Have students create climatograms and explain why major biomes exist. (SC.D.1.4.1.a)

2. Have students explain how and why the appearance of the surface of Earth is changing. (SC.D.1.4.2.a)

3. In small groups with other students, have students determine the density and porosity of common rocks found in the crust (e.g., granite, basalt, sandstone, and limestone) and explain the significance of their crustal positions. (SC.D.1.4.2.b)

4. Have students develop models that explain the theories of how continents are assembled, altered, and changed over vast amounts of time. (SC.D.1.4.2.c)

5. Have students compare and describe methods for determining the ages of organic materials. (SC.D.1.4.3.a)

6. Have students design a flow chart or other mechanism to show how one change in a system, such as the advent of an ice age or the emergence of a new mountain range, causes changes in other systems. (SC.D.1.4.4.a)

7. In small groups with other students, have students develop skits, infomercials, and presentations to governing institutions where laws and decisions are made to describe the systems on Earth and how the decisions made about these systems affect the quality of life on Earth. (SC.D.2.4.1.a)

Earth and Space

1. Have students graph the changes in tide height in relation to time to determine the relationship between phases and positions of the moon, and the times of spring and neap tides. (SC.E.1.4.1.a)

2. Have students calculate and report the amount of time needed to travel from one planet to another and to our moon. (SC.E.1.4.1.b)

3. Have students construct a scale diagram of the orbital diameters of the planets that show the distances and diameters of the planets and their moons in relative units. (SC.E.1.4.1.c)

4. Have students use a model designed by a computer program to describe and compare the characteristics of the planets and their satellites. (SC.E.1.4.2.a)

5. Have students identify the properties of Earth that make it capable of supporting life and explain why it is necessary to understand systems that support life. (SC.E.1.4.3.a)

6. Have students explain the evolution of solar-mass-type stars from the protostar stage to the black dwarf stage. (SC.E.2.4.1.a)

7. Have students discuss the likelihood of intelligent extraterrestrial life and make predictions on the probability that, given the vast distances involved, such life might communicate with beings on Earth. (SC.E.2.4.2.a)

8. Have students describe the galactic system of the universe as it is understood. (SC.E.2.4.2.b)

9. Have students calculate the amount of Earth time needed to travel from one planet to another in our solar system, given pertinent data. (SC.E.2.4.3.a)

10. Have students research and report on the balance between the explosive force of a star, its nuclear fusion, and the implosive force of its gravity. (SC.E.2.4.4.a)

11. Have students debate various theories of the formation of the universe. (SC.E.2.4.5.a)

12. Have students compare the data-collecting abilities of the Hubble Space Telescope and Advanced X-ray Astronomy Facility and describe the data that each generate. (SC.E.2.4.6.a)

13. Have students use computer simulations with mathematical models to study data about the universe that has been collected by telescopes. (SC.E.2.4.7.a)

How Living Things Interact with Their Environment

1. Have students in small groups build an artificial coal bed in the laboratory, subject it to heat and pressure, measure the amount of energy stored with a bomb calorimeter, and report on the processes used and the findings. (SC.G.2.4.1.a)

2. Have students use two or more data sources to conduct an environmental impact study of a local region and report on the findings. (SC.G.2.4.2.a)

3. Have students prepare climatograms and compare these with graphs depicting diversity. (SC.G.2.4.4.a)

4. Have students use native plants to explain regional climate and geography. (SC.G.2.4.4.b)

5. Have students participate in role playing and/or case studies involving the consequences of human impact on the environment, presenting evidence supporting or refuting both sides of environmental conservation and economic-development issues. (SC.G.2.4.6.a)

6. Have students research and role-play activities that allow the development of a sense of responsibility for future generations to conserve what's left of Earth's natural resources. (SC.G.2.4.6.b)

7. Have students determine cause-and-effect relationships (e.g., predator/prey or climate/population), while tracing the flow of energy and the cycling of matter through the food web, and predict the impact of introducing new species into an ecosystem, given the populations and other pertinent data about an ecosystem. (SC.G.2.4.6.c)

The Nature of Science

1. Have students formulate a testable hypothesis supported by the knowledge and understanding generated by an experiment. (SC.H.1.4.1.a)

2. Have students engage in a debate on changes and continuity that are persistent features of science. (SC.H.1.4.2.a)

3. Have students compare closely aligned theories and identify ways to test the validity of these theories. (SC.H.1.4.3.a)

4. Have students review scientific publications on a topic, identify the conclusions of the researcher in the articles cited, and compare the findings of these different investigations. (SC.H.1.4.4.a)

5. Have students discuss the big new ideas in science today and trace their origins and developments. (SC.H.1.4.5.a)

6. Have students select and describe several scientific theories that were ridiculed as preposterous by some but are now supported with convincing evidence. (SC.H.1.4.6.a)

7. Have students review and edit the laboratory reports of peers. (SC.H.1.4.7.a)

8. Have students develop and record in a journal alternative interpretations based upon experimental evidence collected. (SC.H.2.4.1.a)

9. Have students describe scientists' efforts to predict the weather using computer modeling of weather conditions. (SC.H.2.4.2.a)

10. Have students use a computerized architectural design (CAD) program to determine the stress on bridge supports. (SC.H.3.4.1.a)

11. Have students compare the problems that had to be solved to make the first airplane flights with the problems that had to be solved to make airplanes fly faster than the speed of sound. (SC.H.3.4.2.a)

12. Have students review and discuss the efforts of scientists over the past three centuries to inform the public about environmental, political, and economic consequences of population growth. (SC.H.3.4.3.a)

13. Have students select one science topic that is actively being researched and determine the sources of funding for the research and who will benefit from new discoveries. (SC.H.3.4.4.a)

14. Have students compare the communication methods people use in cities of Bombay, Sao Paolo, and New York. (SC.H.3.4.5.a)

15. Have students identify practical problems solved with technology and describe the effect of the solutions on human values. (SC.H.3.4.6.a)

Accommodations/Modifications for Students

The following accommodations/modifications may be necessary for students with disabilities and other students with diverse learning needs to be successful in school and in any other setting. Specific strategies may be incorporated into each student's individual educational plan (IEP), 504 plan, or academic improvement plan (AIP) as deemed appropriate.

Environmental Strategies

Provide preferential seating. Seat student near someone who will be helpful and understanding.
Assign a peer tutor to review information or explain again.
Build rapport with student; schedule regular times to talk.
Reduce classroom distractions.
Increase distance between desks.
Allow student to take frequent breaks for relaxation and small talk, if needed.
Accept and treat the student as a regular member of the class. Do not point out that the student is an ESE student.
Remember that student may need to leave class to attend the ESE support lab.
Additional accommodations may be needed.

Organizational Strategies

Help student use an assignment sheet, notebook, or monthly calendar.
Allow student additional time to complete tasks and take tests.
Help student organize notebook or folder.
Help student set timelines for completion of long assignments.
Help student set time limits for assignment completion.
Ask questions that will help student focus on important information.
Highlight the main concepts in the book.
Ask student to repeat directions given.
Ask parents to structure study time. Give parents information about long-term assignments.
Provide information to ESE teachers and parents concerning assignments, due dates, and test dates.
Allow student to have an extra set of books at home and in the ESE classroom.
Additional accommodations may be needed.

Motivational Strategies

Encourage student to ask for assistance when needed.
Be aware of possibly frustrating situations.
Reinforce appropriate participation in your class.
Use nonverbal communication to reinforce appropriate behavior.
Ignore nondisruptive inappropriate behavior as much as possible.
Allow physical movement (distributing materials, running errands, etc.).
Develop and maintain a regular school-to-home communication system.
Encourage development and sharing of special interests.
Capitalize on student's strengths.
Provide opportunities for success in a supportive atmosphere.
Assign student to leadership roles in class or assignments.
Assign student a peer tutor or support person.
Assign student an adult volunteer or mentor.
Additional accommodations may be needed.

Presentation Strategies

Tell student the purpose of the lesson and what will be expected during the lesson (e.g., provide advance organizers).
Communicate orally and visually, and repeat as needed.
Provide copies of teacher's notes or student's notes (preferably before class starts).
Accept concrete answers; provide abstractions that student can handle.
Stress auditory, visual, and kinesthetic modes of presentation.
Recap or summarize the main points of the lecture.
Use verbal cues for important ideas that will help student focus on main ideas. ("The next important idea is....")
Stand near the student when presenting information.
Cue student regularly by asking questions, giving time to think, then calling student's name.
Minimize requiring the student to read aloud in class.
Use memory devices (mnemonic aids) to help student remember facts and concepts.
Allow student to tape the class.
Additional accommodations may be needed.

Curriculum Strategies

Help provide supplementary materials that student can read.
Provide *Parallel Alternative Strategies for Students* (*PASS*) materials.
Provide partial outlines of chapters, study guides, and testing outlines.
Provide opportunities for extra drill before tests.
Reduce quantity of material (reduce spelling and vocabulary lists, reduce number of math problems, etc.).
Provide alternative assignments that do not always require writing.
Supply student with samples of work expected.
Emphasize high-quality work (which involves proofreading and rewriting), not speed.
Use visually clear and adequately spaced work sheets. Student may not be able to copy accurately or fast enough from the board or book; make arrangements for student to get information.
Encourage the use of graph paper to align numbers.
Specifically acknowledge comments to correct responses on written and verbal class work.
Allow student to have sample or practice test.
Provide all possible test items to study and then student or teacher selects specific test items.
Provide extra assignment time.
Accept some homework papers dictated by the student and recorded by someone else.
Modify length of outside reading.
Provide study skills training and learning strategies.
Offer extra study time with student on specific days and times.
Allow study buddies to check spelling.
Allow use of technology to correct spelling.
Allow access to computers for in-class writing assignments.
Allow student to have someone edit papers.
Allow student to use fact sheets, tables, or charts.
Tell student in advance what questions will be asked.
Color code steps in a problem.
Provide list of steps that will help organize information and facilitate recall.
Assist in accessing taped texts.
Reduce the reading level of assignments.
Provide opportunity for student to repeat assignment directions and due dates.
Additional accommodations may be needed.

Testing Strategies

Allow extended time for tests in the classroom and/or in the ESE support lab.
Provide adaptive tests in the classroom and/or in the ESE support lab (reduce amount to read, cut and paste a modified test, shorten, revise format, etc.).
Allow open book and open note tests in the classroom and/or ESE support lab.
Allow student to take tests in the ESE support lab for help with reading and directions.
Allow student to take tests in the ESE support lab with time provided to study.
Allow student to take tests in the ESE support lab using a word bank of answers or other aid as mutually agreed upon.
Allow student to take tests orally in the ESE support lab.
Allow the use of calculators, dictionaries, or spell checkers on tests in the ESE support lab.
Provide alternative to testing (oral report, making bulletin board, poster, audiotape, demonstration, etc.).
Provide enlarged copies of the answer sheets.
Allow copy of tests to be written upon and later have someone transcribe the answers.
Allow and encourage the use of a blank piece of paper to keep pace and eliminate visual distractions on the page.
Allow use of technology to correct spelling.
Provide alternate test formats for spelling and vocabulary tests.
Highlight operation signs, directions, etc.
Allow students to tape-record answers to essay questions.
Use more objective items (fewer essay responses).
Give frequent short quizzes, not long exams.
Additional accommodations may be needed.

Evaluation Criteria Strategies

Student is on an individualized grading system.
Student is on a pass or fail system.
Student should be graded more on daily work and notebook than on tests (e.g., 60 percent daily, 25 percent notebook, 15 percent tests).
Student will have flexible time limits to extend completion of assignments or testing into next grading period.
Additional accommodations may be needed.

Internet Site Suggestions

The following is a listing of suggested Internet sites for each unit in *Earth/ Space Science*. These sites may be used to expand and enrich student involvement. For example, sites may be used to stimulate discussion on research or to develop a scavenger hunt for current events. (Teachers should visit sites beforehand to verify the site address has not changed and contains appropriate information.)

Unit 1: Introduction to the Scientific Processes

National Geographic
http://www.nationalgeographic.com/kids/index.html

Hubble Space Telescope Current Images
http://www.yahoo.com/Science/Space/Satellites/Missions/Telescopes/Hubble_Space_Telescope/

The Why Files - Why do certain phenomena happen?
http://whyfiles.news.wisc.edu/

CNN Current Science and Technology Happenings
http://www.cnn.com/TECH/

NASA Science Links and Current Happenings
http://imagine.gsfc.nasa.gov/docs/science/science.html

The Weather Channel - current severe weather information - good for hurricanes and other natural disasters
http://www.weather.com

Unit 2: Map Reading

Map Quest - creates maps of areas and distances between points
http://www.mapquest.com/

Yahoo Maps
http://b1.maps.yahoo.com/py/maps.py

Xerox PARC - map viewer creates maps of any area
http://mapweb.parc.xerox.com.map/

Quick Maps of The World - good for geography and geological features
http://www.theodora.com/maps/abc_world_maps.html

Map Projections - good explanations of how maps are made and why certain projection are better for different uses
http://everest.hunter.cuny.edu/mp/

ETAK Guide - uses Global Positioning System (GPS) technology to locate and zoom in on locations
http://www.etakguide.com/

Unit 3: The Universe and the Solar System

Views of the Solar System
http://www.hawastsoc.org/solar/homepage.htm

NASA Hubble Space Telescope
http://www.yahoo.com/Science/Space/Satellites/Missions/Telescopes/Hubble_Space_Telescope/

Windows to the Universe
http://www.windows.umich.edu/

NASA for Kids
http://kids.mtpe.hq.nasa.gov/

Nine Planets - a multimedia tour of the solar system
http://www.seds.org/billa/tnp/

Imagine the Universe
http://imagine.gsfc.nasa.gov/docs/homepage.html

Unit 4: The Earth, the Moon, and the Sun

Eclipse Tutorial
http://www.earthview.com/tutorial/tutorial.htm

SKY Online's Eclipse Page - includes dates of eclipses and safety information
http://www.skypub.com/eclipses/eclipses.shtml

Sunrise, Sunset, Moonrise, Moonset and Phases of the Moon Data from the Navy
http://aa.usno.navy.mil/AA/data/

WWW Tide and Current Predictor
http://tbone.biol.sc.edu/tide/sitesel.html

Tidal Information Page
http://www.catalina.org/goodies/tides.htm

Introductory Eclipse Tutorial
http://www.earthview.com/tutorial/tutorial.htm

Solar Eclipse - the Path of Totality
http://www.exploratorium.edu/eclipse/

Lunar Eclipses
http://www.eso.org/outreach/spec-prog/aol/market/collaboration/luneclipse/

A Virtual Tour of the Sun
http://www.astro.uva.nl/michielb/od95/

Lunar Exploration
http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo_25th.html

Geologic History of the Moon
http://www.media.wright.edu/studorgs/lunar/moonhi~1.htm

Unit 5: Space Exploration

NASA Shuttle Web
http://shuttle.nasa.gov/index.html/

The Space Experience - a guide to past and future space missions
http://www.geocities.com/CapeCanaveral/Hangar/5816/

Kennedy Space Center
http://www.ksc.nasa.gov/

NASA Web Site
http://www.nasa.gov/

NASA Online Resources for Educators
http://www.hq.nasa.gov/office/codef/education/online.html

NASA Classroom of the Future
http://www.cotf.edu/

NASA Observatorium
http://observe.ivv.nasa.gov/nasa/core.shtml

NASA Observatorium Human Spaceflight
http://observe.ivv.nasa.gov/nasa/spacefly/spacefly_index.shtml

Project Gemini
http://www.ksc.nasa.gov/history/gemini/gemini.html

Project Mercury
http://www.ksc.nasa.gov/history/mercury/mercury.html

Eye on the Universe - A Hubble Mission
http://www.thetech.org/hyper/hubble/

Hitchhiker's Guide to Hubble
http://www.discovery.com/area/specials/hubble/hubble1.html

Star Journey from National Geographic
http://www.nationalgeographic.com/features/97/stars/

Space Telescope Science Institute
http://www.stsci.edu/

Satellite Passes - shows positions of current satellites and orbiters over the United States
http://www.bester.com/satpasses.html

GOES Project Science
http://climate.gsfc.nasa.gov/~chesters/goesproject.html

The Satellite Site - What is a satellite? Build one on the Internet.
http://www.thetech.org/hyper/satellite/

Unit 6: Rocks and Minerals

Minerals and Gemstone Kingdom - reference on rocks, minerals, and gemstones allows you to sort minerals by characteristics (color, streak, hardness, etc.)
http://www.minerals.net/

Mineralogy Database - also classified by mineral characteristics and A-Z
http://web.wt/~daba/Mineral/

Atlas of Igneous and Metamorphic Rocks and Minerals
http://www.geolab.unc.edu/Petunia/IgMetAtlas/mainmenu.html

Unit 7: Mountains

Himalayas: Where Earth Meets the Sky - student award winning project
http://library.advanced.org/10131/

Rocky Mountain National Park
http://estes.on-line.com/rmnp/

Try searching for other mountain ranges for specific sites.

Unit 8: Plate Tectonics

Current Earthquake Data - lists current earthquakes and data for current and previous year
http://wwwneic.cr.usgs.gov/current_seismicity.shtml

The Dynamic Earth - a full text from USGS
http://pubs.usgs.gov/publications/text/dynamic.html

Earthquakes and Plate Tectonics
http://wwwneic.cr.usgs.gov/neis/plate_tectonics/rift_man.html

Activities for Teaching Plate Tectonics - all grade levels
http://volcano.und.nodak.edu/vwdocs/vwlessons/plate_tectonics/plate_activities.html

Volcano World References - from University of North Dakota
http://volcano.und.nodak.edu/vw.html

Tectonic Plate Motion - tracks current plate movements
http://cddis.gsfc.nasa.gov/926/slrtecto.html

San Andreas Fault Field trip
http://emerald.ucsc.edu/~es10/fieldtripSAF/SAF.html

Big Trouble in Earthquake Country - estimate damage in hypothetical earthquakes
http://www.lhs.berkeley.edu/SII/SII-eqcountry/5eqcountry.homepage.html

Earthquake Report from New Scientist
http://quakes.newscientist.com/

United States Geological Survey's Earthquake Bulletin Web site
http://geology.usgs.gov/quake.shtml

Tsunami: The Big Wave - from NASA
http://observe.ivv.nasa.gov/nasa/exhibits/tsunami/tsun_bay.html

The Electronic Volcano - information and images of current active volcanoes
http://www.dartmouth.edu/~volcano/

Volcanoes of the World - volcanoes on Earth and evidence on other planets
http://volcano.und.nodak.edu/volc_of_world.html

Ocean Floor Databases - images and maps of ocean ridges
http://imager.ldeo.columbia.edu/

Marine Geology Resources
http://www.ngdc.noaa.gov/mgg/mggd.html

Unit 9: Geologic History and Fossils

Dinosaurs
http://www.ucmp.berkeley.edu/diapsids/dinosaur.html

Dinosaur Trace Fossils
http://www.emory.edu/GEOSCIENCE/HTML/Dinotraces.htm

Extinction Theories
http://www.execpc.com/~maas/extinction/

Rebuilding the Lost World
http://www.sciam.com/explorations/070196explorations.html

UCMP Web Time Machine
http://www.ucmp.berkeley.edu/help/timeform.html

Geological History of Florida
http://www.dep.state.fl.us/geo/geohist.html

The Geologic History of the Southeastern United States
http://www.dep.state.fl.us/geo/geohist.html

Trilobites
http://www.trilobites.com/

Fossil Vertebrates at the Burke Museum
http://weber.u.washington.edu/~vertp/BurkeVertPage.html

Ice Age Explanation
http://culter.colorado.edu:1030/~saelias/glacier.html

Fossils of the La Brea Tar Pits Ice Age Fossils
http://www.lam.mus.ca.us/page/exhibits/fossils/

Illinois State Museum Ice Age Exhibit
http://www.museum.state.il.us/exhibits/larson/environments.html

Unit 10: The Water Cycle

What is Groundwater?
http://www.dep.state.fl.us/rules/grndwtr.html

USGS Fact Sheet Florida Wetlands
http://marine.usgs.gov/fact-sheets/FLAwetlands/

State of Florida Wetlands
http://www.dep.state.fl.us/water/Slerp/pds/fsewet.htm

Sinkholes
http://www.dep.state.fl.us/geo/sinkhole.html

SPLASH - Water Resource Education from DEP
http://www.dep.state.fl.us/swfwmd/splash/splash.html

America's Wetlands
http://www.epa.gov/OWOW/wetlands/vital/toc.html

Basic Ground Water Hydrology
http://www.issaquah.org/COMORG/gwac/Hydro.htm

Everglades Information Network
http://everglades.fiu.edu/

Unit 11: Rivers

Wild and Scenic Rivers
http://www.nps.gov/rivers/

Water Resources in the United States
http://water.usgs.gov/

Water Resources of Florida (main office in Tallahassee)
http://fl-water.usgs.gov/

Mississippi River Road Map
http://www.mississippi-river.com/

Unit 12: Glaciers

GLACIER Project - from Antarctica
http://www.glacier.rice.edu/

Glacier Bay National Park - Alaska
http://www.nps/glba/

Fire and Ice - Blackcomb Glacier - excellent site for formation of glaciers and glacial interactions
http://www.whistler.net/glacier/index.html

Unit 13: Weathering and Erosion

The Problem of Wind Erosion
http://www.weru.ksu.edu/problem.html

Smithsonian Exhibit on the Dust Bowl
http://drylands.nasm.edu:1995/bowl.html

Wind Erosion Student Activity
http://www.soest.hawaii.edu/spacegrant/class_acts/Wind.html

Soil Teaching Activities
http://www.agri.upm.edu.my/jst/soilinfo.html

Weathering Vocabulary
http://bellnet.tamu.edu/res_grid/cuedwe17.htm

Weathering Activities
http://www.hintze-online.com/sos/soils-online.html#41

Unit 14: The Atmosphere and the Weather

The Weather Channel
http://www.weather.com

The Weather Classroom
http://www.weather.com/education/wx_class/introduction.html

Yahoo! Weather
http://weather.yahoo.com/

NOAA - National Weather Service - from Tallahassee
http://www.nws.fsu.edu/

Intellicast Weather
http://www.intellicast.com

Hurricane Center - Miami
http://www.nhc.noaa.gov

Hurricane Hunters
http://www.hurricanehunters.com

Florida State University Meteorology Department - Florida EXPLORES Project - all types of weather and climate data
http://www.met.fsu.edu/explores/

Internet Weather Sites
http://www.state.fl.us/comaff/DEM/BPR/EMTOOLS/wx.htm

GOES Project - Weather Satellite Forecasting
http://rsd.gsfc.nasa.gov/goesb/chesters/web/goesproject.html

Climate Related Web Sites from NOAA
http://www.ogp.noaa.gov/OGPFront/clmtsites.html

National Oceanographic and Atmospheric Administration
http://www.noaa.gov

Severe Weather Safety Guide
http://www.nssl.noaa.gov/~nws/safety.html

Blue Skies - Interactive JAVA Weather
http://cirrus.sprl.umich.edu/javaweather/

Atmospheric Ozone
http://uarsfot08.gsfc.nasa.gov/HP_THEME/Ozone_Topic/Stat_Ozone

Unit 15: Energy Sources

Energy Quest
http://www.energy.ca.gov/education/index.html

Super Scientists - A Gallery of Energy Pioneers
http://www.energy.ca.gov/education/scientists/index.html

Hydroelectric Power
http://www.ilstu.edu/~kkkuzer/hydro.html

Department of Energy - Office of Fossil Energy
http://www.fe.doe.gov/

Frontline: Nuclear Power - Why do Americans fear nuclear energy?
http://www.pbs.org/wgbh/pages/frontline/shows/reaction/

Nuclear Energy Institute
http://www.nei.org/

One World Guide to Energy - information on all types of energy and problems associated with them
http://www.oneworld.org/energy/

Department of Energy Geothermal Energy Site
http://DOEGeothermal.inel.gov/

Unit 16: Our Environment

United States Environmental Protection Agency
http://www.epa.gov

Florida Department of Environmental Protection
http://www.dep.state.fl.us/index.html

Florida - State of the Environment: Wetlands
http://www.dep.state.fl.us/water/Slerp/pds/fsewet.htm

Florida DEP - Environmental Education
http://www.dep.state.fl.us/enved/

ABCs of Acid Rain
http://qlink.queensu.ca/~4lrm4/table.htm

Ocean Planet: Oil Pollution
http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/peril_oil_pollution.html

Department of Energy - Energy Efficiency and Renewable Energy Network - student information
http://www.eren.doe.gov/kids.html

Recycle City
http://www.epa.gov/recyclecity/

Quest of the Ring Leaders - an interactive game about marine entanglement and problems associated with entrapment by six-pack rings
http://www.ringleader.com/quest/welcome.html

Recycling Ideas - for all types of items
http://www.geocities.com/RainForest/5002/index.html

Atmospheric Ozone
http://uarsfot08.gsfc.nasa.gov/HP_THEME/Ozone_Topic/Stat_Ozone

Correlation to Sunshine State Standards

Course Requirements for Earth/Space-Course Number 2001310

These requirements include, but are not limited to, the benchmarks from the Sunshine State Standards that are most relevant to this course. Benchmarks correlated with a specific course requirement may also be addressed by other course requirements. Benchmarks from Science, Strand H, should not be taught and assessed in isolation, but should be combined with other benchmarks listed for this course.

1. Use scientific methods to solve problems and demonstrate safe and effective use of laboratory instruments.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.H.1.4.1	Know that investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories.	1	
SC.H.1.4.2	Know that from time to time, major shifts occur in the scientific view of how the world works, but that more often, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.	1	—
SC.H.1.4.3	Understand that no matter how well one theory fits observations, a new theory might fit them as well or better, or might fit a wider range of observations, because in science, the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not to absolute truth.	1	
SC.H.1.4.4	Know that scientists in any one research group tend to see things alike and that therefore scientific teams are expected to seek out the possible sources of bias in the design of their investigations and in their data analysis.	1	
SC.H.1.4.5	Understand that new ideas in science are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from unexpected findings, and usually grow slowly from many contributors.	1	
SC.H.1.4.6	Understand that in the short run, new ideas that do not mesh well with mainstream ideas in science often encounter vigorous criticism and that in the long run, theories are judged by how they fit with other theories, the range of observations they explain, how well they explain observations, and how effective they are in predicting new findings.	1	
SC.H.1.4.7	Understand the importance of a sense of responsibility, a commitment to peer review, truthful reporting of the methods and outcomes of investigations, and making the public aware of the findings.	1	
SC.H.2.4.1	Know that scientists assume that the universe is a vast system in which basic rules exist that may range from very simple to extremely complex but that scientists operate on the belief that the rules can be discovered by careful, systemic study.	3	

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Correlation to Sunshine State Standards

Course Requirements for Earth/Space-Course Number 2001310

2. Contrast scientific theories of the formation of the universe and the solar system.			
Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.B.2.4.1	Know the universe is the result of interactions involving fundamental particles (matter) and basic forces(energy) and that evidence suggests that the universe contains all of the matter and energy that ever existed.	3	
SC.C.2.4.1	Know that acceleration due to gravitational force is proportional to mass and inversely proportional to the square of the distance between the objects	3	
SC.E.2.4.2	Identify the arrangement of bodies found within and outside our galaxy.	3	
SC.E.2.4.3	Know astronomical distance and time.	3	
SC.E.2.4.4	Understand stellar equilibrium.	1	
SC.E.2.4.5	Know various scientific theories on how the universe was formed.	3	
SC.E.2.4.6	Know the various ways in which scientists collect and generate data about our universe (e.g., X-ray telescopes, computer simulations of gravitational systems, nuclear reactions, space probes, and supercollider simulations).	3	
SC.E.2.4.7	Know that mathematical models and computer simulations are used in studying evidence from many sources to form a scientific account of the universe.	1	
SC.H.2.4.1	Know that scientists assume that the universe is a vast system in which basic rules exist that may range from very simple to extremely complex but that scientists operate on the belief that the rules can be discovered by careful, systemic study.	3	
SC.H.2.4.2	Know that scientists control conditions in order to obtain evidence, but when that is not possible for practical or ethical reasons, they try to observe a wide range of natural occurrences to discern patterns.	1	

Correlation to Sunshine State Standards
Course Requirements for Earth/Space-Course Number 2001310

3. Describe the developmental cycles of stars.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.E.2.4.1	Know that the stages in the development of three categories of stars are based on mass: stars that have the approximate mass of our Sun, stars that are two- to three-stellar masses and develop into neutron stars, and stars that are five- to six-stellar masses and develop into black holes.	3	

4. Analyze Earth, moon, and sun relationships as they apply to time and seasons.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.E.1.4.1	Understand the relationships between events on Earth and the movements of Earth, its moon, the other planets, and the sun.	4	
SC.E.1.4.2	Know how the characteristics of other planets and satellites are similar to and different from those of Earth.	3, 4	
SC.E.1.4.3	Know the various reasons that Earth is the only planet in our Solar System that appears to be capable of supporting life as we know it.	4	

5. Identify and classify rocks and minerals.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.A.1.4.2	Know that the vast diversity of the properties of materials is primarily due to variations in the forces that hold molecules together.	6	
SC.A.1.4.5	Know that connections (bonds) form between substances when outer-shell electrons are either transferred or shared between their atoms, changing the properties of substances.	6	
SC.D.1.4.3	Know that changes in Earth's climate, geological activity, and life forms may be traced and compared.	6	

Correlation to Sunshine State Standards

Course Requirements for Earth/Space-Course Number 2001310

6. Describe crustal movements and their effects, the formation of land masses, and basic mountain types.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.D.1.4.2	Know that the solid crust of Earth consists of slow-moving, separate plates that float on a denser, molten layer of Earth and that these plates interact with each other, changing the Earth's surface in many ways (e.g., forming mountain ranges and rift valleys, causing earthquake and volcanic activity, and forming undersea mountains that can become ocean islands).	7, 8	

7. Describe the changes that occur over time in different Earth system processes.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.D.1.4.3	Know that changes in Earth's climate, geological activity, and life forms may be traced and compared.	9	
SC.E.1.4.2	Know that Earth's systems and organisms are the result of a long, continuous change over time.	9	
SC.E.1.4.3	Know that layers of energy-rich organic materials have been gradually turned into great coal beds and oil pools (fossil fuels) by the pressure of the overlying earth and that humans burn fossil fuels to release the stored energy as heat and carbon dioxide.	15	
SC.G.2.4.6	Know the ways in which humans today are placing their environmental support systems at risk (e.g., rapid human population growth, environmental degradation, and resource depletion).	16	

Correlation to Sunshine State Standards

Course Requirements for Earth/Space-Course Number 2001310

8. Describe and interpret types of erosion with emphasis on soil types, glaciation, ocean currents, and weather patterns.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.B.1.4.1	Understand how knowledge of energy is fundamental to all the scientific disciplines (e.g., the energy required for biological processes in living organisms and the energy required for the building, erosion, and rebuilding of Earth).	13	
SC.D.1.4.1	Know how climatic patterns on Earth result from an interplay of many factors (Earth's topography, its rotation on its axis, solar radiation, the transfer of heat energy where the atmosphere interfaces with lands and oceans, and wind and ocean currents).	8, 13, 14	
SC.D.1.4.3	Know that changes in Earth's climate, geological activity, and life forms may be traced and compared.	8, 13	

9. Assess renewable and nonrenewable earth resources.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.G.2.4.1	Know that layers of energy-rich organic materials have been gradually turned into great coal beds and oil pools (fossil fuels) by the pressure of the overlying earth and that humans burn fossil fuels to release the stored energy as heat and carbon dioxide.	15	
SC.G.2.4.2	Know that changes in a component of an ecosystem will have unpredictable effects on the entire system but that the components of the system tend to react in a way that will restore the ecosystem to its original condition.	16	

Correlation to Sunshine State Standards
Course Requirements for Earth/Space-Course Number 2001310

10. Interpret and develop topographic, geologic, and weather maps.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.D.1.4.3	Know that changes in Earth's climate, geological activity, and life forms may be traced and compared.	2	

11. Describe how earth/space sciences interact with technology and society.

Benchmarks		Addressed in Unit(s)	Addressed in Class on Date(s)
SC.D.2.4.1	Understand the interconnectedness of the systems on Earth and the quality of life.	15, 16	
SC.G.2.4.4	Know that the world ecosystems are shaped by physical factors that limit their productivity.	13	
SC.H.3.4.1	Know that performance testing is often conducted using small-scale models, computer simulations, or analogous systems to reduce the chance of system failure.	1	
SC.H.3.4.2	Know that technological problems often create a demand for new scientific knowledge and that new technologies make it possible for scientists to extend their research in a way that advances science.	1	
SC.H.3.4.3	Know that scientists can bring information, insights, and analytical skills to matters of public concern and help people understand the possible causes and effects of events.	15, 16	
SC.H.3.4.4	Know that funds for science research come from federal government agencies, industry, and private foundations and that this funding often influences the areas of discovery.	5	
SC.H.3.4.5	Know that the value of a technology may differ for different people and at different times.	5	
SC.H.3.4.6	Know that scientific knowledge is used by those who engage in design and technology to solve practical problems, taking human values and limitations into account.	1, 5	

References

Alexander, Peter, et al. *Earth Science*. Morristown, NJ: Silver, Burdette, and Ginn, 1987.

Barnes-Svarsey, Patricia, ed. *The New York Public Library Science Desk Reference*. New York: Stonesong Press Incorporated and the New York Public Library, 1995.

Bledsoe, Lucy Jane. *General Science*. Paramus, NY: Globe Fearon Educational Publisher, 1994.

DiSpezio, Michael, et al. *Science Insights: Exploring Earth and Space*. New York: Addison-Wesley, 1996.

Florida Department of Education. *Florida Course Descriptions*. Tallahassee, FL: State of Florida, 1998.

Florida Department of Education. *Florida Curriculum Framework: Science*. Tallahassee, FL: State of Florida, 1996.

Fonk, Robert H. and Linda B. Knight. *Earth Science*. New York: Holt, Rinehart, and Winston, 1994.

Hesser, Date T. and Susan S. Leach. *Focus on Earth Science*. Columbus, OH: Merrill, 1989.

Namowitz, Samuel N. and Nancy E. Spaulding. *Earth Science*. Lexington, MA: D. C. Heath, 1994.

Otto, James H. and Albert Towle. *Modern Biology*. New York: Holt, Rinehart, and Winston, 1985.

Pasachoff, Jay M., Naomi and Timothy M. Cooney. *Earth Science*. Glenview, IL: Scott Foresman, 1986.

Ramsey, William L., et al. *Modern Earth Science*. New York: Holt, Rinehart, and Winston, 1998.

Stevenson, L. Harold and Bruce Wyman, eds. *The Facts on File Dictionary of Environmental Science*. New York: Facts on File, 1991.

Tarbuck, Edward J. and Frederick K. Litgens. *Earth Science*. Columbus, OH: Merrill, 1985.

White, Jo Ann, ed. *The New American Desk Encyclopedia*. New York: Penguin Putnam, 1997.

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Macromedia Freehand 8.0. San Francisco: Macromedia.

Microsoft Word 5.0. Redmond, WA: Microsoft.

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