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ABSTRACT

This is one of a set of curriculum guides for the Stoneham Elementary School Science Program (see SE 012 153 - SE 012 158). Each guide contains a chart illustrating the scope and sequence of the physical, life, and earth sciences introduced at each grade level. For each of the topics introduced at this grade level an overview of the topic, a list of concepts to be developed, motivating ideas, suggested activities to develop each concept, a reading list, a list of supplies needed, and examples of student work sheets are provided. In most activities the teacher is expected to involve all students in experimenting and applying scientific thinking. The topics covered in the grade four guide are: molecules and changes of state, sound as energy, electricity, animal diversity and characteristics, plants as food-makers, and weather. (AL)

Transfer: ERIC/Science

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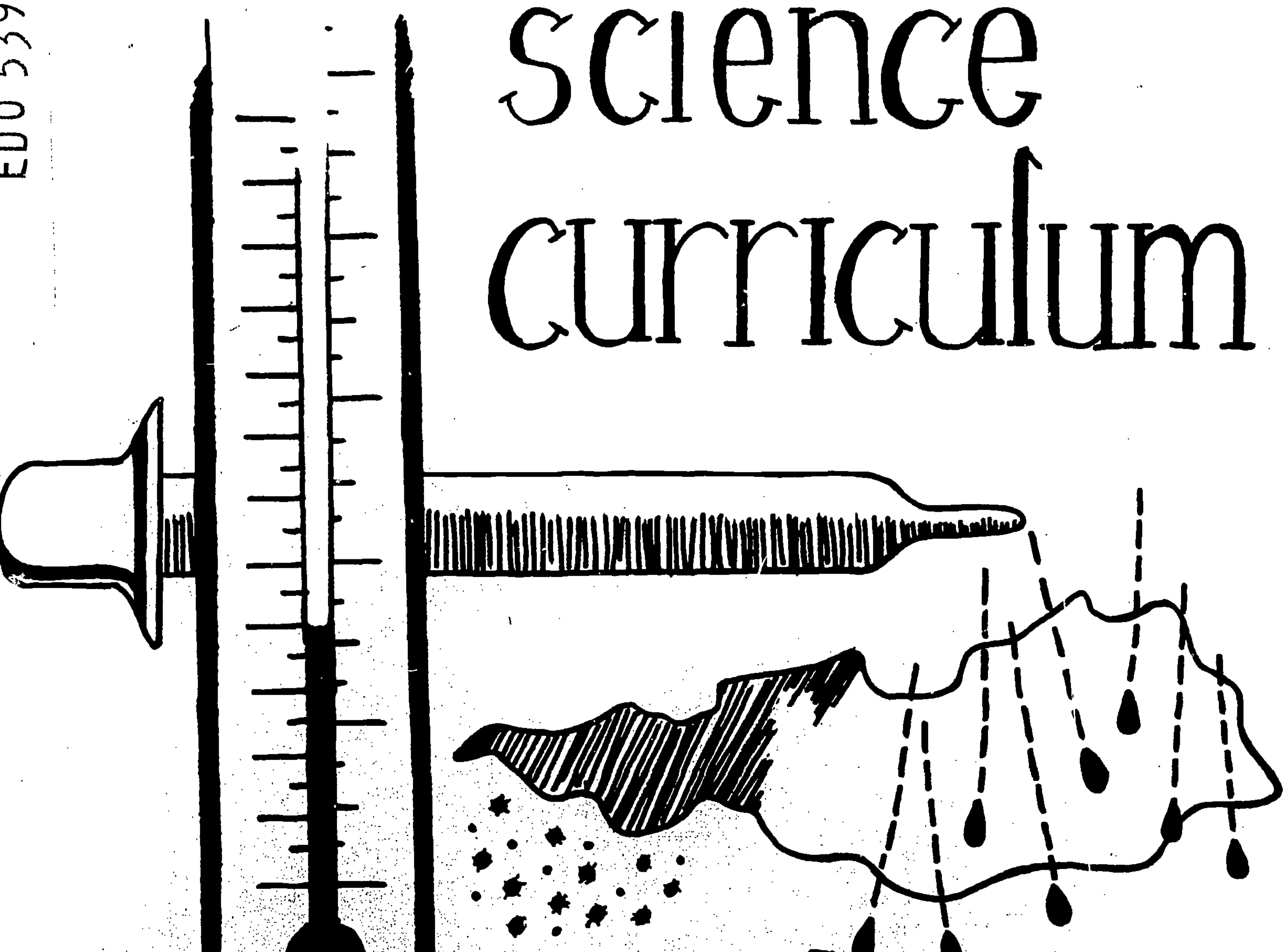
Elementary science curriculum



stoneham, mass.

grade 4

SE 012 156

STONEHAM PUBLIC SCHOOLS

STONEHAM, MASSACHUSETTS

ELEMENTARY SCIENCE CURRICULUM GUIDE

GRADE 4

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FOREWORD

These units were written as guides for the teachers of science. The activities suggested are given to assist the teacher in illustrating the given concepts. In some instances several activities are suggested for one concept. It is not expected that the teacher use all these activities, but only those which will best suit her class. In other cases the activities suggested follow a particular sequence which would encompass several days illustrating several related subconcepts along the way. It is not expected that the teacher stick rigidly to her curriculum guide. If deviating to include another concept, however, the teacher is advised to consult the other Stoneham Science Curriculum Guides to be certain that the concept is not introduced at another grade level. The teacher is encouraged to have reference materials in the classroom at all times for each unit.

Whenever possible, the teacher is expected to involve all the children in experimenting and encouraging application of the scientific method and thinking. This would involve the following skills:

1. to formulate hypothesis
2. to reason quantitatively
3. to evaluate critically
4. to draw conclusions
5. to select procedures
6. to define problems
7. to create charts and keep records
8. to use equipment effectively

It is intended that the teacher will adequately adapt this guide to her own class needs.

Susan Hopkins----------Grade 1
Judith Bowen-----------Grade 2
Bette Littman----------Grade 3
Carol Bearse-----------Grade 4
Joan Knipping----------Grade 5
Linda Young------------Grade 6 Co-Chairman
Mary White-------------Grade 6 Co-Chairman

November 1969

Table of Contents

Unit Plan

STATEMENT OF PHILOSOPHY

We have all experienced the confusion of sorting out events that come at us, seemingly, haphazardly. We try to perceive the link, the relationship, that will make everything clear, that will help us decide. In fact, from the time we are born the main activity of our lives is trying to sense some order in our constantly changing world. Science is a tool that man uses to seek order. Modern science has evolved not only as a body of fact, but also as a logical approach to problem solving. In the elementary school this aspect of science should not be overlooked. The study of science should encourage growth in the ability to solve problems, as well as introduce a background of knowledge.

To achieve this goal the emphasis must shift away from the teaching of "facts" to the development of such abilities as: observation, collection of information, classification, formation of hypotheses, data interpretation, generalization, and prediction. Thus the process of learning becomes just as important as the information obtained.

This approach to teaching science transforms the classroom into a laboratory and the children into scientists working within it. The teacher provides enough orientation so that the children develop goals of their own, and guides them through concrete experiences that nurture both technique and knowledge of facts. There are many outcomes of a lesson: skills, facts, aroused curiosity, ideas, and discovery of new relationships. The pupils gain confidence in their own ability to learn, a process which will be valuable long after the facts are forgotten.

SCOPE AND SEQUENCE CHART

SCOPE AND SEQUENCE CHART

		GRADE 1	GRADE 2	GRADE 3
PHYSICAL	Chemistry	**Changes in Matter** melting freezing heating	Changes in Matter solid liquid gas molecular	
	Physics	**Magnets** push & pull		**Magnets** attraction repulsion **Simple Machines** their uses relationships of applied force
LIFE	Human Body	**Growth** bones teeth nutrition health	**Growth** muscles skeletal structure emotions	
	Plants	**Reproduction** seeds bulbs spores regeneration	**Life Activities** structure classification seed plants non-seed plants	**Ecosystem** Pond Community
	Animals	**Classification** Vertebrates	**Life Activities** life cycles insects brine shrimp	

SCOPE AND SEQUENCE CHART

GRADE 4	GRADE 5	GRADE 6
Molecular Theory matter molecules their energy relations		
Electricity static-current- production conductors **Sound** waves, vibration, pitch, reflection	**Heat** motion expansion-contraction conduction, convec- tion radiation insulators	**Light** photons- reflection- waves color
The Ear Producing and hearing sounds	**Collulor Organization** cells tissues organs	**Genetics** heredity dominant & recessive traits
		Photosynthesis leaf structure- carbon cycle
Simple & Complex 5 basic life- processes- cellular structure classification		**Animal Behavior** inherited & learned **Ecology** balance in nature disbalance

SCOPE AND SEQUENCE CHART

		GRADE 1	GRADE 2	GRADE 3
EARTH	Astromomy	Earth - Sun - Moon rotation day & night		Solar System orbits revolution seasonal change
	Geology		Fossils dinosaurs fuels evolution	Earth Composition soil rock formation classification
	Meteorology	Changes in Weather clouds		Water Cycle cloud formation precipitation weather prediction

SCOPE AND SEQUENCE CHART

GRADE 4	GRADE 5	GRADE 6
	Forces in Space centrifugal centripetal gravitational	**Motion in Space** movement of plants parallax, triangulation gallaxies-atomic energy
	Earth Changes surface interior **Ocean Environment** water food life exploration	
Influence on Man Air's ingredients of weather effects of weather		

MOLECULES AND ENERGY

UNIT I - MOLECULES AND ENERGY Grade 4

Background - There is hardly any other theory that has had as far-reaching effect upon scientific thinking than the molecular theory. The theory holds that every substance in the universe is composed of tiny, tiny particles. These particles are so small that it is impossible to comprehend their minuteness. There are millions of molecules in one drop of water. One hundred million molecules could be placed on a line an inch long. A molecule is the smallest particle into which a substance can be divided and yet retain the characteristics of that substance.

Molecules are composed of still smaller particles called atoms. If you could line up atoms on your ruler, it would take 250 million of them to make an inch.

Most substances occur in any of three states or forms-solids, liquids, or gaseous.

Molecules of substances are in constant and rapid motion. Molecules of liquids move more rapidly than those of solids, and molecules of gases move more rapidly than those of liquids. In solids, molecules are held closely in place. The more energy molecules have, the faster they move. The faster they move, the higher is the temperature.

Concepts -

1. Matter is composed of tiny particles called molecules.
2. Molecules are often composed of smaller particles called atoms.
3. Molecules and their atoms are in constant motion.
4. Matter may generally exist in one of three forms-solid, liquid, or gaseous.
5. Matter can be changed from one form to another.
6. Molecules of substances move more rapidly when heated and less rapidly when cooled.
7. Most substances expand when heated and contract when cooled.
8. Solids tend to keep their shape.
9. Liquids take the shape of the container they are in.
10. Gases spread out to fill whatever space is available.

Motivating Ideas

Show a picture of unrelated items. Ask what these items have in common. (all matter made of molecules.) Have children think of the tiniest thing they can think of. (How tiny is a molecule?) Show a picture of a molecule taken by an electron microscope.

Motivating Experiment

Materials: shoe box, large onion, knife

Procedure: Close the doors and windows. Cut the onion in half. Put one piece in a covered shoe box and the other on the table in front of the room. Can you explain how the onion odor reached your nose? Open the shoe box and sniff. What a strong odor - much stronger than the onion smell in the room. Can you explain the stronger odor in the closed box, using the idea of molecules?

Concept 1 Matter is composed of tiny particles called molecules.

Experiment - Materials: teaspoon of sand, eye dropper of water.

Procedure - Move a few of the grains of sand away from one another. Notice how tiny just one grain is. Yet each grain of sand is made of millions of molecules. Squeeze just one drop of water into your hand. In that one drop of water, how many molecules do you think there are?

Enrichment - Draw a line one inch long on a piece of paper. Prick as many holes as you can side by side on the line. Count as you prick. If you could line molecules up side by side on the same line, you would need 100 million of them.

Concept 2 Molecules are often composed of smaller particles called atoms.

Experiment - Materials: Styrofoam balls, toothpicks

Procedure - Show how water is composed of two atoms of hydrogen and one atom of oxygen, by combining styrofoam balls in a molecular structure.

Enrichment - Show the difference between an element and a compound using the same compound of water. Have children infer how we could separate CO_2 into separate elements, and further into molecules and atoms.

Concept 3 Molecules and their atoms are in constant motion.

Experiment - Materials: glass partly filled with water, eye dropper, ink.

Procedure - Place the glass of water on the table. Let it stay there until you are sure the water is quite still. Then, very carefully, put an eye dropper, with ink on it, into the water. Be careful not to move the glass. Watch what happens. In the morning, look at the water again. Remember the ink is made of molecules and so is the water. How can you explain what happened?

Enrichment - Materials - cotton, large jar with lid, oil of peppermint, oil of wintergreen

Procedure - Put the cotton in the jar, and sprinkle a few drops of oil on it. Leave the jar open for a little while. Ask several children at their seats to raise their hands when they can smell the odor of the oil. How long does it take for those farthest away to smell the oil? Would the idea that molecules keep moving help you to explain the smell in the air?

Concept 4 - Matter may generally exist in one of 3 forms - solid, liquid or gaseous.

Activity - Divide children into groups - solid, liquid, and gas. List as many of each kind as possible. Play 20 questions - am I a solid, liquid, or gas?

Concept 5 - Matter can be changed from one form to another.

Experiment - bowl of ice cubes, glass of water, tea kettle, hot plate.

Procedure - Place ice cubes in the sun. What happens? Heat water in a tea kettle. What appears coming out of the spout? Infer how matter can be changed from one state to another.

Enrichment - A few substances change directly from solid to gaseous, skipping the liquid state. For example, moth balls, camphor balls, and dry ice. Keep a jar of moth balls in the room over a period of a month. What happens?

Concept 6 - Molecules of substances move more rapidly when heated and less rapidly when cooled.

Experiment - Materials: balloon, thread, tape measure, bowl of ice cubes.

Procedure - Inflate the balloon just enough to make it round. Close the mouth of the balloon by tying the thread tightly around it. Use the measuring tape to find out how large the balloon is around the middle. Record this measurement. Then push the balloon down into the bowl of ice cubes for four minutes. Measure the balloon again. Compare this measurement with the first one. Next, hang the balloon in a warm place such as a sunny window. Leave it there for about half an hour. What happens to the molecules of air inside the balloon as they become warmed by the sun? Measure the balloon again. Remove the balloon from the window and push it down into the bowl of ice water again. Explain the change in the size of the balloon when you measure it again.

<u>Enrichment</u> - Feel the difference in the amount of pressure of warmed and cooled molecules. Use same balloon as above. Warm the balloon again and then press it gently against the sides. Do you feel the molecules pushing against your hand? Cool the balloon and press gently on the sides. Do the molecules push back on your hand with as much force now? Does this help you to understand that molecules in cooled substances have less energy than they do in warmed substances?

<u>Concept</u> 7 - Most substances <u>expand</u> when heated and <u>contract</u> when cooled.

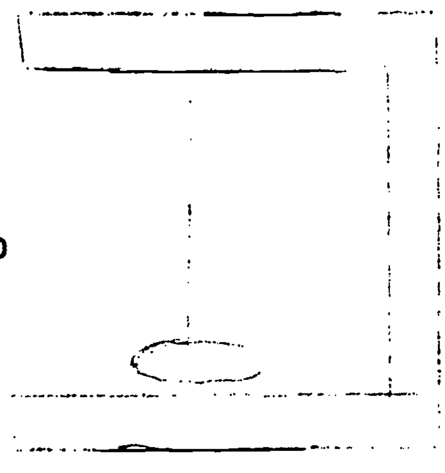
<u>Experiment</u> - Materials: baby nursing bottle, pan of ice cubes, warm water, plastic tube, one-hole rubber stopper.

<u>Procedure</u> - Put the plastic tube through the hole in the rubber stopper by twisting it. Fill the bottle with warm water and then put on the stopper. Add enough water so there is no air space at all below the stopper. Mark the water line on the tube. Set the bottle into a pan of ice. Leave it there for about 20 minutes. Notice whether the water has moved up or down in the plastic tube.

<u>Enrichment</u> - Materials: wooden stand, candle, 13" straight piece of wire, 1/2 pound stone.

<u>Procedure</u> - Make a wooden stand as shown below. Fasten one end of the wire around the stone. Fasten the other end to the wooden stand. The wire should be just long enough not to let the stone touch as it swings. However, it should almost touch. Now light the candle. Hold the lighted candle near the wire. What will this do to the wire? Swing the stone gently back and forth. Do this until the swinging is no longer possible. Why is the swinging no longer possible? Blow out the candle. Let the wire cool. In a few minutes, see if the stone and wire will swing freely again. If they will not, allow the wire to become even cooler. Then try it again. Why do they swing again when the wire is cooled?

WOODENSTAND



Concept 8-Solids tend to keep their shape.

Experiment - Materials: nail, pencil, round pan, eraser scissors, square pan.

Procedure - Look at these objects. Turn them over in your hand. Notice their shapes. Stand them on end. Do they still keep their same shapes? Put them one by one into first a round pan then into a square pan. Find other dishes of other shapes to put them into. What happens to their shapes as you put them into different dishes? Do they take the shape of the dish they are in? Or do they keep their own shape?

Concept 9-Liquids take the shape of the container they are in.

Experiment - Materials: glass of water, two dishes, one round, and one square .

Procedure - Pour some water into the round dish. Pour some water into the square dish. What is the shape of the water in each dish? If you poured the water into two dishes of different shapes, what would happen to the shapes of the liquids in each dish?

Concept 10 -Gases spread out to fill whatever space is available.

Experiment - Imagine that you have an empty suitcase. Suppose that a teaspoon of air could be put into the empty suitcase. What shape would the air have? Place a cut onion in the container. Show what happens by drawing molecules of gas.

Enrichment - Into what kind of empty containers could you put a teaspoon of air to give it the shape of a sphere or some other shape? Make charts showing how the molecules might look in a solid, liquid, and gas.

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Audio-Visual Aids

Films	What Are Things Made Of?	(Coronet)
	World of Molecules	(Churchill)
Filmstrips -	The Universe and Space	(M H)*
	The World's Matter Supply	(M H)*
	The World's Energy Supply	(M H)*
	All Matter Has Three Forms	(M H)*
	Molecules and You	(M H)*
	Solids, Liquids, Gases, and Molecules	(Curriculum)

Community Resources

Museum of Science, Boston, Mass.

* M H - McGraw - Hill

WORKSHEET IDEA FOR UNIT I

Finding the Missing Molecules

Many times scientists do not see an event directly, but they see signs that this event has probably taken place. Then they have to study the evidence carefully to decide whether it really proves that the event has taken place.

For example, one day Mrs. Hill poured milk into a dish for Lynx, her cat and left. When Mrs. Hill came back, she found the dish empty and Lynx meowing around the dish as if he were hungry.

Speculating - 1. What did Mrs. Hill guess had happened to the milk?

2. What evidence led her to make this guess?

3. Do you think there was enough evidence to make her guess a good one?

Here is what really happened. When Mrs. Hill left, she shut a door near the dish. A mop leaning on the door fell over and landed in the dish. Some of the milk was absorbed by the mop, and the rest of the milk spilled over the floor. Later, her husband went through the room and almost tripped over the mop. He stood the wet mop up against the door again.

4. Suppose that, when Mrs. Hill came back, she had observed the room as carefully as a scientist might. From what evidence could she have guessed that perhaps the cat had not had the milk after all?

5. Look over all the evidence from questions 1 - 4. Does any of this evidence prove anything?

6. Is there any way Mrs. Hill could have changed her guess into a hypothesis?

Problem 2 - If you eat eggs with a silver spoon, you will find that the spoon soon gets coated with a black material. However, if you eat cereal with a silver spoon, you will find that the spoon does not get coated.

1. What is your guess as to why a silver spoon turns black in egg but not in cereal?

2. How could your guess be turned into a hypothesis?

WORKSHEET IDEAS

To show that atoms combine together to form molecules use some of the following formulas to make your own molecule puzzle. There should be a separate piece for each atom. You may cut the puzzle as you wish, as long as you can see how atoms combine together to form a molecule. They may have colors representing each atom.

CO_2: Carbon dioxide

H_2O: Water

Fe_2O_3: Iron Oxide (rust)

NaCl: Sodium Chloride (salt)

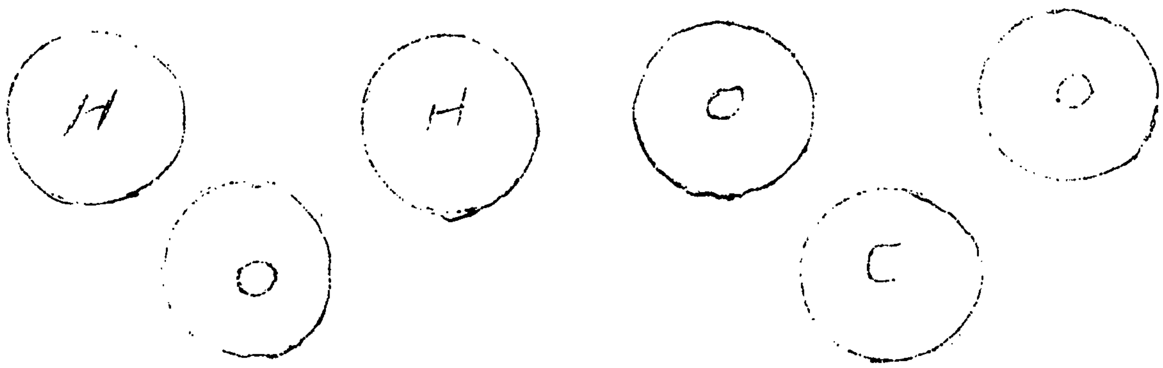
$CaCO_3$: Calcium Carbonate (chalk)

This sheet will help you to see how atoms from elements combine to form molecules, and how molecules combine to form different kinds of matter.

Color these atoms the appropriate colors.

Oxygen (red)
Hydrogen (blue)
Iron (brown)
Carbon (black)

Atoms from these elements combine to form molecules of matter. Color them correctly.



Molecules combine to form different kinds of matter. Using the correct colors, can you draw the correct molecules to show the following:

Water

Salt

Rust

BULLETIN BOARD IDEAS

1. Have children collect and assemble pictures of solids, liquids, and gases.

2. Have giant posters of molecular structure of some common substance such as water.

3. Illustrate an experiment showing how molecules change in different states of matter.

SOUND - A FORM OF ENERGY

UNIT TWO - SOUND - A FORM OF ENERGY

Background

Sound is a form of energy. It is caused by a certain kind of wave produced by a vibrating object. The vibrating object does not need to be a solid, though it often is.

To understand a sound wave, try to picture a rubber band stretched around the fingers of your hand. As the rubber band is plucked, you can observe its back and forth movement. You can see how it bulges this way and then bends inward again. Each time the vibrating rubber band bulges one way, it pushes against molecules of air next to it and squeezes them. These, in turn, push against other molecules.

Sound waves move out in all directions from the vibrating source. Have children imagine sound as an invisible sphere emanating from the source of sound. Sounds may travel through solids such as wood and metal, through liquids such as water, and through gases such as those which make up air. Sound waves travel farther and faster through water, wood, metal, and stone than through the air.

Sounds travel faster in higher temperatures and more slowly as temperatures drop. Relate this to the fact the molecules when warmed, have more energy and the sound vibrations are thus moved along more rapidly.

Like all other sounds, speech is produced by vibrations. Stretched across the inside of the larynx, or voice box, are the vocal cords. These cords vibrate whenever you speak. When you speak, muscles that control the cords cause them to come together, leaving only a narrow slit between them. Air passing through the narrow slit makes the cords vibrate. If the cords are very tightly stretched, a high-pitched sound is produced. If the cords are less tightly stretched, a lower pitched sound is produced.

Ears are the organs in the body which receive the waves that produce sounds. The outer ear catches the sound waves around it. These waves move down a crooked tube to the eardrum, a thin membrane stretched across the tube or canal. Sound waves set the eardrum vibrating. Behind the eardrum are three bones: the hammer, anvil, and stirrup. These magnify the strength of the vibrations and transmit them to the inner ear where they are converted to nerve impulses sent to the brain. If an object is vibrating more slowly than 16 times a second or more rapidly than 20,000 times a second, most humans cannot hear any sound. These sounds are ultrasonic.

Sounds differ in pitch, intensity, and quality. High pitch is related to rapid vibrations, lower pitch to less rapid vibrations. Pitch can be changed by changing the length of the vibrating object, the tautness of the vibrating object, or by the thickness of the vibrating object.

Echoes are reflected sounds. The sound waves moving out from a vibrating object may be obstructed by a high wall or mountain and be turned back to your ears.

Note: All underlined words are new words for pupils.

CONCEPTS

1. Sound is caused by vibrating objects.

2. Sound waves are set in motion when something vibrates.

3. Sound waves travel in all directions from their source.

4. Sound waves travel through many kinds of material.

5. Sound waves can be produced in different ways.

6. The pitch of assound may be altered by changing the length of the vibrating object, the tautness, or the thickness of the vibrating object.

7. Echoes are reflected sounds.

8. The vocal cords in human beings produce sound waves.

9. The ear is the organ through which sound waves come to us.

10. Sound is not possible in a vacuum.

Motivating Ideas

1. Have the children close their eyes and listen very carefully. How many different sounds can they hear?

2. Play a record of varied sound effects or tape the sounds in downtown Boston. How many sounds can you identify?

3. Motivating Experiment - "The Squeaky Straw."

Materials: glass, soda straw, razor blade, water, pencil

Procedure: Stand a soda straw in an empty drinking glass. Make a pencil mark on the straw at the spot where it touches the rim of the glass. At the mark you have made, cut the straw with the razor blade, but only cut the straw nearly all the way, not all the way through. Now fill the glass with water to about 1/2 inch from the top. Stand the straw in the water and bend the top half of the straw across the rim of the glass. Take a deep breath and then blow hard through the end of the straw. You will hear a squeak like the chirping of a day-old chick. Why? The squeaking noise made by the vibrating air in the bottom half of the straw.

CONCEPT I.

Sound is caused by vibrating objects.

EXPERIMENT

Materials: ruler, student's desk

Procedure: Place your ruler across the desk so that it juts out over the edge. Hold the end that is on the table firmly. Push down on the other end of the stick and let it snap back. What do you hear?

ENRICHMENT I

Materials: drum, bits of tissue, paper or cereal

Procedure: Strike the drumhead. Put your hand on it. Did the sound stop when you put your hand on the drum? Now drop several pieces of tissue paper on the drumhead. Strike it again. What happens? What causes the paper to move up and back?

ENRICHMENT II

Materials: table tennis ball, tuning fork

Procedure: Tape a short piece of string to the table tennis ball. Hang it on a hook so that the ball does not touch the wall. Wait until the ball stops moving. Strike the handle of the tuning fork against your rubber heel. Quickly, but gently, touch the ball with one of the vibrating tongs of the fork. What happens?

ENRICHMENT III

Materials: two strips of paper about an inch wide and seven or eight inches long

Procedure: Take the two strips of paper and flatten them against each other. About an inch from one end, place your thumb and second finger around the paper strips and then spread the strips apart near the end. Blow hard between the papers. You will hear a squeaking sound. The sound is made by the fast vibration of your breath.

CONCEPT II

Sound waves are set in motion when something vibrates.

EXPERIMENT

Materials: a rubber heel, tuning fork, small basin filled with water.

Procedure: Strike the tuning fork against the rubber heel. Hold the fork up to your ear. Touch the top of the water in the basin with the vibrating ends of the fork. What did you see when you touched the tuning fork to the water?

ENRICHMENT 1

Materials: basin of water, marble or small stones.

Procedure: Drop a marble into the middle of a basin of water. What do you see? Why?

ENRICHMENT 2

Materials: 15 or more feet of clothesline or light rope

Procedure: Tie one end of the rope to a firm support, such as a doorknob. Hold the other end so that the rope hangs just above the floor. Now, move your hand forward and back quickly. You will make a kind of half-loop in the rope. The loop travels down the rope in a wave.

CONCEPT 3

Sound waves travel in all directions from their source.

EXPERIMENT

Materials: tuning fork

Procedure: Some children should be standing at their desks, some should remain seated, and others should sit on the floor. Select someone to stand in the middle of the room and strike the tuning fork against the heel of his shoe. As the children hear the sound, have them raise their hands.

ENRICHMENT

The above experiment can be done the same way, but only alter the materials used. A metal triangle will give the same effect.

CONCEPT 4

Sound waves travel through many kinds of materials.

EXPERIMENT

Materials: ruler

Procedure: Make the ruler vibrate. Listen carefully. Do the same thing again but this time, press your ear to the desk on which you are holding the ruler. What do you hear this time?

Enrichment 1:

Materials: alarm clock, desk

Procedure: place the clock in the center of the table. Stand nearby and listen. How clearly can you hear the ticking? Now place your ear down on the

Materials: solid brass curtain rod, clock

Procedure: Hold the brass rod so that one end is near your ear and the other end is near the clock. How loud does the tick of the clock sound? Without changing your position, have someone take the rod away. Compare the differences.

Enrichment 3:

Materials: six feet of string, two small tin cans (the same size), candle wax

Procedure: Make a hole in the bottom of each can with a nail. Rub the entire length of the string with the candle. This puts a coating of wax on the string and helps keep it from tangling and knotting. Pull the waxed string through the holes in the two cans. Tie a knot in each end of the string so that the cans cannot slip off the string. Ask someone to hold the open end of one can to his ear. Cup the open end of the other can around your mouth. Move back until the string is stretched tight. Speak softly into the can. Ask your friend to tell you what he heard. Explain by using what you know about molecules of solids transmitting sound.

Enrichment 4

Materials: Piece of string two to three feet long, soup spoon

Procedure: At the middle of the string, attach a soup spoon by tying the string around the spoon in a slipknot. The bowl of the spoon should be free to hand down. At each end of the string make a loop large enough for your finger to fit through. Slip your second finger of each hand into one of the loops. Then put one of your fingers in one ear and the other finger in your other ear, so that the spoon is hanging down in front of you. Lean forward near a table or chair. Swing the spoon so that it hits the table or chair. You will hear a beautiful chime. You can vary this experiment by trying spoons and knives of different sizes. You will hear chimes, each one having a different tone than the other.

CONCEPT 5

Sound waves can be pro duced in different ways.

EXPERIMENT

Materials: drinking straw, rubber band

Procedure: Fasten one end of the rubber band around a door knob or a hook on the wall. Stretch the rubber band by holding the other end around your finger. Blow through the straw onto the middle of the stretched rubber band. Can you feel the vibrations? Stretch the rubber band tighter. What difference does this make in the sound?

Enrichment 1

Materials: drinking glass, piece of fairly stiff wire about three inches long, vinegar, water

Procedure: Bend the wire in the middle into the shape of the letter V. Then place the wire over the rim of the drinking glass. (Make sure the glass is very clean.) Wet the second finger of your right hand with the vinegar. Hold the glass firmly with your left hand. Rub your wet finger along the rim of the glass. Rub it back and forth, but be careful not to touch the wire. In a few moments, the wire will begin to move - even to dance. Why? As you rub the rim the entire glass starts to vibrate. This vibration makes the wire move up and down, so that you see a dancing movement.

A variation of this is to take the wire off the glass, and then pour water into the glass until it is about halffull. Rub the rim of the glass. This time you can actually see the water ripple.

CONCEPT 6

The pitch of a sound may be altered by changing the length, tautness, or thickness of the vibrating object.

EXPERIMENT

Materials: a chalk box, thumbtacks, rubber bands of different thicknesses but about the same length

Procedure: Put thumbtacks into one side of the box at different distances. Stretch rubber bands of different thicknesses around the box. Pluck them.

Notice the difference in pitch of each. Tighten each band by winding it around one thumbtack. Pluck each band. How has the pitch of each changed? Wind the bands a few more turns around the thumbtacks. Pluck each band again. Is the pitch still higher?

Enrichment 1

Materials: eight tall glasses of the same size, pitcher of water

Procedure: Arrange the glasses in a row. Gently tap the rim of each glass with a pencil. Are the vibrations alike? Now set three of the glasses to one side. Fill the first one almost full of water. Tap the rim. How has the sound changed? Is it higher or lower? Pour a little less water into the second glass and still less into the third. Tap each. Which gives the highest tone?

Enrichment 2

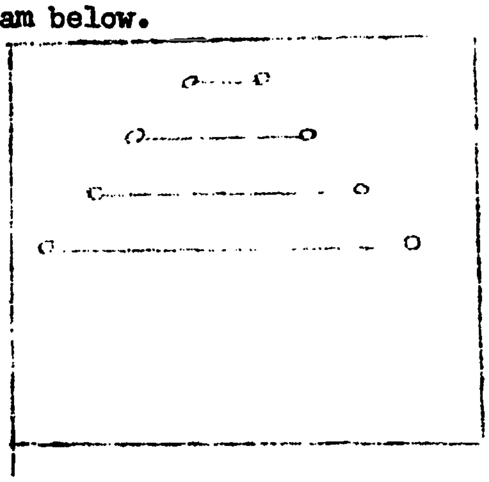
Materials: a comb, piece of thin, stiff cardboard

Procedure: Hold the comb in one hand and the cardboard in the other. Pull the cardboard slowly and steadily along the teeth of the comb. Listen to the pitch. Now pull the card board faster along the teeth. What happens to the pitch? Now draw the cardboard along the teeth very slowly. What happens to the pitch now?

Enrichment 3

Materials: plywood about 3' by 5', nails rubber bands of different sizes

Procedure: You can make a rubber band harp by following the same procedure as in experiment one in this section. See the diagram below.



Enrichment 4

Materials: eight glasses of water filled at different levels, masking tape.

Procedure: Use the same procedure as in Enrichment 1. Use the piano to help you get the tone as accurately as possible. The music teacher may possibly help you. She can help you add and pour out water in order to get just the right pitch. You will soon have a musical scale. Place a piece of tape at the water line to keep the glasses in tune.

CONCEPT 7

Echoes are reflected sounds

EXPERIMENT

Materials: two large tin cans, the larger the better.

Procedure: Have several students yell into a can while the rest of the class notes what happens. Take another can the same size and make several holes in the end of it. What will happen to the sound now?

Enrichment 1

Materials: cloth, can without holes in the end

Procedure: Take a cloth and place it inside the can without holes. What will happen when someone yells into the can? Repeat the experiment, using the other substances such as paper, steel, and wool, and note the difference in sound. Why is the sound different each time? When sound waves hit a hard, smooth solid surface, they are easily reflected, but when they hit a soft substance, such as cloth, they are absorbed.

Enrichment 2

Materials: alarm clock, wool cloth

Procedure: Turn the alarm clock on and wrap it in the cloth. What happened to the sound? Repeat the experiment, using cotton cloth, silk, newspaper, and coat, sweater, shoe box. What is the difference in sound for each of the above substances?

CONCEPT 8

The vocal cords in human beings produce sound wave.

EXPERIMENT

Have the children hum softly, then louder. While they are humming, have them put their fingers against their vocal cords. What do they feel?

Enrichment

Refer to the first experiment under Concept 5.

CONCEPT 9

The ear is the organ through which sound waves come to us

EXPERIMENT

Materials: scarf

Procedure: Blindfold yourself with a scarf. Be careful not to cover yourears, too. Close one ear by holding your finger lightly over the opening to your ear. Ask someone to strike two pencils together in any place in the room. Can you point to the direction from which the sound comes? Ask the person with the pencils to move to other places in the room. As he claps the pencils together, try to point to the direction from which the sound comes. Why is it difficult to do this?

Enrichment 1

Have the children observe how dogs lift their ears and turn them to catch more sound waves. How would this explain them dogs hear some sounds before we hear them?

Enrichment 2

Materials: wheat paste, water, paint

Procedure: Have children construct a papier mache' model of the human ear.

CONCEPT 10

Sound is not possible in a vacuum.

EXPERIMENT

Materials: florence flask or large milk bottle, water, hot plate, glass rod, one-hole stopper, bell

Procedure: Fill the flask partially with water. Boil the water for several minutes. After boiling, take the flask away and insert a one-hole cork stopper. A solid glass rod should be pushed through the hole and a small bell attached to the one end. Let the flask cool for several minutes. Shake the flask in order to ring the bell. Can you hear the bell? Why not? Is there a partial vacuum in the flask? Remove the stopper from the flask and allow some air to enter. Ring the bell again. What does the bell sound like now? Why is it louder? Do you need air in order to transmit sound?

SUPPLEMENTARY EXPERIENCES

1. What is an aural illusion?

Experiment

Materials: empty drinking glass

Procedure: Close one ear with your hand and put an empty drinking glass over the other. Doesn't it seem you are hearing the waves of the ocean? All the small sounds in the air around you cause the glass to vibrate. Then the air inside next to your ears, starts to vibrate. Since it is so close to your ear, it sounds very loud.

2. What is a sympathetic vibration?

Experiment

Materials: violin

Procedure: Sing the note "A" near a violin. The A string on the violin will begin to sing, also. When you sing, you make the air vibrate and this air will make the string of the violin vibrate, but it will only affect the string that corresponds to the note you are singing.

Enrichment

Materials: two soda bottles of the same size and shape

Procedure: Blow across the mouth of one of the bottles. Blow across the mouth of the other bottle. You will hear the same note. Now hold one bottle to your ear while you blow across the mouth of the other bottle. The bottle against your ear will begin to "sing," the same note that you blew across the first bottle.

Try two bottles of different sizes. What happens? The bottle against your ear doesn't sing this time. The two bottles are not "in tune" with each other.

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AUDIO-VISUAL AIDS

Filmstrips

* Sounds Around Us 3-4-E8
* The Sounds We Hear 3-3-D4
Sound (EBF)
Exploring Sound (MH)
The Cause and Nature of Sound (JH)
How Sounds Travel (JH)

Films

Sounds All About Us	(Exploring Science)	Coronet
Nature of Sound		Coronet
What is Sound	(McGraw-Hill Text Films)	

* Indicates filmstrips available in Stoneham Public Schools.

APPENDIX

WORKSHEET IDEAS

Unscramble the Letters

1. Materials that absorb and control noises and echoes.
2. The number of times an object vibrates in a second.
3. The up-and-down, or back-and-forth movement of an object.
4. Describes how low or how high a sound is.
5. Sounds which have such a high frequency we cannot hear them.
6. The way sound travels through air.

Match the numbers to the correct answer below:

A. D O P O F O S G N U I R N

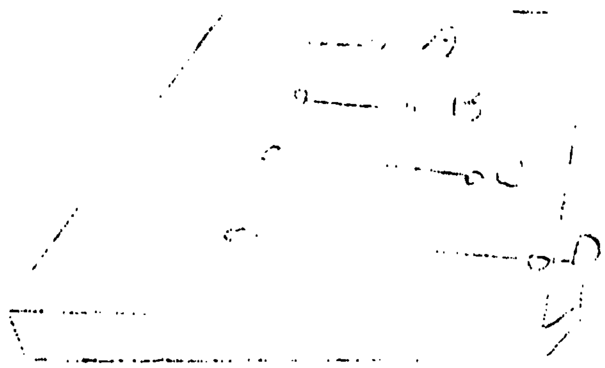
B. Q U E E N F R Y S

C. S N A V B I T O R I

D. T C H I P

E. S L A U T R O N I C D O N U S S

F. N O D S U V E S A W



Ellen hammered four pairs of nails into a thick board, as in the picture.
She got four new rubber bands of the same size and thickness.
She stretched each rubber band around a pair of nails.

1. Were all the rubber bands stretched the same amount? Explain.----------------

2. Ellen plucked rubber band A, then B. Which rubber band do you think gave a sound of higher pitch?--- Why?-----

3. Ellen plucked rubber band B, then C. Which of these rubber bands gave a sound of higher pitch? --- Explain. ---

   Each rubber band vibrated too quickly for Ellen to count its vibrations. Yet she thought she could tell which of the four rubber bands vibrated the fastest.

4. How could she decide?---
   Which rubber band did she choose?----

Solving Problems - Applying the Concepts

A. The following is an idea for an experiment. See if you can figure out what would happen in this experiment from what you know about the nature of sound.

1. Get a glass or metal funnel with a long stem. Cut a large balloon apart to get a sheet of rubber. Stretch the rubber sheet over the bowl of the funnel. Keep the rubber stretched as you fasten it to the funnel with rubber bands. This makes a kind of drumhead. Prepare a lighted candle in a fireproof holder. Point the stem of the funnel at the candle. Run your finger over the rubber sheet as you watch the flame.

2. As you run your finger over the rubber sheet, it vibrates. How do you know?

3. What happens to the flame as the rubber sheets vibrates?----

4. Now point the stem of the funnel a few inches to the side of the flame. Run your finger over the rubber sheet.

5. What happens to the candle flame this time? ----

6. What does this show about the direction in which sound waves travel? ----

B. Some workers were cutting down trees on one side of a mountain range. The rest were cutting down trees on the other side. The foreman blew a whistle to call both groups together. Only those men standing on the same side of the mountain as the foreman heard the whistle.

1. Why couldn't the men on the other side of the mountain hear the whistle?---

2. If the foreman had blown the whistle while standing on top of the mountain, would both groups have heard it? ---- Why? -----

3. Suppose those men on the same side of the mountain as the foreman had been standing 3,300 feet from him when he blew the whistle. How long would it have taken for the sound to reach them?--

4. If the foreman had been in a valley 200 feet from the side of the mountain when he blew the whistle, might he have heard an echo of it? --- Why?-------

BULLETIN BOARD IDEAS

1. Life-size diagram of the human ear. Bell Telephone has an excellent chart of the human ear and sound waves in the telephone kit the 4th grades are sent.

2. Variety of posters showing how pitch may be changed.

3. Variety of posters showing musical instruments and how they produce sound.

4. Poster showing the signs of communication which the deaf use. One could be easily obtained from the School for the Deaf in Boston.

ELECTRICITY - A FORM OF ENERGY

All matter can be classified as either conductors or non-conductors. Conductors contain charges which are relatively free to move over large distances in the material. The following substances are listed in the order of electrical conductivity. silver, copper, aluminum, tungsten, nickel, brass, iron, platinum.

In 1819, the Danish scientist Hans Oersted discovered that when he held a wire carrying an electric current over a compass, the needle was deflected away fron the north-seeking position. In 1820 André Ampère found that a coil of wire carrying and electric current had north and south poles, and behaved like a magnet. The strength of the magnet could be greatly increased by placing a soft iron bar inside the coil. Such a combination is called an electromagnet.

CONCEPTS

1. When certain objects are rubbed, and electric charge is built up in them. (review - structure of an atom)

2. Objects that have like chareges repel each other, and objects that have unlike charges attract each other.

3. Distance affects the pull between charged objects.

4. A flow of electric energy in one direction from one electrode to another produces a direct current.

5. A circuit is a controlled pathway for an electric current flow.

6. Electric current will flow through conductors but not through insulators.

7. A dry cell makes an electric current through a chemical reaction.

8. Wire carrying electric current is surrounded by a magnetic field.

9. An iron core surrounded by a current-carrying coil of wire becomes an electromagnet.

10. Safety rules are an important part of using electricity wisely.

Motivating Ideas

1. Bulletin board - What Is Wrong With This?
   Arrange a bulletin board showing a generating station, transmission towers, houses, and factories in various places. Do not have any wires showing in the display.

2. Make a display of common electrical devices, such as electric bells, motors, and switches. Let the children become familiar with them and tell what they know about how they work.

3. Put out dry cells, switches, lamps, lamp sockets, wire, and let the children connect them in various ways. Let them describe some of the circuits they have made and tell the class how well they worked out.

4. Motivating Experiment - "Magic Comb."

Materials: rubber comb, woolen cloth, ping-pong ball

Procedure: Rub a hard comb of rubber briskly with a woolen cloth. Hold the comb near a ping-pong ball resting on a table. The ball will roll mysteriously toward the comb, attracted by an invisible force. You will be able to lead the ball wherever you like around the table, as if by magic.

CONCEPT 1

When certain objects are rubbed, an electric charge is built up in them.

EXPERIMENT

Materials: tissue paper, rubber comb, wool cloth

Procedure: Tear tissue paper into tiny pieces. Rub a rubber comb several times on a piece of wool cloth. Immediately bring the comb close to the pieces of paper. Do some of the pieces of paper jump up to the comb? Watch the pieces of paper closely. Are some of them eventually repelled by the comb? Why?

Enrichment 1

Materials: hard rubber or plastic comb, wool scarf or sweater

Procedure: Hold the comb by one end. Bring it near your cheek, but not quite touching it. Now rub the comb briskly with the wool. Again, bring it near your cheek. Did you feel a slight shock this time?

Enrichment 2

Materials: comb, plastic pen or pencil, wool

Procedure: Comb your hair briskly. Bring the comb near your cheek. What happens? Hold a plastic pen near your cheek. Rub the pen briskly with wool and bring it near your cheek. What happens?

Enrichment 3

Materials: wool rug, leather soled shoes, metal doorknob

Procedure: Walk across a wool rug with leather-soled shoes on. Then touch a metal doorknob lightly. Did you feel a shock? Why?

Enrichment 4

Materials: comb, woolen cloth, faucet of flowing water

Procedure: Rub the comb thoroughly with a woolen cloth. Bring the tip of the comb close to - but not touching, a thin stream of water flowing from a faucet. As the stream falls, it will bend toward the electrically-charged comb.

Enrichment 5

Materials: sheet of newspaper, chalkboard, wool

Procedure: Hold a sheet of newspaper against the blackboard. Rub the paper with a piece of wool. You can use the sleeve of your coat if you have no other wool around. Rub the paper until it stays against the blackboard. Without holding the paper, and using just one hand, fold the paper twice. The paper will stay against the blackboard while you fold it.

CONCEPT 2

Objects that have like charges repel each other, and objects that have unlike charges attract each other.

EXPERIMENT

Materials: two balloons, thread, wooden support.

Procedure: Blow up two ballons and tie the neck of each tightly. Use thread to hang the balloons from a wooden support. The balloons should just touch. Now rub one balloon briskly with a wool scarf or sweater. Do the same with the other. Let the balloons go. What happens? Rubbing charges each negatively and they repel.

Enrichment 1

Materials: comb

Procedure: Have each child choose a partner. Each person will need his own comb. One should comb his hair briskly and then take the comb away. What happens to the hairs on your partner's head? Electrons seem to move from hair to comb. Thus, the hairs become positively charged and repel each other.

Enrichment 2

Materials: two strips from an old nylon stocking, about 2" wide and 10" long;paper folded crosswise

Procedure: Hold the strips so that they hang side by side. Then hold the paper so that the strips are inside it. Press the paper together, and pull it down and away quickly. What happens to the strips? Why? (electrons can be rubbed rather easily off the atoms of which nylon is made.)

Enrichment 3

Materials: two balloons, wooden support, wool.

Procedure: Hang two balloons from a support. Charge them negatively by rubbing each with wool. Why do the balloons repel each other? Now bring the wool near one of the balloons. What happens? What kind of charge does the balloon have? (-) What kind of charge does the wool have? (+)

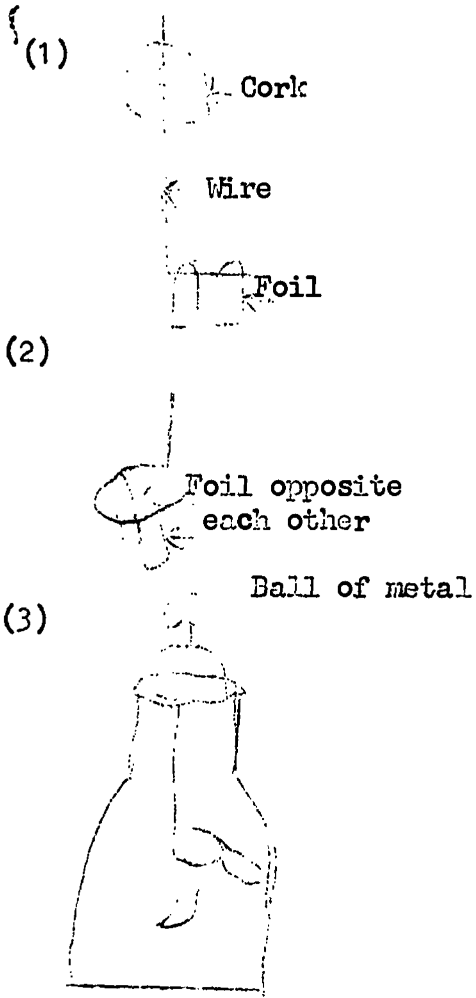
Enrichment 4

Materials: puffed cereal, piece of wool, wooden support, needle and thread, rubber or plastic comb.

Procedure: Thread the needle with a piece of thread about 12" long. Make a knot at one end of the thread. Draw the needle and thread through a piece of the puffed cereal. Now tie the thread to the wooden support. Now put a negative charge on the comb by rubbing it with wool. Bring the comb near the cereal again. What happens? The cereal is attracted and repelled. Why?

Explanation: When the charged comb was held near the cereal, the cereal was attracted to the comb. Probably the electrons on the side of the cereal nearest the comb were being repelled by the negatively charged comb. If electrons move away from the side of the cereal nearest the comb, then that side would become charged positively.

The positively charged cereal was attracted by the negatively charged comb. This is actually producing an electrical charge on a neutral object.



Enrichment 5

Materials: large bottle with a cork that fits, 6" length of copper wire, metal foil, and scissors

Procedure: Making an Electroscope- Push the wire through the cork, leaving an inch showing above the top. Bend about 2" of the lower end of the wire at a right angle. With scissors, cut two strips of the metal foil about $1\frac{1}{2}$" long and $\frac{1}{2}$" wide. Coil one end of each strip and place the strips on the bent end of the wire. Then bend the wire back on itself so that the strips are close together. Carefully fit the cork in the bottle, making sure that the strips do not touch the bottom. Make a ball of metal foil and stick it on top of the wire. This will be the knob of your electroscope.
Charge a comb and bring it near the foil knob. Do not touch the knob with the comb. What happens to the metal strips? Why? (comb charged -, strips become -) Remove the comb;what do the strips do now?
Charge a glass rod positively by rubbing it with silk cloth. Bring the rod near the foil knob. Again the metal strips swing apart. Why?

CONCEPT 3

Distance affects the pull between charged objects

EXPERIMENT

Materials: two balloons;piece of wool two glass rods, piece of silk

Procedure: Rub two balloons with wool. Place the balloons far apart on the table. Bring the balloons closer together. Next rub the glass rods with silk. First, hold them far apart. Then, slowly move them toward each other. What happens when the balloons are far apart? What happens when the balloons are close together? What happens when you hold the rods far apart? What happens when you bring the rods closer together?

CONCEPTS 4 and 5

A circuit is a controlled pathway for an electric current flow.

EXPERIMENT

Materials: light bulb, dry cell, insulated copper wire, knife switch

Procedure: Have children attach one piece of the copper wire to one pole of the dry cell, and the other copper wire to the other pole. (be sure the ends of the insulated wire are scraped.) Attach one end of wire to the light bulb. Attach one wire to the knife switch. Close the switch. Does the light bulb go on? Why not? What is wrong? Why is there not a complete circuit? How many pieces of wire do we need? (three)

Enrichment 1

Materials: tin shears, metal, two nails, dry cell, light bulb, wood

Procedure: With tin shears, cut a narrow strip of metal fron a tin can. File the edges and rub sandpaper on the strip to remove sharp edges. Bend the strip at two angles (__/‾‾‾). Pound a nail part of the way into one end of a small board. Then nail the strip to the board, leaving a small space under the nail head. Make sure that the end of the strip does not touch the first nail. With wire, connect one nail to a flashlight bulb, and the other to a dry cell. Then connect the dry cell and the flashlight bulb. Now press down the strip so that it touches the nail head. What happens?

Enrichment 2

Materials: metal foil as from a gum wrapper, two pieces of copper insulated wire, dry cell, wood, tacks

Procedure: Cut a piece of metal foil so that the middle is very narrow. Tack the foil to a piece of wood. Attach a piece of insulated wire to each tack (be sure to scrape ends.) Touch the other ends of the wire to the posts of a dry cell. What happens to the piece of metal foil? Why? How is the flow of electric current affected? Do our fuses at home work the same way?

CONCEPT 6

Electric current will flow through conductors but not through insulators.

EXPERIMENT

Materials: flashlight bulb, tape, dry cell, piece of wood, two nails, three pieces of copper wire

Procedure: Drive two nails into a block of wood. Tape the bare end of a wire to the screw base of a flashlight bulb. Tape the bare end of another wire to the button on the bottom of the bulb. Connect one wire from the bulb to one nail and the other wire to a dry cell. Then, connect the second post of the dry cell to the other nail. Does the bulb light? Now place a piece of copper wire between the nails. Does the bulb light? Test other materials by placing them between the nails. Try materials such as a rubber band, an iron nail, a paper clip, a plastic comb, paper, wood, and string. Remove some insulation from a piece of electrical wire and test the insulation.

CONCEPT 7

A dry cell makes an electric current through a chemical reaction.

EXPERIMENT

Materials: five dimes, five pennies, piece of blotting paper, salt, bowl of water.

Procedure: Cut the blotting paper into shapes about the size of the coins. Soak the blotting paper in salt water for a few moments. Now make a pile in the following way: one dime, one piece of wet blotting paper, one penny.

Build up the pile in this order until you have used up all your coins. Begin with a coin and end with a coin. To feel the current, moisten the tips of both your forefingers and hold the pile up with them. You will feel a slight, harmless electric shock.

Enrichment 1

Materials: paper clip, copper wire, lemon

Procedure: Stick copper wire and paper clip into the lemon. Hold ends of wire close together, (not touching) and touch them to your tongue. You will feel a slight tingle and metallic taste due to current of electricity.

Explanation: Electric cells are basically composed of two unlike substances (paper clip and copper wire) and a solution to carry a current (lemon). "Citrus Cell."

Enrichment 2

Materials: dry cell, chisel, blotting paper

Procedure: Have a team of children take a dry cell apart. Have them find each part: carbon rod, moist paste of chemicals, two metal poles of opposite charges.

CONCEPT 8

Wire carrying electric current is surrounded by a magnetic field.

EXPERIMENT

Review of magnetic field

Materials: bar magnet, sheet of paper, iron filings

Procedure: Lay bar magnet on a table. Cover magnet with paper. Sprinkle iron filings on the paper evenly. Tap paper lightly. Iron filings arrange according to lines of force.

Enrichment

Materials: dry cell, iron filings, knife, switch, screwdriver, cardboard about 10" squ., two (36") pieces of insulated copper wire

Procedure: Work as partners. Make two piles of books, each about 4" high. Place the piles 6" apart. Make a hole in the center of the cardboard. Then, pull one of the pieces of wire through the hole. Place the cardboard across the piles of books. put a book on each end to hold it steady. Set up an electric circuit with the dry cell, wires, and the switch. Leave the switch open. Sprinkle iron filings on the cardboard. Tap the cardboard gently. Notice the filings. Now, close the switch. Quickly tap the cardboard again. Open the swithh and notice the filings.

CONCEPT 9

An iron core surrounded by a current-carrying coil of wire becomes an electromagnet.

EXPERIMENT

Materials: dry cell, nail, insulated copper wire

Procedure: Wind an insulated wire many times around a large nail. Wind the wire from the head of the nail almost to its point. Leave a foot of wire free at each end. Reel the insulation from the ends of the wire. Connect one end of the wire to one post of a dry cell. Hold the nail near a pile of paper clips. Does anything happen? Why not? Now keep the nail near the paper clips and then touch the other end of the wire to the second post of the dry cell. Does the electric current in the wire make the nail act as a magnet?

Enrichment

Materials: two dry cells, five pieces of insulated wire, nails, paper clips, assorted metal objects

Procedure: Connect an electromagnet using the same procedure as the above experiment. Then, begin winding more and more wire around the nail. Notice how many metal objects you can pick up as the strength of the wire becomes stronger. Then connect another dry cell to the first dry cell. What happens to the strength of the magnet?

CONCEPT 10

Safety rules are an important part of using electricity wisely.

DISCUSSION

Discuss with the children the rules of safety in using electricity. Make a chart of the following rules:

1. Never plug in an extension cord or an electric appliance if the insulation is worn or coming off the wire.

2. Never replace a burned-out fuse with a new one having a different number on the metal strip.

3. Never put your fingers inside an empty light-bulb socket.

4. Never place electric cords underneath rugs.

5. Never touch a switch when your hands are wet, or when any part of your body is in water or is touching a water pipe, faucet or radiator.

6. Never leave electrical appliances turned on if they are not being used.

7. Never fly kites near electric power lines.

8. Never go near fallen or hanging outdoor wires.

9. Never go near poles or towers that carry electric wires across long distances.

Supplementary Experiences

1. How can electricity be used to give off heat?

Experiment

Materials: pliers, dry cell, insulated wire

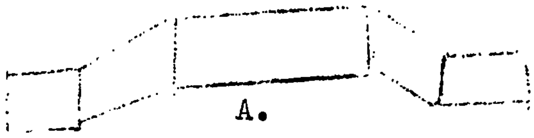
Procedure: Connect one end of a thin copper wire to one post of a dry cell. Using pliers to hold the wire, place the other end of the wire on the second post for only a few seconds. Does the wire become warm? In two or three seconds the wire may become too hot to touch.

2. How can you make a telegraph system?

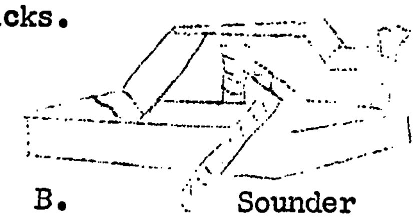
Experiment

Materials: metal from a tin can, wire, two pieces of wood, some mails, a screw, and a dry cell, tin shears

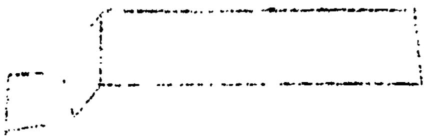
Procedure: Pound a thick nail into a small piece of wood. Wind about 100 turns of insulated wire around this nail to make an electromagnet. Leave about two feet of wire free at each end. With tin shears, cut two narrow 5" strips from a tin can. File the edges of the strips and sandpaper them. To make the sounder, bend one of the metal strips as shown below. Fasten one end of this strip with a small nail to the piece of wood with the electromagnet on it. Adjust the metal strip so that it passes directly over the electromagnet. Turn a wood screw into the other end of the piece of wood so that the end of the metal strip fits under the head of the screw. The distance between the electromagnet and the metal strip can now be adjusted by simply turning the wood screw. To make the key, pound another nail into one end of the second block of wood. Bend the second metal strip as shown below. With a small nail, fasten one end of the metal strip to the block of wood so that the other end is just above the nail. Leave a small space under the head of the small nail. Connect the bare ends of one insulated wire from the electromagnet to one of the posts of a dry cell. Connect the bare ends of another insulated wire from the electromagnet to the small nail on the sender. Now pound the small nail all the way into the board. This will hold the wire in place. Wrap the bare end of another insulated wire several times around the other nail on the sender. Connect the other bare end of this wire to the other post of the dry cell. Press the metal strip on the sender down to the nail and release it. You should hear two clicks.



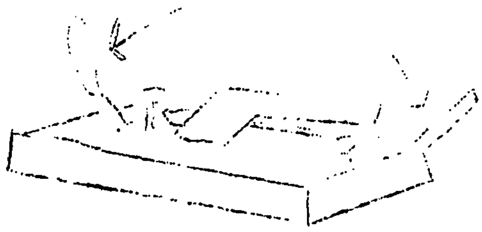
A.



B. Sounder



C.



D. Key

3. How can simple galvanometer be made?

Experiment

Materials: dry cell, compass, wire

Procedure: A galvanometer is a meter for detecting small currents of electricity. It can be made by wrapping wire around a compass. When the ends of the wire are touched to a source of electricity such as an electric cell, the compass needle will move. After wrapping the wire around a compass, try touching the ends of the wire to the terminals of several different cells. Watch the compass needle carefully. What happens? Touch the ends of the wire to the terminals of an electric cell. Watch the compass needle. Then touch the wire to the terminals again, this time using opposite terminals. What happens? Why does the compass needle move? How is electricity connected to magnetism?

4. How can you make a light bulb?

Experiment

Materials: Two dry cells, wire, cardboard, small glass jar.

Procedure: Scrape the insulation off the ends of two pieces of copper wire. Push the uncovered wire through the cardboard so that they are about an inch apart. Unwind one thin strand from a short length of picture wire. Wrap the strand around the ends of the copper wire. The thin wire now will serve as a filament. Rest the cardboard on the jar with the picture wire inside. Connect the free ends of the copper wires to a switch and two dry cells. Look at the picture wire as you close and open the switch quickly. Does the picture wire glow? You will find that the wire will burn and break if the switch is left closed.

5. Can you light a flourescent lamp in your hands?

Experiment

Materials: flourescent tube, wool

Procedure: Remove a flourescent lighting tube from its sockets and take it into a darkened room. Rub it briskly with a piece of wool and it will light up!
This works best on a cold, dry day.

Explanation - Rubbing gives the glass an electrical charge by removing electrons. Movements of these negative electrical particles produce the current which lights the lamp in the magical manner.

6. How is an electric cell made?

Experiment

Materials: copper penny, iron washer, steel wool, 1" square of white blotting paper, vinegar, wire, galvanometer

Procedure: Clean with steel wool the copper penny and washer. Soak the blotting paper in vinegar. Place the wet blotting paper between the washer and the penny. To detect the feeble current produced by the cell, you can use the simple galvanometer described in #3. Touch one wire of your meter to the penny and the other wire to the iron washer. Squeeze the wires between your fingers to improve your "electrical sandwich."

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Walter, Helen. Nikola Testa: Giant of Electricity. New York: Thomas Crowell, 1961.

Audio-Visual Aids

Filmstrips

* Electricity in Everyday Life	3 - 2 - D1
* The Wonder of Electricity	3 - 3 - F2
* The Wonder of the Electric Light	3 - 3 - F3

Films

Electricity All About Us.	Coronet
Electricity from Power Plant to Home.	MGH
Electricity: How To Make A Circuit.	EBF
Electricity Works for Us.	MGH
Electromagnets.	MGH
Electromagnets: How They Work.	EBF
Flow of Electricity.	MGH
Series and Parallel Circuits.	CEN
Simple Demonstrations With Static Electricity.	Coronet
Static Electricity.	CEN

* Indicates filmstrips available in Stoneham Public Schools.

APPENDIX

Bulletin Board Ideas

1. How Do We Use Electricity? Mount pictures of various electrical devices - electric lamps, toasters, heaters, mixers, vacuum cleaners. Have the children discuss how these appliances operate and what part electricity plays in this operation. Have them try to figure out how the various types of work might have to be done if no electricity were available.

2. Where are the Electromagnets? Put up pictures of electric bells, buzzers, telephones, telegraphs. Have the children tell where the electromagnets are and then describe their function in the operation of the device.

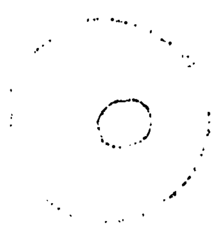
3. What Did These Men Add To Our Knowlege Of Electricity? Obtain pictures of scientists and engineers who made contributions to the study and use of electricity. Ask the children to read and find out what each person did. Include pictures of William Gilbert, Michael Faraday, Alessandro Volta, George Ohm, Andre Ampire, James Watt, Luigi Galvani, Thomas Edison, Hans Oersted, and others.

WORKSHEET IDEAS

Identify the following atoms by telling how they are changed:

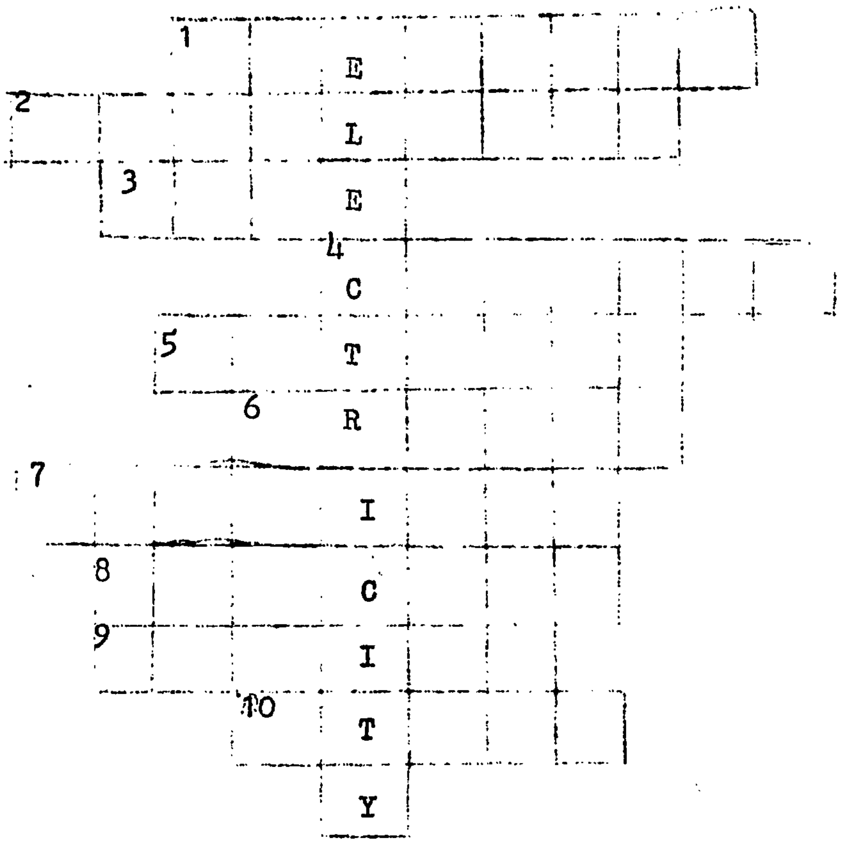
Make this atom balance. What did you do?

Now change the atom so it will be negatively charged.



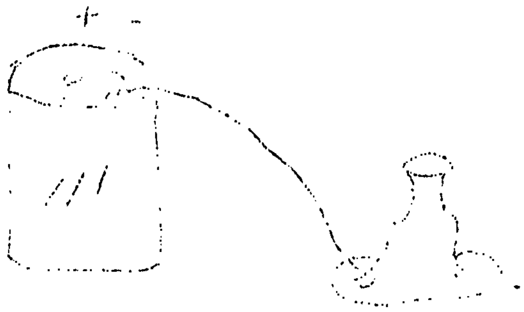
CROSSWORD PUZZLE

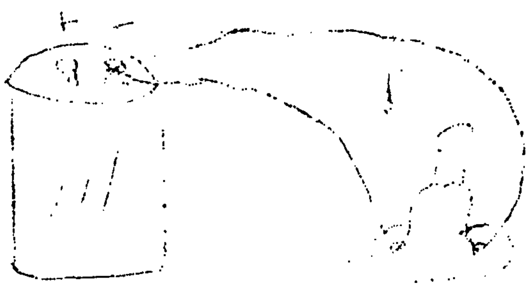
1. The part of the atom that has a - (negative) charge.
2. Poor conductor of electricity.
3. Protects your home when electric wires are overloaded or broken.
4. The kind of electricity that lights our houses.
5. Anything that fills space.
6. The part of an atom with a (postive) charge.
7. Electricity which is at rest on an object.
8. A good path for electricity.
9. To circle around something.
10. What all matter is made up of.

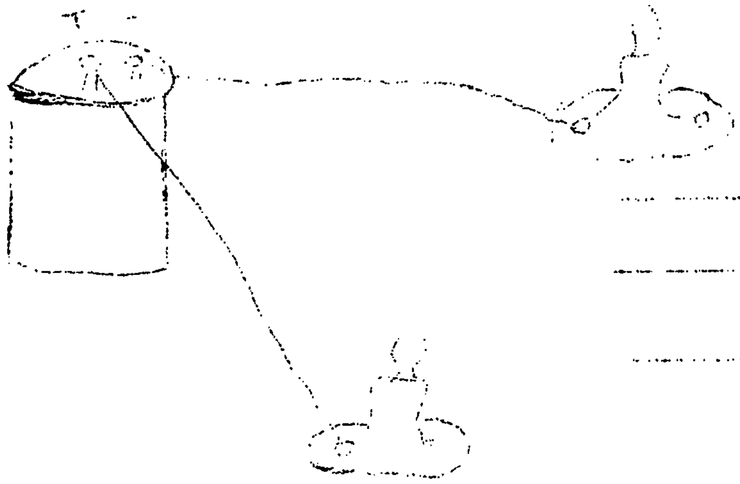


WORKSHEET IDEA

None of the lamps in the pictures below are lighted. Trace the circuits and tell why they do not light.







ANIMALS - SIMPLE AND COMPLEX

Animals - Simple and Complex

Background

From earliest times it was believed that living things can originate from non-living material. Known as the doctrine of spontaneous generation, this was the view of the classical philosophers. It was the generally accepted view all through the Middle Ages and well into the 17th century. Francesco Redi did an experiment to prove that living things come only from other living things. He used gauze to cover a jar containing a piece of meat. As the meat began to rot, flies were attracted to it by its odor. The flies laid their eggs on the gauze. Later, worms appeared on the gauze. They had hatched from the eggs. They were not true worms but maggots which later changed into flies. Redi had shown that the worms were not made from the meat at all.

To keep alive, all living things must carry on certain life activities. These life activities include getting and using oxygen and food, removing wastes, and producing offspring.

With minor exceptions (viruses) all living things contain cells. All living cells utilize oxygen in order to produce energy; all cells eliminate cellular wastes; all cells grow; most cells reproduce. Many cells are organized with their neighbors to form a system for carrying out special functions more efficiently.

There are distinguishing differences between plant and animal life. On the cellular level, both contain cell membranes, nucleus, and cytoplasm. However, only plant cells have cellulose walls, large sacs or vacuoles containing water and wastes, and chlorophyll. Plants have only limited motion, while animals can move about with varying degrees of freedom. Plants can manufacture their own food but animals cannot.

It is important at this level to convey how scientists classify living things, bringing order to a very complicated universe. By grouping together the animals that have certain homologous features in common, scientists can classify several million forms into a relatively small number of groups. Such groups are called phyla. Within the phyla, we can examine other sets of homologous characteristics and further subdivide into class. By further progression in this manner, we can place all animal life in a system of classification based on their similarities and differences. The common progression is as follows: Kingdom, Phylum, Class, Order, Family, Genus, Species. The proper names are not as important at this level as the idea of classifying by common characteristics is. The following chart may be used by the teacher to guide the children in classification:

ALL THINGS

Living
Non-living

Classifying Living Things By Structure

Animals
Plants

Animals

Vertebrates
Invertebrates

Mammals
Birds
Reptiles
Fishes
Amphibians

Arthropods
Others
Insects
Arachnids
Crustaceans
Many-legged

Classifying Living Things By Effects, Environment, or Activities

Effects

Helpful
Harmful

Environment

Terrestrial
Fresh Water
Salt Water

Activities

Producers
Non-producers

* See Appendix for detailed classification

Concepts

1. To keep alive, all living things must carry on certain life activities.

2. All living things are made up of cells.

3. There are ways of distinguishing between plants and animals.

4. The kinds of animals range from very simple to highly complex ones.

5. The classification of animals is based upon comparative structure.

6. Animals are adapted to the environments in which they live.

Motivating Ideas

1. Build a small aquarium as a class project. Discuss the need for supplying food, air, and proper temperature to keep the fish alive. Talk about how wastes will be taken care of. Let children understand the need for plants as oxygenators and to provide food for the fish, and the need for a few snails to remove wastes. Place a male and female of the same species in the tank, allowing for reproduction. Discuss the idea of a balanced aquarium, where there is an interdependence between animal and plant life. See Gr. 3. Guide for setting up aquarium.

2. Bulletin Board - Plants or Animals?

Have pictures of living things which are very difficult to classify - examples, pitcher plant, venus fly-trap, bladder wrack, sea anemone, algae, hydra.

3. Obtain microscopic slides of ameba or paramecium from a supply house. (see appendix). Or mount a drop of pond water on a clean glass slide and show it on a microprojector. Observe the many kinds of microscopic life.

4. Show the film - Life in a Drop of Water. Coronet films.

Note: Underlined words are new words.

Concept 1 - To keep alive, all living things must carry on certain life activities.

Experiment - Build an aquarium. Refer to Motivating Ideas #1.

Enrichment #1 -

Materials: goldfish, two jars, one containing water which has been allowed to accumulate air bubbles by standing for several hours, and another containing water which has been freshly boiled and allowed to cool to room temperature; dip net

Procedure: With a dip net, place a healthy goldfish in the second jar. As soon as the fish appears at the surface to gulp air, remove it to the first jar. Have pupils note the difference in the behavior of the fish in the two jars.

Enrichment #2 - Make a chart of the activities necessary to living things: using oxygen; using food; removing wastes; reproducing offspring. Make a checklist of things to be compared - Living or non-living? A few examples could be desk, table, bird, bee, boy, crayon, etc.

Concept 2 - All living things are made up of cells.

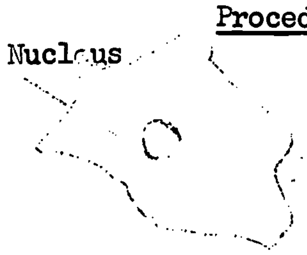
Experiment -

Materials: set of children's blocks

Procedure: Have a child build a structure with a set of blocks. Take one block away. What happens? Discuss and compare how a cell is the building "block" of life. Use what the children already know about molecules.

Enrichment #1 -

Materials: microscope, slide of an ameba



Procedure: Have a microscope set up with an ameba slide in it. This simplest one-celled animal is an excellent example to show what a cell is like. See diagram to the left. Note: amebas continually change shape; they engulf their food and reproduce by fission.

Enrichment #2 -

Materials: microscope, slides of connective tissue, muscle tissue, human hair, cheek-lining tissue

Procedure: Have children prepare slides or order slides from supply houses. (see appendix). Notice how many cells make up a tissue.

Concept 3 - There are ways of distinguishing between plants and animals.

Experiment -

Materials: microscope, slides of a cross-section of a leaf, root cells, muscle tissue, connective tissue

Procedure: Have several microscopes set up with above-mentioned slides. (If a microprojector is available, the entire class can see the slides.) Notice the distinguishing characteristics between plant and animal cells: Only plants have cellular walls, large vacuoles containing water and wastes, and chloroplasts.

Enrichment #1 - Refer to bulletin board under motivating ideas, #2. Emphasize how plants have limited motion and can make their own food.

Enrichment #2 - Have children make a survey in their own neighborhood. Have them make a chart distinguishing between plants and animals. Follow-up: Play 20 questions.

Enrichment #3 - Have the pupils prepare reports on sponges, barnacles, oysters, Venus fly-traps, sundews, and bladderworts. Have them consider these questions. Can this living thing move from place to place? Does it move in every stage of its life? How does it obtain food? How is it classified?

Concepts 4 and 5 - The kinds of animals range from very simple to highly complex ones.

The classification of animals is based upon comparative structure.

Experiment -

Materials: set of varied shapes of books, children of varied sizes

Procedure: Set a wide variety of books on a table. Have children compare them: size, color, shape, number of pages, depth, printing size, pictures. Compare children of different sizes. How could we group each into sets, subsets?

Enrichment #1 - Have pupils survey the animals in their neighborhoods. They may include pet dogs, cats, fish, birds, turtles, etc. The survey should include observations on how these different animals breathe, eat, reproduce, move, get rid of wastes, and are sensitive to stimuli.

Enrichment #2 -

Materials: microscopes, slide of the hydra (two layers of cells)

Procedure: Have the children study the slide of the hydra. How does it compare with the ameba? What do you notice about the cells? Why does the hydra have more cells? Note picture below.

Cross-Section of a Hydra's stinging cell.

Enrichment #3 - Discussion - Do you think it would be possible for one man to build an automobile all by himself? Discuss the problems involved including construction of special parts, special tools and machines, special skills required. Determine the advantages of having different men, each skilled in his own way, to do different jobs. Speed, uniformity of product, and better quality would result.

Draw an analogy with living things by discussing an imaginary ameba grown to a gigantic size. Talk about the difficulties it would encounter in attempting to carry on its life activities. The discussion should lead to the conclusion that the efficiency of the organism would be greatly increased if, instead of one large cell, many cells were used, each one capable of doing a special type of work. Refer back to the hydra.

Enrichment #4.

Materials: stamp collection

Procedure: How are stamps classified? Emphasize color nationality, denomination, subject matter, size, or shape

Enrichment #5

Materials: pictures of fish, frogs, turtles, snakes, alligators, amebas, birds, cows, etc.

Procedure: Divide the class into several groups with pictures of animals in each division of the animal kingdom. Deduce the special characteristics of each group of animals. Deduce further the presence of a backbone in some groups.

Enrichment #6- Show the film Animals with Backbones, available in the Stoneham Schools.

Enrichment #7- Discussion - How are human beings adapted to being so complex? What different parts of the body do special things? (heart, lungs, eyes, brain, kidneys) Are these made of many cells?

Concept 6 - Animals are adapted to the environments in which they live.

Activity - Have a display of pictures of animals from different environments such as the camel, the fish, polar bear. Discuss how each is adapted to fit its environment, for example, the camel's eye lashes are quite long to protect against the blowing sand, gills of a fish to breathe in water, polar bear's snowshoe-shaped feet to walk on the snows of the Arctic.

Refer to Roads to Everywhere. Ginn, 1961, pp 268-277. "When You Go to the Zoo." Glenn O. Blough and Marjorie H. Campbell.

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Audio-Visual Aids

Films

Life in a Drop of Water. Coronet.

Life Science: Response in a Simple Animal. Film Associates of California.

The Microscope and Its Use. McGraw-Hill Book Co.

Microscopic Life: The World of the Invisible. Encyclopedia Britannica Filsm.'

Protozoa (One-celled Animals) Encyclopedia Britannica Films.

* Animals With Backbones

* Available in Stoneham Public Schools

Filmstrips

Bacteria - Good and Bad. McGraw-Hill Book Co.

Introduction to the Microscope. Society for Visual Education.

* How Amphibians Get Their Food	3 - 1 - E2
* How Fish Get Their Food	3 - 1 - E3
* How Insects Get Their Food	3 - 1 - E4
* How Reptiles Get Their Food	3 - 1 - E5
* How Birds Get Their Food	3 - 1 - E6
* How Mammals Get Their Food	3 - 1 - E7
* How Animals Are Protected From Their Enemies	3 - 1 - C1
* Animals Affect Man and Other Living Things	3 - 2 - C6

* Available in Stoneham Public Schools

Community Resources

Walter D. Stone Memorial Zoo	Stoneham
New England Aquarium,	Boston
Science Museum	Boston

APPENDIX

Biological Supply Houses

National Teaching Aids, Garden City Park, New York.

Has inexpensive sets of microviewers and slides, ideal for showing cellular structure.

Denoyer-Geppert C., 5235 Ravenswood Ave., Chicago, Illinois

16 page booklet, "Aquariums and Terrariums in Your Classroom." (free)

Stansi Science Kit. Materials and apparatus for use in elementary school. Order from Standard Science Supply Company, Chicago, Illinois

Curriculum Materials Center, 5128 Venice Boulevard, Los Angeles, 19, Calif.
Write for catalogue.

Science Materials Center, 59 Fourth Avenue, New York 3, New York
Write for catalogue.

Science Education Products Co., 2796 Middlefield Road, Redwood City, Calif.
Write for catalogue.

Central Scientific Co., 1700 Irving Park Rd., Chicago, 13, Illinois
Special Elementary science apparatus catalogue.

Worksheet Ideas

A. Crossword Puzzle

1. What kind of cell helps us to move?

2. What is a simple one=celled animal?

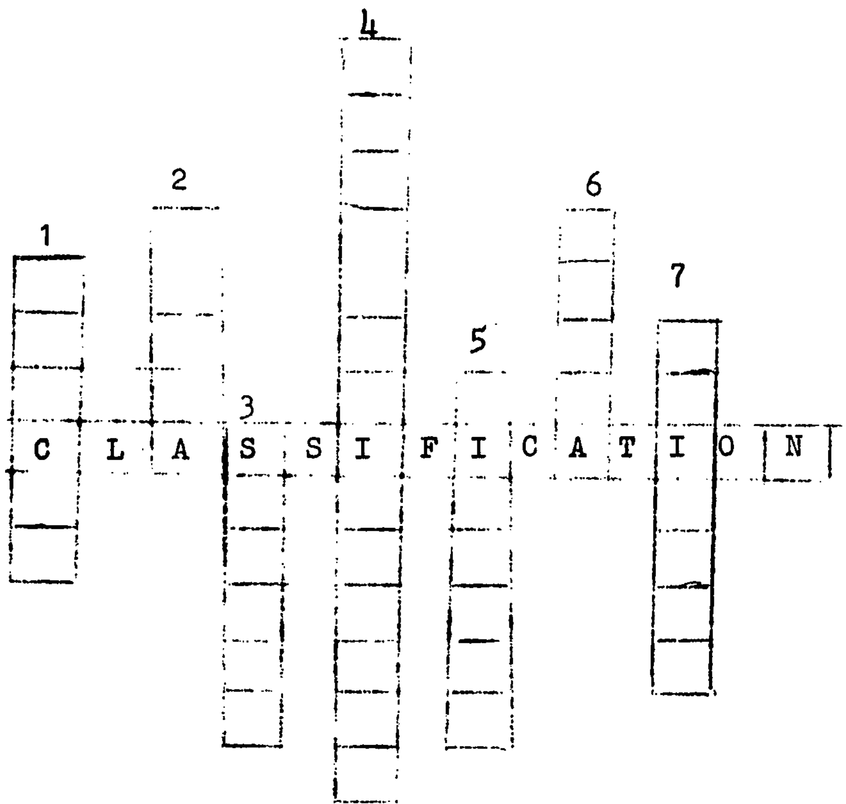
3. What are we making when we look for something and keep a record of what we find?

4. What do we call these things: using oxygen, using food, and getting rid of wastes?

5. What is the study of living things called?

6. What is a simple many-celled animal?

7. What is a complicated many-celled animal?



Who Am I?

If you guess on the first clue, you get 3 points; on the second clue, 2 points; on the third clue, 1 point.

1. I live in the water, but I breathe in air.
2. I am the biggest animal that lives in the ocean
3. I am not a fish.
4. I cannot fly, but I am a bird.
5. I look as though I am wearing a man's suit.
6. I live near the North and the South Poles.

Now make up your own "Who Am I?" questions.

Classification Game

All the items below are mixed up. Put the items under the correct heading:

	GLASS	METAL	PAPER	CLOTH
wool mitten				
package of Kleenex				
paper cup				
tea kettle				
test tube				
magazine				
wash cloth				
envelope				
window pane				
scissors				
necktie				
hair ribbon				
door knob				
water glass				

Bulletin Board Ideas

1. Plants or Animals? Refer to Motivating Ideas #2.
2. Display of Invertebrates Vs. Vertebrates.
3. Chart of an Ameba, blown up to life size showing the components of a cell.
4. Display of an evolutionary scale starting with the ameba and culminating with the human being.

Detailed Classification

Invertebrates

Protozoa - smallest, all consist of a single cell.
Arthropoda - largest group, have skeletons outside their bodies, bodies are jointed and they have legs. They include centipedes and millipedes, lobsters, crabs, and spiders, and insects.

Vertebrates - backboned animals

Fish - cold-blooded, gills, covered with scales.
Amphibians - cold-blooded, breathe by gills when young and with lungs as adults; covered by a smooth, often slimy skin. Examples: frogs, salamanders.
Reptiles - cold-blooded, lungs, covered with scales. Examples: snakes, turtles, alligators, crocodiles.
Birds - warm-blooded, lungs, covered with feathers.
Mammals - warm-blooded, lungs, hair growing over their bodies, feed their young with milk produced by mammary glands.

PLANTS - THE WORLD'S FOOD-MAKERS

PLANTS - The World's Food-Makers

Background

The endless cycle of food production, consumption, utilization for energy, deterioration, and eventual re-use of raw materials has its beginning in the green plant.

All living things are dependent for their food on the sun's energy, which is trapped by green plants. This fact raises the question of how many people the earth can comfortably support. The answer ultimately depends on the amount of the sun's energy that can be trapped by photosynthesis. Possibly 80 to 90 percent of photosynthesis occurs in marine and fresh water environments. This may be a clue to a new source of food. Perhaps we can farm the sea, or cultivate in tanks, algae fit for food.

Inside the green leaf, carbon dioxide from the air is combined with water from the soil in a chemical process which utilizes light energy to produce sugar and oxygen. Only green plants, plants containing chlorophyll, can do this. The chemical reaction for this process may be written: $6\ CO_2 = 6\ H_2O \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6O_2$

Sugar (gluecose) is stored by the plant in a compact form as starch.

The leaves, branches, stems, and roots of plants exhibit a unity of function associated with food-making, storing, and transport.

The stem of a plant plays at least two major roles. First, it provides support for the leaves and tissue involved in photosynthesis. Second, it carries, or transports materials from leaves to roots and from roots to leaves. The materials transported by stems are of two types: water plus dissolved mineral salts, which are taken in by the roots; and sugar, formed in the leaves.

Every living cell in a plant requires food energy. The sugar manufactured in the leaves is used by these cells and the excess is stored for future use. In the corn plant, for example, the food made in the leaves is used as follows: 25% to supply current energy needs, 50% for growth and repair, 25% stored. The stored foods are usually in the form of sugars and starches, proteins, fats, and oils.

The key to plant survival is adaptation. For example, the cactus stems contain many water storage cells. Elodea, the common aquarium plant, can live submerged. Cotton, requiring 200 growing days, grows only in tropical or semitropical regions. These adaptations are hereditary, not intentional, and the cause of the initial adaptation can only be guessed at.

Diseases and weeds are harmful to plant growth. Weeds are a hindrance to plants in that they compete with the crop for minerals and moisture; they reduce the yield of a crop; they provide hosts for diseases and shelter for harmful insects; and they increase the labor of cultivation and harvesting.

In order to prosper, plant life must have continuous supplies of light, carbon dioxide, oxygen, water, and mineral salts. Where these are deficient, man attempts to supply them.

A seed contains the embryonic plant, and has a large supply of sugars and starches available for its first period of growth. When the seed produces the first green leaves, it is a seedling and no longer depends on stored food. It then needs all the nutrients required by larger plants.

Concepts

1. All living things are dependent upon green plants for food.
2. Green plants carry on photosynthesis (energy is needed).
3. The structure of green plants makes it possible for them to carry on food-making processes.
4. Molecules are in constant motion inside plants.
5. Green plants are adapted to different environments.
6. Man protects plants from their natural enemies and provides materials needed by plants.

Supplementary Concepts

1. Structure is the most important element in the scientific classification of plants.
2. There are important relationships between structures and functions of plants.

Motivating Ideas

1. Encourage children to bring many kinds of seeds to school, and use them for germination experiences. Let the group discuss likenesses and differences among the growing plants. Watch for roots, stems and leaves to appear. Discuss the action of molecules in growth.

2. Visit a botanical garden or a nursery. The Boston Public Gardens has an excellent display.

3. Write to the New England Horticultural College, Boston, on the Botanical Gardens in Hamilton, Bermuda, for information and pictures or varieties of plants.

4. Motivating Experiment

Materials: shoe box, small plant, scissors

Procedure: With a scissors, cut a small opening in the cover of the shoe box. Place the plant in the opposite end of the shoe box. Place the box on a window sill near the sunlight. What happens to the plant's leaves? In which direction are they turning?

Concept 1 - All living things are dependent upon green plants for food.

Activity: Begin by asking pupils to raise their hands. Where did the energy come from to do this? When a pupil suggests that it comes from food, ask where the food comes from. As each pupil names a food, ask him to trace the food back to its original source. For example: Food-butter--Animal cow--Plant-grass.

Enrichment: Have students inspect all the packaged breakfast cereals to determine the basic plant ingredient of each. Or, investigate where in the world people eat seaweed - a simple green plant.

Concept 2 - Green plants carry on photosynthesis. (Energy is needed)

Experiment

Materials: wide-mouthed glass jar and cover, small glass bottle, hot plate, rubbing alcohol, green leaves (geranium)

Procedure: To prove the presence of chlorophyll in a green leaf, soften the leaves by boiling them in water. Put some leaves in the jar and cover them with alcohol. The next day, pour the alcohol into a small glass bottle. What color are the leaves? What color is the alcohol? How did the chlorophyll from the leaves get into the alcohol?

Enrichment #1 -

Materials: green plant, black paper envelopes, cellophane envelopes

Procedure: To discover what happens to leaves without light, make black paper envelopes and cellophane envelopes. Fasten them on some of the leaves of a healthy plant. Be sure that the black envelopes do not allow light to reach the leaves. Remove the envelopes after five days. Do you think that all the leaves were producing food? Why?

Enrichment #2 -

Materials: green plant, iodine, water, closet, eye-dropper

Procedure: To show that green plants need light to make food,test two or more leaves of the plant for starch by placing an eye-dropper full of iodine on the leaf. The blue color indicates the presence of starch. Water the plant well. Place the plant in a closet for two days. After two days, test two or more leaves for starch. Which leaves have less starch in them? What does this show?

Note: Underlined words are new words.

Enrichment #3 -

Materials: green leaves, cold water, warm water

Procedure: Do you think leaves breathe? What happens in water when your head is under water and you let some air out of your mouth? What do you see? Place some leaves under the surface of some cold water and determine whether or not they give off any bubbles. You might have to squeeze the two sides of the leaf together in a fold in order to force the air out.

Repeat the above procedure using warm water. Did you notice more air escape from the leaves in cold water or warm water?

Enrichment #4 -

Materials: microscope, iodine, eye-dropper, slide

Procedure: Peel off the outer layer of the underside of a leaf. Place this on a slide. Put a few drops of iodine solution on it and look at it through a microscope. You should be able to see the stomates, or little openings through which the leaves breathe.

Enrichment #5-

Materials: pan, candle, glass, water, sprig of mint

Procedure: Attach a candle, by melting the wax, to the bottom of a pan. Place an inch of water in the pan. Light the candle and turn a glass jar over it. Place a sprig of mint to one side away from the flame. What will happen to the flame? Why?

Add another inch of water to the pan. The stems of the mint sprigs must be in water and their leaves above the level of the water. Place it in good light, but not in direct sunlight, for several days. Set up a similar jar and place it in a closet. What will happen? Why?

After ten days test the air in each jar. Turn the glass and its contents right side, up. Test both jars with a burning wooden splinter. What was in the jar in the closet? What was in the jar in the light?

Enrichment #6 - Have children infer from the above experiments the ingredients necessary to photo synthesis: sun, chlorophyll, CO_2, starch as the food produced in leaves.

Concept 3 - The structure of green plants makes it possible for them to carry on food-making processes.

A. Roots Experiment

Materials: paper towel, water, radish seeds, Saran Wrap

Procedure: Place in the bottom of a pan or dish, a paper towel which has been folded several times. Soak this towel so that it drips with water. Place on top of the towel several radish seeds. Cover the pan with Saran Wrap. Have the class observe the seeds for several days. What do you notice about the roots? Did you notice any roots that are smaller, compared to other roots? Does anyone know where the roots actually absorb water and mineral from the soil? (root hair)

Enrichment #1 -

Materials: bean seeds, blotting paper, pan of water, two pieces of glass, small stones

Procedure: Soak the bean seeds overnight. Wet the blotting paper and place the seeds on it. Place some obstacles (as a small stone) in the way of the seeds. Put the blotting paper between two pieses of glass. Put the pieces of glass in a pan of water so that the blotting paper will be kept wet. Let the glass remain in the pan for several days. What do you think will happen to the roots when they hit the obstacles in their way? How do you think seeds can sprout and grow in rocky soil?

Enrichment #2 2-

Materials: a carrot or a sweet potato, pan of water

Procedure: Cut off about an inch from the top of a carrot or from one end of a sweet potato. Put this piece in a pan of water with the cut end of the piece down. Do not cover the whole piece with water. What is the first thing to grow out of the plant? How does the plant get water? How long did it take for roots to grow?

B. Stems - <u>Experiment</u>

<u>Materials:</u> water, knife, celery, glass jar, red or blue vegetable coloring

<u>Procedure:</u> Mix the red or blue vegetable coloring with water. Put a piece of celery into the colored water. Cut off the end of the celery while it is under the water. Place the jar of colored water in sunlight for several hours. What happens to the red or blue coloring mixed with water? How does water from the soil travel up the plant?

Enrichment

<u>Materials:</u> white carnation, two glasses of water, red ink, blue ink

<u>Procedure:</u> Split the carnation stem in half with a knife. Place $\frac{1}{2}$ of the stem in glass of red-colored water; place the other half in a glass of blue colored water. The carnation will soon be a two-toned color. Why?

C. <u>Leaves</u> - <u>Experiment</u> Refer to experiments under Concept 2.

<u>Enrichment</u>

<u>Materials:</u> two potted plants, two large, clear plastic bags

<u>Procedure:</u> Remove all the leaves on one of the plants. Cover each plant with a plastic bag and tie the open end of the bag to the stem. Make certain that only the plants and not the pots or soil are inside the bags. Place the plants where they receive light but not direct sunlight. On the next day, examine each bag. What do you observe? What conclusion can you draw? (leaves take part in transpiration).

D. <u>Flowers</u> - <u>Experiment</u>

<u>Materials:</u> flower, three straight pins, a magnifying lens, a sheet of white paper, tape

<u>Procedure:</u> Place an enlarged illustration of a flower on the board or on an overhead transparency before beginning the following project.

Lay the flower on a piece of white paper. Put the point of a pin where the petals seem to be joined together at the base of the flower. Pull the pin down toward the bottom of the flower. Do not press too hard. Press just hard enough for the pin to cut through the petals, but not through the whole flower. Lift the cut petals and lay them flat, like the pages of a book. Use your other two pins to fasten the petals down. What do you see?

The container shaped like a vase with a long neck is called the pistil. The long thread-like parts, with knobs at their tips, are stamens. Remove the stamens carefully. Put them aside so that you can observe them later. With the stamens out of the way, you should be able to see the enlarged part of the pistil more clearly. This is called the ovary.

Gently run a straight pin down the length of the ovary to open it. Place the magnifier above the flower so that you can see the opened ovary cleary. The small, shiny beadlike parts are the ovules. Ovules are the beginnings of seeds.

Observe the knobs at the tips of the stamens. Touch one to a piece of white paper. The powder you see is the pollen.

Keep a record of your dissection by saving the parts of the flower. Lay some of the petals on one side of the paper. Fasten them with plastic tape. Lay the stamens on the paper and fasten them down. Do this with the rest of the flower. Label each part carefully.

Enrichment #1 - Have children collect flowers of many types. Are the shapes all the same? Are the main parts inside all alike?

Enrichment #2 -

Materials: stamens of several different flowers, glass slides, and cover glasses, a microscope, a medicine dropper, and some water

Procedure: Rub the top of the stamen of each kind of flower on a different slide, until you see some pollen on the slide. Add one drop of water to the powdery spot on each slide, to spread the pollen evenly. Gently put a cover glass over the water drop. Gently lift the slide onto the microscope. Look at each slide carefully. Do any of your pollen grains look alike?

Note: Scientists can usually identify flowers from their pollen because of the unique structure of each kind.

E. Seeds - Experiment

Materials: Bean or corn seeds, well-soaked paper towels, stiff cardboard, Saran Wrap, dish

Procedure: Place the bean seeds on some well-soaked paper towels and stiff cardboard. Wrap with Saran Wrap. Make two or more of these demonstrations. Place one of them near a heater and the other in a cool place. Which seeds will start to grow first?

At the same time you do the above experiment, take some seeds and place them on some wet paper towels in a dish. Cover the dish with Saran Wrap. After several days, when the seeds have swollen considerably, have the students crack them open and locate the embryos (the undeveloped baby plants).

Why is the embryo so small compared to the entire size of the seed? Where does the embryo get its food while it is growing? What will happen to these seeds if we don't plant them in the ground?

Enrichment #1 - Draw a cut-open seed just about to sprout. Label the embryo and the parts of the seed that will become the root and the stem.

Enrichment #2 - Draw the steps that a seed goes through in developing into a plant.

Concept 4 - Molecules are in constant motion inside plants.

Activity --- Review the first three concepts in terms of molecular motion. Molecules move about on the outside of plants. Molecules move into plants. Some remain in plants and become part of new cells. New cells make larger root systems. New cells make longer stems. New cells form new leaves.

Enrichment - To summarize what you know about movement of molecules in plants, choose a common plant in your community. Try to explain the motion of molecules in the plant. (CO_2, H_2O, O_2, etc.)

Concept 5 - Green plants are adapted to different environments.

Activity - - - Does a pine tree have any leaves? (Yes, the needles are modified leaves.)

Bring in some pine needles for class examination. Crush some of them to stain white paper and show chlorophyll. Examine some cut needles under a magnifying glass.

Note: The structure of the pine tree's leaves reduces water loss during the winter season. Loss of water through the leaves is reduced by a lessening of the surface area. To illustrate this concept, take a test tube half full of water and pour the water on a blotter. Half fill the test tube again. Then set aside both the tube and blotter. Have class check them daily and oompare the times needed for complete water loss.

Enrichment -- Have children report on a variety of plants in different environments. Have children deduce what structures have adapted to their environments. Examples: cactus, water lilies, reeds

Concept 6 - Man protects plants from their natural enemies and provides materials needed by plants.

Activity - - - If a greenhouse is nearby, a visit would be ideal at this time to illustrate how man can change a plant's environment for his own purposes. A small greenhouse could be easily constructed in the classroom from a wood frame and a sheet of plastic film. Place it on a sunny window ledge and have pupils study temperature and moisture conditions daily.

Enrichment #1 - Ask the children if anyone has seen a tree limb sawed off. Ask if he noticed whether anything was done to the stump, or "wound," that was left on the tree.

Note: Proper management requires that the wound be painted with a barrier material. The barrier blocks the entrance of disease organisms or insect carriers from the exposed living tissue of the tree.

Now, ask the children how a disease organism, which can't move about by itself and which is not carried by an insect, could get into the wound of a tree. (Air) Some of the diseases of plants are caused by non-green plants called fungi, the spores of which are carried by air.

Enrichment #2 - Encourage children to talk about their own experiences in getting rid of weeds. Why are weeds harmful to plants?

Enrichment #3 - Appoint committees to report on four principal methods of disease control in plants: exclusion before planting, eradication, protection, and immunization.

Enrichment #4 Discuss how some insects kill plants. Discuss the wise use of insect sprays. If we spray the plant to kill the attacking insect, what will happen to the bird that uses the insect for food? What happens to fish in a nearby stream after heavy rains carry some of the spray into the water, killing the insect larvae on which the fish feed? What can happen if a vegetable farmer uses the water of this stream to irrigate his vegetable crop?

Enrichment #5 - Compile a list and gather samples of insects injurious to plants in your county or state. State conservation departments and land-grant colleges usually have free literature.

Enrichment #6 - Discuss insects which are helpful to plant life. Examples: beetles, bees, butterflies, dragonflies, ants

Enrichment #7 - Discuss how to grow plants in a garden at home. Discuss the importance of the kind of soils: sandy, clay, and humus. Discuss also the importance of fertilizers, water, air, and a sufficient number of seeds.

Supplementary Concepts

1. Structure is the most important element in the scientific classification of plants.

   Note: The following chart may help clarify the classification of plants in the teacher's mind.

- Producers of Seeds
  - Covered Seeds
    - Monocots
    - Dicots
  - Exposed Seeds
    - Conifers
    - Others
- Non-Producers of Seeds
  - Algae
  - Fungi
    - Ferns
  - Mosses

Activity - Have children make a collection of flowering plants. Examine the seeds. What do you notice about all the seeds? (all covered) Now examine the petals of each flower. Are there two sets we may further divide into? (flower parts arranged in 3's: monocots; flower parts arranged in fours or fives; dicots)

Enrichment #1- How does man use the covering around the apple seed, cherry seed, peach seed? Can you name other uses of seed coverings? (animal food, fertilizer, filters, insulation, industrial alcohol) Make a display from the above deductions.

Enrichment #2 - Bring in a pine cone. Have children examine it carefully. What function does the cone have? How can you tell? What do you notice about its seed? (exposed)

Enrichment #3 - Bring in a fern leaf, a moss plant, a mushroom. Have the children examine them carefully. Do you see any seeds? Do you find anything unusual about these plants? (under-side of fern - black spots are spores; stemlike structures of the moss porduce spores; the underside of the mushroom has spores, and is non-green.)

Enrichment #4 Have the pupils lay a mushroom crown with gills down on a piece of paper for a day. When they lift the crown, it will leave a print made up of thousands of spores.

2. There are important relationships between structure and function of plants

Activity - Deduce from the above investigations the interrelationship between structure and function. Make a display showing Seed-Producers, and Non-Seed Producers. Have an enlarged diagram of the structure of each, labeling the parts.

Supplementary Experiences

1. Plant four bean seeds in each of two cans filled with soil. Keep the soil moist in both cans. Put one can in a warm, dark closet. Put the other in a refrigerator. Observe the cans carefully every day. Are there differences? What may have caused them?

2. You can raise plants such as the narcissus and hyacinth from bulbs. Plant the bulbs in a bowl, with pebbles to hold them. Use enough water to come up to the bottom of the bulbs. Put two or three pieces of charcoal in the bottom of the bowl. They will keep the water from smelling uppleasant when the brown leaves of the bulbs begin to rot. Put the bulbs in a dark place until they begin to grow. Then put them in the sun and water them.

3. Get four flowerpots of the same size and number them. Plant five bean seeds in each one. Put flowerpot #1 on the windowsill, and water it every day. Put flowerpot #2 next to flowerpot #1, but do not water it. Put flowerpot #3 in a closet, and water it every day. Put flowerpot #4 in a closet, but do not water it. Keep a daily chart for 3 weeks, of how much each plant grows. Which plant grows best? What do plants need to grow?

4. Grow a bread mold by placing some damp bread in a jar outside for few hours. Cover the jar and place it in a dark closet. What happens in a few days? Why?

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* Plants and Parts	3 - 1 - B8
* Wild Flowers	3 - 1 - F4
* Parts of a Flowering Plant	3 - 1 - B1
* Green Plants	3 - 2 - C4
* Living Things Need Other Living Things	3 - 2 - C5
* Climates and Plants	2 - 2 - E6

* Available in Stoneham Public Schools

Community Resources

Gardner Museum, Boston, Mass.

Massachusetts College of Horticulture, Boston, Mass.

Public Gardens, Boston, Mass.

Museum of Science, Boston, Mass.

APPENDIX

Worksheet Ideas

Susan and her parents went to her grandmother's farm for Sunday dinner. They ate all these things:

fruit salad	peas and carrots
chicken soup	rolls and butter
celery and olives	lettuce and tomato salad
baked potatoes	chocolate layer cake
roast beef	milk

At the end of dinner, Susan said, "We couldn't have had a thing to eat today if it were not for green plants." Her grandmother asked Susan to explain. How might Susan trace each food they ate back to green plants?

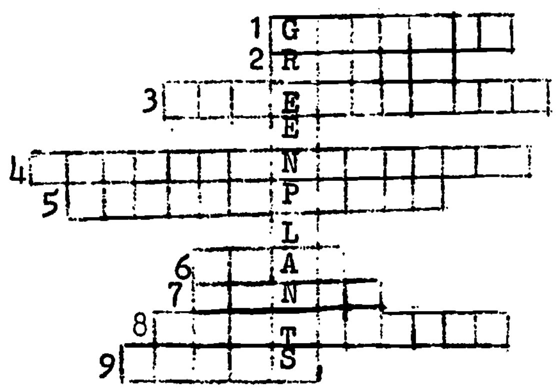
We use many kinds of seeds for food. We also eat the seed containers, or fruits, of some plants. Look at the list of plants below. Pick out the seeds that you eat. Pick out the seed containers that you eat. Which foods on this list are not seeds or seed containers?

lettuce	eggplant
corn	tomatoes
lima beans	cabbage
squash	turnips

carrots
cucumbers
peas
peanuts

Crossword Puzzle

1. Sugar that green plants make.
2. They get water from the soil.
3. How insects grow and change.
4. The putting together of carbon dioxide and water, in sunlight, to make sugar.
5. Green plants need this chemical to make food.
6. The best kind of soil.
7. Plants that cannot make their own food.
8. This is added to the soil to give it minerals.
9. Material formed from decayed plants and animals.



Bulletin Board Ideas

1. Have a display of pictures of a variety of plants from all parts of the world: tropical, dry, temperate.

2. Make a chart showing the parts of a flowering plant.

3. Have a display showing how plants make food by photosynthesis.

4. Have a display comparing animals that are harmful and helpful to plants.

5. Show by illustration the proper way to care for a garden.

6. Make a simple classification of plants showing Seed-Producers and Non-Seed-Producers and their subdivisions.

WEATHER IN YOUR LIFE

Weather In Your Life

Background

The components of weather are heat, pressure, wind, and moisture. Weather is the condition of the atmosphere as determined by these components. Moisture may be in the atmosphere in many different forms: as vapor, as clouds of tiny drops of water, as clouds of ice crystals, or as fog, rain, snow, sleet or hail falling to the earth.

It is the light energy of the sun which penetrates the earth's atmosphere and warms the surface of the land and the oceans. The warmed earth then radiates heat energy into the atmosphere near the earth. This radiant heat from the earth warms the atmosphere, much as radiant heat from a hot iron warms cooler things near it. It is this heat energy, which originally came to the earth as sunlight, that modifies all the other elements of the weather and causes the many varied conditions that we speak of as weather.

The sun is the chief cause of weather since all energy affecting our weather comes from the sun. If, however, the entire earth were equally heated by the sun, the weather would be uniform. Since weather depends upon the movement of air masses, and since differences in the temperature of air masses cause them to move, on a uniformly heated earth there would be no motion of air; consequently, there would be no weather changes.

But the earth is not heated evenly, the sun's rays reach only half the earth at one time - the side facing the sun. The sun's rays also reach different parts of the globe at different angles, causing varying amounts of heat to be absorbed.

Another factor that affects the temperatures on the earth is the fact that the earth's surface is made up of land and water. Each absorbs sunlight at a different rate.

All these phenomena lead to the conclusion that the absorption of solar energy varies in intensity from place to place. The result is an uneven heating of the earth which has a direct effect on the weather.

The denser air at the bottom of the atmosphere can absorb more radiation from the sun than the air in the upper layers can. The earth itself absorbs the greatest amount of the sun's energy, radiating the heat to the air closest to the earth's surface.

Weather may be measured by precise instruments: barometer (air pressure), thermometer (air temperature), wind vane (direction), anemometer (speed), and raingauge (amount of rainfall).

Note: Underlined words
are new words for
the pupils.

Concepts

1. Air occupies space and has weight.

2. Air exerts pressure.

3. Warm air holds more moisture than cool air.

4. When air is warmed, it expands and becomes lighter.

    a. Cooler, heavier air flows in and pushes up the warm air.

    b. Movements of air are called air currents.

5. Water does not heat up as quickly as land.

6. Land cools more quickly than water.

7. Wind is air in motion.

    a. On a sunny day, cool air over water flows in and replaces warmer rising air over land. This is called a sea breeze.

    b. At night, the cool air over land flows out and replaces the warmer air rising over the water. This is called a land breeze.

    c. Big differences in temperature cause strong winds; small temperature differences cause gentle winds.

8. Water vapor is an invisible gas; it is of major importance in the water cycle.

9. Clouds are formed when water evaporates and collects in little droplets in cool air. Fog is a cloud near the ground.

10. Meterology is the science of weather.

MOTIVATING IDEAS

Refer to Supplementary Experiences and Bulletin Board displays.

Concept 1 - Air occupies space and has weight.

Experiment

Materials: large pan of water, two tall drinking glasses.

Procedure: Get a large pan and fill it with about eight inches of water. Get two tall drinking glasses, tip one sideways so that it fills with water. Force the second one straight down into the water. Hold the two glasses and pour the air from the second glass into the glass of water. Listen to the bubbling. What is making the sound?

Enrichment #1

Materials: handkerchief, glass, bowl of water

Procedure: Push a handerchief to the bottom of a dry glass. Turn the glass upside down and push it straight down into the bowl of water. Be sure the bowl holds enough water to cover the glass completely. What will happen to the hanky?

Enrichment #2

Materials: two soda bottles, clay, funnel, water

Procedure: Get a soda bottle and a small funnel. Set the funnel in the open end of the bottle. Use some clay to seal the point where the funnel fits into the bottle. Now pour water into the funnel. A small amount goes into the bottle, and then it stops. It is almost as if something were keeping the water out of the bottle. What is happening?

Enrichment #3

Materials: two balloons, a ruler, string

Procedure: Suspend two balloons from a ruler. Then deflate one of them. What will happen to the balance?

Concept 2 - Air exerts pressure.

Experiment

Materials: straw, one inch square of paper

Procedure: Place the paper underneath the straw. Suck through the straw. What happens to the paper?

Note: Inside air pressure is less than outside. The outside pressure holds the paper in place. Link to drinking milk out of a straw.

Enrichment #1

Materials: straw, water, food coloring

Procedure: Place food coloring in the water. Hold your finger over the end of the straw and push the other end straight down into the glass of water. What will happen to the water? Take your finger away and the water will rise into the straw. Why? Place finger on the end of the straw and lift the straw out of the glass. Why does the water stay in the straw?

Enrichment #2

Materials: glass, water, cardboard

Procedure: Fill a glass with water. Turn it upside down with the cardboard square on top. Take your hand away from the cardboard. Why will the water stay in the glass?

Enrichment #3

Materials: water, ice cubes, gallon can, hot plate, measuring cup

Procedure: Put one cup of water in the can. Place the can on the hot plate. Allow the water to boil. When steam rises from the can, put the cap in place. Remove the can from hot plate. Rub ice cubes along the side of the can. What happens to the can? (can collapses because pressure outside is greater than inside).

Enrichment #4

Materials: empty milk bottle, hard-boiled egg, paper napkin, match

Procedure: Peel the hard-boiled egg and rest it on the mouth of the milk bottle. You will see that it will not fall in. Now, remove the egg, crumple up the paper napkin, light it with the match, and drop it into the milk bottle. Immediately place the egg back on the mouth of the bottle, its narrow end downward. What happens to the egg when the flame goes out? Why? To remove the egg from the bottle, first, rinse out the bits of burnt paper and pour the water out of the bottle. Then old the bottle so that the egg is at its mouth. Press your lips tightly against the mouth of the bottle and blow into it as hard as you can. Why will the egg pop out?

Concept 3 - Warm air holds more moisture than cool air.

Experiment

Materials: quart jar, ice cubes

Procedure: Fill a quart jar with ice cubes, securely cover the jar and allow it to stand in the air in the classroom. Droplets of water will probably form on the outside of the jar. Why?

Enrichment

Materials: pan of hot water, closed window

Procedure: On a cold day, set a pan of hot water near a closed window. Be sure the window is dry when the pan is placed near it. Watch what happens to the inside of window pane. Where is the moisture coming from? Why does it collect on the window pane?

Concept 4 - When air is warmed, it expands and becomes lighter.

Experiment

Materials: balloon, empty bottle, hot plate

Procedure: Place a balloon over the mouth of an empty bottle (pyrex). Make sure that the inside is dry. Place this on a hot plate. Why does the balloon fill up? Place it in a cool place. Now, what happens?

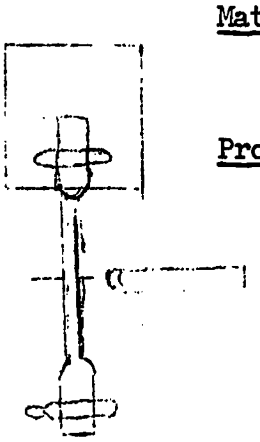
Concepts a and b - Air currents.

Enrichment #1

Materials: electric lamp, talcum powder

Procedure: Place the electric lamp on the table. Turn it on. After the bulb has become warm shake a little talcum powder into the air above it. Watch the way the powder moves. Why does it move as it does? Does it keep on moving up? Or does it begin to move out and down again as it gets farther and farther away from the lamp?

Enrichment #2



Air Current Tester

Materials: drinking straw, piece of paper about 3" wide and 4" long, paper clip, a pencil, a pin, and cellophane tape.

Procedure: Flatten one inch at the end of the straw. Tape the paper to it. Push the pin through the middle of the straw and into the eraser of the pencil. Wiggle the straw a little, so that it can turn easily around the pin. Flatten the other end of the straw, as in the picture to the side. Slide the paper clip on the end. Pick up the pencil and see if the straw hangs level. If not, slide the paper clip back or forth, until it is level.

Now, you have an air current tester.

Enrichment #3

Materials: air current tester (see enrichment #2)

Procedure: Hold the tester over a warm place - a lighted bulb, an electric heater, a sunny windows sill- What happens to the paper? What made it move? Which way does warm air move? Hold the tester below the bottom of a refrigerator door. Open the door a few inches. Which way does the paper move? Which way does cold air move?

Enrichment #4

Materials: one thermometer

Procedure: Take the temperature of the air in your classroom in several different places. Take readings near the floor, ceiling, radiator, and a sunny window. Record each reading and where it was taken. Does the temperature of air vary in your room? Where is air in your room warmer and lighter? Where is it cooler and heavier? Draw a picture of the way air is moving. Use arrows to show the movement of air in your room.

Concepts 5 and 6 -Water does not heat up as quickly as land; land cools more quickly than water.

Experiment

Materials: two bowls, two thermometers, some water, some dry soil, measuring cup

Procedure: Put one cup of dry soil into one bowl. Put one cup of water into the other bowl. Take the temperatures near the top of the soil and the top of the water. If the water is colder than the soil, pour some out and stir in warm water until it is about the same temperature. Record this temperature. Put both bowls in a sunny place for 10 minutes. Then take the temperatures again and record them. Which stays cooler in sunlight, the water or the soil?

Enrichment

Materials: bowl of dry soil, bowl of water, refrigerator

Procedure: Put a bowl of water and a bowl of dry soil in a warm, shady place. When the soil and water are the same temperature, you are ready to start. Put both bowls in the refrigerator for 15 minutes. Take both bowls out of the refrigerator. Test the temperatures at the tops of the soil and the water with a thermometer. Which keeps its heat longer, soil or water?

Concept 7 - Wind is air in motion.

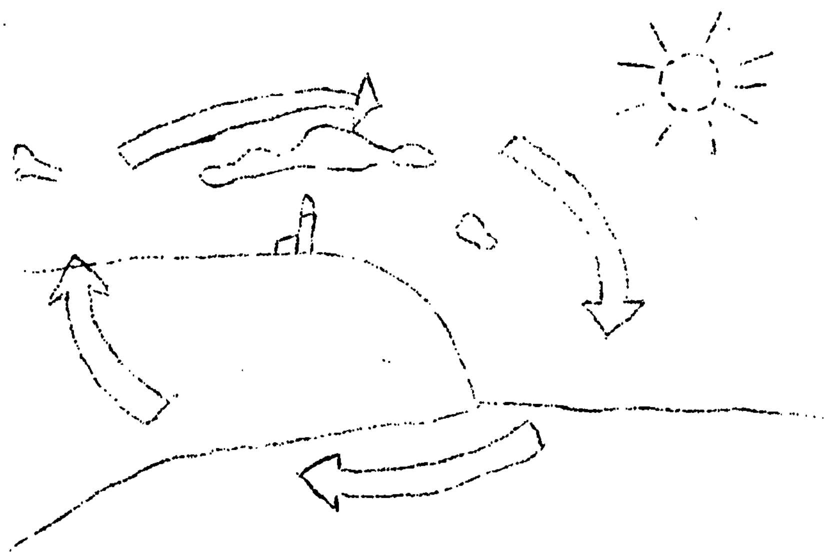
Experiment

Materials: glass aquarium, two glass kerosene lamp chimneys, piece of cardboard, a short candle, few matches

Procedure: Cut two circles in the cardboard, just large enough to hold the chimneys. Place the candle in the aquarium, light the candle, and cover the aquarium with the cardboard. Insert the chimneys through the cardboard. Be sure the candle is directly underneath one of the chimneys. Light a match and blow it out. Then hold the smoking match above the chimney which is farther from the candle. In what direction does the smoke travel? Why?

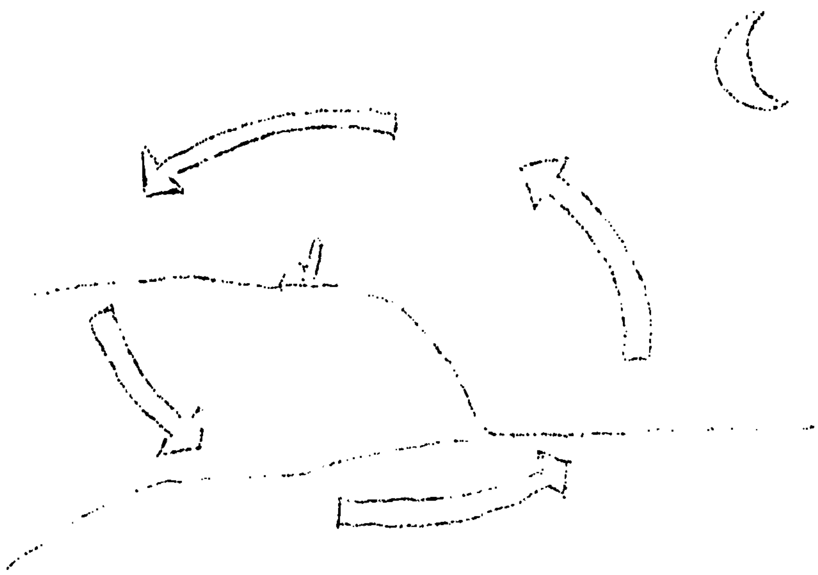
Enrichment #1 Refer to concepts 2-6 and the connecting experiments. Illustrate on the board how the concepts are interrelated: air exerts pressure, temperature affects pressure, colder, heavier air replaces warmer, lighter air, uneven temperatures affect winds.

Enrichment #2 Illustrate the effect of a sea breeze and the concept that cool air over water flows in and replaces warming rising air over land. See diagram below.



Sea Breeze

Illustrate a land breeze. How is this different from a sea breeze? Which is cooler at night - land or water? See diagram below.



Land Breeze

Concept 8 - Water Vapor is an invisible gas; it is of major importance in the water cycle.

Experiment

Materials: wet sponge, blackboard, dish of water, cup

Procedure: Rub a wet sponge over the board and watch the film of water evaporate into the air. How can you make it disappear faster?
Place a dish of water in the sun and a dish of water in the shade. Which will evaporate faster? Why?

Enrichment #1 Have children recall how in very cold weather, moisture in breath forms a small visible cloud. Point out that water vapor is constantly being breathed out, but because air around us is usually close to body temperature, it does not condense. Refer to the experiments under Concept 3.

Enrichment #2 Have a flannel-board demonstration showing the constant cycle of evaporation-condensation known as the water cycle. Refer to Grade 3 curriculum guide for material in depth.

Concept 9 - Clouds are formed when water evaporates and collets in little droplets in cool air.

Experiment

Materials: milk bottle, an ice cube, and hot water

Procedure: Fill the bottle with hot water. Pour out most of the water, leaving about an inch of it. Set the bottle in a bright light. Hold an ice cube over the opening. What will probably happen? Where did the water vapor come from?

Enrichment #1

Materials: large glass jar, rubber cap, water, smoke

Procedure: Put some water into the glass jar. Then put in some smoke. Cover the jar with the rubber top and then pull it up. When you do this, a cloud will suddenly appear. Can you explain why this happens?

Enrichment #2

Materials: ice cubes, hammer, plastic bag

Procedure: Put some ice cubes into a bag and crush them. Colorless ice looks white. Compare this with a single ice cube. Can you now see why clouds appear white?

Enrichment #3

Materials: tea kettle, hot plate, steam

Procedure: Heat water in a tea kettle, until steam forms. Then place ice cubes near the steam. What happens? Why?

Enrichment #4

Materials: milk bottle, hot water, match

Procedure: Rinse the inside of a clean milk bottle with hot water. Light a match, and then blow it out. Drop the smoking match into the bottle. Stand with your back to the light. Suck air out of the bottle. What happens? When you sucked air from the bottle, the air remaining in the bottle expanded. What change in temperature takes place as air expands?

Enrichment #5

Materials: large fruit juice can (#10), small juice can (#2), ice mixed with salt

Procedure: Take a large juice can. Put some ice mixed with salt in the can. Set a smaller can on the ice. The tops of both cans should be even. Pack more ice and salt into the space between the two cans. Breathe into the smaller can. What happens?

Concept 10 - Meterology is the science of weather.

Experiment

The following are detailed plans for making a weather station in your classroom.

Enrichment #1 - Barometer (air pressure)

Materials: balloon, glass jar, rubber band, paper straw, cardboard

Procedure: Stretch a balloon over the top of a glass jar and put a rubber band around the balloon to hold it tight. Glue a straw to the center of the balloon top. If the air pressure on the outside is greater than inside, the balloon will be pushed into the jar and the point of the straw will rise. If the pressure on the outside is less, air inside will push balloon up and the point of the straw will go down. To make a scale, draw a line on a barameter. Put the paper so that the pointer will move up and down on the line. At the same time each day, mark the changes in air pressure. Changing air pressure usually means changing weather.

Enrichment #2 - Thermometer

Materials: food coloring, water, rubber stopper, tube, bottle

Procedure: Mix some food coloring with water in a bottle. Place the tube through the rubber stopper and put it on the bottle. When there is rise in temperature, water will rise in the tube. When the temperature decreases, water will descend in the tube. The thermometer can be calibrated by putting the temperature of the room on a cardboard at the height of the water.

Enrichment #3 - Cricket Thermometer

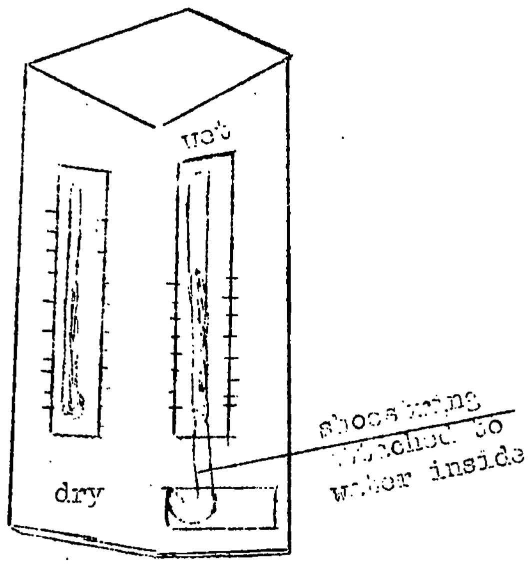
Procedure: We can tell the temperature by the chirping of a cricket. The rate at which a cricket chirps increases as the air temperature rises. The higher the temperature, the greater the number of chirps per minute. If the temperature is between 45 - 80°, the temperature can be measured by counting the number of chirps in 15 seconds and adding 37.

Enrichment #4 - Hygrometer (humidity)

Materials: milk carton, two identical thermometers, clean, white shoestring

<u>Procedure:</u> Attach two identical thermometers to a milk carton, as shown in the picture below. Cut the tips off a clean white cotton shoestring. Slip the bulb of one thermometer into one end of the shoestring.

Hygrometer



Let the other end of the string rest in a small container of water that is inside the milk carton. Each day record the readings on both the "wet" and "dry" thermometers.

Use this as a guide: record a difference in temperature of 15 or more degrees as "low"; record a difference of less than 15 degrees as "high." If the difference between the two thermometers is high, why is the humidity low?

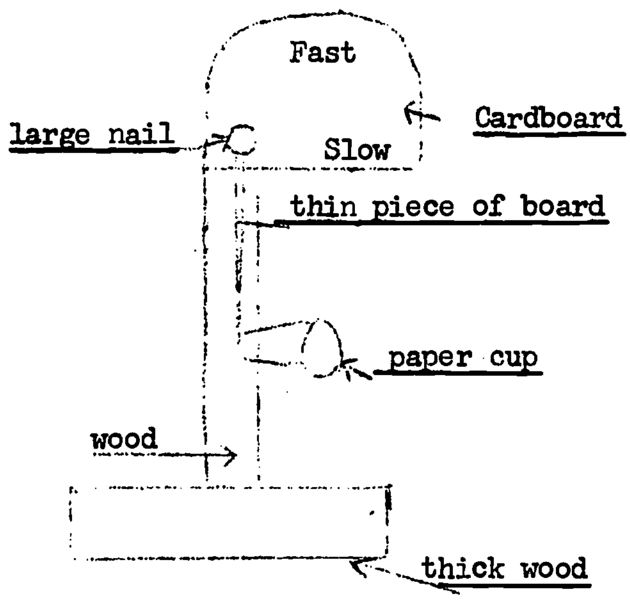
Enrichment #5 - Wind Vane (direction)

Materials: cardboard, straw, knitting needle, clay, spool

Procedure: Fasten a small knitting needle in an empty spool with modeling clay, so that it stands firmly with the pointed end up. Make an arrowhead and tail vane out of cardboard. Split a paper straw at each end, fasten these in place with airplane cement. Punch a small hole through one side of the center of the straw and place the straw on the point of the needle. The arrow should line up with the direction from which the wind is blowing.

Enrichment #6 - Anemometer (Speed of Wind)

See diagram and labels below.



ANEMOMETER

Supplementary Experiences

1. Experiment

Materials: scales, books, ruler

Procedure: Pile the books, one at a time, on the scales. Each time you add a book, check their weight. When you have enough books to weigh 15 pounds, do not add any more books. Lift the whole pile of books. Do they feel heavy? The weight of the books you are holding is about equal to the pressure of air on every square inch of your body.

To see how large a square inch is, draw several squares an inch long and an inch wide. Cut them apart. Fit as many squares of paper as you can on the back of your hand. Think of each square as pressing about as much as the pile of books weighed. On each square, air pressure is about 15 lbs. of weight.

2. Activity - Compose a class letter to:

The Superintendent of Documents
Government Printing Office
Washington, D. C.

Ask him to send one copy of a chart called, "Cloud Forms." Study the many kinds of clouds and try to find some of these clouds in the sky overhead.

3. Experiment

Materials: flat piece of wood, table, bat, newspaper

Procedure: Lay the wooden slat on the table with the wood extending beyond the edge of the table. Cover the part of the slat on the table with two pieces of newspaper. Smooth out the newspaper carefully all over the wood and the table. Pick up your bat and come down hard on the piece of wood sticking out beyond the edge of the table. What happens to the wooden slat? Why?

4. Experiment

Materials: balloon, soda bottle, pencil

Procedure: Hold a balloon so that it is hanging over the open end of an empty soda bottle. With a pencil, push it into the neck of the bottle.

Now stretch the open end of the balloon over the mouth of the bottle. Blow up the balloon. Blow harder! No matter how hard you blow, you just can't get the ballooon to expand. Why?

5. Experiment

Materials: two apples, string, towel rack

Procedure: Carefully tie string around the stem of each apple. (string should be about two feet long). Hang the two apples from a towel rack so that they are about an inch apart. Now blow very hard between the two apples. They will come together and bump! Why?

6. Experiment

Materials: funnel, dime

Procedure: Drop a dime into the funnel; it probably will settle at the bottom. Hold the funnel near your mouth and blow hard along the inner side of the funnel. The dime will stay right where you dropped it. Now, hold your thumb over the bottom opening of the funnel. Then blow down the inner side just as you did before. This time the dime will rise up as you blow, and it may even jump out of the funnel. Why?

7. Experiment

Materials: two drinking glasses, blotting paper, scissors, match, paper

Procedure: Cut a circle of blotting paper so that it is about a half-inch wider than the rim of a drinking glass. Now cut a circular hole in the blotter, leaving a "collar" that is about an inch wide. Wet this collar of blotting paper and set it on the rim of the empty drinking glass. The blotter will stick because it is wet. Now take a small piece of paper and light it with a match. Throw the burning paper into the glass. Immediately, place another glass, rim downward, over the first one - so that the blotter of paper is between the two glasses. The glasses are now "glued" together. Lift the top glass. What happens? Why?

8. Experiment

Materials: milk bottle, candle, match

Procedure: Light a candle. Then place a milk bottle directly in front of the candle. Lean over the table, blow hard against the bottle, and the candle will go out! Why?

9. Activity - Have committees set up to cut out the daily weather map and post the weather. Several committees could report on weather in different parts of the United States.

10. Projects - Have students do research on cloud-seeding and the new technology of weather forecasting as satellites and balloons.

11. Activity - Explore the weather superstitions, How did they develop, and what "truth" do they have? See Appendix.

12. Display - Have a weather station corner where the children can display their homemade instruments and predict the weather.

13. Field Trip - Visit the U.S. Weather Bureau at Logan International Airport.

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Zim, Herbert S. Lightning and Thunder. New York: William Morrow & Co. Inc., 1956.

Audio - Visual Aids

Films

Air All About Us.	Coronet Films.
The Air Around Us.	Encyclopedia Brittanica Films.
How Weather Helps Us.	Coronet Films.
How Weather Is Forecast.	Coronet Films.
Let's Learn to Predict the Weather.	Coronet Films.
Operation Hurricane.	U. S. Weather Bureau.
Origins of Weather.	Encyclopedia Brittanica Films.
Our Weather.	Encyclopedia Brittanica Films.
Simple Demonstrations With Air	Coronet Films.
The Weather.	Encyclopedia Brittanica Films.
Weather for Beginners.	Coronet Films
* Air All About Us.	(Exploring Science)
* How Weather Is Forecast.	

Filmstrips

* Weather	3 - 1 - B6
* A Visit To A Weather Station	3 - 2 - A1
* Weather Maps and Weather Forecasting	3 - 2 - A2
* All Kinds Of Weather	3 - 2 - A3
* Air In Action	3 - 3 - B5
* Water In Weather	3 - 3 - B6
* Thunderstorms	3 - 3 - B7
* Be Your Own Weatherman	3 - 3 - B8
* What Is Air?	3 - 3 - C1
* What Makes the Weather?	3 - 3 - D6
* The Weather Powerhouse	3 - 4 - C2
* Adventures Of A Raindrop	3 - 4 - C3
* Our Ocean Of Air	3 - 4 - C4
* Whirling Winds	3 - 4 - C5
* The World Of Clouds	3 - 4 - C6
* Weathermen At Work	3 - 4 - C8
* Changing The Weather	3 - 4 - D1
* Weather Folklore	3 - 4 - D2

* Indicates that films are available in Stoneham Public Schools.

Transparencies

The following transparencies are available at Robin Hood School. They can be ordered from the Instructo Corp., Paoli, Pennsylvania.

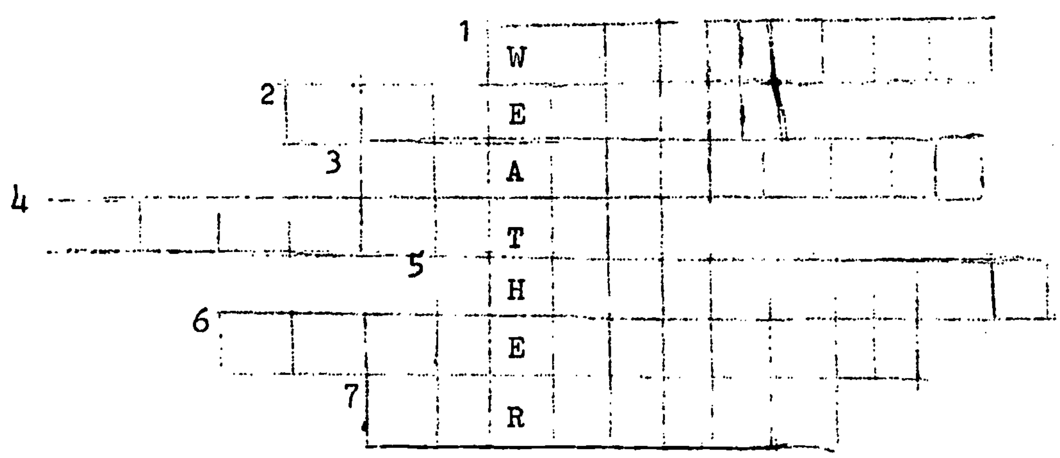
1. Air Currents, mountains, and precipitation.
2. The Atmosphere.
3. Basic cloud shapes.
4. Cloud formations.
5. Cold Front.
6. Global winds.
7. Hurricanes.
8. Land and Sea breezes.
9. Major air masses.
10. Predicting the weather.
11. Tornadoes.
12. Warm front.
13. Water cycle.
14. Weather maps: fronts.

APPENDIX

Worksheet Idea

Crossword Puzzle

1. What water in the air is called.
2. The very small parts that the air is made of.
3. The changing of liquid water to water vapor.
4. It measures air pressure.
5. It measures air temperature.
6. What water vapor changing to a liquid is called.
7. To tell the weather ahead of time.



Bulletin Board Ideas

1. Can You Predict the Weather?

   Display the daily weather maps cut from newspapers over a period of one month. After each four or five maps leave a blank map. Let the children discuss the kind of weather on that date and tell how the weather was predicted. After the discussion, let them see the weather map that shows what happened. Encourage them to revise their predictions in the light of the weather map.

2. Can You Name These Clouds?

   Using blue paper as a background, shape fluffs of cotton to represent different kinds of clouds. Show them on the bulletin board in their proper altitude relationship. Discuss the kinds of weather the clouds indicate.

3. How does Weather Affect Us?

   Arrange pictures of various kinds of weather, such as heavy rainfall, hurricane damage, and drought conditions. Let children discuss the types of weather shown and how they affect the ordinary activities of man.

4. What Makes Weather?

   Make a display illustrating the ingredients of weather: Sun plus Earth plus Air plus Water ————> Make Weather.

5. Weather in the News

   Children bring in articles from the newspaper of interesting stories about weather, such as hurricanes, typhoons, tidal waves, tornadoes, etc.

6. How Can We Reduce Smog?

   Show a skyline of an industrial city or town. Show a layer of smog hanging over the city and the bright sun shining above the smog layer. Be sure to include automobiles, incinerators burning, factory chimneys smoking in the background scene. Let the children discuss why there is smog and tell how it might be reduced.

7. What Is the Water Cycle?

   Make a large chart showing the stages in the water cycle. Let the children attach labels to the various parts, indicating evaporation, condensation, precipitation.

Weather Superstitions

1. When ants travel in a straight line, expect rain. When ants scatter, expect fair weather. People who live in the Ozarks say "Bugs march when the rain is near." People from Maine say, "Flies scatter in good weather." (False)

2. Squirrels lay a big store of nuts; look for a hard winter. (False)

3. There's news in the wind. (True.) Beginning letters for N E W S spell news. (from a wind vane.)

4. The higher the clouds, the better the weather. (True) High clouds show drier air and higher pressure in the atmosphere.

5. When the sheep collect and huddle, tomorrow will be a puddle. (False)

6. "Red sky in the morning, sailors take warning." (True) The presence of dust particles serve as condensation nuclei.

7. See the book Everybody's Weather by Joseph Gaer.

Flag Scale	Wind Speed
Flag hangs limp.	Wind less than 4 mph.
Flag flaps occasionally.	Wind 4 - 7 mph.
Flay waves.	Wind 8 to 12 mph.
Flag stands out from pole.	Wind 13 to 18 mph.
Flag pulls rope with it.	Wind 19 to 24 mph.
Flag snaps as it flaps.	Wind 25 to 31 mph.
Flag must be taken in.	Wind more than 31 mph.

WIND FORCE SCALE
Adapted From the Beaufort Scale

0. Smoke rises vertically less than 1 mile per hour. Sea completely smooth.

CALM

1. Smoke drifts; weather vanes still. Small ripples on water. 1-3 miles per hour

LIGHT AIR

2. Leaves rustle and weather vane moves. Water short and pronounced.

LIGHT BREEZE
4-7 miles per hour.

3. Leaves and small twigs in constant motion; light flag extended. Crests begin to break.
8-12 miles per hour

GENTLE BREEZE

4. Dust, dry leaves, loose paper raised; small branches move.
13-18 per hour.
White caps.

MODERATE BREEZE

5. Small trees in leaf start to sway; crested wavelets form on inland waters.
10-24 miles per hour.
White foamy crests.

FRESH BREEZE

6. Large branches in motion; umbrellas hard to hold; telephone wires whistle.
Large waves form
25-31 miles per hour.

STORMY BREEZE

7. Whole trees in motion; Walking against wind difficult.
32-38 miles per hour.
Foam blows in streaks.

MODERATE GALE

8. Twigs break off the trees.
39-46 miles per hour.
Foam blows in streaks.

FRESH GALE

9. Slight building damage.
47-54 miles per hour.

STRONG GALE

10. Seldom happens inland; trees uprooted; much damage.
55-63 miles per hour.
Great foam patches.

WHOLE GALE

11. Very rare; much general damage.
64-75 miles per hour.
Ships hidden in troughs of waves.

STORM

12. Devastation

HURRICANE