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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 five guide are: the changing earth (erosion, volcanoes, and uplift); introductory oceanography; gravity and the laws of motion; heat; and cells, tissues, and organs. (AL)

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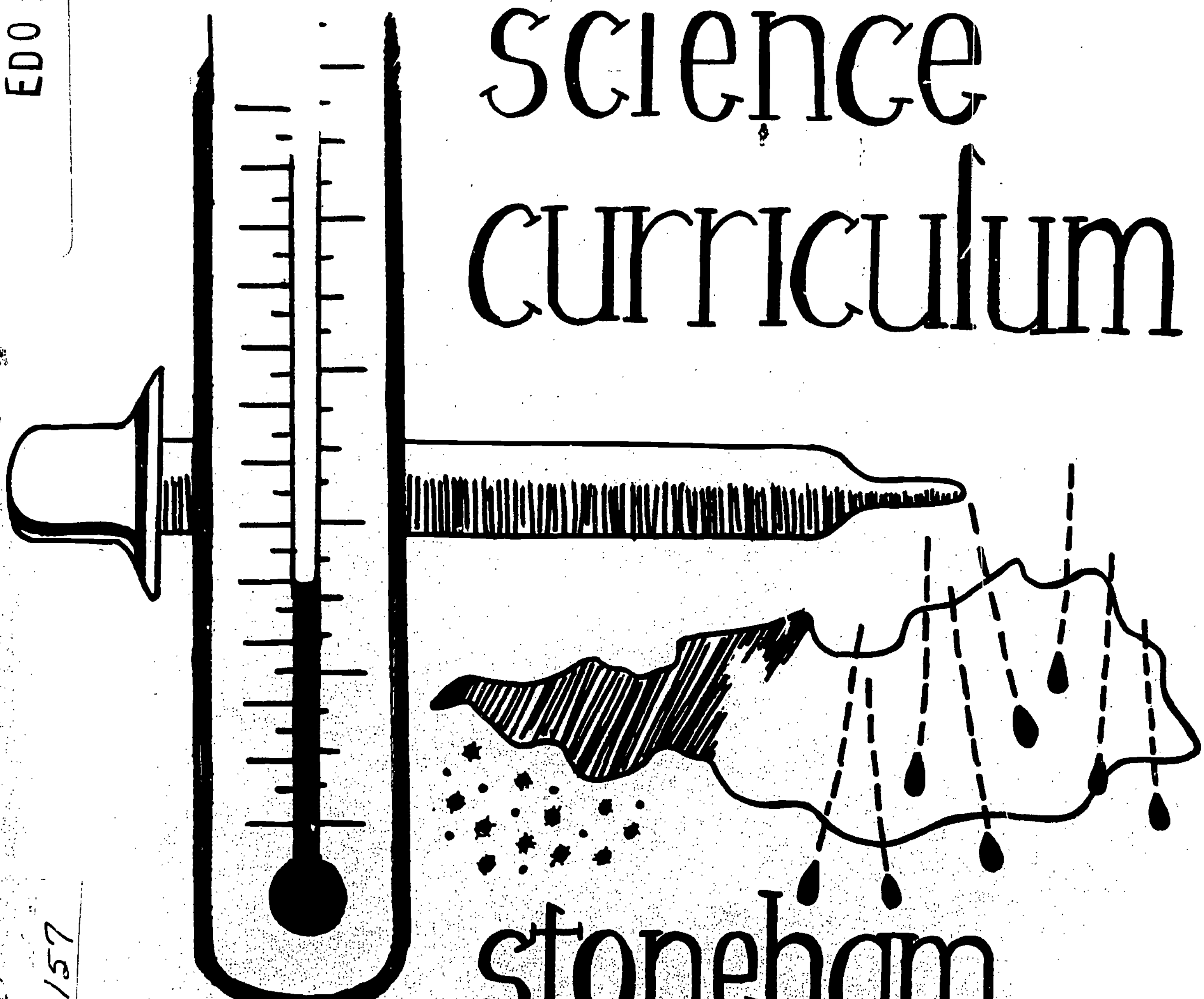
Elementary science curriculum



SE 012 157

grade 5

stoneham, mass.

STONEHAM PUBLIC SCHOOLS

STONEHAM, MASSACHUSETTS

ELEMENTARY SCIENCE CURRICULUM GUIDE

GRADE 5

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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

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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

		GRADE I	GRADE 2	GRADE 3
PHYSICAL	Chemistry	Changes in Matter melting freezing heating	Changes in Matter solid liquid gas molecular	
PHYSICAL	Physics	Magnets push and 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	
LIFE	Plants	Reproduction seeds bulbs spores regeneration	Life Activities structure classification seed plants non-seed plants	Ecosystem pond community
LIFE	Animals	Classification vertebrates	Life Activities life cycle insects brine shrimp	

SCOPE AND SEQUENCE CHART

GRADE 4	GRADE 5	GRADE 6
<u>Molecular Theory</u> matter molecules energy - relations		
<u>Electricity</u> static-current production conductors <u>Sound</u> waves, vibration, pitch, reflection	<u>Heat</u> motion expansion-contraction conduction, convection insulators	<u>Light</u> photons- reflection waves color
The Ear producing and hearing sounds	<u>Cellular Organization</u> cells tissues organs	<u>Genetics</u> heredity genetic code dominant and recessive traits
		<u>Photosynthesis</u> leaf structure carbon cycle
Simple and Complex 5 basic life-processes cellular structure classification		<u>Animal Behavior</u> inherited and learned <u>Ecology</u> balance in nature disbalance

SCOPE AND SEQUENCE CHART

	GRADE 1	GRADE 2	GRADE 3
Astronomy E A R T H	<u>Earth - Sun - Moon</u> rotation day and night		<u>Solar System</u> orbits revolutions seasonal change
Geology		<u>Fossils</u> dinosaurs fuels evolution	<u>Earth Composition</u> soil rock formation classification
Meteorology	<u>Changes in Weather</u> clouds		<u>Water Cycle</u> cloud formation precipitation weather prediction

SCOPE AND SEQUENCE CHART

	GRADE 4	GRADE 5	GRADE 6
		<u>Forces in Space</u> centrifugal centripetal gravitational	<u>Motion in Space</u> movement of plants parallax, triangulation gallaxies atomic energy
		<u>Earth Changes</u> surface interior <u>Ocean Environment</u> water food life exploration	
	<u>Influence on Man</u> air ingredients of weather effects of weather		

THE CHANGING EARTH

OVERVIEW

Men once thought the mountains, plains, plateaus, and other large features of the earth had always existed. The science of geology reveals that two processes work continuously in sculpturing and altering the face of the earth: the forces of construction and the forces of destruction. This unit will study these forces individually.

Motivational ideas:

1. Display pictures showing volcanoes, earthquakes, erosion.
2. Have a collection of rocks available.
3. Display books on how the earth is changing.

Concepts

1. The depth of the earth's crust is very small in relation to the diameter of the earth.

2. Constructional forces build up the surface of the earth and make mountains.

   A. Subconcept: The enormous pressure of land and sea, pushing down on molten magma, forces it to press up against weak spots in the earth's crust and sometimes heave the crust into hills and mountains.

   B. Subconcept: When tremendous pressure forces magma to break through the earth's crust, we have volcanoes.

   C. Subconcept: Folding is a force which lifts the surface of the earth. In folding, forces deep within the earth push a part of the earth's crust sideways, causing the rock layers to become folded.

   D. Subconcept: An earthquake is caused by the settling and shaking down of the earth's crust. It is called a constructional force because it raises the earth's surface in some places.

   E. Subconcept: Faulting, huge masses of bedrock, shifting upwards, downwards or sideways, during movements, is a constructional force.

3. Destructional forces are constantly wearing down the surface of the earth.

   A. Subconcept: The greatest destructional force is water.

   B. Subconcept: Frost and frozen water break up rocks by contraction and expansion.

   C. Subconcept: Extremes of temperature break rocks.

   D. Subconcept: The mountain glaciers deepen the valleys; the broad glaciers smooth the mountains and rocky hills.

   E. Subconcept: Little plants called lichens which grow on rocks give off acids which slowly crumble the surface of the rocks on which they grow.

4. Rocks are formed through the forces that wear down and build up the earth's surface; there are igneous, sedimentary, and metamorphic rocks.

   A. Subconcept: Igneous rocks are formed from lava and magma flow.

   B. Subconcept: Sedimentary rocks are formed through the depositing of sediments which are squeezed and cemented together.

   C. Subconcept: Metamorphic rocks are formed when heat and pressure change sedimentary and igneous rocks.

CONCEPTS	EXPERIMENTS
I The depth of the earth's crust is very small in relation to the diameter of the earth.	A. Sharpen a piece of chalk so that the end is a circle ¼ inch in diameter. Tie a piece of twine around it and measure off 40 inches. Put your finger against the 40 inch mark, at the bottom of the chalkboard. Make a half circle. This half circle is a diagram of half the earth. One inch on this diagram shows 100 miles on the earth. The scale is one inch to 100 miles.
	The chalk line, ¼ inch thick, is the rocky crust of the earth. This crust is about 3 to 25 miles thick.
	Make a pointed mountain, about 1/16 of an inch high. This is the world's highest peak, Mount Everest.
	Erase a bit of chalk, a little more than 1/16 of an inch, and fill the space with blue chalk. This is the deepest ocean, the Pacific.
	B. Use a geological map to show the distribution of mountains, valleys, plains, etc.

CONCEPTS | EXPERIMENTS

II Constructional forces build up the surfaces of the earth and make mountains.

A. Subconcept: The enormous pressure of land and sea, pushing down on molten magma, forces it to press up against weak spots in the earth's crust and sometimes heave the crust into hills and mountains.

1. Materials: half empty tube of toothpaste

Procedure: With the cap screwed on tight, flatten the tube so that the toothpaste is spread evenly inside. Now push down on the lower half of the tube. What happens to the other end?

B. Subconcept: When tremendous pressure forces magma to break through the earth's crust, we have a volcano.

1. Materials: plaster of Paris, a flat liquid detergent bottle with cap, a large tin can.

Procedure: Mix a thick batter of plaster of Paris and water in the large tin can. Pour enough plaster of Paris into the bottle so that it is completely filled. Screw the cap on tightly.
Lay the bottle on its side. Punch a hole in the upper section.
Press firmly on the bottle at the other end.
Plaster of Paris (magma) will pour out of the hole (break the earth's crust.)
Let the plaster of Paris harden into a "volcano."

2. Materials: toothpaste tube

Procedure: (Simpler version of above experiment)
With a pin, make a hole near the bottom of the toothpaste tube.
Press the other end of the tube. What do you observe?

To show power of a volcano

3. Materials: unopened soft drink bottle, hand bottle opener, suitable outdoor location.

Procedure: Discuss the tremendous explosive power of some volcanoes. Develop that powerful gases in the molten rock suddenly expand when released into the air. The soft-drink bottle contains a confined gas. Pretend that the liquid is magma. Shake the bottle rapidly, several times. Quickly flip off the top. An eruption will take place.

Extension: Make reports on famous volcanoes: Vesuvius, Etna, Krakatoa, Fujiyama.

Build a papier maché model of a volcano. Make a three dimensional cone from newspaper strips and wheat paste. Cut the cone in two parts after it has dried. Using poster colors, paint the interior of the volcano with the rock strata, lava core, and other parts found inside a volcano. Label all parts of the volcano and display model.

Locate major volcanoes on a world map.

C. Subconcept: Folding is a force which lifts the surface of the earth. In folding, forces deep within the earth push a part of the earth's crust sideways, causing the rock layers to become folded.

1. Materials: bath towels or modeling clay.

Procedure: Put towels folded on top of each other to represent the layers of the earth. Push them in from both sides.

Many mountains are formed this way. Sometimes the sea bottom is pushed up to form mountains. The Appalachian Mountains and the Alps are fold mountains.

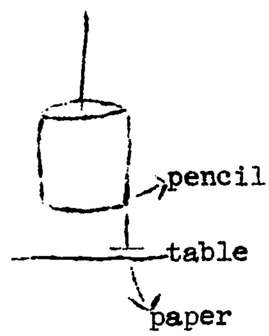
D. Subconcept: An earthquake is caused by the settling and shaking down of the earth's crust. It is called a constructional force because it raises the earth's surface in some places.

Make a seismograph.

1. Materials: Tin can, sand, pencil, tape, table, and paper.

   Procedure: Suspend a large tin can filled with sand from the ceiling of the classroom or a crossbar. Tape a pencil to the side of the can as shown. Lower the can until the pencil just touches the table top. Slip a piece of paper under the pencil point. Move the table gently back and forth in a horizontal plane under the pencil and observe the traces on the paper.

   Explanation: A seismograph is basically a free-hanging pendulum: its weight holds it steady in the vertical plane. Any horizontal movement of the table under our seismograph will cause the pencil to record a trace on the paper. The greater the movement of the table, the longer the trace. The tracings record the vibrations of the earth during an earthquake. A seismograph can record some of the slightest tremors and give warnings of possible earthquakes.



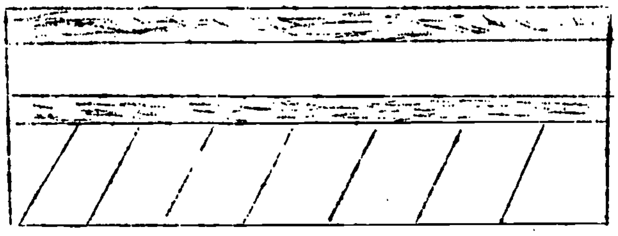
E. **Subconcept:** Faulting, huge masses of bedrock shifting upwards, downwards or sideways during movements, is a constructional force.

Information: When the shift is straight up and down you have a cliff. Slanted faults result in a sloping ridge. Huge faults which occur on two sides produce long chunks of high land called block mountains.

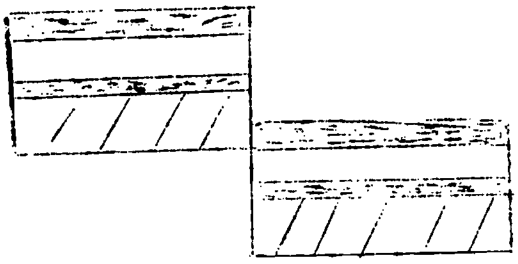
To demonstrate the different faults.

1. **Materials**: foam rubber and paint

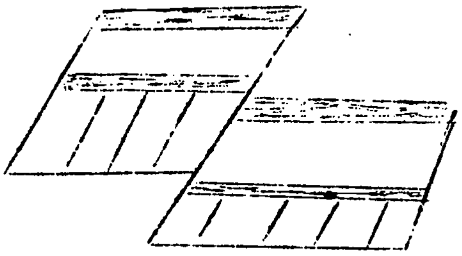
   Procedure: Paint lines to represent the layers of the earth.



Hold the rubber to show a normal fault.



Show a thrust fault.



CONCEPTS	EXPERIMENTS

III Destructional Forces are constantly wearing down the surface of the earth.

A. Subconcept: The greatest destructional force is water.

1. Materials: tray, dirt, water can, flat rocks or pebbles.

   Procedure: On a tray shape a mound of dirt to represent a mountain. Place several pebbles on the top of the mountain. Use a sprinkling can to cause "rain" on the mountain. Observe the results.

2. Materials: two milk cartons, dirt, grass seed

   Procedure: Plant grass seed in one carton. When the grass is about one inch in length, tip the cartons at a slant. Sprinkle water on the cartons. Repeat this procedure for several days. Observe results.

   Extension: Have class look for examples of erosion in the neighborhood and school playground, especially after a heavy rain.

   Show pictures of the Grand Canyon to show an example of the cutting power of a stream carrying abrasive materials.

   To show how waters smooth stones in traveling. (rivers)

3. Materials: coffee can with lid, stones, smooth and rough

   Procedure: Place stones in can and fill halfway with water. The students must shake the can many hundreds of times. The rough stones should get smoother, as well as some stones breaking up into small particles.

B. Subconcept: Frost and frozen water break up rocks by contraction and expansion.

1. Materials: two small glass jars with screw top lids, two heavy paper bags.

Procedure: Fill one jar with water and cap tightly. Put it and an empty capped jar - this is the control - in separate paper bags. Place both in the freezer section of a refrigerator. The jar with water should break, as water is one of the few materials known that expands rather than contracts when it freezes.

C. Subconcept: Extremes of temperature break rocks.

1. Materials: candle, matches, clear glass marble, glass of water, pliers.

Procedure: Hold a marble with pliers in a candle flame for ten seconds or so, then thrust it into water. Many tiny cracks will appear in the marble.

D. Subconcept: The mountain glaciers deepen the valleys; the broad glaciers smooth the mountains and rocky hills.

1. Materials: cardboard milk carton, long pan, water, sand, soil, gravel, and pebble mixture, clay, ice.

Procedure: Put a handful of the rock mixture into the milk carton and add enough water to cover the mixture. Freeze the water. Then add another handful of the mixture, cover with water, and freeze again. Continue until you have the carton half-filled with ice containing the mixture of sand, soil, gravel and pebbles.

Peel the container from the block of ice over the clay. The clay should be in a long flat piece laying in the bottom of the pan. What does the block do to the clay?

Leave the block of ice on the clay. Tilt the pan slightly and allow the ice to melt. Describe the "moraines" that are formed.

E. Subconcept: Little plants called lichens which grow on rocks give off acids which slowly crumble the surface of the rocks on which they grow.

1. Materials: radish or bean seeds, pie tin, plaster of Paris, paper toweling.

   Procedure: Mix plaster with water to the consistency of thick cream. It will set firmly after about 20 minutes. Sprinkle with radish seeds. Place several layers of paper toweling on top and keep soaked with water. One or two waterings a day should suffice. In a few days the tiny roots of some seeds will have penetrated into the plaster.

   a. Find pictures of lichens growing on rocks.

   b. Find a rock with lichens. Scrape the lichens off and notice that the top layer of rock crumbles. Scrape another section of the rock to show that it crumbles, only where the lichens are. This is caused by chemical action.

   c. Look up added information on this plant and give a report.

   d. To show how chemicals break down rocks.

2. Materials: vinegar, two small sea shells or piece of limestone, glass container.

   Procedure: Put some vinegar in the container and immerse the sea shell. Have some pupils listen to the bubbling sounds. After setting for 24 hours, scrape the shell with a knife. It will crumble and break much more easily than a control shell that has not been soaked in vinegar.

CONCEPTS | EXPERIMENTS

IV Rocks are formed through the forces that wear down and build up the earth's surface: there are igneous, sedimentary, and metamorphic rocks.

A. Subconcept: Igneous rocks are formed from lava and magma flows.

1. Materials: Pumice, volcanic breccia, obsidian, granite, and basalt rock specimens, hand lenses.

Procedure: Have the children recall how lava and magma flows build up the land. Rocks made in this way are called igneous or fire rocks. Relate to the word "ignite". Show the five specimens. Indicate all are of igneous origin, but under what conditions were they formed? Allow time for close observation. Provide two clues.

Challenge the class to find two rocks from the five rocks to match these clues.

a. Small bits of lava and rock materials were thrown high in the air when a volcano erupted. Which rock may have been formed in this way? (volcanic breccia)

b. Some top parts of a lava flow were whipped into a bubbly foam from gases inside the lava. (Pumice)

Identify the obsidian specimen as a type of volcanic glass. This forms on and near the top surface of a lava flow.

Just below the lava flow surface, basalt forms. Hold up this specimen.

Now identify a specimen of granite. Develop that it cools under the earth's surface, as when a dome mountain is formed.

Pass around hand lenses and these three rock samples for close examination. Help the children notice that obsidian has no viewable crystals, basalt has very tiny crystals, and granite has large crystals. Raise speculation as to why these conditions obtain. There are some differences in the mineral composition.

B. Subconcept: Sedimentary rocks are formed through the depositing of sediments which are squeezed and cemented together.

1. Materials: Conglomerate, sandstone and shale rock specimens; Mason jar about two-thirds full of equal portions of soil, sand and pebbles. (Put water in the jar, shake, and allow materials to settle overnight before starting this activity).

Procedure: Have the children speculate about what happens to the tremendous amounts of soil and rock particles which erode and wash from the land into the seas. Develop that the enormous pressure of overlaid materials gradually causes those deeper down to be squeezed together. Chemicals in the water help to cement the particles together.

Exhibit the materials settled in the Mason jar. Draw on the chalkboard a large diagram of the jar and materials. Let the children label the levels of mineral content in order, from bottom to top: pebbles (and a little sand), sand, silt, and clay. Identify the silt and clay as ordinary mud. Materials like these settle in large bodies of water and are pressed into rocks.

Show the class the conglomerate, sandstone, and shale specimens. Can anyone identify the jar materials which might, under proper conditions, form into these rocks?

Before permitting identifications, pass around the rock specimens to enable close observations. Place some water on the shale and have the children smell it. (It smells like mud.) Let someone rub several pieces of sandstone together. Put a piece of black paper underneath to catch the sandy fragments.

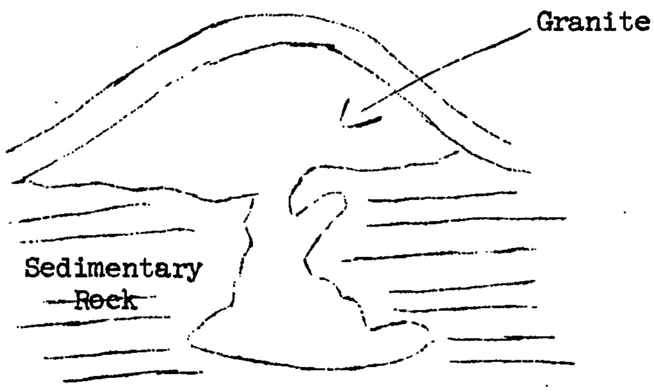
Enrichment: Let pupils confirm their observations through reading. Pebble and sand particles are cemented into conglomerate or puddingstone; sand becomes pressed and cemented into sandstone; mud becomes shale. However, layers may not necessarily form in this order--it depends on which materials erode and settle.

C. **Subconcept:** Metamorphic rocks are formed when heat and pressure change sedimentary and igneous rocks.

1. **Materials:** Limestone, shale, sandstone, quartzite, marble, and slate rock specimens; wire clothes hanger, wax crayons, halfful glass of vinegar.

Procedure: Have your class recall how modeling clay looks after it has been baked in a kiln. If available, show baked and unbaked pieces of clay. Develop that both sedimentary and igneous rocks can be changed into a third rock called metamorphic rock.

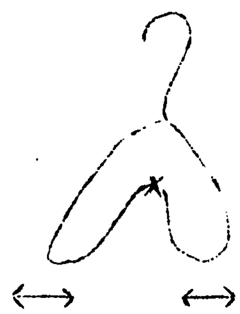
Sedimentary Rock →



On the diagram point out that hot igneous rock touches surrounding sedimentary rock inside the dome. The adjacent sedimentary rock is baked and changed, almost as if it were in a kiln.

Remind your group of how the earth's surface may be folded. The tremendous pressures bend, squeeze, twist, and heat the rock into changed form. Have everyone observe the effect of bending a solid material. Let a child rapidly bend a wire coat hanger back and forth about twenty times.

Touch some wax on the X. Wax will partly melt on contact with the hot metal.



Bring out that the folding of rocks also produces heat, even though it takes place very slowly. The combined heat and pressure changes the rocks into a new and different type.

Pair the sedimentary and metamorphic specimens:

a. Limestone can change into marble.

   Will marble bubble like limestone? Wrap a piece in some cloth and crush it with a hammer. Immerse the crushed marble in vinegar. It should bubble.

b. Shale can change into slate. (Does wet slate also smell like mud?) It does somewhat.

c. Sandstone can change into quartzite.

Have children notice the distinctness of separate sand grains has diminished through the crushing action of metamorphosis.

Have pupils rub the paired samples together and also compare their weights if possible. Challenge them to explain why metamorphic rocks seem harder and heavier than the parent rocks. (The heat and pressure have compacted them more; they are denser.)

VOLCANOES

Although some volcanoes have done great damage, many volcanoes have also helped build up the earth's crust. Write how volcanoes have helped form the following:

1. Mountains -

2. Islands -

3. Soil -

Use resource books to fill in the formation on the following chart

NAME	LOCATION	ACTIVE OR INACTIVE	OTHER INTERESTING FACTS
MAUNA LOA			
PARICUTIN			
VESUVIUS			

EARTHQUAKES

In books or magazines, find out about two earthquakes that happened in the past ten years. In the table below, write the facts asked for about each earthquake. You may wish to write in your science notebook other interesting information that you discover about earthquakes.

Facts about the Earthquake	Earthquake I	Earthquake II
1. When the earthquake happened		
2. Where it was strongest--its "center"		
3. How it changed the earth's crust		
4. The damage done to homes and people		

ADDITIONAL STUDENT ACTIVITIES

1. Look in magazines and newspapers for pictures that show the earth's surface at many different places on the earth to compare and contrast and to discover what changes have occurred in these places.

2. Prepare a report on the world's great caves. Where are these huge underground caverns located? How were they formed? Is there any life in any of these caves? Include some pictures of what it is like inside a large cave.

3. Construct a diorama of the inside of a cave. Make the main room in your cavern out of papier-maché. Drip candle wax or melted crayon down the sides of the cave to represent limestone.

4. Find out as much as you can about Project Mohole. Why is this project important?

5. Suggest reading about the great "Dust Bowl" wind erosion disaster in the thirties. What caused it? What measures are being taken today to prevent a recurrence?

6. Encourage children to bring in magazine pictures that feature weathering and erosion.

7. Have a child report on Paricutin, a volcano that developed in a Mexican cornfield in 1943.

8. Encourage children to gather magazine pictures of the great Alaskan earthquake of 1964, and more recent earthquakes.

AUDIO-VISUAL AIDS

Filmstrips

Changing Surface of the Earth - 46 frames - McGraw-Hill Company
Our Earth is Changing - 67 frames - Jam Handy Organization
Volcanoes and Earthquakes - 40 frames - Harper and Row
Mountains - 46 frames - Harper and Row
Glaciers - 22 frames - color - Universal Ed. and Visual Arts

FILMS

The Earth's Changing Surface - 12 min. - color - McGraw-Hill
Glacier Park Studies - 15 min. - color - Bailey
Understanding Our Earth: How Its Surface Changes - 11 min. - color - Coronet
Birth and Death of Mountains - 13 min. - color - Film Assoc.

Educational Television - Channel 2 - Exploring our Earth

BULLETIN BOARD SUGGESTIONS

1. Prepare a bulletin board, including pictures of such phenomena as a volcanic eruption, a flood, an iceberg floating in the ocean, or a geyser. Captions under pictures may be in question form to encourage children to use books to find the answers.
2. Collect pictures for a bulletin board that illustrate various landforms and water bodies on the earth's surface.
3. Illustrate surface features of the earth such as volcanoes, hills, buttes, and faults.

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INTRODUCTION TO OCEANOGRAPHY

OVERVIEW

Though oceanography is a young science, it has already presented man with a host of intriguing problems and many potential solutions to world needs for minerals and other goods. Only recently has the technology of underwater exploration been developed. Efficient submarines are a very recent development; sonar, the bathyscaphe, and the aqualung are more recent still.

Motivational ideas:

1. Collection of books on oceanography.
2. A film, such as "The Restless Sea" put out by Bell Telephone Company.
3. Diving equipment on display in the room.

<u>CONCEPTS</u>

1. The origin of the oceans is still controversial.
2. The ocean is in constant motion.
3. Currents are caused by the water being unevenly heated by the sun.
4. There are many substances dissolved in ocean water.
5. Evaporation is a method used to regain some of the mineral wealth from the ocean.
6. The greater the salinity (salt content in ocean), the greater the density.
7. The buoyancy of water causes objects of various sizes and shapes to float.
8. To float, an object must displace its own weight.
9. A boat, or object, will float higher in salt water than in fresh water.
10. Objects weigh less in water.
11. Water pressure is one of the problems confronting divers when they explore the ocean depths.
12. The greater the ocean depth, the greater the water pressure.
13. Distorted vision, caused by water, is another problem to the divers.
14. The oceans and seas have layers of cold and warm water which affect the diver.
15. Many devices are used to help man explore the ocean.
16. Sea water is being purified to be used in irrigation and as a source of drinking water.
17. Living organisms are dependent on one another for survival in the ocean.
18. The mineral wealth of the ocean is a great, but unexploited area.

Background:

The origin of the oceans is still controversial, although certain features have been adequately accounted for. When the earth was formed some three-five billion years ago, it was a molten ball. It cooled like a desiccating orange, its skin becoming more and more wrinkled as the interior shrank. In this manner the ocean basins were formed.

Another hypothesis suggests that the continents of the world are receding from one another. The ocean basins are, then, created as this vast motion takes place.

It is also thought that the moon was formed when the earth spun off a part of its mass during the cooling period, and that the scar of that gigantic upheaval is the basin of the Pacific Ocean.

CONCEPTS	EXPERIMENTS
I The origin of the oceans is still controversial	A. Discuss with the class the different ways the oceans might have been formed. Some children might do added research and report to the class. B. Material: Apple, water Procedure: Dunk the apple in water. Explanation: The thin film of water shows the depth of the ocean in comparison to the earth's diameter.
II The ocean is in constant motion.	A. Discuss these ideas 1. If seaweed grows on the bottom of the ocean, how does it get to the shoreline? 2. How do seashells get to the sand? 3. If you float in the ocean, you often end up in a different place than from where you started. Why?

III Currents are caused by the water being unevenly heated by the sun.

A. Materials: Quart bottle, a 3" x 5" card, water, food coloring.

Procedure: Fill a quart bottle with warm water. Add a small amount of food coloring and mix. Fill a second quart bottle with cold water. Cover the mouth of the first bottle with a file card. Invert the first bottle over the second bottle. Pull out the card from between the bottles. Tell the children to watch the direction in which the water flows. Repeat the experiment reversing the position of the bottles.

In which direction is there a greater flow of water?

B. Pour some very hot water into a sink. Let the water be as hot as you can stand to touch. Then slowly add cold water. Where do you find the cold water in the sink? You could add food coloring before you pour and see what happens.

Reverse the procedure, putting cold water in the sink and adding hot water.

Explanation: Different areas of water in our oceans and seas differ in temperature and saltiness. These differences cause variations in the density of water. Dense water tends to sink toward the bottom of the ocean or sea, while less dense water tends to rise. There is a pattern of ocean currents very similar to the pattern of wind currents.

IV There are many substances dissolved in ocean water.

A. Materials: pint of sea water

Procedure: Evaporate a pint of sea water to see how much salt and other minerals it contains. You will find that there is about one tablespoon of salt and other minerals in a pint of sea water.

V Evaporation is a method used to regain some of the mineral wealth from the ocean.

A. Materials: Water, salt

Procedure: Pour a cupful of water into a shallow pan. Add 3 tablespoons of salt. Let it stand for several days. Observe what happens.

B. Evaporation was used to get salt long ago in Greece and Egypt. It is still used today in Iran and California.

Prepare a special report on how ancient and modern methods differ.

VI The greater the salinity (salt content in ocean), the greater the density.

A. Materials: beaker, water, salt, scale

Procedure: Place a beaker on a scale, weigh it, and then fill the beaker with water. Record the weight of the water (subtract the weight of the beaker from entire amount). Make a red line with a crayon to indicate the water level. Then add several tablespoons of salt to the water and dissolve it. Record the new weight.

1. Does it weigh more now? (It will.)
2. Does it occupy more space? (Yes)
3. Is it any more saline? (Yes)
4. Is it denser? (Yes)

Explanation: The salt is now in solution between the water molecules, so the water increases in volume as well as in weight.

Density of water varies with the kinds of elements dissolved in it, as well as with the amount packed into the same space.

The saltiness of water is called salinity.

VII The buoyancy of water causes objects of various sizes and shapes to float.

A. Materials: several objects including paper clips, marbles, bath stoppers, corks, balls, bottle tops, spoons, cans, and waxed cartons.

Procedure: 1. Sort these objects into three different piles according to their weight--light, medium or heavy.

Test each group, observing what happens to each object when you drop it into the water. Why do some objects float, while others sink? Make a chart and keep a record of which objects float and which sink.

2. Sort the objects as to size. Test each group and observe what happens. Does size change an object's capacity to float?

B. Materials: tin can, water

Procedure: Drop a small tin can into water. Turn it around in different positions. Observe.

Remove the can and flatten it. Drop it into the water and observe. What happens? Has its weight changed? What has changed?

What two facts about an object might determine whether it floats or sinks?

C. Materials: aluminum foil, water

Procedure: Drop a ball of aluminum foil into the water--observe. What force is working on the ball?

Flatten out the foil and shape it into a small boat. Hold it over the water and then let it drop. What keeps the boat afloat? The water pushed aside is called displaced water.

Push the palm of your hand down on the water. The upward push of the water against your hand is called buoyancy. The buoyancy of water pushes up on an object; gravity pulls down on an object.

To float, an object must displace its own weight.

A. Materials: large pan, tin can, spring balance, block or wood

Procedure: Place the can in the large pan. Fill the can to the top with water. Wipe up any spilled water in the large pan. Carefully place the wooden block in the water. The water which the block has pushed over the sides of the can is called displaced water.

Weigh the displaced water. Weigh the block. Compare the two weights.

Background: This concept was discovered by Archimedes, a Greek scientist, over two thousand years ago.

IX A boat, or object, will float higher in salt water than in fresh water.

A. Materials: glass of water, a fresh egg, salt

Procedure: Put the egg in fresh water. Observe the results.

Now dissolve as much salt as you can in the water. Stir the water carefully. What happens to the egg when placed in the salt water?

X Objects weigh less in water.

A. Materials: spring scale, wire, various objects

Procedure: Make a sling of wire and attach the wire to a hook so that you can place objects in the wire sling for weighing. Weigh each object out of the water. Then weigh each object while it is submerged in water at room temperature. Try to use objects made of known materials such as iron, glass, copper, lead, silver or gold.

Record the results:

Object and Material	Weight out of water	Weight in the water	Difference
Magnet--iron	16 oz.	14 oz.	2 oz.

Try various objects made of the same material. Divide the weight out of water by the difference in weight in each case. Is the quotient very nearly the same in each case? How would you explain this?

XI Water pressure is one of the problems confronting divers when they explore the ocean depths.

A. Materials: water, sink, large round stopper

Procedure: Place the stopper in the sink drain. Fill the sink with water. Now try to remove the plug. Do you feel any resistance? The water is pressing on the plug.

B. Discuss the experience of diving to the bottom of a pool. Some children may have felt their ears pop, chest feeling heavy, or a strange feeling about the head.

XII The greater the ocean depth, the greater this pressure.

A. Materials: 3 milk cartons, water, a nail, tape, a large pan

Procedure: Remove the tops from the cartons. Using the nail, make three holes in the side of one carton. One hole should be near the bottom of the carton, one near the middle, and one near the top. Put tape over each hole. Hold the carton over the pan and fill the carton with water. Remove the tape from all three holes. What happens? Why? How do you explain the difference between the jets of water?

Cut the bottom out of the other carton. Tape the carton on top of the carton you have already used. Put tape on the holes again and fill the cartons with water. Remove the tape. How do the water jets now compare with those from the single carton?

Tape the third carton and repeat the activity. How do the jets of water now compare?

XIII Distorted vision, caused by water, is another problem to the divers.

A. Materials: water, glass, pencil

Procedure: Place a pencil in a glass of water. Look at the pencil through the water. What do you see?

Explanation: The pencil seems to bend because of the way light rays pass through the water. Light rays bend, or refract, when they pass from air to water. The refraction causes objects under water to appear distorted.

XIV The oceans and seas have layers of cold and warm water which affect the diver.

A. The water near the surface of the ocean is warmer than the water deep below the surface. The layers of cold and warm water are sharply divided which makes it difficult for the divers to adjust to the changes in temperature. The colder the water becomes, the more heat it draws from the body of the diver. This can cause the diver's body to become cold and numb.

Discuss the above information with the class. Ask if they have ever felt extremely cold and possibly numb when in the ocean.

XV Many devices are used to help man explore the ocean.

A. A demonstration to show how the early diving bells worked--the Greeks used this method -

Materials: glass, tank, or large container of water

Procedure: Push a glass of air upside down in a tank full of water. Tip the glass slightly.

Explanation: The Greek diver of long ago could not leave his air supply for any length of time. When the diver needed air, he slipped under the bell and took a deep breath.

B. Materials: Snorkel, face mask, flippers

Procedure: Show these to the class and discuss how they would help the diver. Discuss the limitations of not going too deep or for too long of time.

C. The aqualung has been developed to help solve the problem of breathing and permitting man to dive as low as 40 feet below sea level. This is called free diving or skin diving.

Skin diving has many advantages over helmet diving, in which the diver wears a bulky suit and a heavy metal helmet with windows to see through. Air is pumped through the tubes attached to the helmet. A ship is stationed above the diver to feed him air and to pull him up. In helmet diving there is always the danger that something may happen to the air tubes. Skin diving permits the diver to carry his oxygen with him. Another advantage is that the skin diver can swim like a fish and do much more than the helmet diver who is limited mostly to walking.

1. Discuss the above information with the class.
2. Find pictures to illustrate the equipment.
3. Find additional information on what the skin divers have found in the ocean.

D. Prepare a report on the small two-man subs that are being used to explore beneath the sea.

E. Find out about Flip, the research vessel that can stand on end.

F. Discuss operation "sealab". Note astronaut Scott Carpenter's involvement in this project as a member of the underwater research teams.

G. Look up information about Matthew Fontaine Maury, one of the first great oceanographers.

H. Make a chart to show various devices used for underwater exploration. Include a picture of each device, the scientist or technician who made a dive in the device and the depth recorded.

I. Prepare a report on scuba diving. Interview the man at the local sporting goods store and ask him to show the equipment used by scuba divers to the class.

J. Look up information on William Beebe, bathyscaphe, bathysphere, Conshelf III, Deepstar, Sealab I, II, III, Alvin.

XVI Sea water is being purified to be used in irrigation and as a source of drinking water.

A. Materials: salt, water, teakettle hot plate, drinking glass, piece of glass.

Procedure: Mix a solution of salt and water. Taste the solution to be sure it is salty. Pour the solution into a teakettle. Boil it. Hold a piece of glass in the path of the water vapor. Note how the vapor changes back to water. Catch the water in a drinking glass. Taste the water. It should no longer be salty.

B. Find information on the distillation process of purifying salt water, the freezing method.

XVII Living organisms are dependent on one another for survival in the ocean.

Discuss with class -

Life in water is in constant search for food. Animals often compete for the same food. They also eat one another to survive. This eating pattern is called a food chain. This food chain will end when bacteria attaches to matter and all energy is removed.

The salt water food chain can be illustrated with five links. The first organisms in the chain are different types of one-celled green plants referred to as plant plankton. The plants manufacture food from CO_2, water, and from the sun. These plants are eaten by small one-celled animals. These animals serve as a food source for small fish such as herring. The herring and small fish are preyed upon by cod. The next link chain can be considered to end with the mackerel shark, which eats the cod, which has few enemies except man.

Sooner or later everything dies. If it dies naturally, one-called plants and animals may use its body for food.

A. Have children find information on plankton to discover where it grows best. They should find that plankton grows best in cool waters as far down as light can reach (400 feet about).

B. Materials: Seaweed, water

Procedure: Obtain different kinds of seawwed from the ocean for the children to examine. Have them look for roots and stems. Explain holdfasts. (Seaweed do not have roots; they have holdfasts that fasten to rocks or shells on the bottom of the sea.

C. Have children select one living organism (trying to be sure that each child chooses a different one) and find as much information as possible. Information can be discussed in oral reports.

D. To illustrate underwater life, children may work individually or in groups constructing a diorama. Cutouts of various kinds could be hung by threads at proper depths.

E. Make a mural showing different types of ocean life (both animals and plants).

F. Investigate and report on aquaculture, the farming of the seas.

G. Have the class make a study of the different zones in which seashore plants and animals of different kinds may be found. Study life on a rocky shore, sandy beach, mud flat, wharf, or piling.

H. Not all the animals found in the sea are fishes or lower forms of animal life. Mammals are found in the sea, too. Study the sea otter, whale, dolphin, seal, and sea lion. How are these animals alike in their internal structure? How are they different?

XVIII The mineral wealth of the ocean is great, but unexploited.

Minerals are found on the ocean floor in the form of nodules. A nodule is a lump. Nodules in the ocean are about the size of potatoes and are made of such minerals as manganese, cobalt, iron, nickel, and copper. So far, no inexpensive way has been found to collect these nodules, but mineralogists are trying to develop a method.

Refer to chart to see the many uses of the ocean minerals to man.

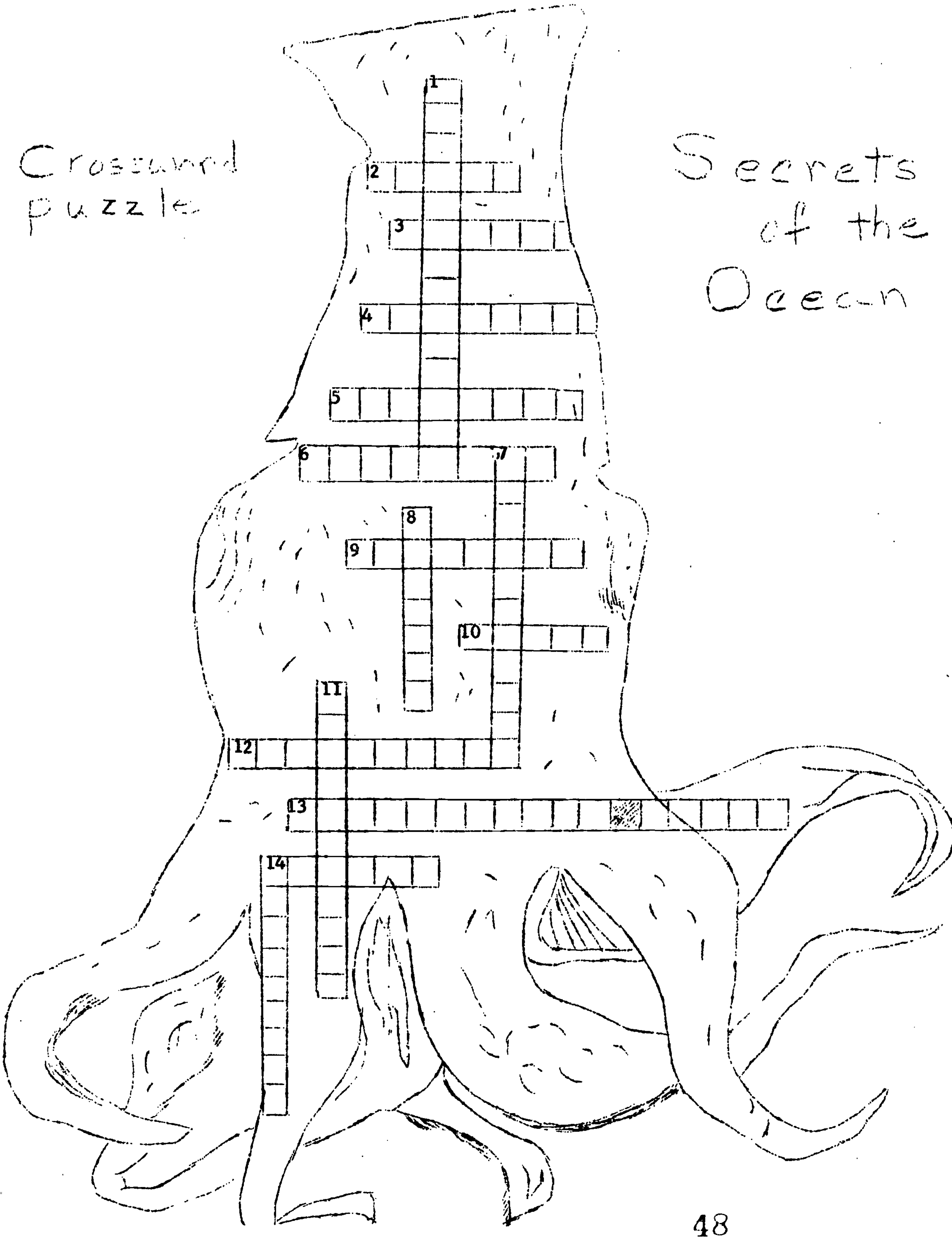
A. Discuss the information above with the class. Have some children find more information and report to the class.

IMPORTANT ELEMENTS OF THE OCEAN

CHEMICAL	USES
Sodium	Table salt
Magnesium	Airplane parts, printing inks, insulating materials, medicine.
Potassium	Medicines, dyes, fertilizers, paints.
Bromine	High test gasoline, medicines, photographic films
Chlorine	Table salt, bleach, disinfectant

Crossword puzzle

Secrets of the Ocean



CROSSWORD PUZZLE
Secrets of the Ocean Clues

DOWN:	ANSWERS:
1. Men who study the ocean	Oceanographers
7. Farming the ocean	Aquaculture
8. Rovers of the ocean	Current
11. Moisture in the air from the ocean caused by the sun	Evaporation
14. Underwater vessel	Submarine

ACROSS:	
2. Large mammal	Whale
3. Project to examine the crust of the earth	Mohole
4. Food of the sea	Plankton
5. Wealth of the ocean	Minerals
6. Underwater research vessel	Deepstar
9. Underwater worker	Aquanaut
10. Vessel used to recover lost bomb in the Mediterranean	Alvin
12. Process of making fresh water	Desalinate
13. Vast area of the ocean for future use	Continental Shelf
14. The outer covering of the fish	Scales

BULLETIN BOARDS

1. Why do they float?

   Display pictures of objects, such as boats, swimmers, surfboards, and rafts floating in water. You can also include life jackets and life-saver rings. Let the children speculate as to why these objects float and do not sink.

2. Show foods that we get from the sea. Use pictures of sea foods from magazines and newspapers--caviar, codfish cakes, tuna fish, etc.

3. Make a chart showing how man uses the wealth of the sea.

FILMS

"Exploring the Ocean Floor" - 11 min., Churchill Films, Los Angeles, California

"Oceanography: The Science of the Sea" - 11 min., Film Association of California

"What's Under the Ocean" - 14 min., Film Associates of California

"The Restless Sea" - The Bell Telephone Company

"The Living Tide" - Dr. Roman Vishniae, Albert Einstein School of Medicine, New York City

"Secrets of the Underwater World" - a Walt Disney Production

"Science of the Sea" - Oceanographic Institute, Woods Hole, Mass.

FILMSTRIPS

"The Oceans" - 36 frames, McGraw-Hill Book Company

"Under the Sea" - 29 frames, Society for Visual Education

"Plant, Animal Life Under the Sea" - 32 frames, Society for Visual Education

"Plants and Strange Animals of the Sea" - 65 frames, Jam Handy Organization

"How Fish get their Food" - 3-1-E3, Stoneham

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FORCES IN SPACE

attached to the helmet. A ship is

50

OVERVIEW

Gravity and the natural laws of motion create problems in placing an object in orbit or sending it into outer space. This unit is designed to show these natural forces as they pertain to familiar objects in the child's environment.

Motivating Activities:

1. Discuss a recent rocket launching.
2. Display news clippings of the latest developments and events occurring in astronautics.
3. Display a group of books about astronautics.

<u>Concepts</u>

1. Gravity gives weight to all objects.
2. The force of gravity tends to hold all objects on earth.
3. Free falling objects fall at the same rate of speed.
4. Air offers resistance to objects moving through the atmosphere.
5. Gravity affects the distance an object can travel.
6. Gravitational attraction affects the path of a moving body.
7. For every action there is an equal reaction.
8. Energy of motion reacts against gravitational pull to create thrust.
9. The rocket engine works on the principle of Newton's third law.
10. A body at rest tends to stay at rest unless acted upon by some external force.
11. A body in motion tends to stay in motion and resists any effort to stop it.
12. A moving object tends to travel in a straight line.
13. Rockets must overcome the force of gravity to escape into outer space.
14. Centrifugal force keeps the satellite in orbit. Whenever an object travels a curved path, a force is exerted on the object which is in the direction away from the center of the curved orbit.
15. Speed and power are necessary to place a satellite in orbit.
16. Added acceleration is necessary to escape the earth's force of gravity when shooting a space craft into outer space.

Background:

Gravity is a word which is used to describe or identify a phenomenon which no one has successfully explained in terms that can really be understood. What has actually happened is that man has given a label to a phenomenon which he cannot explain but can demonstrate. The understanding of how gravity acts upon objects on earth and in space is essential in many fields of science.

CONCEPTS	EXPERIMENTS
I Gravity gives weight to all objects	A. Materials: Spring scale and several objects Procedure: Weigh each object and read the weights indicated on the face of the scale. All objects have weight because gravity pulls them toward the center of the earth.
	B. Materials: Soil, cup, bathroom scale, gallon pail Procedure: Place pail on scale. Write the weight of the pail. Put 4 cups of soil in the pail. How much does the soil weigh? This is the amount gravity is pulling on the soil. Add more soil. Explain what gravity has to do with the change of pressure on the scale.
II The force of gravity tends to hold objects on earth.	A. Have children jump as high as possible. Discuss the fact that regardless of how hard they try, they cannot get very far off the surface.
	B. Throw various types of objects into the air. Observe that there is a difference in the height various objects can be thrown, but they all fall back to earth because of gravity.

III. Free falling objects fall at the same rate of speed.

A. Materials: Pencil, book, eraser, ruler, coin

Procedure: Hold two of the above objects at the same height and release them at the same instant. Observe which object strikes the ground first. Continue the experiment using two different objects each time until you have compared all the objects and how they fall.

Explanation: All the objects will strike the floor at the same instant from the same height. This is Galileo's Law of Free Falling Objects. There is, however, another part to this law, concerning the effect of the resistance of air to free falling objects. If these objects had been dropped from a greater height, they would not have landed at the same time because of air resistance.

IV Air offers resistance to free falling objects moving through the earth's atmosphere.

A. Materials: Sheet of paper

Procedures: Drop a flat sheet of paper from a height of 9 or 10 feet. Observe the path and rate of the flat sheet of paper. Crumple the paper into a tight ball. Drop the crumpled paper ball and note the rate of fall.

B. Materials: Large sheet of corrugated cardboard

Procedure: Hold a large sheet of corrugated cardboard about waist high. Run as fast as possible and feel the resistance of the air pushing upon the cardboard. Repeat without the cardboard; note that it is now easier to run fast.

V Gravity affects the distance an object can travel.

A. Materials: Softball, tape measure

Procedure: Throw ball 3 times, first easily, then harder, then as hard as you can. After each throw, measure and record the distance the ball covered. Which throw caused the ball to cover the greatest distance? Make a list of factors (force, gravitation, air friction) which slowed and stopped the ball's movement.

VI Gravitational attraction affects the path of a moving body (satellite).

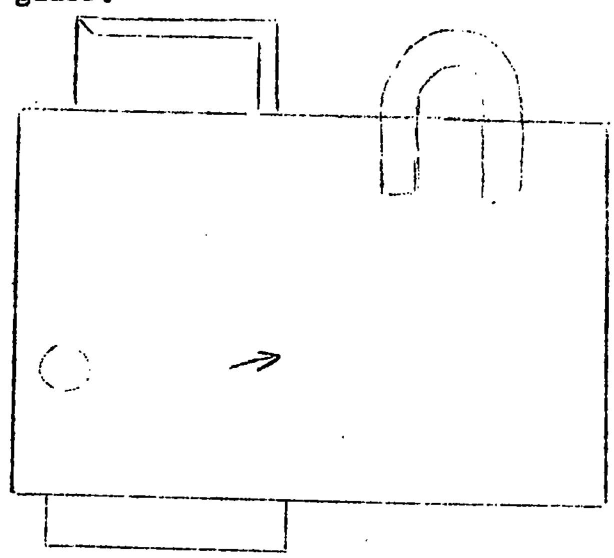
A. Materials: A tennis ball and table

Procedure: Roll the ball off the edge of the table and mark the spot where it hits the floor. Do this several times increasing the speed each time.

Explanation: Gravity pulls on the ball each time causing it to fall toward earth in an arc bending toward the earth. With an increase in speed the ball moves farther horizontally while falling. For a ball to continue in an orbit around the earth without hitting the ground, it would have to travel at a speed of 5 miles per second, or about 18,000 M.P.H. This would be impossible close to the earth because air resistance would cause the ball to slow down.

B. Materials: Book, magnet, steel ball, sheet of glass

Procedure: Place a thin book under one end of the sheet of glass so that the glass is tilted slightly. Slide a magnet under the other end of the glass.



Allow the steel ball to roll down the sheet of glass. Observe the ball carefully. How is the motion of the ball affected by the magnet?

In this experiment the magnetic attraction of the magnet works in very much the same way as the gravitational attraction of a planet.

You may wish to repeat this with stronger magnets and various sized steel balls.

VII For every action there is an equal reaction.

A. Materials: One balloon

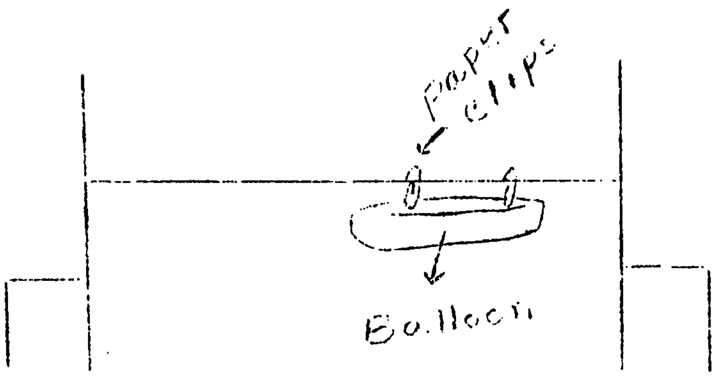
Procedure: Blow up the balloon, close nozzle with fingers, then release it.

Explanation: The balloon moves rapidly through the air in an erratic pattern. Its motion is due to the force of the air leaving the nozzle of the balloon. This is explained by Isaac Newton's Third Law of Motion, two bodies are involved in every force found in Nature, the body that exerts the force and the body that receives the force. Force exists in pairs and never alone.

In the case of the air-filled balloon, the air escaping from the balloon was the body that exerted the force and the balloon received the force. The hot gases escaping through the nozzles of a rocket engine have the same effect on the rocket body as the air did on the balloon.

B. Materials: Masking tape, long balloons, wire, paper clips, balsa stick (½" square x 12" long), 25 feet of nylon sewing thread, 2 chairs

Procedure: Stretch the thread tightly. Make two hooks out of paper clips. Mount hooks at each end of stick.



Blow up one balloon and hold tightly so no air leaks out. Tape the balloon to the stick as shown.

Carefully slip the hooks over the thread. Let the balloon go and release the air from it without shaking the stick or thread.

Measure the distance the stick traveled. What was it?

Does it travel the same distance the second time?

C. Materials: Roller skates, basketball

Procedure: Have a child wear roller skates and throw a basketball forward.

As the ball goes forward, the child rolls backward.

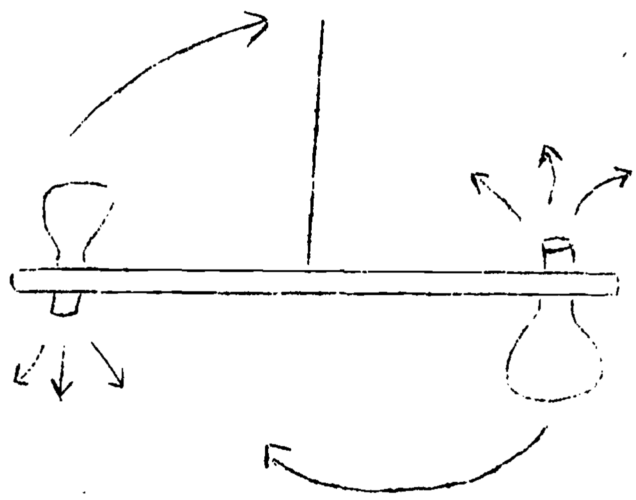
(Newton's Third Law of Motion)

D. Step off the rear of a small wagon. Note the direction the wagon moves.

VIII Energy of motion reacts against gravitational pull to create thrust.

A. Materials: Dowel rod, string, 2 balloons, 2 medicine droppers

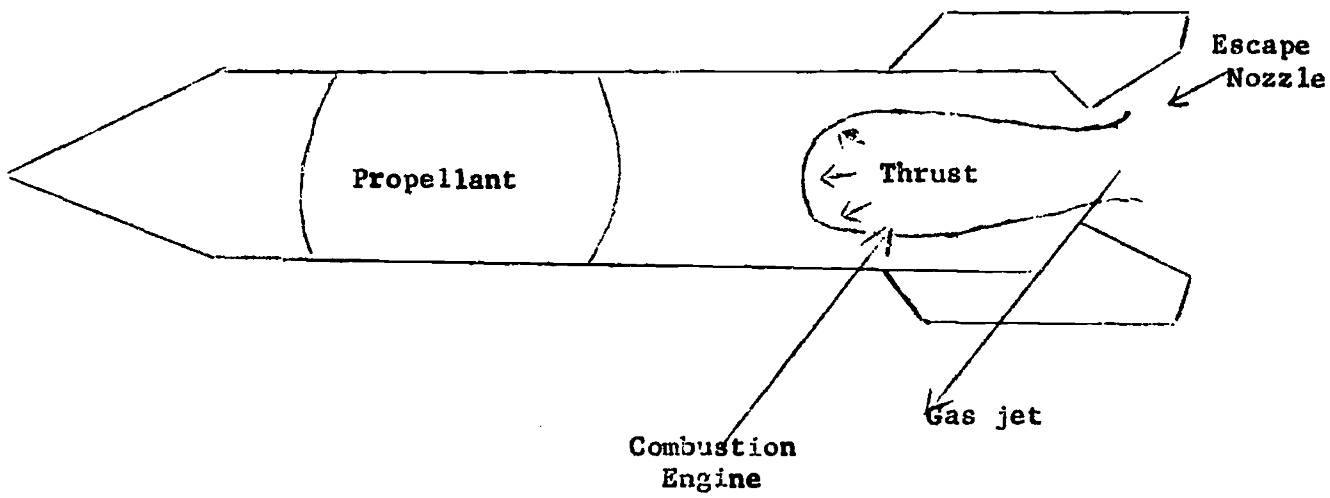
Procedure: Suspend a balanced dowel rod by means of a string tied at the center. Inflate two similar balloons through medicine dropper tubes that have been secured in the mouths of the balloons. Attach one balloon to each end of the rod so that the medicine droppers are horizontal and pointing in opposite directions.



B. To show how a narrow opening affects thrust have children do this at home. Take a garden hose and turn on the water. Place a finger over opening of the hose to make it smaller. Notice the change in the force of water.

IX The rocket engine works on the principle of Newton's Third Law.

Illustration of a rocket motor:



<u>Background</u>: In the combustion chamber, the fuel-oxygen mixture is converted into gases which ignite at a high temperature, This combustion causes the gas to expand, creating extremely high pressures within the chamber. A stream of high-speed gases is exhausted through the escape nozzle at the rear of the combustion chamber. Pressure on the chamber wall opposite the nozzle pushes the rocket forward, The forward motion results from the forces created internally and not from the exhaust gases pushing the outside air. The greater the internal push or thrust on the forward chamber wall.

A. Draw the diagram on the board and discuss its relation to Newton's Third Law of Motion.

X A body at rest tends to stay at rest unless acted upon by some external force.

A. <u>Materials:</u> Glass, 3" x 5" card, coin

<u>Procedure</u>: Take a glass and place a card over the open end. Place a coin on top of the card. Pull the card suddenly from under the coin.

Why does the coin fall into the bottle?

Why do you have to pull the card rapidly?

What could you say about the inertia of the coin?

<u>Explanation</u>: When the card is pulled rapidly from under the coin, the inertia of the coin at rest tends to cause it to remain at rest. After the card is pulled from under it, the force of gravity pulls the coin into the bottle.

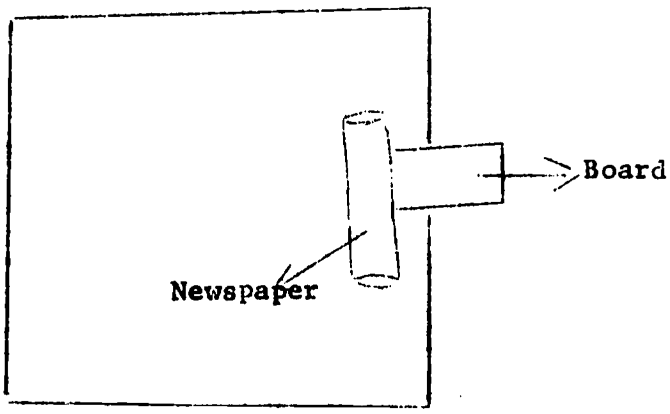
B. <u>Materials:</u> Glass jar or tin can, paper

<u>Procedure</u>: Set a glass tumbler or tin can on a sheet of paper in the center of a table top. Hold one end of the paper tightly in your hand and pull the paper out from under it.

XI A body in motion tends to stay in motion and resists any effort to stop it.

A. Materials: Thin board, newspaper

Procedure: Place a thin board under some newspaper. The board should hang off the edge of the table.



Move your hand rapidly and hit the board, attempting to break it with the side of your fist. The board should break.

Repeat this experiment moving your hand slowly. Why didn't the board break?

Explanation: When you moved your hand rapidly, it had considerable inertia. It was moving and tended to keep moving. The board, however, was at rest and tended to remain at rest. When your moving hand hit the board, its inertia of movement was such that it overcame the resistance of the board and broke it. When you moved your hand slowly, it did not have as much inertia and as a result did not break the board.

B. Materials: Ball of foil, plastic container

Procedure: Put foil ball in a container. Lay the container on its side on a table about 2 feet from the edge. Push the container along the table quickly, stopping it at the edge of the table. The open end of the container should be in the direction of the motion.

What happens to the ball? Why? (Effects of inertia and gravity)

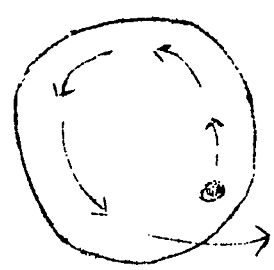
Try using different amounts of force in pushing the container. Give reasons for what happens. (Greater force produces greater forward motion).

XII A moving object tends to travel in a straight line.

A. Materials: Foil, round shallow pan

Procedures: Make a ball of the foil, and place it in a round shallow pan. Move the pan so that the ball goes round and round but stays in the pan.

Move the pan so that the ball goes around faster and faster. Make the motion fast enough so that the ball leaves the pan. It should go out in a straight line until pulled down by gravity.



B. Materials: Tennis ball, string, tape

Procedure: Fasten one end of a three foot length of string to a tennis ball. Hold the other end of the string in your hand and twirl the ball in a circular motion in front of you. Release the end of the string. What happens to the ball?

Explanation: When released, and before gravity has an appreciable effect, the tennis ball will fly off in a straight path, in a direction tangent to the orbital path.

A satellite stays in an orbital path around the earth because the gravitational pull of the earth bends its straight line path. The tension is in the string of the ball.

XIII Rockets must overcome the force of gravity to escape into outer space

A. Materials: Kitchen scale, brick, spring scale

Procedure: Weigh the brick on the kitchen scale. It will probably weigh about 5 pounds. Tie a string around the brick so that it will not slip off. Attach the spring scale to the string. Watch the pointer. Lift the scale slowly and smoothly until the brick is off the floor.

How much pull was shown on the spring scale? Why did you need more than 5 pounds to pick up this brick?

Explanation: The brick required force greater than its weight because of its inertia, or tendency to remain at rest. When this inertia was overcome, the brick rose into the air. According to the second half of Newton"s First Law, the brick should rise indefinitely. It doesn't because it is acted upon by the outside forces of gravity and the friction of the air.

Scientists have learned that the force should be at least 1½ times the weight of the rocket.

B. Materials: Magnet, steel paper clip, and string

Procedure: Suspend a paper clip from the end of a length of string. Hold a magnet in one hand and the suspended paper clip in the other hand. Keep moving the paper clip closer to the magnet until it is attracted to it. Find the distance from the magnet at which the paper clip is barely attracted to the magnet.

Explanation: The paper clip may be compared to a rocket which must escape the attractive force of the earth's gravity to "break away" into outer space. One way for a rocket to escape the earth's gravitational pull is to attain a top speed of 25,000 M.P.H. close to the earth's surface.

XIV Centrifugal force keeps the satellite in orbit.

Background: Whenever an object travels a curved path, a force is exerted on the object which is in the direction away from the center of the curved orbit.

A. Materials: Pail, water

Procedure: Fill a pail with water. Swing it around rapidly and observe that the water remains in the pail even when the pail is inverted.

B. Materials: Spool from thread, string, art gum eraser, or other light weight object.

Procedure: Thread a 2-foot length of string through a spool. To one end tie a light weight object. To the other end tie an object two or three times as heavy as the eraser. Holding the spool with the hole vertical, adjust the length of the cord from the eraser to the spool and the length from the spool to the other object so that they are approximately equal. Move the hand holding the spool, so that the gum eraser travels in a circle overhead.

Explanation: The centrifugal force exerted by the smaller swinging clay ball will hold up the weight of the larger clay ball.

If a satellite slows down, it will be pulled toward the earth by a force of gravity. This can be shown by slowing the circular motion of the smaller object.

XV Speed and power are necessary to place a satellite in orbit.

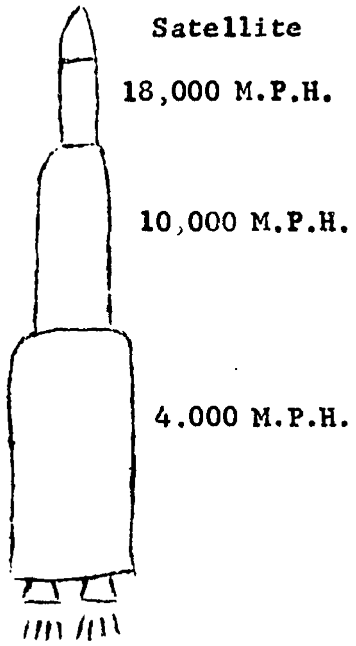
A. Materials: Flannel board, flannel-back three-stage rocket cutouts, and speed labels.

Procedure: Make cutouts according to figure shown. These are comprised of a three-stage rocket and the labels indicating the speed to which each stage accelerates.

The following information can be presented and discussed.

A satellite placed in orbit at an altitude of 300 miles must attain a speed of 18,000 M.P.H. To attain this speed more power is needed than can presently be provided by a single stage. This problem is solved by including several stages. The first stage is the largest and must produce the most power to overcome its own inertia and that of two other stages, plus the force of gravity and the air resistance closest to the earth.

The first stage attains a speed of 4,000 M.P.H., just as the fuel burns out. With a running start, now of 4,000 M.P.H., the second stage ignites as the first stage drops off, and accelerates to a speed of 10,000 M.P.H. With a running start of 10,000 M.P.H., the third stage ignites as the second stage drops off. At this time it attains a "horizontal" flightpath, following the curvature of earth, and the satellite or capsule is shot forward into orbit around the earth



Figures change in Demonstration 2

XVI Added acceleration is necessary to escape the earth's force of gravity when shooting a space craft into outer space.

A. Materials: Flannel board, flannel-backed three-stage rocket cutouts, and speed labels

Procedure: Refer to previous demonstration. The speed label for the third stage of rocket will be 25,000 M.P.H., instead of 18,000 M.P.H.

Explanation: For a rocket to escape the influence of the earth's gravity, it must accelerate to a speed of 25,000 M.P.H., which is known as escape velocity. This is accomplished by rocket staging.

The speed required for the rocket to continue climbing as it gets further out into space need not continue to be 25,000 M.P.H., because the pull of the earth's gravity decreases as the rocket gets further away from the earth.

When a rocket is fired toward the moon its third stage must accelerate to a speed of 25,000 M.P.H., for it to escape the earth's force of gravity. After the fuel in the third stage burns up, the rocket keeps moving due to inertia, but will slow down as it continues to travel toward the moon. At a distance of about 210,000 miles from the earth and about 30,000 miles from the surface of the moon, the moon's gravitational pull becomes the dominating attractive force on the rocket.

ADDITIONAL ACTIVITIES

1. Report on current happenings of space travel.

2. Collect articles and pictures from magazines and newspapers to make a space scrapbook.

3. Construct scale models of United States rockets and satellites of wood, cardboard, papier-maché, or clay.

4. Draw a mural showing the development of space travel, or space craft.

5. Make a list of things that depend on gravity. Check each one that you would have to do on a space journey. How would you do these things?

6. Read and report on the first manned flights into space. You might be able to answer these questions.

   How long did the flight last?
   How were the men dressed?
   What experiments did the men have to do in space?
   What were their experiences with weightlessness?
   What did they discover about space?
   How was the capsule made to re-enter the earth's atmosphere?

7. Find information about one or more of these scientists.

   Robert Goddard
   Colonel Stapp
   Montgolfier Brothers
   Captain H. C. Gray
   Auguste Piccard

WORKSHEET

The Laws of Motion in Action

Here are four things that happened to Jim. Write why they happened. The main ideas you have learned about the laws of motion will help you explain why.

1. As Jim rode to school with his father, his father stopped the car suddenly at a red light. Jim was thrown forward until his head almost hit the front window. Why was Jim thrown forward?

____

____

2. That day, Jim's father decided to put safety belts in the car. Why?

____

____

3. After school, Jim went sledding in the snow. The snow had turned to ice. Jim found that once he gave his sled a starting push, it coasted a long way before it stopped. Why did Jim have to push his sled to start it moving?

____

What kept the sled moving after he pushed it?

____

Why did the sled finally stop moving?

____

____

4. At dinner, Jim's baby sister kept pushing things off the table. She laughed with great glee as they dropped to the floor. What natural force was amusing Jim's baby sister?

____

____

BULLETIN BOARD IDEAS

1. Display pictures and photographs on the bulletin board with captions that motivate discussion. For example, under a picture depicting a rocket flying to the moon, the caption might read, "Will you be one of the first passengers to the moon?"

2. Prepare a book-jacket bulletin board illustrating the books about space and space travel.

3. Prepare a bulletin board illustrating conditions necessary for man to live on the earth. The caption might read, "How can man meet these needs in space?"

SPACE INFORMATION RESOURCES

1. NASA
   Educations Publications Distribution Center
   FAD
   Washington, D. C. 20546

   for "NASA FACTS" - Living in Space - Volume III, No. 5
   Gemini Pictorial - Volume IV, No. 1
   Orbiting Geophysical Observatory,
   Volume II, No. 3

2. Superintendent of Schools
   Dept. of Education, San Diego County
   6401 Linda Vista Road
   San Diego, California 92111

   Chart - How Big are Missiles?
   Picture - "Astronaut's View of the Earth"

3. Nasa Electronics Research Center
   575 Technology Square
   Cambridge, Massachusetts 02139

FILMS

"How Man Travels Through Space" BW/color, 12 min. Cenco Educational Films

"Space Science: An Introduction", 14 min. BW and color - Coronet Films

"Gravity and What it Does" (in Stoneham)

FILMSTRIPS

"Gravity" - Color, Young America Films

"Man in Space" - Color, Encyclopedia Britannica Films

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Verral, Charles, Robert Goddard: Father of the Space Age, Englewood Cliffs, New Jersey, Prentice-Hall, 1963.

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THE PROPERTIES OF HEAT

OVERVIEW

Heat, by definition, is a form of energy associated with the rapid, random motion of molecules. Heat is transferred from one substance to another by conduction, convection, or radiation and usually produces a rise in temperature.

This unit will include the nature of heat, the effects of heat, and how heat travels.

Motivational Activity:

1. Tracing all sources of heat back to the sun.

   List as many different sources of heat as possible, example, friction, electricity, fires, atomic energy. Tell some of the things that heat from each of these sources does for them. Then try to trace the heat back to the sun.

2. Display equipment to be used in the demonstrations and experiments.

Concepts to be Developed

1. Heat is a form of energy - the energy of moving molecules.
2. As a substance gets warmer, its molecules move rapidly; as it cools, less rapidly.
3. Solid substances generally expand when heated and contract when cooled.
4. When gases are heated, the molecules move farther apart and exert greater pressure on the walls of the container.
5. Gases will contract when cooled.
6. Water is unique in that it expands just before it freezes.
7. The addition or removal of heat from a substance may cause it to change from one state into another.
8. Air carries heat.
9. Water carries heat.
10. Radiant energy carries heat.
11. Solids carry heat.
12. Dark colored materials absorb more heat than light colored materials.
13. Clothing, blankets and home insulators are effective in preventing loss of heat because they contain trapped air which is a poor heat conductor.

CONCEPTS	EXPERIMENTS
I Heat is a form of energy, the energy of moving molecules	A. Materials: nail, hammer Procedure: Hit a nail several times with a hammer. Let the students feel the nail. Compare with another nail at room temperature.
	B. Materials: sandpaper, board Procedure: Rub sandpaper over a board. Feel the warmth of the board.
II As a substance gets warmer its molecules move more rapidly; as it cools, less rapidly.	A. Explain this concept, after doing the experiments for Concept I.
III Solid substances generally expand when heated and contract when cooled.	A. Materials: screw and screw eye on two dowel stick handles. Procedure: The screw should be just too large to go through the eye. When the screw eye is heated, it expands, and the screw will go through it.
	B. Materials: wire, two poles, weight, ruler Procedure: Suspend a wire from two poles - put a small weight on the wire. Measure the distance from the wire to the table top. Heat the wire and measure the distance.
IV When gases are heated, the molecules move farther apart and exert greater pressure on the walls of the container.	A. Materials: balloon, tube, heat source Procedure: Slip balloon over tube, heat tube; air should expand balloon.

V Gases will contract when cooled.

A. Materials: ice cubes, container, four balloons, light bulbs

Procedure: Blow the balloons up so that they are the same size. Place one by a heater; place one by an infrared light or large light bulb; and place the third balloon in ice-cold water, over its surface. Leave one balloon at room temperature. Observe results.

VI Water is unique in that it expands just before it freezes.

A. Materials: stiff plastic refrigerator container with lid, cellophane or masking tape

Procedure: Fill the plastic container to overflowing. Put lid on carefully so that there is no air in the container - only water. Tape the lid on tightly. Put the container in the freezer. Leave it there until it freezes. Container might crack from expansion of ice.

VII The addition or removal of heat from a substance may cause it to change from one state into another.

A. Materials: burner, ice cubes, three containers

Water in three forms - discuss the three states - show ice cubes melting into liquid state - water boiling into steam

VIII Air carries heat. (Convection)

A. Materials: lamp chimney, candle, two wooden sticks

Procedure: Light candle and set chimney over it on two blocks to raise it above the table surface. Note the warm air at the top of the chimney. Hold a smoking stick at the bottom of the chimney. This will show the air is moving into the bottom of the chimney and is traveling up to the top. It is moving air that carries the heat. Hold a thermometer a foot above the chimney and note changes as the air is warmed.

B. Materials: thermometer, pole

Procedure: Fasten a thermometer to the end of a pole and find the air temperature near the ceiling of your room. How does it compare with the temperature near the floor?

C. Materials: ice cubes, container, thermometer

Procedure: Place some ice cubes in a container. Fill the container with water. Every minute check the temperature of the water at the surface amd at the bottom. Be extremely careful not to stir the water. Record your results and continue to record temperatures for five minutes. After half an hour, check the surface and bottom results again.

IX Water carries heat.

A. Materials: flask or Pyrex bottle, heat source, sand, thermometer

Procedure: Fill a flask or Pyrex baby bottle nearly full of water and heat it at the bottom. Hold a thermometer in the water at the top. It soon shows the water is getting hot. The water at the bottom is traveling to the top, carrying the heat with it. Some grains of sand or pieces of sawdust placed in the bottle will show how the currents are traveling.

X Radiant energy carries heat.

A. Materials: candle, paraffin, a fire, a toaster, or any other object that radiates heat.

Procedure: Light a candle and hold a block of paraffin alongside it. The paraffin melts on the side of the flame. (The higher temperature above the candle is due to convection currents, but the higher temperature beside it is caused by radiation.

B. Materials: mounted light bulb, three thermometers

Procedure: Place an unshielded electric light bulb near the center of a large table. Place three thermometers on the table so that each thermometer is one foot away from the bulb. Turn the bulb on. Wait five minutes. Check the temperature. Next, rearrange the thermometers at different distances from the light bulb. After five minutes, check the temperatures.

XI Solids carry heat

A. Materials: silver spoon, plastic spoon

Procedure: Place a silver spoon in hot water. Feel the spoon, Compare metal spoon with plastic spoon. Which is a better conductor?

B. Materials: metal bar, candle, five thumb tacks

Procedure: Fasten the tacks to the metal bar with wax, close together in a row. Place one end of the bar in the flame of a burner. Can you see how the heat is traveling along the bar?

C. Materials: jar and lid

Procedure: Tighten the lid of a jar so it is difficult to loosen. Hold jar under the hot water. The metal will expand more than the glass. Try to loosen lid again. Result?

XII Dark colored materials absorb more radiant heat than light colored materials.

A. Materials: two thermometers, white cloth, black cloth

Procedure: Put the two thermometers in sunlight. When they show the same temperature, place a square of white cloth over the bulb of one and a piece of black cloth over the bulb of the other. The temperatures will change.

XIII Clothing, blankets and some home insulators are effective in preventing loss of heat, because they contain trapped air which is a poor heat conductor.

A. Examine carefully home insulating or insulated bags used for ice cream

B. Materials: three jars, 1 wool sock, 1 cotton sock

Procedure: Fill three jars to the top with hot water and cover them tightly. Wipe the outside of the jars dry. Pull a woolen sock around one jar, a cotton sock around the second jar, and leave the third jar as it is. Place all jars in a cool place. After about a half hour, remove the socks and feel the jars. Measure the water temperature with a thermometer.

FILMSTRIPS

"How Heat is Transferred" - 46 frames, McGraw-Hill Book Co.

"The Thermometer" - 44 frames, McGraw-Hill Book Co.

"How Heat is Transferred" - color, Young America Films

FILMS

"Heat and Its Behavior" - 11 min., Coronet Films

"Things Expand When Heated" - 10 min., McGraw-Hill Book Co.

"Transfer of Heat" - 11 mins., McGraw-Hill Co.

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CELLS OF THE BODY

OVERVIEW

Through studying cells, scientists are learning more and more about life. This unit is designed to study the structure and function of the individual cell, of the group of related cells called tissues, and the group of related tissues called organs.

Motivational Ideas:

1. Place microscopes with slides of cells and tissue out to be independently observed.
2. Find pictures of cells, tissues, and organs to put on the bulletin board.
3. Display books with information about cells.

Concepts

1. According to the cell theory, all living things are made up of cells.

2. The structure of the cell includes the nucleus, cell membrane, and cytoplasm.

3. Plant cells differ from animal cells in that they have a cell wall.

4. Plant cells have a cell membrane inside the cell wall.

5. Some of the materials in living cells are dissolved in water.

6. Some of the materials in living cells, such as fats and proteins, are not dissolved in water.

7. The cell membrane is living material that completely surrounds the cell.

8. Substances that dissolve can enter and leave a cell that has no opening through the cell membrane by osmosis.

9. Cells reproduce by means of cell division.

10. Groups of cells that work together are called tissues.

11. Groups of tissues that work together are called organs.

12. Organs that work together are called systems.

13. All the systems working together make up an organized living system, or organism.

Background:

The cell theory has been accepted as the unit of life for only a little more than 100 years. The cell theory says that all living things are made of one or more cells or of cells and their products. All cells come from cells, and the activities of all living things are possible because of the activities in cells.

CONCEPTS	EXPERIMENTS
I According to the cell theory, all living things are made up of cells.	A. Find information about Theodor Schwann and Matthias Schleiden who developed the cell theory.
II The structure of the cell includes the nucleus, cell membrane, and cytoplasm.	A. Materials: microscope, glass slide, iodine, water, clean medicine dropper, toothpick Procedure: Put a drop of water on the center of the glass slide. Gently scrape the inside of your cheek with the side of the clean toothpick. A whitish material will collect on the toothpick. The material is made up of cells from your cheek. Mix this material in the drop of water. To see the cells more clearly under the microscope, stain them. Add just one drop of iodine solution to the drop of water on the slide. To make the solution, add one dropperful of drugstore iodine to one cupful of water. Place the slide under the lens of the microscope. The shapes are cells from the skin of your cheek. Can you observe a dark spot in each cell? It is the nucleus of that cell, stained by the iodine solution.
	B. Let the drop of water on the slide dry, and observe what happens to the cells. What do you think this result means?

C. Have children make a large drawing of what they see. Help them to label the parts of the cell.

III Plant cells differ from animal cells in that they have a cell wall as well as a cell membrane.

A. Materials: glass slide, cover slip, microscope, medicine dropper, onion, iodine thinned with water, (1 part iodine to 2 parts water)

Procedure: Place a drop of iodine in the center of a clean slide with the medicine dropper. Gently pull the skin off a piece of onion. Put the onion skin in the drop of iodine. Look at the onion skin first under the low power of your microscope, then under the high power.

The nucleus is probably the most important part of the cell as it controls much of the activity that takes place within the cell. When a cell reproduces itself, or when a cell uses food or oxygen, the nucleus controls these activities.

Point out that a cell has three dimensions (length, breadth, and thickness).

IV Plant cells have a cell membrane inside the cell wall.

A. Materials: onion skin, salt, water

Procedure: Place a few drops of weak salt water (2%) on a slide containing onion tissue. Tell the children to watch what happens under the microscope.

They should see shrinkage of the cell contents. The membrane shrinks away from the cell wall as water leaves the cell. If purple onion is used, this shows up very sharply. The purple color becomes more intense inside the vacuoles, indicating loss of water by the cell.

Background:

A large part of the cell is water. However in the water are minerals made up of elements such as sodium, calcium, and potassium. There are sugars, fats, and proteins in the water, too. These are made up of carbon, hydrogen, oxygen, nitrogen, and other chemical elements.

V Some of the materials in living cells are dissolved in water.

A. Materials: sugar, water

Procedure: Mix a spoonful of sugar in the water. What happens to the sugar crystals? Why can't you see them when the sugar is dissolved in water?

Explanation: When sugar crystals are mixed with water, they break up into smaller bits called sugar molecules. Sugar molecules are too small to see. The sugar seems to disappear when its molecules are scattered throughout the water. You cannot even see them with a microscope.

VI Some of the materials in living cells, such as fats and proteins, are not dissolved in water.

A. Materials: cooking oil, water, jar

Procedure: Put a spoonful of cooking oil in a jar of water, and you will see that it does not mix with the water. However, if you shake the jar hard for some time, some of the oil will break up into smaller bits. When you stop shaking it, they will collect again at the top of the water.

B. Materials: egg white, toothpick

Procedure: Use a toothpick to examine the white of an egg. Note how thick and sticky it is. Most of the egg white is protein and water. The protein is not dissolved in the water. In this way, egg white is something like the contents of a cell.

VII The cell membrane is living material that completely surrounds the cell.

A. To make a model cell membrane:

Materials: a box of clear gelatin, starch, cologne, 3 or 4 small plastic bags (sandwich size), string, 3 small pieces of clay, scissors.

Procedure: Boil one cup of water and stir in a package of gelatin. After the gelatine is dissolved, add ½ cup cold water. Add a teaspoonful of starch, and another teaspoonful of cologne.

Pour some of this mixture into a plastic bag. An amount the size of a pingpong ball will do. Add a small round piece of clay about the size of a pea. Tie the bag tightly with the string so that it has the shape of a ball. There should be as little air as possible in the bag. Cut away the unused part of the bag with scissors.

Make 3 or 4 of these cell models so you can try several investigations.

Let the gelatin cool and harden overnight in the plastic bag.

VIII Substances that dissolve can enter and leave a cell that has no opening through the cell membrane by osmosis.

A. Materials: A gelatin cell model, iodine solution, a bowl or jar, water

Procedure: Fill the jar about three-quarters full with warm water. Add just enough iodine solution to turn the water a light tan. Place the gelatin cell model in the jar.

1. Why did the gelatin turn blue and then black?

Reason this way: Iodine turns starch blue and then black. The starch inside the membrane slowly turned blue. The iodine reached the starch by going through the membrane which seems solid enough.

If starch had passed through the membrane, it would have met the iodine in the water outside the membrane. The water outside the membrane would have turned blue. Since the water did not turn blue, starch did not pass through the membrane.

B. Materials: cell model, dish, water

Procedure: Place another cell model in a dish of clear water. After a few hours, smell the water in the dish. What has happened to the cologne in the plastic bag?

IX Cells produce by means of cell dividion.

A. Materials: packet of dry yeast powder, two lumps of sugar, two jars with screw top lids, handkerchief, water

Procedure: Put water into one jar until it is about one-quarter full. Dissolve two lumps of sugar in the water. Lightly cover a dime with yeast powder. Put this amount of yeast into the jar of sugar water. Screw a cap loosely on the jar, so that dust can't get in but gas can get out. There will be two million yeast cells in the jar.

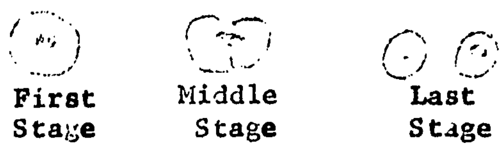
Leave the jar at room temperature for four days.

More yeast cells form by cell division. How much more yeast is there now? Strain the yeast mixture through a closely woven handkerchief or through filter paper into the second jar. This will filter out the yeast cells. Let them dry overnight. Compare them with the amount of yeast you started with.

B. Materials: lump of clay

Procedure: Put the clay between your hands and pull it apart. You will have two lumps of clay representing two cells. Each of these can be pulled apart again to make more cells.

C. Put diagram on board to show cell division. Stress that the nucleus must divide also.



Background:

All the cells that look alike are useful in the same way. All skin cells protect, all bone cells support, and all muscle cells move.

Groups of similar cells are called tissues. The billions of cells that make up your body may be divided into five kinds of cells that make your tissues.

1. Covering tissue - this tissue covers the surfaces inside and outside your body.

2. Connective and supportive tissue - this tissue supports your body and holds your cells and other tissues together. The cells of connective tissue spread among other cells and bind them together. Bone cells build bone and teeth.

3. Muscle tissue - your muscles are formed from muscle cells. You have three kinds of muscles; heart muscle, muscles of the food tube and blood vessels, and muscles that are attached to your bones, which enable you to move.

4. Nerve tissue - your brain nerves, and sense organs are made of nerve tissue. Nerve tissue carries messages from one part of the body to another.

5. Blood tissue - two kinds of cells in blood are red cells and white cells. Red cells carry food and oxygen while white cells fight disease.

X Groups of cells that work together are called tissues.

A. Obtain prepared slides of the different tissues (possible from the high school). Examine to find the basic parts of the individual cell. Compare the differences of the appearance of the cells.

B. Have children look for pictures of tissues in books and magazines.

C. Examine a drop of blood under the microscope.

D. You might write for samples of a microviewer and slides of "Cells of Your Body" #10.
Address: National Teaching Aids, Inc.
120 Fulton Avenue
Garden City Park,
New York

Background:

Each organ is made of different kinds of tissues. The heart is made mostly of muscle tissue held together by connective tissue. It also has blood tissue and nerve tissue. All these tissues work together to form one organ.

XI Groups of tissues that work together are called organs.

A. Discuss other organs in the body, deciding on what tissue they contain.

B. Materials: Dead frog, knife

Procedure: Dissect a frog. Locate and describe the digestive organs, including the mouth, tongue, gullet, stomach, liver, gall bladder, pancreas, and intestines.

XII Organs that work together are called systems.

A. Have children discuss the systems of the human body: the nervous system, respiratory system, digestive system, and the circulatory system. What major organs are related to each one? Are there more than one kind of tissue in the system.

B. Have the class divide into groups to further study each system. They could prepare reports, find pictures, and make charts and diagrams to present to the class.

XIII All the systems working together make up an organized living system, or organism.

A. Discuss this concept with the class. Ask for examples of organisms--(people, rosebush, sparrow, etc.)

WORKSHEET

YEAST CELLS

Like all living things, yeasts need more than food and water to grow. They also need the right temperature in which to grow. Do yeasts grow best in a very cold temperature, in a very warm temperature, or in a medium, room temperature? Plan and carry out an investigation to find out.

1. Write how you would go about the investigation.

2. In the table below, write the results you observed.

Temperature	What happened to the yeast cells
Very cold temperature	
Room temperature	
Very warm temperature	

3. Study your results. What are your conclusions from them? In which temperature do yeasts seem to grow best? (If you cannot reach any conclusions from this investigation, explain why you cannot.)

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WORKSHEET

Fill in the chart:

Substance	Dissolves in Water	Does not dissolve in water
Sugar		
Chalk dust		
Salt		
Pepper		
Honey		
Starch		
Iodine		

1. A cell membrane covers each cell. Everything that enters or leaves the cell must pass through this membrane.

   A. Which substance would be more likely to pass through the cell membrane, a dissolved substance or one not dissolved?

   ____

   Explain your answer.

   B. What substances that you tested would be most likely to pass through a cell membrane?

WORKSHEET

TISSUES AT WORK

Suppose you decide to sharpen a pencil. You get up from your seat. You walk to the pencil sharpener. You sharpen the pencil. Then you go back to your seat. You sit down.

The tissues of your body must work together for you to be able to do even such a simple thing as sharpening a pencil.

Carry out the act of sharpening a pencil, thinking about what happens at each step. Then write below one way in which each tissue helps you carry out the act.

1. Nerve tissue

2. Muscle tissue

3. Supporting tissue

4. Blood tissue

5. Covering tissue

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