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ABSTRACT

This curriculum guide, developed to establish statewide curriculum standards for the Louisiana Competency-based Education Program, contains the minimum competencies and process skills that should be included in an earth science course. It consists of: (1) a rationale for an effective science program; (2) a list and description of four major goals of science; (3) a list and description of eight basic process skills (such as predicting and classifying) and five integrated processes (such as controlling variables and defining operationally); and (4) an eight-part curriculum outline. These parts provide performance objectives correlated with a concept, process skill(s), and suggested activities for each of the following major topic areas: five areas of earth science and introduction to scientific processes; atomic structure; physical geology; historical geology; oceanography; meteorology; astronomy; and energy resources. A list of audiovisual suppliers and brief comments on evaluation techniques are also provided. (JN)

STATE OF LOUISIANA
DEPARTMENT OF EDUCATION

EARTH SCIENCE CURRICULUM GUIDE

BULLETIN 1643
1984

Thomas G. Clausen, Ph.D.
Superintendent

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Issued by

Office of Academic Programs

THOMAS G. CLAUSEN, Ph.D.

Superintendent

FOREWORD

Act 750 of the 1979 Louisiana Legislature (R.S. 17:24.4) established the Louisiana Competency-Based Education Program. One of the most important provisions of Act 750 is the mandated development and establishment of statewide curriculum standards for required subjects. These curriculum standards include curriculum guides which contain minimum skills, suggested activities, and suggested materials of instruction.

During the 1979-80 school year, curriculum guides were developed by advisory and writing committees representing all levels of professional education and all geographic areas across the State of Louisiana for the following Science courses: Elementary K-6, Life Science, Earth Science, Physical Science, General Science, Biology, Chemistry, and Physics.

During the 1982-83 school year, the curriculum guides were piloted by teachers in school systems representing the different geographic areas of the State as well as urban, suburban, inner-city, and rural schools. The standard populations involved in the piloting reflect also the ethnic composition of Louisiana's student population. Based upon participants' recommendations at the close of the 1982-83 pilot study, the curriculum guides were revised to ensure that they are usable, appropriate, accurate, comprehensive, relevant, and clear.

Following the mandate of Act 750, the revised curriculum guides will be implemented statewide in the 1984-85 school year. The statewide implementation is not, however, the end of the curricular development process. A continuing procedure for revising and improving curricular materials has been instituted to ensure that Louisiana students have an exemplary curriculum available to them--a curriculum that is current, relevant, and comprehensive. Such a curriculum is essential if we are to provide the best possible educational opportunities for each student in the public schools of Louisiana.

Thomas G. Clausen

Thomas G. Clausen, Ph.D.

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PREFACE

The Earth Science Curriculum Guide contains the minimum competencies and process skills that should be included in an Earth Science course. Each teacher should build on the foundation of these minimum competencies to establish the maximum program possible for his/her students. The teacher must take special care to incorporate all skills contained in this guide within the framework of his/her instructional program. The guide is flexible enough to be adapted to most of the commercial basal programs; and teachers may adjust the sequence of content based on the needs of their students, the available equipment, and the textbooks.

The guide contains suggested activities designed to assist the teacher in teaching each competency; however, the teacher and the students should not be limited to these activities nor bound to utilize all of them. There are many other activities available to the teacher which will help him/her to present each competency and process skill to the student. It is hoped that the teacher will be resourceful in using many types of experiences to teach the topics listed.

Methods of science instruction, to be most effective, must be based upon the development of process skills in critical thinking. An effort has been made to incorporate numerous process skills in the suggested activities, and the teacher should use as many of these skills as possible in daily instruction.

This curriculum guide should be of special benefit to the teacher in helping to organize the Earth Science course. It is suggested that additional textbooks, workbooks, and laboratory manuals be consulted for activities, demonstrations, and experiments to supplement those described in this curriculum guide.

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RATIONALE

Developments in science technology have improved our way of living and have become a major influence on our culture. No one in our culture escapes the direct influence of science. Because of the impact of science on our social, economic, and political institutions, the education of every responsible citizen must include not only the basic principles of science but also the attitudes and processes of scientific thought.

The nature of science itself determines the way that it should be taught. The definition of science is a two-fold one: It is (1) an unending method or process of seeking new knowledge, and (2) the body of knowledge which results from this search. Science is an intellectual, active process which involves an investigator of any age and something to investigate. The discipline of science taught by the process approach teaches the student how to learn, and that intellectual gain is a permanent one for the student.

The process approach develops the intellectual abilities of students. Some students develop thinking skills in the normal course of growing up in a complex world, but the acquisition of useful skills and attitudes is by no means automatic. Many students succeed in school by repeating what they are told in a slightly different form or by memorizing; such strategies are of little extended value. At present, relatively few students develop persistence in and zest for dealing with new concepts because they are not aware of their intellectual capabilities. Thus, they need literally to experience application of scientific process skills in different situations.

To be most effective, methods of science instruction must be based upon the development of skills in critical thinking. Guided practice in experimenting, observing, gathering information, organizing facts, and drawing conclusions will help to develop critical thinking skills. Laboratory techniques should be employed whenever possible, and inquiry teaching/learning situations using both deductive and inductive reasoning should be the predominant method used in all classroom activities. The teacher's role in a process-oriented science classroom includes being a provider of problems, a discussion leader, a supplier of clues (when necessary), and a skillful questioner, i.e., a facilitator of learning activities. Thus, the aim of an effective science program should be to equip each child with competencies in the basic processes and concepts of science through individual participation in activities and investigations specifically designed to develop such capabilities.

GOALS

Achieving scientific literacy involves the development of attitudes, process skills, concepts, and social aspects of science and technology. Based upon this belief, the following major goals of science are stated:

1. <u>To Foster Positive Attitudes Toward the Scientific Process</u>

   Students will develop a deep appreciation of the role the scientific process plays in their everyday lives.

2. <u>To Develop Process Skills</u>

   Process skills development should be an integral part of science activities for students. Students should be given opportunities to develop those intellectual processes of inquiry and thought by which scientific phenomena are explained, measured, predicted, organized, and communicated.

   <u>Basic Process Skills</u>: Observing, inferring, classifying, using numbers, measuring, using space-time relationships, communicating, predicting.

   <u>Integrated Process Skills</u>: Controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting.

3. <u>To Acquire Knowledge</u>

   Included in the basic science curriculum should be those scientific facts, principles, concepts, and terms which will enable the students to understand and interpret natural phenomena.

   <u>Areas of Knowledge</u>: Life Science, Physical Science, Earth Science.

4. <u>To Recognize Social Aspects of Science and Technology</u>

   The students should (a) understand the interrelationships of science, technology, and social and economic development; and (b) recognize both the limitations and the usefulness of science and technology in advancing human welfare.

PROCESS SKILLS

Eight basic science process skills are stressed: (1) observing, (2) inferring, (3) classifying, (4) using numbers, (5) measuring, (6) using space/time relationships, (7) communicating, and (8) predicting. There is a progressive intellectual development within each process category. A brief description of each basic process skill follows:

OBSERVING: To observe is to use one or more of the five senses to perceive properties of objects or events as they are. Statements about observations should be (1) quantitative where possible, (2) descriptive regarding change(s) and rates of change(s), and (3) free of interpretations, assumptions, or inferences.

INFERRING: To infer is to explain or to interpret an observation. Inferences are statements which go beyond the evidence and attempt to interpret or to explain one or more observations. Inferences are based on (1) observations, (2) reasoning, and (3) past experiences of the observer. Inferences require evaluations and judgments, and they may or may not be accurate interpretations or explanations of the observation.

CLASSIFYING: Classifying is the grouping or ordering of phenomena according to an established scheme. Objects and events may be classified on the basis of observations. Classification schemes are based on observable similarities and differences in arbitrarily selected properties. Classification keys are used to place items within a scheme as well as to retrieve information from a scheme.

USING NUMBERS: To use numbers is to describe the measurement, properties, and relationships of quantities through the use of symbols.

MEASURING: To measure is to find out the extent, size, quantity, capacity, and other properties of a given object, especially by comparison with a standard. Once the concept of measuring is introduced and mastered in first grade, the metric and/or SI system should be used exclusively.

USING SPACE/TIME RELATIONSHIPS: Space/Time relationships is the process that develops skills in the description of spatial relationships and how they change with time. This process skill includes the study of shapes, time, direction, spatial arrangement, symmetry, motion, and rate of change.

COMMUNICATING: To communicate is to pass information along from one person to another. Communications may be verbal, nonverbal (i.e., gestures), written, or pictorial (pictures, maps, charts, and graphs). Communications should be concise, accurate, clear, precise descriptions of what is perceived.

PREDICTING: Predicting is forecasting what future observations might be; it is closely related to observing, inferring, and classifying. The reliability of predictions depends upon the accuracy of past and present observations and upon the nature of the event being predicted.

As basic progressive, intellectual development proceeds in each basic process skill, the interrelated nature of the processes is manifested in the five integrated processes: (1) controlling variables, (2) defining operationally, (3) formulating hypotheses, (4) interpreting data, and (5) experimenting. A brief description of each integrated process skill follows:

CONTROLLING VARIABLES: A variable is any factor in a situation that may change or vary. Investigators in science and other disciplines try to determine what variables influence the behavior of a system by manipulating one variable, called the manipulated (independent) variable and measuring its effect on another variable, called the responding (dependent) variable. As this is done, all other variables are held constant. If there is a change in only one variable and an effect is produced on another variable, then the investigator can conclude that the effect has been brought about by the changes in the manipulated variable. If more than one variable changes, there can be no certainty at all about which of the changing variables causes the effect on the responding variable.

DEFINING OPERATIONALLY: To define operationally is to choose a procedure for measuring a variable. In a scientific investigation, measurements of the variables are made; however, the investigator must decide how to measure each variable. An operational definition of a variable is a definition determined by the investigator for the purpose of measuring the variable during an investigation; thus, different operational definitions of the same variable may be used by different investigators.

FORMULATING HYPOTHESES: To formulate a hypothesis is to make a guess about the relationships between variables. A hypothesis is usually stated before any sensible investigation or experiment is performed because the hypothesis provides guidance to an investigator about the data to collect. A hypothesis is an expression of what the investigator thinks will be the effect of the manipulated variable on the responding variable. A workable hypothesis is stated in such a way that, upon testing, its credibility can be established.

INTERPRETING DATA: The process of interpreting data may include many behaviors such as (1) recording data in a table, (2) constructing bar and line graphs, (3) making and interpreting frequency distributions, (4) determining the median, mode, mean, and range of a set of data, (5) using slope or analytical equations to interpret graphs, and (6) constructing number sentences describing relationships between two variables. Interpreting data requires going beyond the use of skills of tabulating, charting, and graphing to ask questions about the data which lead to the construction of inferences and hypotheses and the collecting of new data to test these inferences and hypotheses. Interpretations are always subject to revision in the light of new or more refined data.

EXPERIMENTING: (Using the scientific method): Experimenting is the process of designing a procedure that incorporates both the basic and integrated process skills. An experiment may begin as a question for the purpose of testing a hypothesis. The basic components of experimenting are as follows:

1. Constructing a hypothesis based on a set of data collected by the person from observations and/or inferences.

2. Performing a test of the hypothesis. The variables must be identified and controlled as much as possible. Data must be collected and recorded.

3. Describing or interpreting how the data support or do not support the hypothesis, i.e., deciding whether the hypothesis is to be accepted, modified, or rejected.

4. Constructing a revised hypothesis if the data do not support the original hypothesis.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
I. INTRODUCTION The student will be able to: 1. Recognize the definition of earth science and identify major areas by matching the areas to their definition.	The five areas of earth 1. Astronomy 2. Meteorology 3. Oceanography 4. Physical Geology 5. Historical Geology	Classifying, communicating science:	1. Write a definition of the five areas of earth science. 2. Teacher will name objects or concepts studied in Earth Science and student will name major area: Example: fossil, star, thunder-storm, volcano, river, sanddune, sponge, dinosaur, cloud, summer, oyster, comet.
2. Identify the scientific processes when given a description of a simple experiment.	Introduction to scientific processes: 1. Problem 2. Hypothesis 3. Experimentation 4. Interpretation and/or conclusion	Observing, inferring, classifying, using numbers, measuring, using space/time relationships, communicating, predicting, formulating hypothesis, interpreting data, experimenting	1. Briefly describe a glacier. Problem: To demonstrate the wearing action of a glacier. Hypothesis: Striae are formed by glaciers moving over rocks. Materials: 1. Metric ruler 2. Fine sand 3. Aluminum foil 4. A box or plastic container about 5 cm. high 5. Water 6. Clay 7. Refrigerator Experimentation: 1. Teacher or student(s) will line a box with aluminum foil. Place some fine sand in the bottom of the box. (Make sure the sand fills the box to a depth of about 1 cm.) Slowly pour water

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			into the box, to about 1 cm. from the top. Let the mixture stand until the sand settles. Put the box in the freezer compartment of the refrigerator. Roll the clay out flat. With the sand side of the block down, run the block over the clay. Record observations. Conclusion: Determine the effect the block had on the clay.
			2. Using 3 beakers of water (one room temperature, one warm, one cold) teacher/student(s) will place a sugar cube into each of the beakers of H_2O. Stir each beaker of water vigorously with stirring rod (same for each) until sugar dissolves the cubes. Measuring rate of time dissolving takes for each cube with stopwatch, etc.
II. ATOMIC STRUCTURE			
3. (A) Diagram a model of an atom; label the proton, neutron, and electron, and recognize their charges. (B) Recognize/differentiate isotopes.	Atomic structure	Communicating, using space/time relationships, using numbers, classifying	1. Activity to reinforce these concepts: Cut out circle representing nuclei of atoms. Place symbols in circle, one for protons and another for neutrons. Have several with the same number of protons, but only a few of these with same number of neutrons. Have students classify them into piles of like elements. Further, have them subdivide these piles into isotopes. Have them state the atomic number and mass number for each pile they have made. Now have them use a periodic table to identify the elements.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
4. Define matter.	Matter	Communicating	1. Draw and label parts of an atom and their electric charges.
5. Recognize that atoms combine to form molecules.	Molecular structure	Communicating	1. Student will diagram various simple molecules. 2. Student will make model of simple molecule using different colored circles of construction paper.
6. Distinguish among elements, compounds, and mixtures.	Elements, compounds, and mixtures	Observing, communicating	1. Given list of substances, student labels each as element, compound, and mixture. 2. Student separates a mixture, e.g., sand and NaCl grains or sulfur and iron filings. Hints to teacher: 1. For sand and NaCl use solution. 2. For S and Fe filings use magnet.
7. Recognize the difference between a physical change and a chemical change.	Physical and chemical changes	Communicating, observing	Given list of changes, student physically changes a piece of limestone* and chemically changes a piece of limestone. See section on chemical and physical weathering. *May use clam shell. Hints to teacher: 1. Physically: Break it. 2. Chemically: Apply HCl or vinegar.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
III. PHYSICAL GEOLOGY			
8. Label the four major layers of the earth (inner core, outer core, mantle, and crust) when given a diagram of a cross section.	Layers of the earth	Observing, inferring, communicating, experimenting, interpreting data, formulating hypothesis, controlling variables	1. Draw and label cross-section of earth; cut a hard boiled egg with shell (or apple) in half and relate to layers of earth. 2. In a beaker, make a density layer model with corn oil, water, and syrup to demonstrate how earth is layered because of density. Give students a solid rubber ball and a hollow plastic ball. Have students experiment with them, make observations, and determine what they can about the inside without seeing it. Note: Teacher may opt to use transparencies in place of #1.
9. Name the three classes of rock: igneous, sedimentary, and metamorphic.	Three types of rock	Classifying, defining operationally	
10. Match the names of the rock classes with their mode of origin.	Rock classification	Classifying, observing, inferring	Given rock samples, student will examine, write observations, note similarities and differences.
11. Tell the classification of each rock when given <u>names</u> of common rocks (e.g., sandstone, limestone, shale, slate, marble, quartzite, granite, obsidian).	Rock classification	Observing, classifying, inferring	Given a group of rocks, students will classify them, first according to a characteristic he chooses, then according to possible origin.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
12. Define and differentiate magma and lava and relate them to igneous rock.	Relation of magma and lava to igneous rock	Defining operationally, inferring	Student will draw and label cross section of volcano showing the conduit to the magma.
13. Relate how cooling rate of magma affects size of crystal in igneous rock.	Crystal size	Observing, using space/time relationships, inferring	In each of three test tubes, place 2 crushed mothballs and 1/3 piece crayon. Heat the test tubes in a beaker of water until mothball/crayon mixture liquifies. Place stoppers the test tubes. Place one in beaker of sand, one in ice water and let one remain cooling in warm water. Set aside overnight. Label tubes according to where cooled. Wrap in towel and crack slightly with hammer. Observe variance in number and size of crystals (with magnifying glass).
14. Explain relationship of radioactive decay and molten rock.	Heat source of molten rock	Observing, communicating	1. Discuss diagram of radioactive decay showing energy and particles being given off. 2. Observation of radioactive material in "cloud chamber" (if available). 3. Expose film with radioactive material.
15. Predict which particle will settle first when given particles of varying size and density.	Sedimentary rocks (sedimentation)	Observing, experimenting, hypothesizing, inferring, using numbers, interpreting data, controlling variables	1. Student will drop grains (or beads) of varying sizes into 1000 ml graduate and record (and graph) settling time. 2. Student will shake one-quart soft drink bottle containing various sizes of grains (silt, filled with water; invert bottle sand, pebbles) and observe settling particles.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
16. Relate materials deposited in the ocean to sedimentary rock formed.	Sedimentary rocks	Observing, communicating	1. Student compares unconsolidated material (clay, sand, gravel) to rock formed of same. 2. Student makes sedimentary rock. Put pebbles into paper cup with holes. Pour mixture of water and glue through cup several times. Let dry. Peel off paper. Show porosity by shoving pipe cleaners between particles.
17. Draw a diagram and explain how rocks change from one form to another.	Rock cycle	Communicating, using space/time relationships	1. Draw diagram of rock cycle. 2. Examine metamorphic pairs: Limestone - Marble Shale - Slate Sandstone - Quartzite 3. Put pennies in a ball of clay. Flatten clay ball and see how pennies line up.
18. Upon examining sample of granite and crushed granite, recognize that rocks are made up of minerals. Explain the relationship of the minerals to the granite.	Rocks are made up of minerals.	Observing, classifying, inferring	Student examines and describes samples of granite and samples of crushed granite. Using a magnifier, the student sorts crushed granite into piles of similar particles. Student describes samples in piles and relates to similar crystal in

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			solid rock. Crushed pieces are identified as minerals. (If students or teacher crush any rock they should wear eye protection.)
19. Recognize and demonstrate how streak, hardness, luster, specific gravity, and cleavage are principal properties useful in describing a mineral (recommended for small group of advanced students).	Mineral identification	Observing, classifying, communicating hypothesizing, interpreting data, controlling variables, experimenting, measuring	Given samples of several common, abundant minerals and a key, student will be able to identify minerals using the above properties and to put his results in chart form.
20. Define topography.	Topography	Communicating	
21. Explain how topography results from rock type, and the opposition of internal and external forces acting on the land surface.	Topography	Communicating	
22. Demonstrate how topographic maps reflect the topography by constructing a simple topographic map from a three-dimensional model.	Topographic maps (contour maps)	Observing, communicating, using space/time relationships, using numbers	1. Draw topographic map using as materials a plastic shoebox, a model volcano, and a grease pencil. Put the model in a box and fill with water to a depth of 1.5 cm. Draw a line around volcano with grease pencil where water touches the side. Add water to 3.0 cm level. Draw line at water line. Repeat with 4.5 cm depth. When box is filled to top, transfer contour from three-dimensional mountain to two-dimensional plastic sheet which is placed on lid of box.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			2. Make relief map (3-D) from simplified topographic map. Cut corrugated cardboard in shape of contours and stack pieces.
23. Identify the hills and choose the least steep path to the top of a hill when given a simple topographic map like the one constructed above.	Topographic maps	Observing, using space/time relationships, using numbers	Construct a topographic profile or profile of the earth's surface across a given line of a simplified topographic map. This shows shape of land.
24. List two types of weathering and recognize them in pictures.	Weathering	Observing, classifying, inferring, hypothesizing	Shake rocks (sandstone and shale work well) in bottles to mechanically (physically) weather them; student puts 200 g fine rock pieces in bottle filled with water. All students shake bottles. Stop at two minute intervals from two to 20 minutes. Quickly pour H_2O from shaken bottle into pill bottle or test tube. Let settle and compare amount of sediment to time shaken; examine environment for examples of weathering. Conduct campus or community excursion to observe effects of weathering.
25. Demonstrate how chemical and physical weathering work together.	Weathering	Observing, inferring, hypothesizing	Place a piece of limestone 1" in diameter in a beaker of diluted HCl, and crushed limestone in another. Compare the speed and amount of disintegration.
26. Relate soil to the weathering process.	Soil	Communicating, defining operationally	

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
27. When given a diagram of a soil profile, recognize it as such; label the layers as topsoil, subsoil, and parent (weathered) rock; and tell in own words why they are different.	Soil profile	Communicating, using space/time relationships, defining operationally, observing, inferring	1. Bore into ground with ship auger (available from hardware store) welded to pipe. Pull out auger and observe soil layers. 2. Dig a hole and observe soil layers.
28. Define permeability.	Permeability	Communicating, observing, inferring, predicting, hypothesizing, using numbers, measuring, interpreting data, operationally defining	Fill a paper cup with gravel, one with sand, one with clay. Punch holes in bottom of cup. Pour water into each cup. Through which does it flow most easily?
29. Define porosity (compare permeability to porosity).	Porosity	Communicating, observing, inferring, predicting, hypothesizing, using numbers, measuring, interpreting data, operationally defining	Fill a beaker with 7 mm plastic beads (or ¼" gravel) and another to the same level with 4mm plastic beads. Fill each beaker with water to the level of the beads. Pour water from each beaker into graduated cylinder. Which held most water? Which had more pore spaces? Hint: Beads may be purchased from arts and crafts store and from some sewing centers.
30. Contrast erosion to weathering.	Erosion vs. weathering	Communicating, using space/time relationships, defining operationally, observing	Campus excursion

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
31. Describe the role of gravity as the force behind erosion.	Gravity in erosion	Communicating, observing	Place dry sand or gravel in small trough. As slope is increased, material will move by force of gravity.
32. Explain how vegetation and type of rock affect rate of weathering.	Factors affecting weathering	Observing, inferring	1. Examine pictures of weathering to see effect of vegetation. 2. Repeatedly drop small amounts of diluted HCl on a piece of limestone plus a piece of granite and record results. Be certain the rock is the only variable. 3. Find an oak tree with roots breaking concrete (good example of physical weathering). Vegetation often speeds weathering but retards erosion. Grass or clover is often planted on slopes to prevent erosion.
33. Identify the three agents of erosion, compare their relative effect, and relate their action to gravity.	Three agents of erosion formation	Observing, communicating, classifying, inferring	1. Student should bring magazine pictures of erosion and label the agent. 2. Given pictures of landscape, student will classify them by agent of erosion. 3. Can make bulletin board or poster from above. 4. Discuss local landscape and its formation.
34. Recognize that glaciers move.	Glacial movement	Observing, inferring, using numbers, using space/time relationships, experimenting, interpreting data, controlling variables	Place some "silly putty" on a board which is inclined at approximately 30° - 45°. Mark the position of the putty. Place a small amount of sand and gravel in front of the putty. Observe 24 hours later and record position of

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			putty. What has happened to sand and gravel? Relate to glaciers. Vary angles; record results.
35. List three of five evidences of glaciation and recognize a line drawing of a glaciated area.	Evidences of glaciation	Observing, communicating	View film: "Evidence of an Ice Age." See Introduction, No. 2, Activity No. 1.
36. State that water is the principal agent of erosion and explain why.	Stream action	Communicating, using space/time relationships	
37. Recognize that material is removed from one place and deposited in another.	Areas of erosion and deposition	Observing, inferring, using space/time relationships, communicating, predicting, formulating hypotheses	Given a stream table or similar container, student will add water and observe material being removed from one area (higher) and deposited in another (lower). Put stream table at an angle. Allow student to hypothesize about what will happen. (Streams do three kinds of work: erosion, transportation, and deposition.)
38. Demonstrate the relationship of increased slope and/or increased velocity to the rate of erosion, given a stream table or similar container.	Effect of slope and velocity on rate of erosion	Observing, inferring, predicting, hypothesizing	Raise end of stream table to increase slope, and note the effect on erosion; increase velocity.
39. Recognize landforms that will result from stream action, e.g., deltas, meanders, flood plains, oxbow lake, cut bank, and sand bars (point bar).	Stream-related landforms	Observing, inferring, predicting, classifying, using space/time relationships, formulating hypotheses	Allow students to simulate these landforms on a stream table. (Use of a topographic quadrangle showing these features will help students recognize them.)
40. Show how forces within the earth cause uplift or mountain building.	Uplift	Using space/time relationships	See folding and faulting below.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
41. Define folding and recognize a fold when given a simple line drawing and/or photograph.	Folding	Using space/time relationships, inferring, observing, defining operationally	1. Use several layers (Play-Doh, clay, paper towels), and apply force to ends causing folds. 2. Draw a cross-section diagram of a fold.
42. Define faulting and the three major types of faults (normal, reverse, horizontal) and to be able to recognize a fault when given a simple line drawing or photograph.	Faulting	Using space/time relationships, inferring, observing, defining operationally	1. Student can use fault block or fault box to show various types of faults. 2. Draw a cross-section diagram of a fault.
43. Discover that the earth's crust is divided into mobile plates which have been moving and are continuing to move. He will relate plate tectonics (cause) to continental drift (effect) and recognize the effect on life in the past (see historical geology-continental drift).	Plate tectonics	Using time/space relationships, inferring, predicting, observing	1. View film: "The Not-So-Solid Earth." 2. Using cutouts of continents try to fit them together into one "supercontinent." View various films and film-strips. See National Geographic Film Strip Series "Powers of Nature."
44. Discover that these "plates" are moved by convection currents in the mantle.	Convection currents in mantle move crustal plates	Time/space relationships, observing, inferring, experimenting	Convection currents can be set up in a liquid (water, corn syrup) using small bits of paper or light wood floating on top of representative land masses. Given container (petri dish) of corn-starch paste (one pound corn-starch to ½ cup water), student can demonstrate how a substance can act like a liquid and a solid by "floating" a penny or pushing it across surface. (A drop of food coloring or crystal of $KMnO_4$ can help the student see the convection currents.)

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
45. Discover the relationship of volcano and mountain-building to the "plate" boundaries.	Zones of crustal activity	Using space/time relationships, using numbers, observing, inferring	Students should plot earthquake and volcano locations on a world map to demonstrate that they occur in the same location - the plate boundaries.
46. Be able to relate the occurrence of faults to earthquakes.	Relationship of faults to earthquakes	Using time/space relationships	Have students write a paragraph describing a stream which crosses a horizontal fault before and after an earthquake.
47. Identify the seismograph as the instrument that records an earthquake.	Seismograph	Observing, communicating	
48. Be able to recognize the difference between the focus and the epicenter.	Focus-Epicenter	Defining operationally	Student draws diagram showing focus and epicenter.
49. Given a map and simplified data, determine the epicenter of earthquakes.	Epicenter	Using numbers, measuring	Plot the epicenter of an earthquake, given the distance from the epicenter of three recording stations. The student can use a compass to draw circles representing the distances from the earthquake to the seismograph. The epicenter can be found near the place the three circles meet.
50. Define tsunami.	Tsunami	Defining operationally	Teacher may read stories or news accounts of the destructive features of tsunami.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
IV. HISTORICAL GEOLOGY			
51. Distinguish between absolute and relative time.	Absolute and relative time	Space/time relationships, inferring, interpreting	Have students list the year of their birth, year entered elementary school, and year entered present grade. Note that these are absolute dates (time units). Now have students list four events of their past life. Put the most recent event at the top. Place the other events in relative order. Note that these events are relative to one another. Let students note difficulty in relating relative events.
52. Given the half-life of a material, apply the principles of absolute time (radioactive decay).	Radioactive decay	Observing, inferring, classifying, predicting, using numbers, controlling variables, interpreting data	1. Place 100 pennies into a box and shake. Remove and record "heads." Continue until all pennies have been chosen. Duplicate several times; relate removal of heads to radioactive decay. Can also use corn kernels and thumb tacks, removing those which point to marked side. Graph results. (Box must be big enough for pennies to lie flat. More than one box may be used.)
		Measuring, interpreting, inferring, predicting, using numbers	2. Have students draw a circle to represent the amount of carbon 14 present in a living organism (use 5700 years, half of the C_{14}). For each 5700 years, half of the C_{14} decays. Have students do this by dividing the circle into halves.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			Hypothetical element with half-life of 100 years. How much of the element remains in 100 years? 200 years? 300 years? 400 years?
53. Given a picture or figure of undisturbed layers of rock, choose the layers of rock deposited first (oldest rocks).	Super-position	Observing, using space/time relationships, inferring	Obtain some index cards. Record and stack some of the cards. Note that first card placed in stack (oldest) is on the bottom. Relate to layers of rock (oldest on the bottom). Can also use books such as encyclopedias.
54. Recognize that layers of rocks are originally deposited in flat layers.	Soil horizons	Observing, inferring, using space/time relationships, predicting	Place gravel, coarse sand, fine sand, clay in large jar with lid. Students predict what will happen. Shake and let settle. Note sediments settled into flat layers. Compare to layers of rock. (Since sedimentation usually occurs under water, filling the jar with water is a good idea.)
55. Explain that an unconformity is a gap in the rock record at a certain locality.	Unconformity	Observing, inferring	Using colored modeling clay, demonstrate the relationships of the layers to one another. Remove a layer (erosion) and place new layers (deposition). Observe new relationships (unconformities). Relate model to unconformities in rock layers.
56. Define fossil and recognize characteristics and environment of organism which increase its changes of fossilization.	Fossils	Observing, inferring, classifying	Using modeling clay or Play-Doh, make impressions of common objects (can, pencil, fingerprint, etc.). Allow students to guess what object made the impression. Relate to fossils.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
57. Relate various types of fossils to living organisms and their environment.	Relationship of fossils to living organisms	Observing, inferring, classifying	1. Show students specimens, pictures, or slides of fossils. Have them relate the fossils to recent organisms and their environment.
			2. Students are assigned a fossil. The students research the fossil and develop environmental data on it. These data can include where it lived, what it ate, etc. (Make the fossil come "alive.") The information can be developed into oral presentations, group discussions, or role-playing.
58. Recognize that certain fossils lived only during a certain geologic span of time and became extinct.	Index (key, guide) fossils	Observing, interpreting data, space/time relationships, predicting	1. Prepare for students a large poster or individual sheets on which various index fossils are shown living together. Instruct the student to use a geologic time scale with life development to show why the poster or sheets are incorrect.
		Inferring, space/time relationships, communicating, predicting, formulating hypotheses	2. Students will hypothesize why the dinosaurs became extinct. Students will provide supporting data and decide which hypotheses are most acceptable. Can be conducted as group discussions or oral presentations. Can be developed into bulletin boards or posters. Students will use the hypothesis to predict if other organisms will become extinct.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			3. Students are given the age during which an organism lived in the past. The student will place the organism on a geologic time line or make charts showing the ages in which the organism lived. Students will relate which organisms were in existence at the same time and which were not.
59. Match or correlate rock layers in which index fossils are found.	Fossil correlation	Observing, inferring, classifying, using space/time relationships, interpreting data	Prepare an exercise which shows index fossils in two columns. The students will correlate index fossils in one column to index fossils in the other column.
60. Classify major historical geology events from the oldest to the youngest.	Major historical geology events	Using time/space relationships, measuring, observing	Geologic time tape. Get a piece of paper tape 5 meters long. Each meter will represent 1 billion years. Have students mark the major historical geology events to scale (1st simple plant = 2 meters, 50 centimeters; abundant shelled fossils = 3 meters, 90 centimeters; development of 1st fish 4 meters 10 centimeters; 1st land plants = 4 meters, 10 centimeters; 1st amphibians = 4 meters, 15 centimeters; development of reptiles and dinosaurs = 4 meters, 19 centimeters to 4 meters, 43.5 centimeters; development of mammals = 4 meters, 43.5 centimeters; development of man = 4 meters, 49 centimeters to present).

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			Compare major geological events of earth to a year. Note when events would occur. Especially note when man would occur.
61. State evidence of continental drift.	Continental drift-relationship to geologic history of the earth	Observing, space/time relationships, inferring	1. Reproduce the general outlines of the continents on sheets for the students. The students will cut out these outlines and place them together like a jig-saw puzzle. Note the fit of the continents, especially South America and Africa, North America and Europe, and Greenland and North America.
		Observing, inferring, space/time relationships	2. Obtain a geological map of the world. Have students compare the age of the rocks on the eastern coast of South America and the northwestern coast of Africa. Note other similarities of geological age along the "fit" of the continents. Students explain reasons for these similarities.
62. Infer how continental drift could have affected plants and animals in the past.	The effect of continental drift on past life	Observing, inferring, space/time relationships	Have students prepare reports on the fauna of Australia. Use continental drift theory to explain this distribution. Students find other plant and animal distributions related to continental drift. View Shell's film, "This Land."

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
63. (A) Reconstruct the environment of a fossil (e.g., corals, reptiles, mammals) by using the environment of a similar living organism.	Present is key to past	Interpreting, observing classifying, space/time relationship, communicating	Obtain pictures of various types of organisms such as corals. Student will record the environment in which the organisms live. Then show pictures of fossils and have students reconstruct the fossils' environments.
(B) Explain topographic phenomena (Grand Canyon, glacial valleys, etc.) using process at work on the earth today	Present is key to past	Inferring, observing, classifying, using space/time relationships	Name different topographical phenomena or show pictures of same. Have students suggest processes which may have caused said phenomena.
64. Define evolution and natural selection and demonstrate their relationships.	Evolution/ natural selection	Observing, measuring, using numbers, classifying, hypothesizing	Obtain charts of evolutionary tree of various organisms (such as the horse, elephant, camel, trilobite, etc.). Have students note and record changes in size, complexity, etc. Stress changes from simple to complex, more advanced, and more adapted. Have students hypothesize what will happen to the horse with time.
V. OCEANOGRAPHY			
65. Observe and recognize that the ocean hydrosphere covers three-fourths of the earth's surface.	Extent of the hydrosphere	Observing, classifying, inferring	Given a map or globe, students will estimate the amount of the earth's surface covered by water.
66. (A) Identify the origin of salt in the ocean waters.	Composition of seawater	Observing, interpreting, inferring	Students collect water poured through a salt-sand mixture.
(B) Distinguish between the composition of waters of the land and waters of the ocean.	Composition of seawater	Observing, measuring, communicating, inferring	Use ocean water, if available, or prepare artificial sea water (20 parts H_2O to 1 part NaCl or 25g NaCl to 600 ml H_2O). Then,

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			evaporate the water to observe the salt residue. Students collect water from lakes and streams, let it evaporate, and observe the residue. Compare. If ocean water is used, have students compute percentage of salinity.
67. Recognize waves and currents as the major movements of ocean water; and, given appropriate materials, demonstrate how they occur.	Waves and currents	Observing, inferring, using space/time relationships, communicating, experimenting	1. Student blows across a pan of water to generate waves. 2. Students generate waves in a pan or stream table with a fan and/or rectangular piece of wood (sand can be added to simulate beach activities). 3. Given a map showing major ocean currents, the student will compare these with a map showing major air currents.
68. Recognize that the ocean floor has a variety of topographic features.	Topography of the ocean floor	Observation, classifying, measuring, using space/time relationships, inferring, interpreting, data, using numbers	Students measure a landscape hidden in a box and graph a profile. Students use topographic and physical maps of the ocean floor to identify the various landscape features. Student drops water onto cans from different heights and notes different sounds. Then student drops water onto hidden cans which are at different

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			heights simulating ocean bottom and draws profile of simulated bottom based on sounds. Student uses line and lead weight to determine profile of simulated ocean bottom constructed of plaster of paris in institution-sized tin can or bucket and concealed by cloudy liquid.
69. Recognize the continental shelf, continental slope and mid-ocean ridges (mountain chains) given a simple diagram or map of the ocean floor.	Continental shelf, continental slope, and mid-ocean ridges	Observing, classifying, measuring, using space/time relationships, using numbers, inferring, interpreting data	Using depth measurements along a specific latitude (parallel), construct a profile of the ocean bottom.
70. Describe the concept of sea floor spreading and relate to the mid-ocean ridges. (See plate tectonics in physical geology section.)	Sea floor spreading	Communication, using space/time relationships	1. Examine maps of ocean bottoms and locate mid-ocean ridges and related features. Set up convection currents in a liquid. (See plate tectonics in physical geology section.) View film, "Not So Solid Earth."
71. Recognize the importance of plankton as one source of atmospheric oxygen.	Importance of the ocean to man	Observing, inferring, interpreting	Students examine microscopic green algae in pond or lake water. (Green plants give off oxygen.)
72. Recognize the importance of products from the ocean for the people of the earth.	Importance of the ocean to man	Observing, inferring, communicating	Students research major fishing grounds. Obtain percentages of populations of various countries who make their living from the ocean.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
VI. METEOROLOGY			
73. Recognize air as a mixture of gases.	Composition of air	Observing, measuring, using numbers, inferring, interpreting data	Light a candle; place a jar over it. With its rim just under the surface of the water, let the candle burn out. Then measure the height to which the water has moved in the jar as the oxygen was taken out of the air; calculate the percentage of oxygen.
74. Recognize that the atmosphere is composed of layers of air of varying temperatures.	Layering of air	Observing, measuring, using numbers, inferring, interpreting data	Construct a poster or diagram showing the order of the layers of the atmosphere and their relative ranges.
75. Distinguish among conduction, convection, and radiation.	Conduction, convection, radiation	Observing, inferring, classifying, using numbers, measuring, using space/time relationships, communicating, controlling variables, interpreting data, experimenting	To demonstrate the 3 methods of heat transfer: (materials needed: large beaker of water, thermometer, metal pan, hot plate, metal spoon). 1. Conduction - Fill pan ½ full of H_2O. Put spoon in pan. Heat. Touch spoon handle. WATCH: DO NOT BURN FINGERS! 2. Radiation - Record temperature of H_2O in beaker. Place in direct sunlight or under a heat lamp. Record temperature again. 3. Convection - Place thermometer on floor. Record temperature after 2 or 3 minutes. Place thermometer on desk. Record temperature after 2 or 3 minutes. Place thermometer at highest point in room. Record temperature again after 2 or 3 minutes.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
76. Relate convection movement to the general circulation of air.	Air circulation	Observing, inferring, space/time relationships	Student constructs convection box with two chimneys and places candle under one chimney and smoking stick over other. Observe results.
77. Describe reasons for unequal heating of the earth's surface (land and water).	Unequal heating over earth's surface	Observing, inferring, measuring, using numbers, interpreting data, controlling variables	Student should put container of soil and container of water which are at equal temperature in sunlight (under 250-watt lamp). Record temperature differences at 5-minute intervals for 30 minutes. (Allow sufficient cooling time between classes. Perhaps separate set-ups for each class will be necessary.) Record and graph. Allow to cool, recording temperature at same intervals. Graph results. Compare graphs and answer questions.
78. Explain how latitude affects the amount of energy received from the sun.	Unequal heating of the earth's surface	Observing, using numbers, measuring, inferring, formulating hypotheses	Student should construct and place two squares of equal area on a globe, one at the equator, one at 40°N latitude. Place in direct light. Place a piece of peg board between the globe and the light. Have students count the light dots on each square. Which area received the most light?
79. Distinguish between weather and climate.	Weather and climate	Communicating	

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
80. Explain how mountain ranges affect climate.	Surface irregularities affect climate	Using numbers, measuring, observing, inferring, using space/time relationships, communicating	Use a world map to locate deserts of the world, and discuss their relationships to adjacent mountain ranges and prevailing wind patterns. Cut a piece of black construction paper, about 9 x 24 centimeters, and fold it in half, so it will make a "mountain." Put a block at each end of an aquarium or earth box so that the mountain won't collapse. Rub calcium chloride dust on the surface of the paper strip that will be the mountainsides. Be sure to spread it evenly from one end of the strip to the other. Put the mountain into the box and place a container of hot water on one of the blocks. Put the top on the box and record observations. Make a drawing showing windward and leeward sides of mountains.
81. Describe and explain the difference between continental and marine climates.	Types of climates	Observing, inferring, communicating	Using a world map discuss the effects of air masses that originate over land (continental) and air masses that originate over water (maritime).
82. Identify the processes in the water cycle.	Water cycle	Observing, inferring, communicating, using time/space relationships	Using a diagram of the water cycle, trace the processes taking place. Have students write creative stories enacting the role of a drop of water in the water cycle that has been around for the past four billion years.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
83. Relate humidity to the amount of water vapor in the air.	Humidity	Observing, communicating, using time/space relationships, using numbers, inferring	Have students determine the dew point of the air using the following method or related methods: Remove the label from a tin can. Make sure that the outside of the can is clean and dry. Fill the can about halfway with water. Put a thermometer into the can and read the temperature of the water. Examine the outside of the can carefully to see whether any moisture can seep through the walls of the can. Add ice to the water slowly until the can is about 3/4 full. Stir slowly with the thermometer; keep looking at the outside of the can. As soon as you see some moisture forming on the outside of the can, read the thermometer. Record observations. Repeat the above for at least three trials.
84. Describe how air masses form and explain the relationship of fronts to air masses.	Air masses and fronts	Observing, inferring, communicating	Using a world map, show the position of forming air masses. Indicate the direction of flow of the air masses in relationship to the prevailing wind patterns. (Have a plentiful supply of inexpensive bulletin board material available.) Discuss what could happen when a warm air mass meets a cold air mass (remind students of convection currents). Discuss the activity between the two air masses and relate this to the term "front."

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
85. Identify fronts, temperature, and pressure using a weather map legend.	Weather maps	Observing, inferring, communicating	Using a weather map with symbols, have students identify fronts, temperature, and air pressure.
86. Recognize weather instruments (barometer, thermometer, anemometer) and identify the atmospheric conditions that they measure.	Weather instruments	Observing, inferring, communicating, measuring, using space/time relationships	Construct and/or use models of a barometer, thermometer, and anemometer.
87. Identify a picture of the major kinds of clouds: cirrus, cumulus, stratus, and nimbus.	Clouds	Observing, inferring, classifying	Show pictures of the kinds of clouds. Discuss their composition and relationship to weather changes. Go outside. See what kinds of clouds are around on that day.
88. Select the causes of hurricanes, tornados, and thunderstorms.	Hurricanes, tornados, storms	Observing, inferring, communicating	Using pictures, discuss the formation and composition of each type of storm.
89. Describe the characteristics of hurricanes, tornadoes, and thunderstorms.	Hurricanes, tornadoes, and storms	Observing, classifying, communicating, measuring	Make a table with the following columns labeled: Precipitation, associated phenomena (lightning, thunder, etc.), wind speed, diameter, forward speed, season of occurrence, originates over land or water? Fill in the table for each storm.
VII. ASTRONOMY			
90. Recognize that the earth is one of nine planets orbiting the sun.	Solar system	Measuring, using numbers, communi-, cating interpreting data	Construct a model of the solar system in which the distance and the size are to scale. (Hint: adding machine tape could be used. 1" = 1 astronomical unit.)

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
91. Identify the sun as the major source of the earth's energy.	Characteristics of sun	Observing, using space/time relationships, measuring, predicting	1. Student will research information about the sun as a source of energy. 2. Show that heat energy is absorbed faster by dark colored surfaces than by light colored surfaces; faster by soil than by water.
92. Identify the sun as a middle-sized star.	The sun as a star	Observing, inferring, classifying, using numbers	Construct an H-R diagram of stars.
93. Identify the sun as the star nearest the earth.	The sun as a star	Observing, inferring, classifying, using numbers	Use diagrams or pictures of the Milky Way and the Solar System.
94. Distinguish between rotation and revolution.	Rotation and revolution	Observing, inferring, interpreting data, communicating	1. Students will demonstrate rotation and revolution with their bodies. 2. Demonstrate rotation and revolution using two spheres.
95. Discriminate between the effect of earth's rotation and revolution.	Day and night, year	Observing, inferring, communicating	Demonstrate using a planetary model and with student models.
96. Relate the seasons to the tilt of the earth's axis.	Cause of seasons	Observing, inferring, classifying, using space/time relationships, communicating, predicting, interpreting data	Student uses sphere with perpendicular and tilted axis and a source of light to show the position of the sun's direct rays when the axis is tilted and the position of the sun's direct rays when the axis is perpendicular. Label a diagram showing the sun and earth's position for each season.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
97. Identify pictures of the position and shape of the moon on successive nights.	Phases of the moon	Observing, inferring	Draw and label a diagram to show each phase of the moon.
98. Label the postion of the sun, moon, and earth to show: a. An eclipse of the sun b. An eclipse of the moon	Lunar and solar	Observing, inferring	1. Using models to represent the sun, moon, and earth, show the position of each for both a solar and lunar eclipse. 2. Label a diagram that shows the positions of the sun, earth, and moon for both a solar and lunar eclipse.
99. Match a definition of the major features of the moon (crater, mountains, plains) with the appropriate term.	Major surface features of the moon	Observing, communicating	Using a physical globe of the moon and/or pictures, stress each physical feature of the moon and its characteristics. Use National Geographic map of the moon.
100. Identify the major cause of ocean tides.	Causes of tides	Inferring, using numbers, using space/time relationships, communicating	Using a tide table, have students graph the tidal levels for five consecutive days, and discuss results. Relate the tidal rhythm to moon's position. (See tidal information in daily newspaper.)
VIII. ENERGY RESOURCES			
101. Differentiate between nonrenewable and renewable resources.	Renewable and nonrenewable resources	Inferring, classifying	Given a list of nonrenewable and renewable resources, the student will classify each as to its type (renewable and nonrenewable). Can also use exercise for development of bulletin boards, posters, and charts.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
102. State advantages and disadvantages of renewable and nonrenewable resources.	Renewable and nonrenewable resources	Communicating, inferring, predicting	Students are assigned to research a specific resource. This information can be developed into oral presentations, group discussions, debate and role-playing. Students assume roles as community leaders and decide upon the type and location of a power plant for their imaginary city. Roles can include those of environmental officials, governmental officials, industrial representatives, etc.
103. Relate the advantages and disadvantages of energy sources for Louisiana.	Energy prospects for Louisiana	Communicating, predicting, inferring, interpreting data, using numbers	1. Students contact Louisiana Department of Land and Natural Resources for energy data. 2. Mid-continent oil and gas publications contain data in oil and gas production. 3. Predict energy development using current data.
104. State energy conservation practices applicable to daily life.	Energy conservation	Observing, inferring, using numbers, measuring, communicating, interpreting data	1. Students design energy conservation posters. 2. Contact local utility companies for resource personnel and materials for energy conservation. 3. Students contact the Department of Energy or other governmental agencies for information on energy conservation. 4. Students will read electric and gas meters at school or home. Calculate daily use and graph results.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			5. Students conduct energy conservation inspections of the school and homes. 6. Students could graph energy use per day, perhaps comparing gas use and electricity use.

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AUDIOVISUAL SUPPLIERS

The audiovisual materials suggested in the curriculum guide can be obtained from the following suppliers:

Association Instructional Materials
347 Madison Avenue (Department (DC)
New York, New York 10017

BFA-Ealing Corporation
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

BFA-Educational Media
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

Beckman Instruments Inc.
Attention: New Dimensions
2500 Harbor Boulevard
Fullerton, California 92634

Coronet Films
65 East South Water Street
Chicago, Illinois 60601

Education Audio-Visual Inc.
Pleasantville, New York 10570

Encyclopaedia Britannica
Educational Corp.
425 North Michigan Avenue
Chicago, Illinois 60611

Inquiry Audio Visuals
1754 West Farragut Avenue
Chicago, Illinois 60640

International Communication Films
1371 Reynolds Avenue
Santa Ana, California 92705

John Wiley and Sons, Inc.
605 Third Avenue
New York, New York 10016

Kalmia
Department C1
Concord, Massachusetts 01742

Lansford Publishing Co.
Post Office Box 8711
1088 Lincoln Avenue
San Jose, California 95155

McGraw-Hill Films
CRM/McGraw-Hill
110 15th Street
Del Mar, California 92014

Modern Learning Aids
1212 Avenue of the Americas
New York, New York 10036

Harper and Row Media
10 East 53rd Street
New York, New York 10022

Holt, Rinehart, and Winston, Inc.
383 Madison Avenue
New York, New York 10017

Indiana University
Audio-Visual Center
Office for Learning Resources
Bloomington, Indiana 47401

Prentice Hall Media
Servode HC236
150 White Plains Road
Terrytown, New York 10591

Scholarly Audio-Visuals Inc.
5 Beekman Street
New York, New York 10038

Science Software Systems Inc.
11899 West Pico Boulevard
West Los Angeles, California 90064

Shell Oil Film Library
1433 Sadlier Circle W. Drive
Indianapolis, Indiana 46239

Modern Talking Picture Service
2323 New Hyde Park Road
New Hyde Park, New York 11040

Peter M. Robeck and Company
230 Park Avenue
New York, New York, 10017

James J. Ruhl and Association
Post Office Box 4301
Fullerton, California 92631

Thorne Films
1229 University Avenue
Boulder, Colorado 80302

Universal Education and Visual Arts
100 Universal City Plaza
Universal City, California 91608

Westwood Educational Productions
701 Westport Road
Kansas City, Missouri 64111

Sutherland Educational Films
201 North Occidental Boulevard
Los Angeles, California 90026

Since these materials vary from quite simple to complex, teachers are urged to preview materials before presenting them to the class.

EVALUATION TECHNIQUES

Methods for evaluating pupils' achievement and progress are an integral part of the instructional program. Evaluation techniques must reflect (1) the objectives to be reached, and (2) the activities employed to reach those objectives. Since the objectives are stated clearly, the method of evaluation is indicated within the objective. The objectives are stated in behavioral terms, the process skills are identified, and suggested activities are listed. Thus, it is clear what the student is expected to be able to do after successful completion of a learning activity. The successful attainment of an objective can be demonstrated by having the student do specific things which can be observed.

Therefore, evaluation should consist of more than just paper and pencil tests on recall of factual knowledge. A variety of evaluation activities should be used.