DOCUMENT RESUME

ED 050 062 SP 007 109

AUTHOR Starr, John W., 3rd., Ed.
TITLE Resource Handbook: The Earth. A Supplement to Basic Curriculum Guide--Science, Grades K-6.
INSTITUTION Gary City Public School System, Ind.
PUB DATE 68
NOTE 178p.

EDRS PRICE EDRS Price MF-$0.65 HC-$6.58
DESCRIPTORS *Curriculum Guides, *Elementary School Curriculum, *Elementary School Science, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5, Grade 6, Kindergarten, *Science Education, *Science Units

ABSTRACT

GRADES OR AGES: Grades K-6. SUBJECT MATTER: Science; the earth. ORGANIZATION AND PHYSICAL APPEARANCE: The guide is in three main parts: 1) atmosphere; 2) lithosphere; and 3) hydrosphere. Each section is subdivided into initiatory activities, developmental activities, evaluations, vocabulary, children's books, and films. The guide is mimeographed and spiral-bound with a soft cover. OBJECTIVES AND ACTIVITIES: In each section the developmental activities are described in detail and the objective is stated for each. INSTRUCTIONAL MATERIALS: The materials needed for each activity are listed. The extensive bibliographies and film lists are annotated. STUDENT ASSESSMENT: Samples of evaluation items are included to help the teacher develop an informal testing program. (MBM)

RESOURCE HANDBOOK - THE EARTH

(A Supplement to Basic Curriculum Guide-Science)

Grades K - 6

Dr. Gordon L. McAndrew, Superintendent of Schools
Dr. Haron J. Battle, Assistant Superintendent-Instruction
Dr. Norman R. Turchan, General Elementary Supervisor
Dr. William H. Watson, General Supervisor-Curriculum Development
Dr. John W. Starr, 3rd, Elementary Supervisor

SCHOOL CITY OF GARY

Gary, Indiana

1968

A C K N O W L E D G M E N T S

I wish to express appreciation to the members of the Elementary Science Materials Committee for their extra effort in the preparation of this publication. The publication is a composite of materials which have been developed previously, combined with new material. Much of the material presented in this publication is the result of their intensive work and effort.

Pelham Chatman, Teacher	Brunswick School
Emmalynn Deal, Teacher	Washington School
Stella Hartley, Teacher	Aetna School
Elizabeth Jadoon, Teacher	Nobel School
Gerald Lind, Teacher	Melton School
Geneva Taylor, Teacher	Duncan School

Final Preparation and Editorial Work

By

Dr. John W. Starr, 3rd

Dr. John W. Starr, 3rd
Elementary Supervisor

PREFACE

The teaching of science in the elementary school is a responsibility of major significance. Through our efforts, pupils should be helped to gain an understanding of science in the development of our culture. Likewise, we should emphasize the development of the ability to write and recognize social uses of science in daily life. In developing the ability to understand their natural environment, the pupils must also have a complete understanding of the process involved.

There is a need to improve teaching and learning in science continuously. New materials of instruction, new teaching approaches, and the continuing responsibility to meet the individual needs of students place great demands on all professional staff members to appraise the quality of teaching and learning in science. This publication represents an effort on the part of staff members within our school system to assist all staff members in improving the teaching and learning of science. It is hoped that all staff members who use this publication will find it to be of value.

Norman R. Turchan
General Elementary Supervisor

INFORMATIONAL BACKGROUND

The earth consists of four major parts: the atmosphere, which is a relatively thin shell of gases that surround the earth; the lithosphere, composed of the land areas of the earth; the hydrosphere, composed of the water areas of the earth, including oceans and seas, surface and ground water, glaciers and icecaps; and the biosphere, composed of the plants and animals living on the earth.

While these four parts of the earth can be considered separately, it should be recognized that they are interdependent. The elements of each are constantly interacting. Certainly a complete understnading of any one of the earth's components cannot be achieved without an awareness of the effects of the others. The atmosphere, lithosphere, and hydrosphere are the focus of activities that are developed in this publication.

Developmental Activities

CONCEPT: The earth is made up of three spheres, the lithosphere, the hydrosphere and the atmosphere.

1. Problem

What is density?

Materials

Small wad of cotton, cork stopper, wood block, small piece of iron, piece of glass, small stone, piece of plastic, piece of aluminum.

Procedure

Place several different kinds of objects on the table.

Have the children:

a. Decide which one takes up the greatest amount of space. (Which has the greatest volume.)

b. Decide which has the least volume.

c. Decide whether any are almost equal in volume.

d. Test all the various objects for density by weighing and measuring them.

e. Determine which objects are most dense.

f. Determine which objects are the least dense.

Conclusions

The volume of any object is the amount of space that it occupies. Density is the weight per unit volume. If two objects have the same volume, the heavier object is the more dense.

2. Problem

Why have the atmosphere, the lithosphere, and the hydrosphere assumed their respective positions?

Materials

Olive jar (with lid), water, pebbles.

Procedure

Have the children:

a. Discuss the meaning of the words "liquid," "solid," "gas."

b. Make a list of examples of solids, liquids and gases.

c. Determine what parts of the earth are solid, liquid or gas. (Relate discussion to the three spheres of the earth - the solid lithosphere, the liquid hydrosphere, and the gaseous atmosphere.)

d. Discuss density as it relates to liquid, solid or gas.

e. Conduct the following activity.

    1. Fill olive jar half full of water and screw on cap.

    2. Shake the bottle and observe what happens.
    What happened to the water?
    What is above the water?
    Where did the bubbles go?

    3. Now add a few pebbles to the jar of water.

    4. Cover and shake again and observe what happens.
    Why did the pebbles sink to the bottom?

    5. Apply what has been observed to the Earth and its three layers or spheres.
    Which sphere do the pebbles represent?
    Which sphere does the water represent?
    Which sphere does the air represent?

Conclusion

Gases, liquids, and solids all have densities. Heavier objects, or objects of greater density sink beneath lighter objects, or objects of lesser density. It is the relative density of freely moving objects that determines their relative positions. The Earth's rock layer, or lithosphere, has the greatest density and is below the hydrosphere, or water layer, and the atmosphere or gas layer. Gases rise to the top, as they are the least dense.

3. Problem

Why did the Earth's core, mantle, and crust assume their respective positions?

Materials

Olive jar (large enough to hold more than two cups of liquid), 1 cup of sand, 1 cup of sawdust, and a spring scale.

Procedure

Have the children:

a. Observe the cup of sand and the cup of sawdust.

   (1) Do they both have the same volume?
   (2) Which has the greatest density? - Why?
   (3) Weigh the cup of sand. Weigh the cup of sawdust. Record the results and compare.

b. Place the sand and the sawdust in the olive jar; place the jar lid on and shake very well up and down.

c. Observe which materials settles to the bottom in larger amounts - Why is this so?

D. Relate observations to the solid part of the Earth.

   (1) Which sphere of the lithosphere does the sand represent?
   (2) Which sphere of the lithosphere does the mixture of sand and sawdust represent?
   (3) Which sphere of the lithosphere does the sawdust represent?

Conclusion

When certain solids are free to move, the denser solid settles below the less dense solid. The Earth's rock layer, or lithosphere, also consists of layers with the least dense layer on the surface, and the most dense layer in the center or core.

4. Model

Materials

Modeling clay or wallpaper cleaner, tempera paints, cotton, large piece of transparent plastic.

Procedure

Have the children illustrate the zones of the solid earth by making a model by:

a. Rolling some modeling clay or wallpaper cleaner into a sphere.
b. Cutting out a section and paint the various layers of the earth with tempera paint.
c. Labeling the zones with stickers on toothpicks stuck in the clay.
d. Painting the hydrosphere (on the portion of the model that has not been cut away) blue.
e. Showing the atmosphere by supporting a sheet of cellophane or transparent plastic above the crust with toothpicks.
f. Simulating clouds with puffs of absorbent cotton.

PART I - ATMOSPHERE

ATMOSPHERE

Initiatory Activities

Have the children:

1. Capitalize upon incidental experiences of the class which may lead into the unit, such as the cancellation or disruption of a field trip because of the weather.

2. Display a group of books about weather in the science reading center.

3. Follow the natural leads provided by a previous science unit, in which concepts helpful in understanding the weather have been developed, particularly those on heat, change of state (solid to liquid, liquid to gas), or the solar system. Science concepts which correlate to social studies units that have been pursued likewise may lead into the weather unit. An air transportation unit may easily lead into one on weather.

4. Prepare a bulletin board centered around the theme of "Weather Facts or Fancies." Pictures may illustrate such sayings as "Red in the morning, sailors take warning; red at night, sailors delight," or "Clear moon, frost soon."

5. Display pictures and photographs on the bulletin board with captions to motivate discussion. For example, under a picture depicting a scene in which the sun is shining and it is also raining, show the caption "How can it be raining when the sun is shining?"

6. Display news clippings of unusual weather conditions.

7. Select a particular weather phenomenon regularly observable and characteristics of the time of year for discussion; for example, a spring shower, morning fog, billowing clouds, severe thunderstorm, etc.

8. Discuss the reason we decided to wear the clothing we chose for today.

9. Discuss the accuracy of local weather forecasts.

Developmental Activities

CONCEPT - The earth is covered by a blanket of air.

1. Problem

   How do we know?

   Materials

   Large container (pail), water, glass tumbler, paper.

Procedure Showing Air Occupies Space

Put water in the large container. Crumple the sheet of paper into a ball and push it into the glass tumbler. Turn the tumbler upside down and completely submerge it in the container of water. Take the glass out of the water and remove the paper.

Results

The paper should be dry. Air is real and occupies space. The glass was full of air and wouldn't allow water to enter unless some of the air was removed.

2. Problem

How do we know?

Materials

Shallow pan, candle, matches, cork, drinking glass, water.

Procedure

Fill the pan with water and stand the lighted candle in the pan. Then, cap the candle with the drinking glass. Observe that as the candle burns a portion of the air (oxygen content), water rises in the glass to take the air's place.

Results

Air is real and occupies space.

3. Problem

How do we know?

Materials

Shallow pan, cork, drinking glass, water.

Procedure

Fill the pan with water and float the cork. Then cover the cork with the drinking glass. Note that the air in the glass forces both the cork and the water downward.

Results

Air occupies space and is real. It pushes the cork and water downward.

4. Demonstration

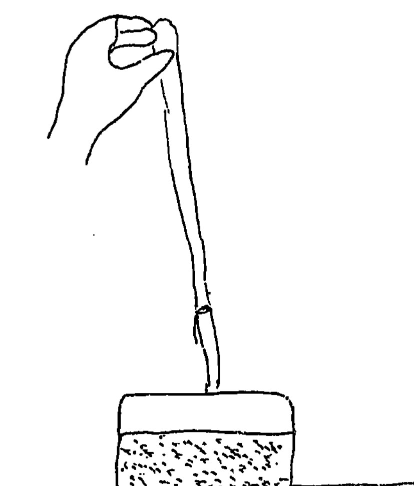
Materials

A dip tube or a drinking straw, a basin of water, a glass.

Procedure

Fill a glass with water. Hold a straight glass tube (about 12 in. long) in a vertical position and put one finger over the top. Push the lower end down into the glass of water. The water will rise into the tube only a very little way because the air cannot get out. The air in the tube keeps the water out. Take your finger away from the top of the tube. Watch the water rise in the tube.

Put your finger over the top again and lift the tube out of the water. The water in the tube will stay because the air presses up against the water with enough force to hold it.



Push an inverted "empty" glass into a basin of water and watch that the water will rise only a little way into the glass. Then tip the glass to allow the air to escape (indicated by bubbles) and observe how the glass will become filled with water as the air escapes.

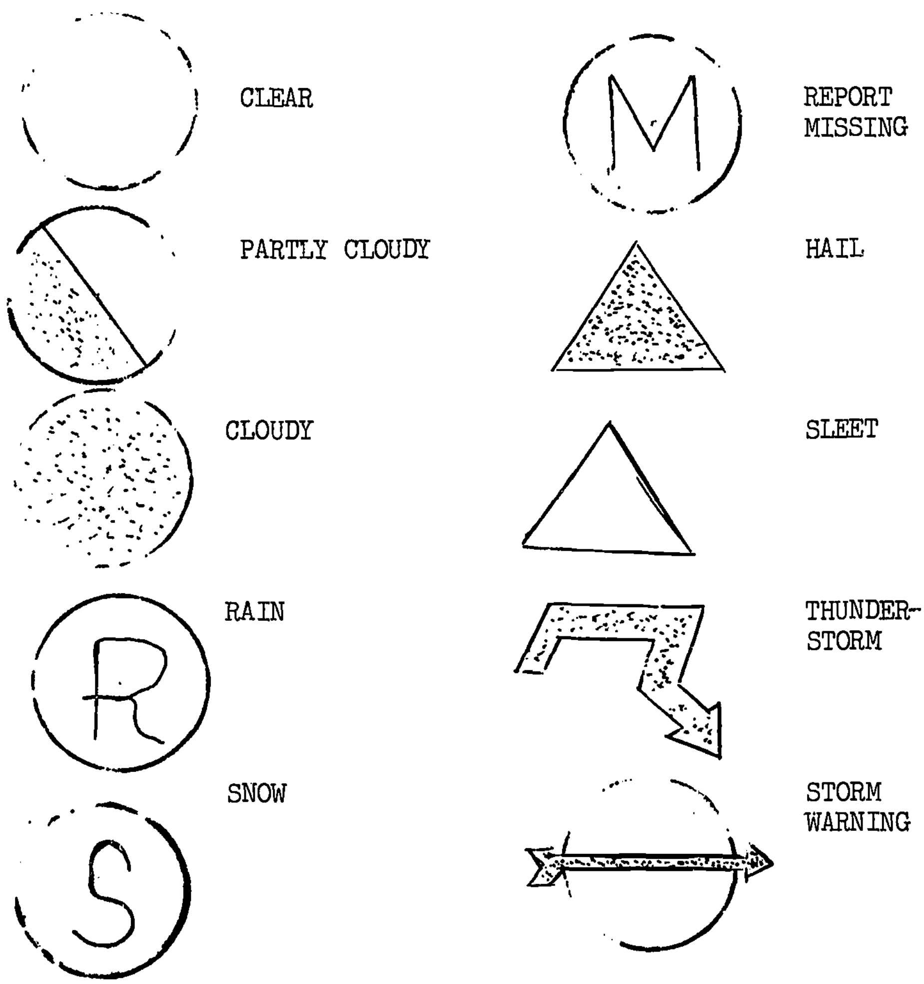
CONCEPT - Meteorologists (weather scientist) can predict weather conditions with a remarkable degree of accuracy by using special instruments and interpreting the information supplied by these instruments and other sources.

1. Problem

How does the meteorologist give us the information?

Draw

UNITED STATES WEATHER BUREAU SYMBOLS



Chart

Have students watch the T.V. weather report and chart this information on a calendar.

A WEATHER CALENDAR

SEPTEMBER

S	M	T	W	T	F	S
	○ 1	○ 2	Ⓡ 3	○ 4	○ 5	⦸ 6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

The calendar may be made on the blackboard or on chart paper.

Each day indicate, on the calendar, the type of weather by using United States Weather Bureau symbols shown on page 12.

A combination of two symbols may be used to show changing weather during the day.

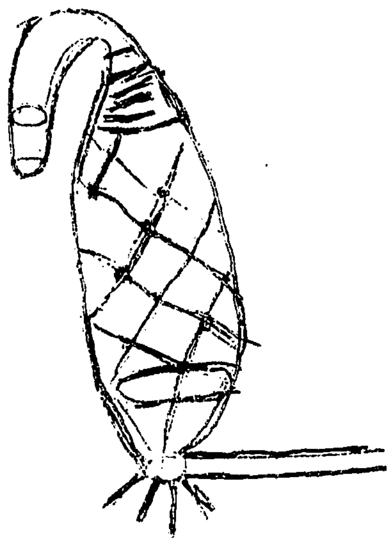
CONCEPT - Weather changes almost daily.

1. Problem

Does air pressure affect changes in the weather?

Make Models

Make A Barometer



Materials

You will need four 4 ft. pieces of string to make the holder, colorless plastic sipper, an empty 7 to 12 oz. beverage bottle, cork stopper to fit, and paraffin or household cement.

Procedure

Make your own barometer which helps forecast changes in weather. A barometer measures air pressure. Air pressure changes with the temperature. Fair or wet weather is generally indicated by the rise and fall of air pressure.

Make a holder for the bottle. Tie the center of each 4 foot string around the neck of the bottle so that the eight ends are equal in length and knots are evenly disposed around the bottle neck. Proceed to knot adjoining strings, making knots 1" to 2" apart until you have completely enclosed the bottle. Tie string ends together so you may later hang to a hook, bottle neck down.

While making holder, soak plastic sipper in hot water for 15 minutes. Then, under hot water, slowly bend one end into "U" shape 2 inches wide.

Bore hole through cork large enough to admit sipper. Fit short end into cork, far enough for it to be firm--about $\frac{1}{4}$ to $\frac{1}{2}$ inch.

Fill bottle with water to about $3\frac{1}{2}$ inches from mouth of the bottle. Color water with ink or dye.

Into bottle insert cork-with-sipper. Seal sipper to cork. Seal cork to bottle. Use heated paraffin or household cement.

Now turn bottle upside down and hang; hang indoors. Do not hang it near radiator or where sunshine reaches it.

Results/Conclusions

If air pressure increases, water level in the sipper will recede, indicating fair weather. If pressure falls, water will rise and may even drip from the sipper, indicating wet weather. Do not fill sipper unless eventual evaporation causes need for more water. It might be fun to mark the highs and lows of water levels in sipper. Markings make forecasting easier too.

2. Problem

How do we make a ribbon thermometer?

Materials

1 foot of $\frac{1}{4}$ inch red ribbon, 1 foot of $\frac{1}{4}$ inch white ribbon, 1 piece of cardboard $4\frac{1}{4}$ inches by 12 inches, 1 chemical thermometer which is marked with both Centigrade and Fahrenheit.

Procedure

Draw the outline of the thermometer tubing $\frac{1}{4}$ inch wide and 10 inches long down the center of the cardboard. Start the strip an inch from one end of the cardboard. The other end of the strip will then be an inch from the other end. Draw a bulb at one end of the tube. Round off the other end. Color the bulb. Cut a slit for the ribbon across the tube just above the bulb. Cut another slit for the ribbon $\frac{1}{2}$ inch below the top of the tube. Put the F° on first. Put a 0° mark 1 inch above the top of the bulb. Put marks every $\frac{1}{4}$ inch until you have 25 marks. Each $\frac{1}{4}$ inch stands for 10° Fahrenheit. Number the marks in tens from 10 to 250. Put four marks $\frac{1}{4}$ inch apart below the zero mark. These stand for below zero readings. Number them in tens, going down from 0 to 40. Across the tube from the 140° mark put a mark. This will be 60° centigrade. By looking at the thermometer marked with both the Fahrenheit and Centigrade scales, find out where to put the other Centigrade marks. Sew one end of the white ribbon and one end of the red ribbon together. Put the other end of the red ribbon through the slit above the bulb. Put the other end of the white ribbon through.

3. Problem

How do we measure changes in weather?

Materials

Milk bottle, rubber balloon, drinking straw, glue.

Procedure — Making a Barometer

Cut the balloon so that you can use the rubber surface to cover the top of the milk bottle. Stretch the rubber tightly over the top of the bottle and tie it on securely. Glue the straw to the rubber surface and set the barometer so that the free end of the straw is very close, but not touching the blackboard. Mark the height of the straw.

Results/Conclusions

Increase and decrease of pressure of the air on the rubber surface will be shown by the height of the straw. Chalk marks on the blackboard will indicate pressure change. We can tell changes in air pressure by use of a barometer.

4. Problem

How do we know that weather changes almost daily?

Materials

Ruler, coffee can, tape.

Procedure — Make a Rain Gauge To Measure the Visible Fall of Water

Tape ruler to inside of coffee can. Place it on an open area outdoors at the start of rain or snow.

Observe the height of the water at the end of the rain.

Results/Conslusions

Chart this for a long period of time. Children can see the different amounts of water that fall during the different seasons.

Water is a part of weather. We know weather changes almost daily by the measurement of rain fall.

5. Problem

Does the humidity change daily? (dampness)

Materials

Cobalt chloride (at drugstore), water, paper toweling (pipe cleaners, unbleached muslin)

NOTE

Tell the children not to taste the solution.

Procedure

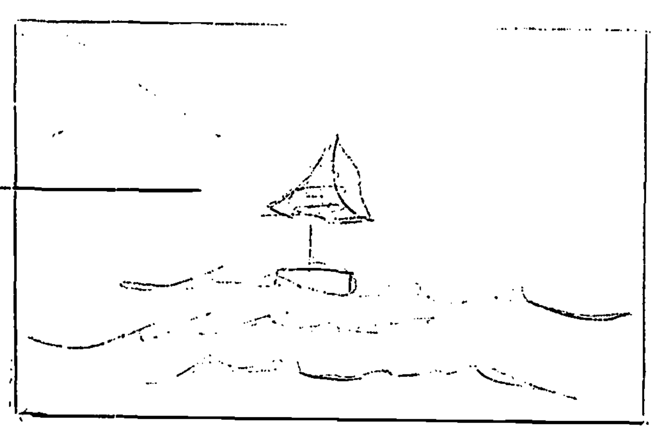
Soak paper toweling in the solution of cobalt chloride and water. Remove them and allow them to dry. These may be pinned up for observation. Tape one piece of toweling outside and one inside.

Results/Conclusions

Compare and record for several days; the materials soaked in cobalt chloride will be blue in dry weather and will turn pink as humidity increases.

Humidity changes almost daily.

Paper toweling



6. Problem

Does the humidity change daily?

Materials

Two thermometers; piece of cotton.

Procedure

Wet the piece of cotton and wrap it around the bulb of one of the thermometers. Hang both thermometers side by side. Use a piece of paper to fan both thermometers until there is no further change in their readings. The thermometer with the wet cotton will have the lower reading.

Results/Conclusions

Use the table below for finding the relative humidity in per cent. Relative humidity is the amount of moisture actually present in the air to the greatest amount possible at that temperature. For example, if the air contains three-fourths as much moisture as it could possibly hold at that temperature, the relative humidity would be 75%. We can measure the relative humidity of the air.

TABLE FOR FINDING RELATIVE HUMIDITY IN PER CENT

Difference Between the Dry and Wet Bulb Thermometer

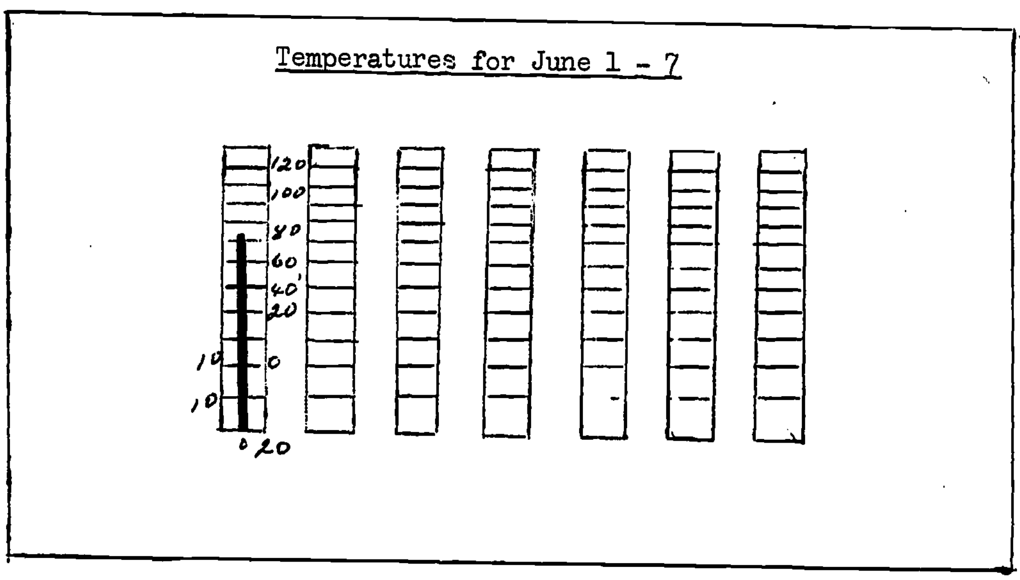
Dry-Bulb	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°
63°	95	89	83	79	69	69	64	60	55	51	46	42	38	33
64°	95	90	85	79	74	70	65	60	56	51	47	43	38	34
65°	95	90	85	80	75	70	65	61	56	52	48	44	39	35
66°	95	90	85	80	75	71	66	61	57	53	49	45	40	36
67°	95	90	85	80	76	71	66	62	58	53	49	45	41	37
68°	95	90	85	81	76	71	67	63	58	54	50	46	42	38
69°	95	90	86	81	76	72	67	63	59	55	51	47	43	39
70°	95	90	86	81	77	72	68	64	60	55	52	48	44	40
71°	95	91	86	81	77	72	68	64	60	56	52	48	45	41
72°	95	91	86	82	77	73	69	65	61	57	53	49	45	42
73°	95	91	86	82	78	73	69	65	61	57	53	50	46	42
74°	95	91	86	82	78	74	70	66	62	58	54	50	47	43
75°	95	91	87	82	78	74	70	66	62	58	55	51	47	44

7. Observe

After a rainfall go out of doors and observe the dampness of the soil and leaves. Observe the puddles.

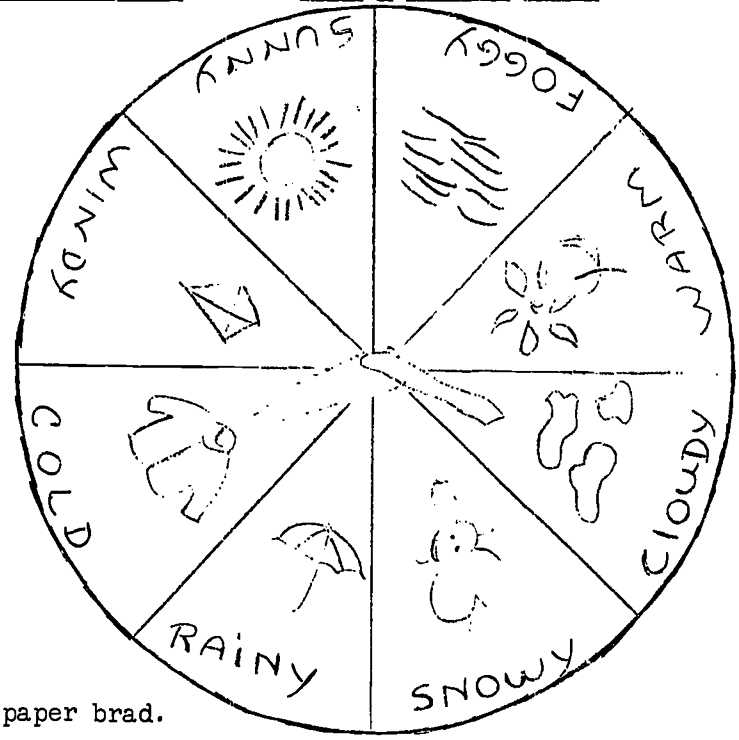
8. Demonstration

Big chart (poster board) thermometer on poster board. Have children chart daily temperatures.



Draw seven thermometers on poster board. Have children chart daily temperatures. This shows that weather changes almost daily. Have children compare charts of temperatures for the different seasons.

9. Charts, Maps, or Graphs — Make A Weather Wheel



Materials

Cardboard, paper brad.

Procedure

Cut a circle about 14 inches in diameter. Divide it in 8 parts. Draw pictures suitable to each kind of weather. Make two arrows about 5 inches in length. Secure them to the center of the circle. Each day the weather may be recorded on the wheel as above. This may be printed on the board as: Tuesday is a cloudy, cold day. Develop the concept that more than one weather factor is needed to describe the day.

10. Charts, Maps, or Graphs

Have children keep a record, by marking the calendar as to daily weather conditions. Use symbols that the children decide upon.

11. Research

Through newspaper reports, make a study of the weather conditions in major cities located throughout our country and those in foreign countries.

CONCEPT - A fog is a cloud near the ground.

1. Problem

What is fog? (A cloud close to the ground)

Materials Sources of Water Vapor

Two small beakers, three glass tumblers, damp soil, fresh green lettuce leaves, water.

Procedure Water Vapor and Condensation

Place some water in one beaker and cover with a glass tumbler. Place some damp soil in the second beaker and cover it with a glass tumbler. Place some lettuce leaves under the third tumbler. Allow all the above materials to stand overnight and observe the next morning. (There will be drops of water on the inside of each glass.) If no drops of water appear on the inside of the glasses, place them outside (if it is a cold day) or put them in some cold place. Bring them back into the room. The glasses must be quite cool in order to have drops of water appear.

Results/Conclusions

The drops of water came from the water under the first glass tumbler: from the soil under the second, and from the leaves in the third. The water first evaporated in the form of an invisible gas (water vapor), and then condensed to water as it came in contact with the cool glasses.

2. Observe Testing Glass for Transparency

Materials

Candle, clear glass, frosted glass.

Procedure

Compare the amount of light that each piece of glass allows to pass through it. Explain that the frosted glass is much like the clouds on a cloudy day. The clear glass would be the same as a sunny day.

Cloud Movement

Have the children observe the movement of clouds on different days. Notice the kinds of days when clouds are moving rapidly and those days when they remain still. Explain the way the wind moves the clouds. On an overcast day, have the children look for the sun. They should be able to notice the "roundness" of the sun even though they will not be able to see the sun clearly.

3. Bulletin Boards (Exhibits and Displays)

Make charts showing different cloud formations. Cotton can be used to form clouds.

4. Demonstration Showing Condensation

Materials

Milk bottle, hot water, ice cube.

Procedure

Preheat the bottle slightly and pour in several inches of hot water. Place the ice cube at the mouth of the bottle. A cloud or fog should form within the bottle. This condensation results from the cooling of the warm air which has a great deal of moisture in it.

CONCEPT - Dew and frost are condensed water vapor.

1. Problem

How is dew formed?

Materials

Two bright tin cans or glasses, ice cubes, spoon or stirrer.

Procedure

Fill containers half full of water at room temperature. Wipe the outside of the containers to be certain they are entirely dry. Put several ice cubes in the water of one container and stir. Let the other container stand close by. Observe changes which occur on the one container which holds the ice cubes.

Questions

What changes occur on the one can which do not occur on the other?

Why does water appear on the container that holds the ice cubes?

Where does the water come from?

Why does the water condense on the colder jar?

How does dew form?

Results/Conclusions

The tiny drops of water on the outside of the container come from the air. Air always contains moisture. Cold air cannot hold as much moisture as warm air. When the container is cooled by the ice inside it, the air that touches the container is also cooled. It drops some of its moisture. The moisture forms in tiny drops on the container.

Dew is formed in exactly the same manner when warm air touches and is cooled by cool ground.

2. Problem

How is frost formed?

Demonstration

Add a small handful of salt and additional ice cubes to one glass of water until the water is chilled below its natural freezing point. Explain the formation on the outside of the glass.

Place a warm pie pan or glass container into a refrigerator. Observe that when moisture condenses on the outside of the container it freezes. When water condenses at temperature below 32°, it freezes. This is the way frost is formed.

CONCEPT - Water evaporates into the air and forms water vapor.

1. Problem

What is dew?

Materials

Teakettle, ice cubes, cup.

Procedure

Boil water in teakettle until steam is coming out. Hold cup filled with ice cubes over the steam. Watch drops of water form. The water vapor in the warm air touching the cooler plants and ground, condenses and causes dew to form on them.

Results/Conclusions

Water vapor condenses on the cup as it does on the plants and ground. On very warm days, large quantities of water evaporate from the earth and plants. When the sun goes down, plants and ground cool more quickly than the air can.

2. Problem

Do air currents affect the rate of evaporation?

Materials

Wet cloth, two glasses (or two aluminum plates).

Procedure

With a wet cloth, make two (2) wet spots on the blackboard about 5 feet apart. Fan one spot with a piece of cardboard. (The spot which is fanned disappears first.) Place equal amounts of water in both glasses. Place one tumbler at an open window exposed to a current of air, or in front of an electric fan. Place the other glass in a cupboard or drawer where there is no movement of air. Observe both glasses from time to time.

Results/Conclusions

The water evaporates from the tumbler exposed to a current of air. Air current does affect the rate of evaporation.

3. Demonstration Showing Condensation

Materials

Metal cup, ice cubes, ink (or food coloring)

Procedure

Place ice cubes, some water, and the ink in the cup. Condensation or water droplets should form on the outside of the cup. Observe that the droplets are clear and not the color of the water inside. Have the children understand that the water came from the air. The warm air hit the cold cup and caused condensation. Compare this to the formation of clouds.

4. Problem

How does the water cycle take place?

Materials

Wooden handle tablespoon or very long metal handle spoon, teakettle, hot plate, a few ice cubes.

Procedure

Bring the water in the teakettle to a boil so that a good jet of "steam" (water vapor) is coming from the spout.

Place an ice cube in the bowl of the spoon, hold the underside of the spoon in the steam, and watch drops of water form on the spoon.

Results/Conclusions

When the water is heated, it turns to steam. When the steam hits the cold metal of the spoon, the invisible vapor turns to visible water droplets.

The water cycle is continually taking place.

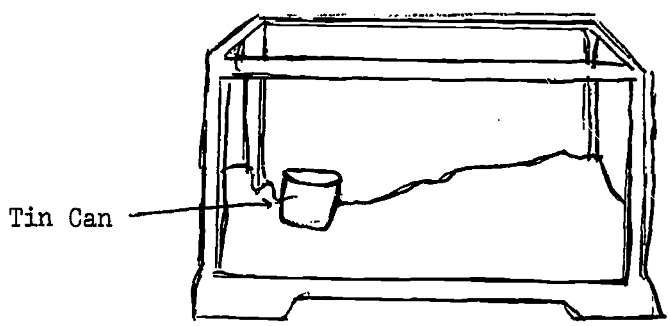
Demonstration How A Well Works

Materials

Aquarium (or other container), sand or soil, tin can (open at both ends).

Procedure

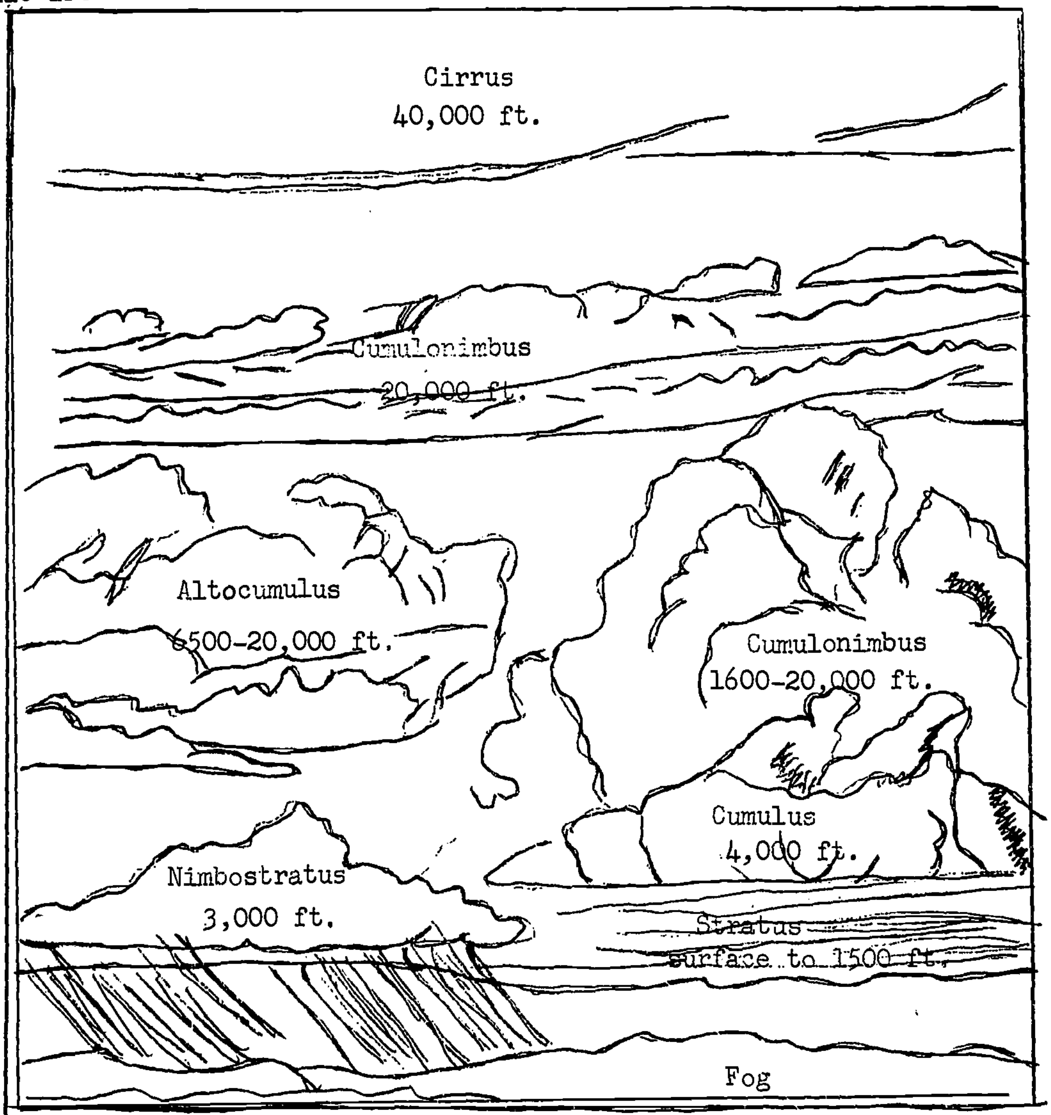
Fill aquarium with sand or soil. Countersink a tin can. Generously water the surrounding soil. The level to which the water rises in the can shows the level of water in the soil. Measure the depth of the "well" at intervals (after one hour, six hours, twenty-four hours).



CONCEPT - There are many different kinds of clouds.

1. Problem

What are the different kinds of clouds?



2. Observe — Study Vapor Trails

Observe the vapor trails caused by a high flying aircraft. Try to determine the approximate altitude of the airplane by comparing the vapor trail with other high altitude clouds.

CONCEPT - If the temperature is low enough, clouds condense into snowflakes.

1. Problem

   What is snow?

   Materials

   Fruit jar, hot water.

   Procedure — Condensation

   Rinse out the jar with very hot water. Drain the jar for a few seconds, then screw the lid on tightly. Allow the jar to cool. Water will probably appear on the inside. If it does not, cool or chill the jar. If an aquarium with a lid is available for viewing, notice if water forms under the lid of the aquarium.

   Results/Conclusions

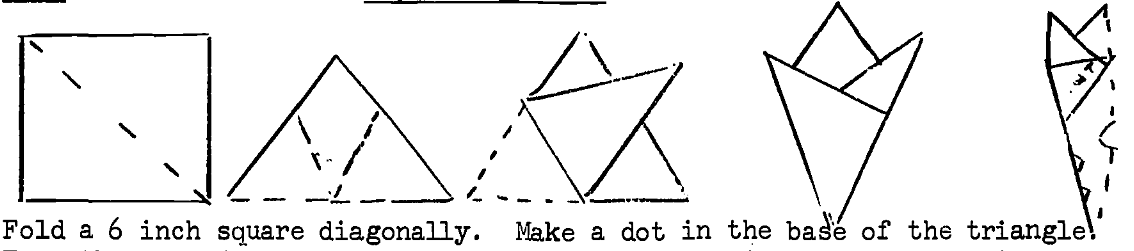
   Explain to children that if the air temperature was 32° or above, the visible droplets would be water.

   When water vapor cools, it turns the visible droplets to snow, if the temperature is 32° or lower.

2. Observe

   When snow has fallen, have a child bring some fresh snow into the classroom to observe the design and shape of the flakes. Collect an amount of snow in a pan and allow it to melt in the room. If it is a very cold period, place the pan outside overnight to allow it to freeze. Emphasize the fact that snow is just another form of rain or precipitation.

3. Draw — Paper Snowflakes



   Fold a 6 inch square diagonally. Make a dot in the base of the triangle. From the top of the triangle put a dot. Draw a line from the dot in the center of the base to each of the dots on the sides.

   Fold the paper along these lines and once more down the middle.

   Make a diagonal cut as the sketch shows. Then cut out triangles from all three sides.

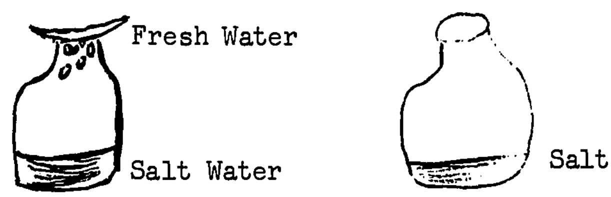
CONCEPT - The water cycle is continually taking place.

1. Problem

Why doesn't the water evaporated from the salty ocean come down as salty rain?

Materials

1½ teaspoon salt
Glass of water
2 jars
1 saucer



Procedure

Stir 1½ teaspoons of salt into glass of water. Stir until salt dissolves and disappears. Pour half of the salt water into the jar and cover with saucer Pour the rest into an uncovered jar. Place both jars in sunlight or warm place. The open jar should be allowed to stand until all the water evaporates. Evaporation may be hastened by heating the water in a saucepan.

Results/Conclusions

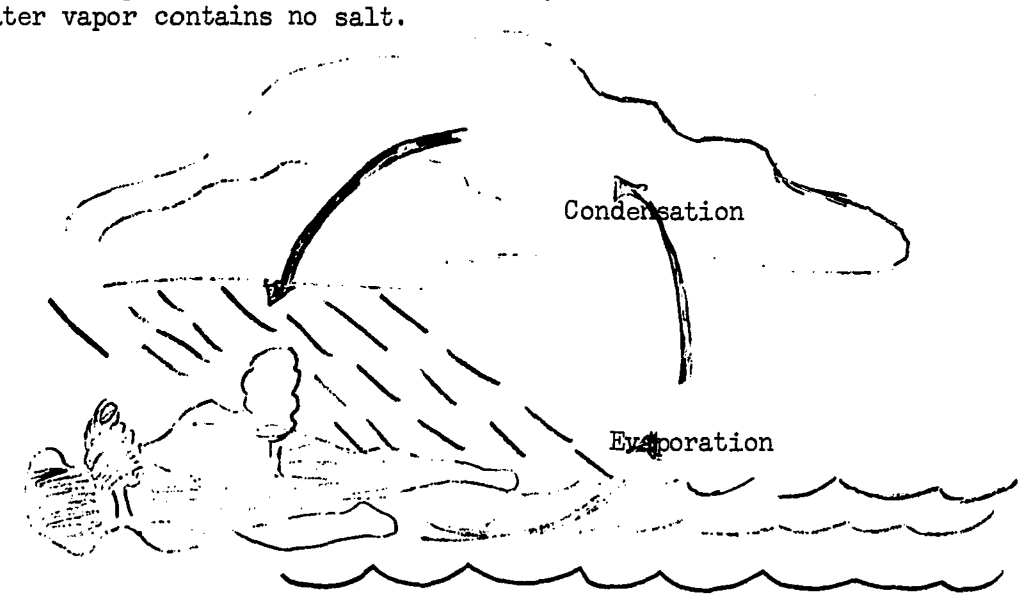
Drops of water form on the sides and on the bottom of the saucer on the covered jar. After all water has evaporated from the open jar, the children can see that the salt is still there.

In the covered jar, water evaporates into the air of the jar in the form of invisible water vapor, and condenses to form the visible droplets.

Note

When water evaporates from a salt solution, the salt is left behind and the water vapor contains no salt.

2. Draw



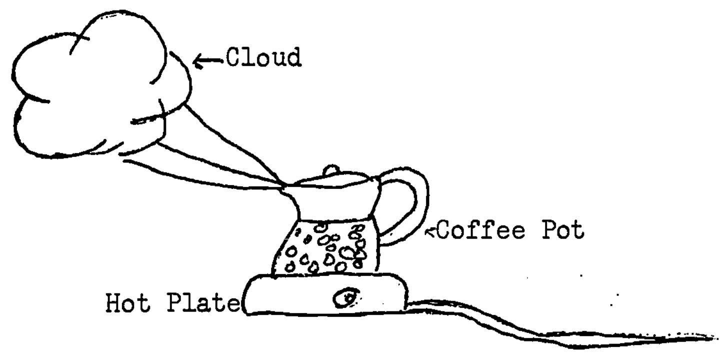
CONCEPT - There is invisible water vapor in the air. When it cools, it may condense.

1. Problem

Does water vapor form clouds when it cools?

Materials

Pyrex coffee pot
Hot plate
Water



Procedure

Heat some water. Watch it boil. Watch the tiny drops jump out. Heat makes them jump out. (Heat causes the water molecules to move rapidly and bump into each other. Some leave the surface of the water.) The tiny drops go into the air, and become water vapor. When they cool, they make a little cloud.

Results/Conclusions

Water evaporates from many places, because of heat from the sun. Water vapor causes weather. Heat changes water to water vapor. When it cools, a cloud forms.

2. Problem

How does water get into the air?

Materials

Large jar
Water
Tape

Procedure

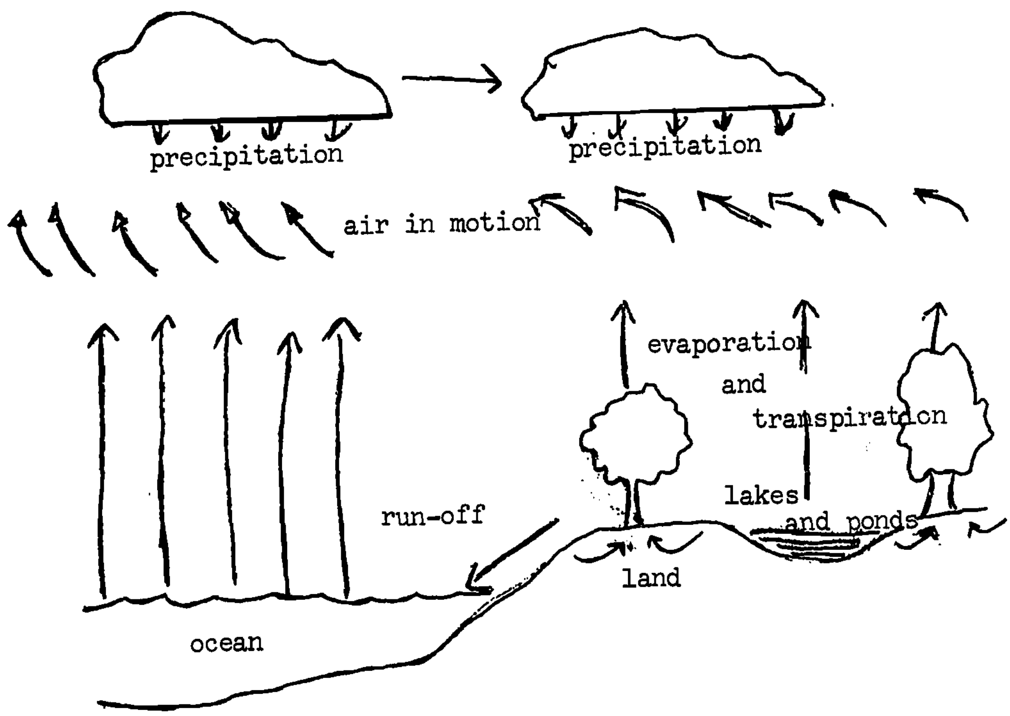
Place some water in the jar, marking the water level with tape. Observe the water level and record it. What happened to the water? Where did it go?

Now place a lid or saucer on top of the jar. Place it in sunlight. Observe water droplets forming on the saucer.

Conclusions

Water gets into the air by evaporation from wet surfaces.

3. <u>Bulletin Boards</u> (Exhibits and Displays)



32

CONCEPT - Meteorologists use many instruments to forecast the weather.

1. Make Models — Barometer

Materials — Mercurial

A piece of heavy glass tubing about 32" long; yardstick; shallow small pan; mercury; an eye dropper.

Procedure

Seal one end of the tubing. Using a medicine dropper, fill the tube with mercury. Then, while holding your forefinger tightly over the open end, invert the tube and insert it into the shallow container of mercury. Be sure not to remove your finger from the open end of the tube until the tube is beneath the surface of the mercury in the container. Use rubber bands to attach the yardstick to the mercury column. Note: Keep jewelry away from mercury. Mercury dissolves gold.

Results

The column of mercury will rise and fall with changes in air pressure. It is possible to calibrate the instrument with a regular barometer. Use the class-made barometer to record changes in air pressure over a period of time.

Materials — Aneroid

Milk bottle, thin sheet of rubber, drinking straw.

Procedure

Stretch the rubber over the top of the bottle and fasten it with a rubber band. Glue an end of the straw to the sheet of rubber. Set the bottle on a table next to a wall. Attach a sheet of paper to the wall and mark the position of the free end of the straw. Note changes from day to day.

Results

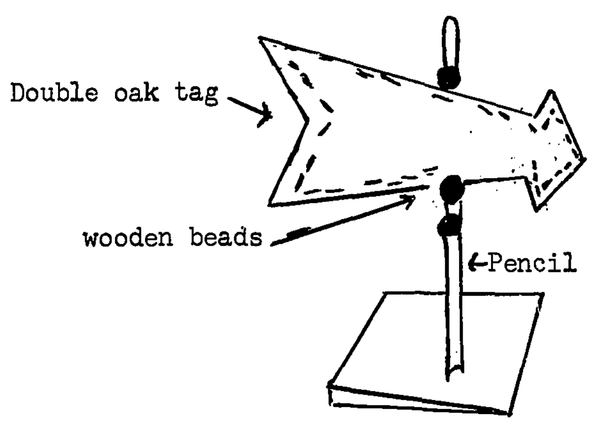
This milk bottle barometer works on the same principle as the aneroid barometer.

2. Make Models   Wind Vane

We can tell wind direction by using a Wind Vane.

Make vane as in illustration. Cut two arrows out of oak tag. Staple them together, leaving a small slot -- nearer the point of the arrow.

Insert a large pin into the eraser of a pencil. Attach the arrow so that it can rotate freely by inserting a bead between the eraser and the bottom of the arrow. Use a compass to help children find out the direction of the wind. What and why is the arrow pointing?

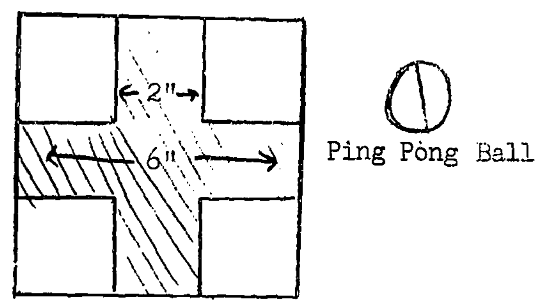


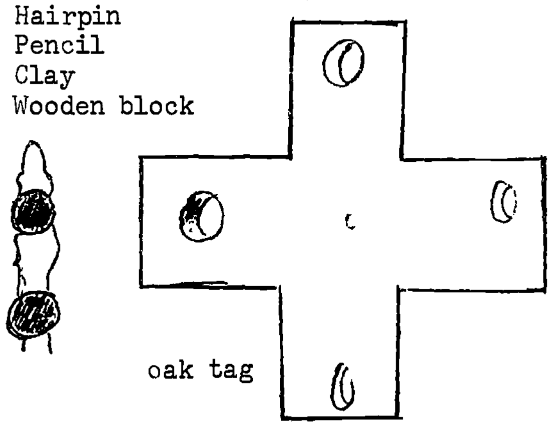
Problem

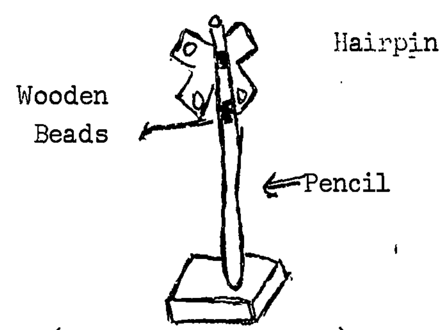
How do we know the wind is blowing?

Materials

Two ping pong balls
Razor blade
Cardboard - (oak tag)
Hairpin
Pencil
Clay
Wooden block







Make Models . Making an Anemometer (To Show Wind Speed)

Procedure

Cut ping pong balls in half. Staple them to oak tag. Attach pencil to wooden block with clay. Attach hairpin, wooden beads, to oaktag. Stick hairpin in the eraser of the pencil. Color one of the ping pong balls so that it is easy to see when the anemometer has made one revolution.

Charts, Maps, or Graphs

Have children keep a chart of daily wind speed. They get their information from their own anemometer.

Observe

Have children observe and record wind speed by using the chart on the following page.

SIGNS	NAME OF WIND	MILES PER HOUR
Flag hangs down, smoke goes straight up - leaves don't move.	Calm	0
Flags blow out lightly, leaves move. You can feel it on your face.	Light Breeze	1 - 5
Tree branches move, dust and loose paper blow about.	Gentle Breeze	5 - 15
Branches sway, whitecaps rise on waters.	Breeze	15 - 25
Umbrellas are hard to use, trees whistle.and sway.	Strong Wind	25 - 35
Branches break, trees are uprooted, houses are damaged; it is hard to walk.	Gale	35 - 75
Destroys houses, causes great damage.	Hurricane	75 - 100

CONCEPT - The amount of moisture in the air can be measured by a hygrometer.

1. Make Model   How to Make A Hair Hygrometer

Materials

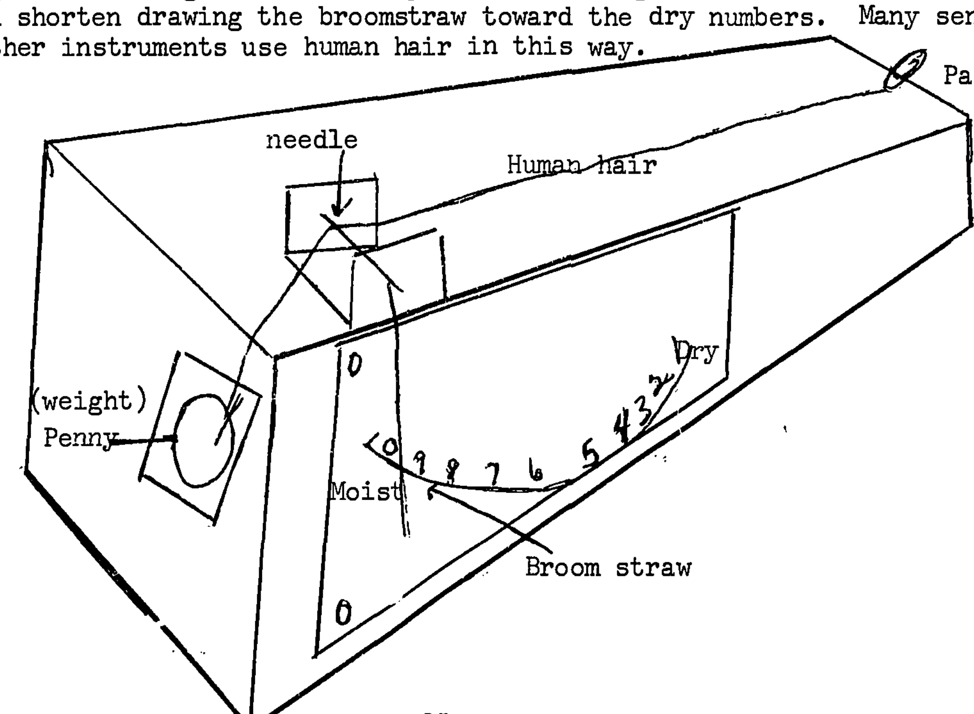
Empty milk carton washed out with cold water, or a box about that size, straw from a broom, a sewing needle, scotch tape, a bit of glue, a human hair at least nine inches long, four pins or thumbtacks, a sharp knife or razor blade, a blank card, a paper clip, and a penny.

Procedure

Wash the hair with soapy water, rinse it in clear water and put it aside to dry. Cut and bend up two tabs at one side of the carton as shown in the diagram. Place the needle through the tabs as shown; twist the needle so that it turns freely. Split off a broom straw about three inches long, with one end the size that will fit the eye of the needle; fasten with glue. With compasses or a circle as a guide, draw a half-circle on the card and print the words dry and moist, and numbers 1 to 10 along the half-circle. With pins or thumbtacks, fasten the card to the carton. Cut a narrow slit at the far end of the carton, and push the paper clip half way in. Scotch tape one end of the hair to the penny. Wind the hair around the needle, one turn from underneath and around. Slip the free end of the hair into the paper clip, and fasten it with glue. The penny should hang about an inch over the end of the carton.

Adjust your hygrometer by taking it to the bathroom and turning on the shower. Allow the shower to run until the mirror and windows are clouded. Now the air is full of vapor or 100 per cent humid. The hair will stretch to its longest. Turn the broomstraw until it points to the number 10, and carry the hygrometer carefully to a shaded protected place.

The human hair is sensitive to moisture in the air. On moist days it will lengthen allowing the straw to point to the higher number. On dry days it will shorten drawing the broomstraw toward the dry numbers. Many sensitive weather instruments use human hair in this way.



CONCEPT - Temperature of the air is measured with a thermometer.

1. Problem

How to make a simple thermometer.

Materials

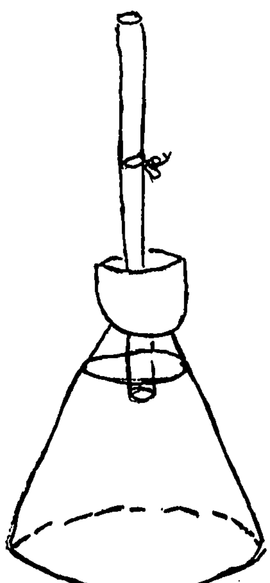
Jär or flask, cork or stopper, glass tubing (1 or 1½ feet) and red ink.

Procedure

Fill flask with water colored with red ink to make it easily seen. Heat and close one end of tubing. Fit tubing into stopper and place stopper into flask firmly. Some of the water will extend into the tube. Mark the distance daily. Compare the changes of height of water in the tube with daily readings on a regular thermometer.

When temperature rises, the water in the tube will rise. When temperature lowers, the water in the tube lowers.

The rise and fall of the water in the tube occurs because of the expansion and contraction of the water in the flask as the water changes temperature. Mercury in a regular thermometer rises and falls for exactly the same reason.



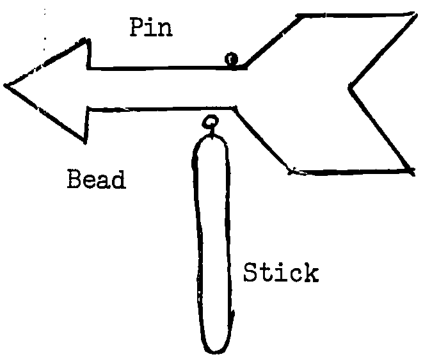
2. Observe

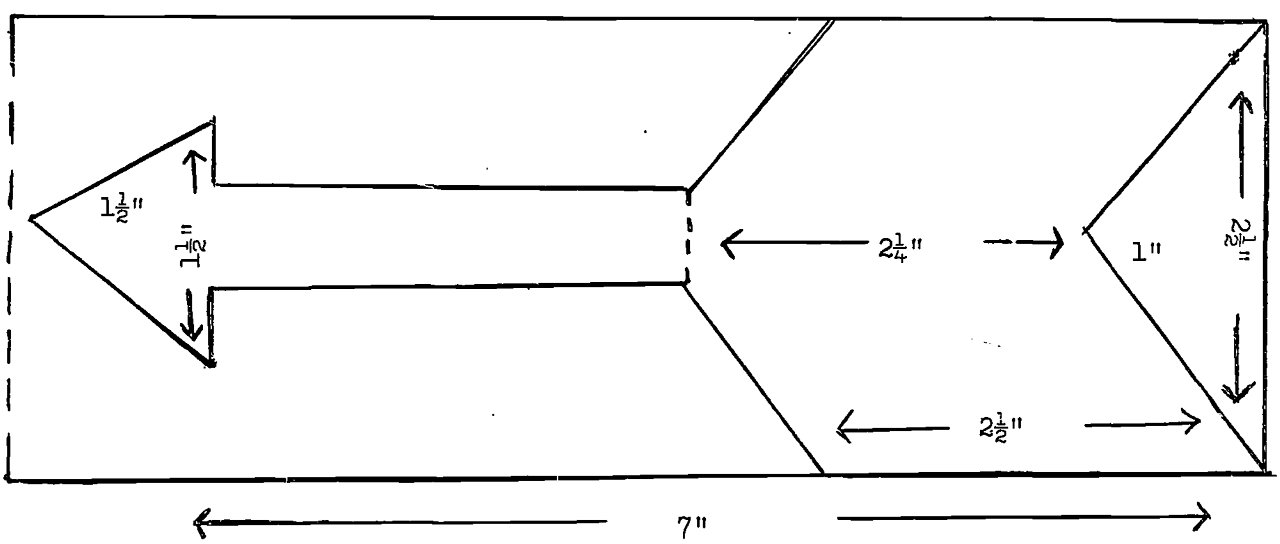
Read, discuss, and observe to find out the degrees of temperature important to children in their daily living, such as:

90° -- Wear light clothes
70° -- Comfortable room temperature
60° -- Need to wear coat or jacket
32° -- Freezing. Wear warm coat, cap, gloves, leggings
0° -- Very cold!! Wear warmest clothes.

CONCEPT - Wind is air in motion.

1. Make Models   A Simple Weather Vane





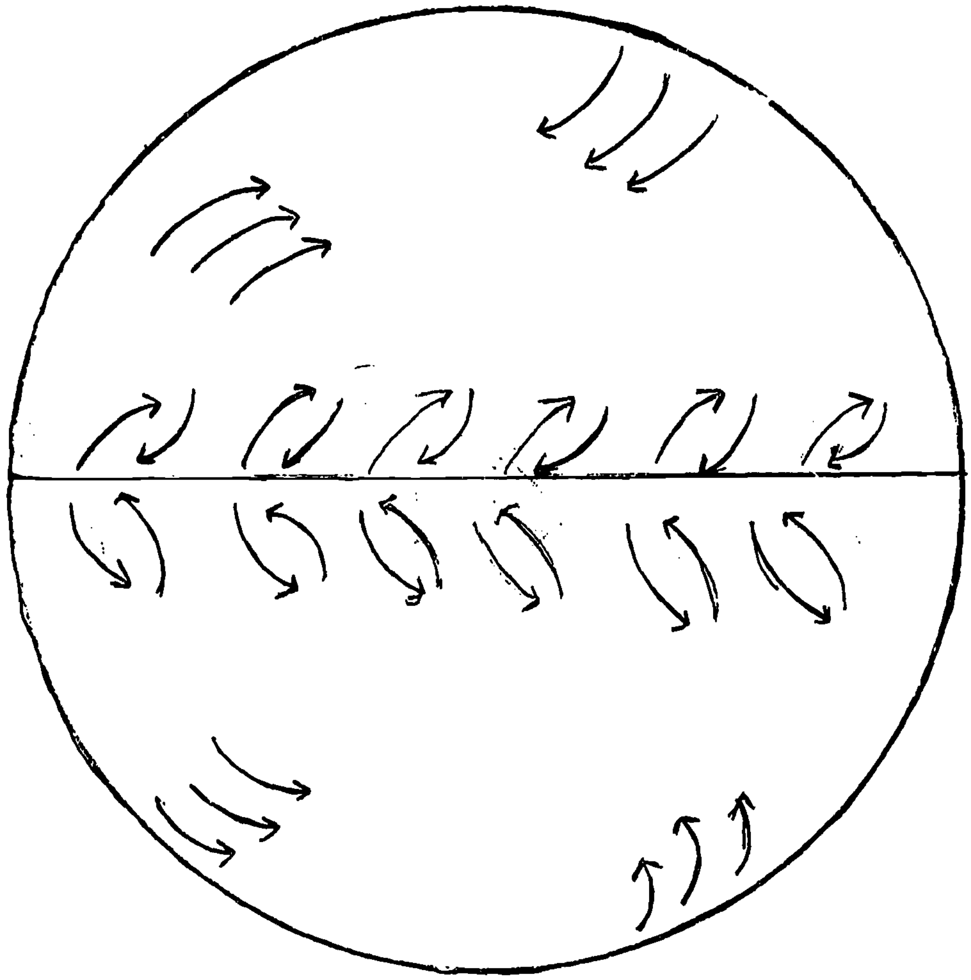
Cut an arrow from a piece of cardboard. Follow the directions given above. Put a pin through the cardboard, a small bead, into the stick.

You may put it in the ground or hold it to determine from which direction the wind is blowing or, you may hold it in front of a fan. The arrow will point in the direction from which the wind is blowing.

2. Observe   How Does Wind Affect Evaporation?

Wet two identical spots on the blackboard far apart. Fan one spot with a cardboard. Allow the other spot to dry by itself. Compare the time it takes for the water to evaporate. Wind speeds evaporation.

3. Draw Wind Belts Of The Earth



Polar easterlies

Prevailing westerlies due to earth's rotation

Horse latitudes (calm)

Trade winds due to heating of air over the equator

Doldrums or equatorial calm

Trade winds due to heating of air over the equator

Horse latitudes (calm)

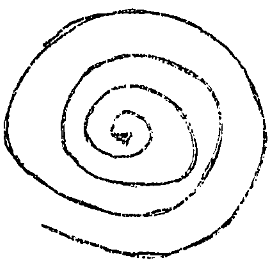
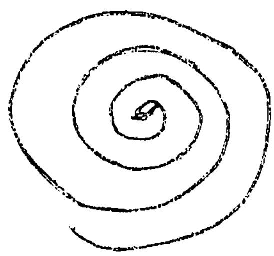
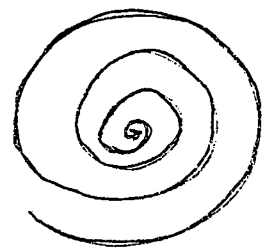
Prevailing westerlies due to earth's rotation

Polar easterlies

CONCEPT - There are many kinds of winds.

1. Charts, Maps, or Graphs

Make a Chart

CYCLONE	HURRICANE	TORNADO
		
Wind - 50-60 miles per hour Area - thousands of miles	Wind - 100-200 m.p.h. Area - thousands of miles	Wind - up to 500 m.p.h. Area - 200 to 800 miles
A cyclone is a mild wind, seldom destructive, covering thousands of miles of the earth. Its speed may be as fast as 50-60 miles per hour. The cyclone may bring rain. Cyclones occur daily across North America and are used by the Weather Bureau in forecasting weather.	A hurricane is a strong wind covering thousands of miles of the earth. Its speed sometimes approaches 200 miles per hour. The hurricane is extremely destructive over large areas. Hurricanes usually reach our east coast after forming along the coast of South Africa.	A tornado is a wind which covers only a small area of the earth, from 200 to 800 miles. The wind speed however, may approach 500 miles making the tornado extremely destructive over small areas.

2. Research — Tracing Storm Movements

Trace on a weather map, the directions of general storm movement. Determine through following storm centers, the speed of individual storms. Average this speed over a period of time. (Roughly 600 miles per day.)

3. Demonstration — Showing Cause of Wind

Open a window at the top and bottom. Move paper streamers up and down in front of the upper and lower window openings. Cold air comes in at the bottom and forces warm air upward and out at the top.

CONCEPT - The sun heats the land and the water.

1. Problem

Do all materials heat at the same speed?

Materials

Two small fruit jars, black paint, thermometer, and water.

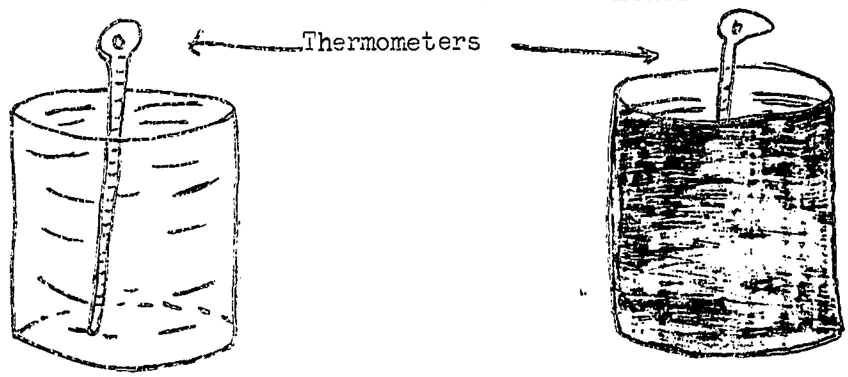
Procedure

Paint one fruit jar black. Fill both jars with water, being sure both jars have the same temperature. Set jars in the sunlight. After half an hour, take the temperature of the water in each jar.

In which jar is the water warmer? Why didn't the water in the clear jar heat as fast as the water in the dark jar? Do all materials heat at the same speed? Would air above all surfaces heat at the same speed?

Results/Conclusions

Sun's rays passed through or were reflected by the transparent materials of the jar and water. Sun's rays were absorbed by the darker surface and heat stored in the water. Different materials absorb and store heat at different rates. Air above different surfaces heats at different rates.



Clear Jar of Water

Black Jar of Water

2. Observe

Effect of Solar Heat

On a sunny day, place several different objects outdoors in the sun. Place several similar objects somewhere in the shade. After a period of time compare the temperature of the objects. Discuss the reasons for the difference. Develop the idea that we get heat from the sun.

3. Demonstration — Testing Temperature Gain In Water And Soil

Materials

Two shallow dishes, some dry soil, warm water, thermometer.

Procedure

Put some of the dry soil in one dish to represent land area. Pour water into the other dish. It should be as warm as the soil. Put both of the dishes in direct sunlight for a period of fifteen minutes. Compare the temperature of each at the end of this period.

Results

The dish with the soil should warm up more rapidly than the dish with the water. Water does not heat up so quickly as land.

Testing Temperature Gain In Water And Soil

Materials

Two shallow dishes, some dry soil, warm water, thermometer, access to a refrigerator.

Procedure

Put the soil in one dish and pour water in the other dish. Use the thermometer to test the temperature of each to be certain that they are the same. Put both of the dishes in a refrigerator for about fifteen minutes. Then, take them out and test the temperature of each.

Results

The temperature of the soil should be lower than that of the water. Soil or land areas cool more rapidly than water areas.

4. Research — Comparing Temperatures

Have the children compare the temperatures as reported at Grant Park in Chicago representing an area very close to the water, with the temperatures as reported for Midway. This would represent a land area. Compare the daytime and night or late evening temperatures to determine if the above principles are correct.

CONCEPT - Number of hours of sunlight helps to determine the weather.

1. Problem

How does the sun affect our weather?

Materials

Two shallow dishes and a thermometer.

Demonstration — Showing The Sun's Heating Effect

Procedure

Put water of the exact same temperature in both of the dishes. Put one of the dishes in bright sunlight and leave it there for ten minutes. Put the other dish in bright sunlight and leave it for twenty minutes. Check the temperature of the water in each dish at the end of each time interval.

Results

The dish that had been in the sunlight for a longer period should be warmer. The longer the sun shines on an object, the warmer it usually becomes.

Note — Recording Length of Daylight

To attempt to show the effect of the above stated principle, compare the number of hours of daylight that we normally have in each season of the year. Emphasize the fact that the number of hours of daylight is directly related to the number of hours of sunshine. Discuss how this affects our weather.

Recording Daybreak and Sunset

Keep an actual record of daybreak and sunset for different times in the year. Emphasize that this is only one factor that determines weather.

2. Demonstration — Showing the Effect of Vertical and Slanted Rays

Materials

World globe, flashlight (or filmstrip projector), yardstick.

Procedure

Darken room. Light up globe (one side) from a distance. Notice how one side of the globe will be lighted while other side is in darkness. Notice how the part of the globe where the light is shining is brighter than the fringe areas.

Results

Use yardstick to show that the fringe areas are receiving the rays of light at an angle. In this area it is not as bright. Discuss the relationship of the demonstration to the slanted rays of the sun and how they affect our temperature.

CONCEPT - Heat causes the evaporation of water into the air and loss of heat causes the condensation of water vapor.

1. Demonstration — Condensation

Materials

A bright tin can or glass, ice cubes, spoon or stirrer.

Procedure

Fill container half full of water that is room temperature. Wipe the outside of the container to be sure it is entirely dry. Put several ice cubes in the water and stir. Soon a film of moisture will appear on the outside of the can. Place this container in electric ice box to form frost.

Results/Conclusions

The tiny drops of water on the outside of the container come from the air. Air always contains moisture. Cold air cannot hold as much moisture as warm air. When the container is cooled by the ice inside, the air that touches the container is also cooled. It drops some of its moisture. The moisture forms in tiny drops on the container.

Dew and frost are formed in this manner. Dew is water and frost is ice. Dew comes out of cool air. Frost comes out of air that is freezing cold.

Demonstration — Evaporation I

Materials

One large flat pan, one wide mouthed jar, one smaller mouthed jar, one tall thin jar.

Procedure

Fill the smallest jar with water. Pour into the large flat pan. In turn fill each jar with the same amount of water. Place these containers where they can be observed daily. Record the time of the evaporation of each jar of water. If all other conditions are the same, the greater the extent of the surface, the faster a given amount of water will evaporate.

Evaporation II

Materials

Two pieces of cloth the same size, and the above mentioned materials.

Procedure

Wet the pieces of cloth with the same amount of water. Leave one crumpled up. Spread the other one out. Compare the length of time it takes each to dry. The greater the extent of the surface, the faster a given amount of water will evaporate under constant temperature.

Demonstration Evaporation III

Materials

Two pieces of cloth the same size, and the same materials as mentioned previously.

Procedure

Wet the two pieces of cloth with the same amount of water. Hang one piece of cloth in the sun. Hang one piece of cloth in the shade. Compare the length of time it takes each to dry. Heat speeds evaporation.

Demonstration Evaporation IV

Materials

Electric hot plate, two like containers.

Procedure

Put the same amount of water in each container. Heat one and leave the other at room temperature. Compare the time it takes for the water to evaporate in each container. Heat speeds evaporation.

Demonstration Evaporation V

Wet two identical spots on the blackboard far apart. Fan one spot with a cardboard. Allow the other spot to dry by itself. Compare the time it takes for the water to evaporate. Wind speeds evaporation.

CONCEPT - The earth receives heat and light from the sun.

1. Problem

How do we know that the earth receives heat and light from the sun?

Materials

Two dishes, two ice cubes, black paper, ruler, small box (cardboard)

Procedure

Put black paper in each dish. Put an ice cube in each dish. Place one dish in the sunlight. Place one dish in the cardboard box. Measure the size of the ice cubes several times.

Results/Conclusions

Ice cubes in the sunlight will melt faster. The sun gives us heat.

Note

Black paper is used to absorb more heat.

2. Problem

Do we get heat from the sun?

Materials

Two glasses of water, thermometer.

Procedure

Leave one glass of water in the sun. Leave one glass out of the sunlight. Check temperature every five minutes.

Results

Water in the sun will have the highest temperature.

Note

Also mention the water cycle. (Evaporation)

3. Charts, Maps, or Graphs

Make an experience chart of the characteristics of the earth. Ask children: "How do we know the earth is round?"

4. <u>Charts, Maps, or Graphs</u>

Have children make an experience chart on, "The Day That The Sun Stopped Shining."

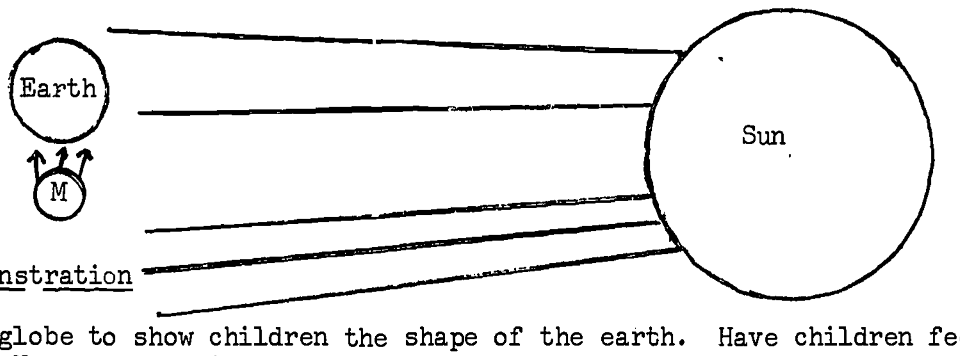
5. <u>Observe</u>

Put one thermometer in the sunlight. Put one in a dark corner of the room. Observe and record the temperatures shown on both thermometers.

Let one child slowly lead another child whose eyes are closed, around the room. Have the child being led tell when he is in the sunshine and when he is out of the sunshine.

6. <u>Draw</u>

Have children draw the rays of light coming from sun to earth.



7. <u>Demonstration</u>

Use globe to show children the shape of the earth. Have children feel it. Name other things that are round.

Display some small marbles and a large beach ball. Have children examine them. Have children put two fingers on the marble. Does it feel round? (Yes)

<u>Note</u>

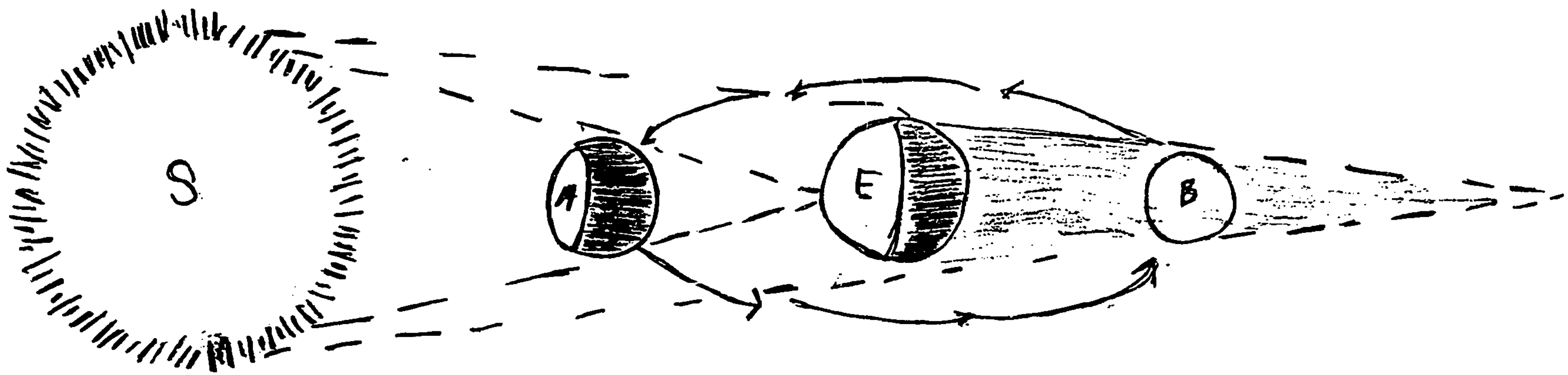
Point out that the earth does not seem round because it is so large.

8. <u>Bulletin Boards</u> (Exhibits and Displays)

Display any actual pictures that you might have of spots of the earth taken by the astronauts.

9. <u>Make Models</u>

Have children make a clay model of the "round earth." Insert a toothpick near the upper part to represent Gary.



KEY: S represents the Sun.

E represents the Earth.

A and B represent the Moon.

When the moon is at position B, it is in the shadow of the earth and is consequently eclipsed (an eclipse of the moon). When it is in Position A, it hides the sun (an eclipse of the sun).

How To Make A Simple Planisrhere

Materials

An old floor or table lamp, a wire coat-hanger, 3 hairpins, a rubber ball about 3 or 4 inches in diameter, and a rubber ball about one inch in diameter.

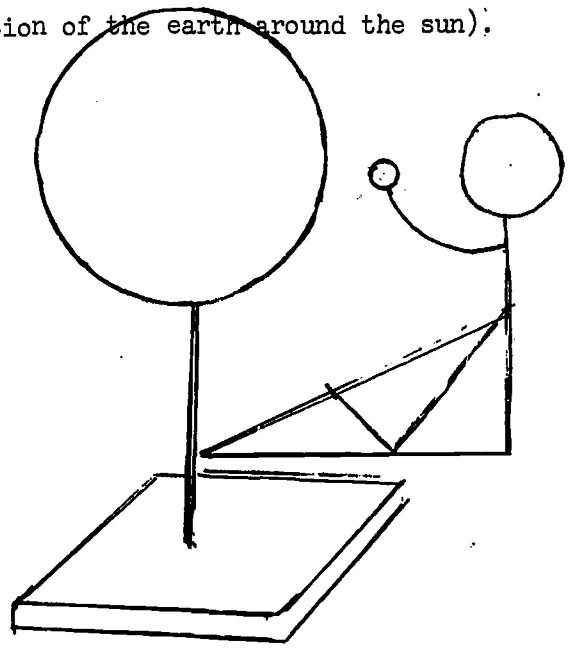
Procedure

Assemble materials as they are shown in the drawing. Use the planetarium for showing the class:

a. The causes of seasons (revolution of the earth around the sun).

b. The cause of night and day (rotation of the earth on its axis).

c. The cause of moon phases and eclipses (revolution of the moon around the earth).



10.. Make Models

Make box scenes (dioramas) of the sun's influence on:

a. Winter - Summer

b. Spring - Fall

c. Summer scenes

d. Shadows

CONCEPT - Differences in temperature bring about movements of air.

1. Problem

What makes the wind blow? (Air movements)

Materials

Convection box (wooden or metal) that has a glass front that can be raised; candle, wooden splints.

Procedure

Set up convection box. Place a lighted candle under one chimney. Close the box with the glass plate. Hold the smoking splint of wood over the chimney above the candle. Hold the smoking splint above the other chimney.

Results/Conclusions

The smoke rises above the heated air near the lighted candle. The smoke passes down through that chimney across the box and up the other chimney.

The air around the candle was heated and became lighter. The air above the other chimney was cooler, and thereby heavier. This cooler, heavier air came down through the chimney, moved across the box and forced the warmer, lighter air around the candle and up the chimney above it. In the same way, great volumes of air around the earth are heated by the sun. This warm air becomes lighter and is forced upward by the cooler surrounding air. This, in turn, causes horizontal movements of air which are called winds. Winds are caused by unequal temperatures of air.

2. Demonstration Showing Effect of Heat On Air Movement

Materials

Balloon, piece of string.

Procedure

To further demonstrate that warm air goes up, have children hold an inflated balloon over a warm air register or steam radiator (not a univent with a blower.) Then, have them hold the balloon over other objects in the room - chairs, desks, and so on. Note the different results. Have children draw their own conclusions as to why the balloon behaves as it does in different locations.

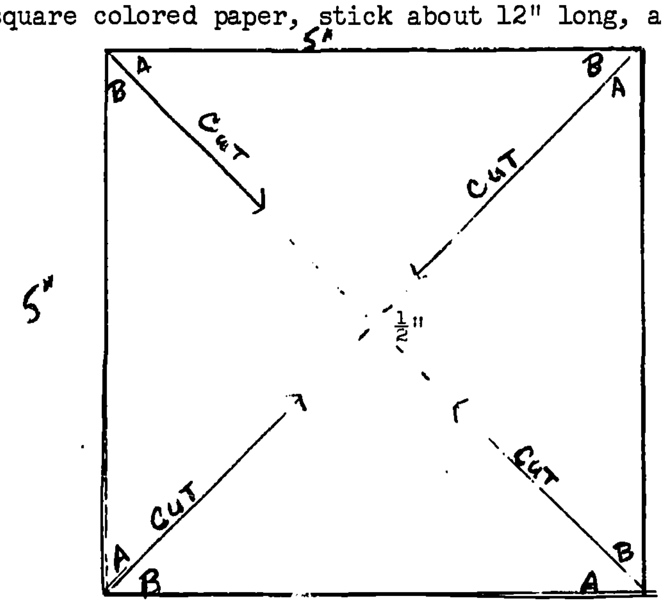
CONCEPT - Warmed air expands and becomes lighter; cooler air is heavier.

1. Problem

How do we know?

Materials

Five inch square colored paper, stick about 12" long, a pin.



Procedure

a. Draw lines on the square or fold as shown in the diagram.

b. On each line going out from the center of the square, make a dot ½ inch from the center. Cut in from the corners of the square along each of the four lines until you reach the dots.

c. Then bend in to the center the corners marked A in the diagram.

d. Put a pin through the four corners and through the center of the square into the wooden stick.

e. Hold the pinwheel over a heater. The pinwheel will turn, showing heated air rises.

2. Observe — Showing Warm Air Expands

Materials

Chemical flask or pyrex nursing bottle, balloon, source of heat.

Procedure

Fit the balloon over the mouth of the flask or bottle. Heat the bottle. The air within will expand and partially fill the balloon. Explain why the balloon fills up.

3. Demonstration

Place one thermometer near the top of the room and another on the floor and note the temperature differences and note that warm air rises.

Hold a piece of tissue paper over a radiator to notice motion of warm air rising.

Showing the Effect of Temperature in Air

Materials

Two quart jars, a piece of cardboard four inches by four inches, a small piece of scrap cloth, a short stick, matches.

Procedure

Cool one jar while the other remains at room temperature. One jar will then contain cold air (heavy) and the other warm air (light). To make the warm air visible, invert the jar and hold a smoldering cloth beneath the mouth of the jar until the jar is filled with smoke. With the warm air jar still inverted, place a piece of cardboard beneath the mouth and set it on top of the cold air jar. Then, gently remove the cardboard. While holding the mouths of the two jars tightly together, invert the arrangement.

Results

In the first case, the warm air will remain in the top position and will not mix with cold air. When the two are inverted, the warm air is forced to the top by the heavier and more dense cool air which displaces it.

CONCEPT - The temperature of the air depends mainly on the heating effects of sunlight.

1. Problem

How do changes in temperature affect air.

Demonstrations

Materials

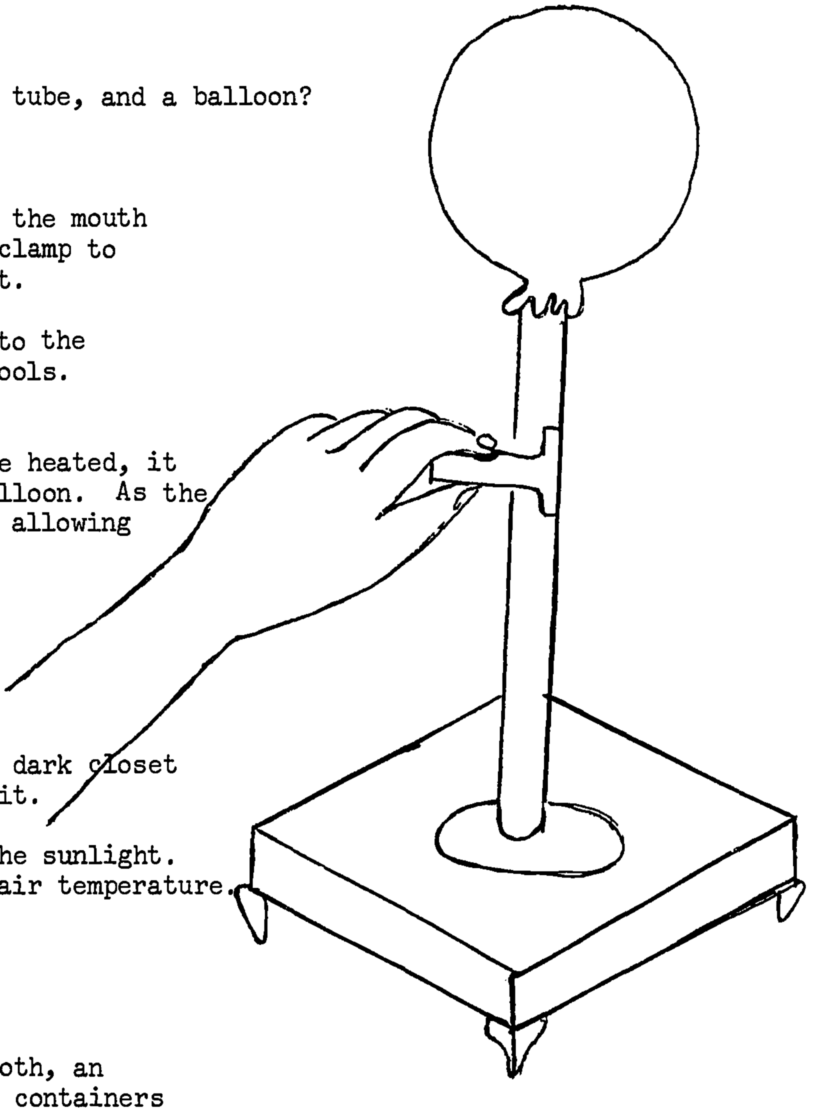
You will need heat, a test tube, and a balloon?

Procedure

Attach deflated balloon to the mouth of the test tube. Attach clamp to tube and hold over the heat.

Watch to see what happens to the balloon as the test tube cools. Why does this happen?

As the air in the test tube heated, it expanded, inflating the balloon. As the air cooled, it contracted, allowing the balloon to deflate.



Materials

Two thermometers.

Procedure

Place one thermometer in a dark closet where no sunlight can hit it.

Place one thermometer in the sunlight. Compare the difference in air temperature.

Record this.

Materials

Two identical pieces of cloth, an electric hot plate and two containers

Procedure

Wet the two pieces of cloth with the same amount of water. Hang one piece of cloth in the sun. Hang one piece in the shade. Compare the length of time it takes each to dry.

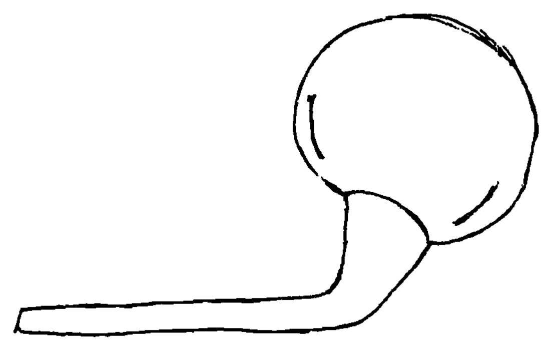
CONCEPT - Air is a real substance that takes up space.

1. Problem

How do we know?

Materials

Soap bubbles, pipe, paper sack, balloon.



Procedure

Blow soap bubbles to observe what happens to a drop of soap when it becomes full of air. Listen for the "puff" when the bubble breaks and the air rushes out.

Blow up a paper sack and a balloon to show that the air blown into the sack and the balloon takes up space.

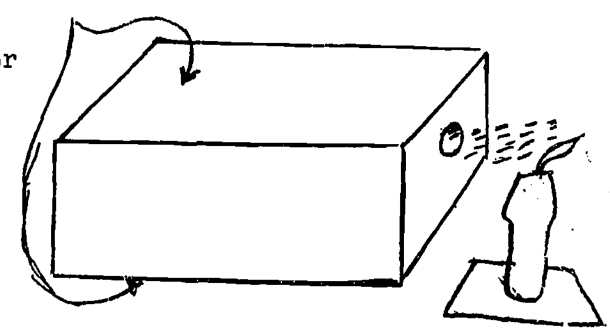
Conclusions

We can see that the air takes up space.

2. Demonstration — Air is Real

You will need a suit box or shoe box, candle flame, dust, paper streamers, or bits of paper.

Cut hole about $\frac{1}{2}$ inch in diameter in the end of the box. Squeeze box and feel the air come through the hole. Squeeze box and let air blow the candle flame, dust and/or paper bits and streamers.



Can you feel something leave the box? Does something happen to the candle flame? Does something happen to the dust? Does something happen to the paper? Is the box empty?

The box can not be empty since one can feel something leave it and since something blows the flame, dust and/or streamers. Air must be in the box.

CONCEPT - Air has weight. (Air pressure)

1. Problem

   Does air have weight?

   Materials

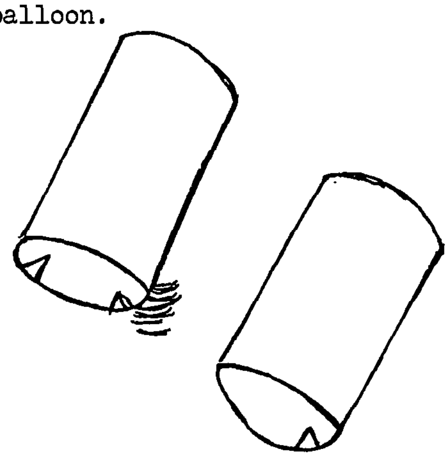
   Two balloons, yardstick, string, pin.

   Procedure

   Inflate both balloons to the same size. Tie each to either end of the yardstick. Tie the string to the center of the yardstick and suspend it, so that it is in perfect balance. Then, deflate one of the balloons with a pin. Observe how it goes out of balance. Have the children decide if there is weight in the inflated balloon.

   Results

   Children see that air has weight.



2. Problem

   Does air have pressure?

   Materials

   Tin can, water, can opener.

   Procedure

   Punch one hole in a tin can containing a liquid. Try to pour the liquid. Punch another hole in the can. Try to pour the liquid again.

   Why does the liquid flow better when two holes have been cut?

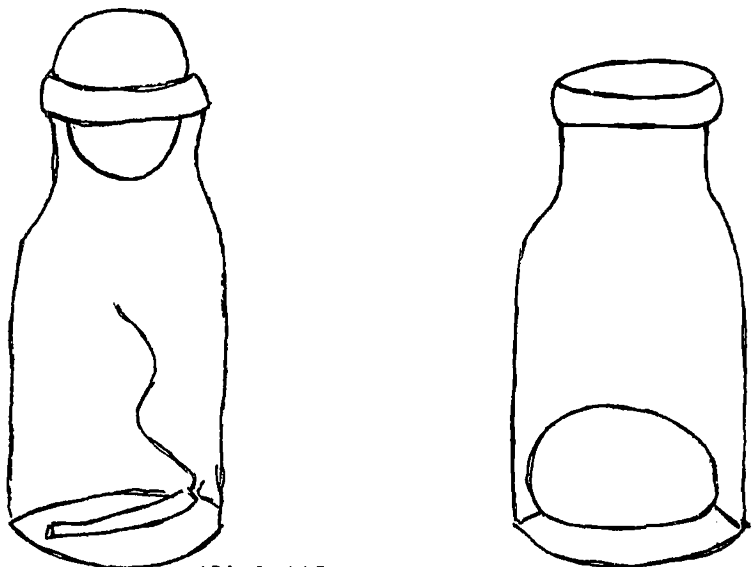
   Results

   Air pressing on liquid trying to come through one hole holds liquid back. When two holes are punched, air presses on liquid through second hole forcing it out through other hole.

   Conclusion

   Air has pressure.

3. <u>Demonstration</u> <u>Air Has Pressure</u>

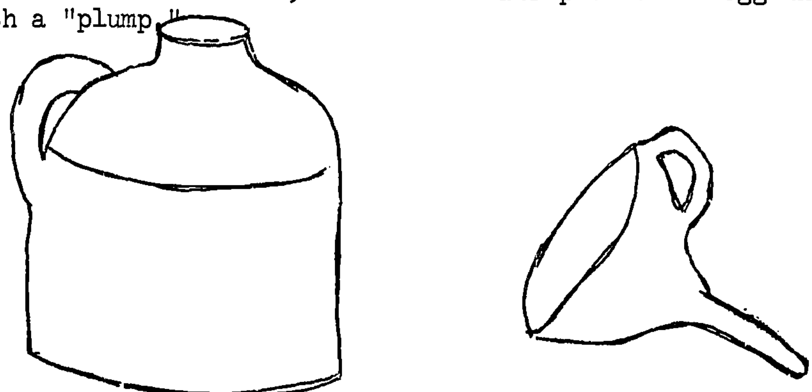


<u>Materials</u>

Hard-boiled egg, match, milk bottle.

<u>Procedure</u>

Take off the shell of a hard-boiled egg. Light a match and drop it into a milk bottle. Put the egg in the mouth of the bottle. The egg will not fall through. As the match heats the air in the bottle, the air expands and some of it is forced out. The escaping air may cause the egg to bounce a little. The match goes out when it burns up the oxygen in the air in the bottle. Then the air in the bottle cools and contracts. Because the oxygen is used up and the air on the inside exerts less pressure than the air on the outside exerts, the outside air pushes the egg into the bottle with a "plump."



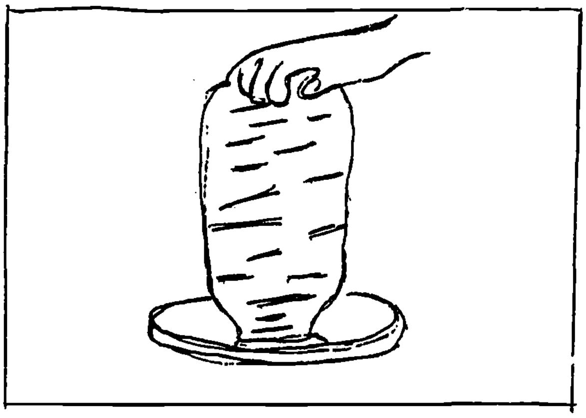
Place a funnel (glass one preferred so children can see what is happening) tightly in a narrow-necked jug. Observe how the water stands in the funnel. Lift the funnel slightly so air may get out of the jug and observe how freely the water flows into it. This shows that the air in the jug is displaced by the entering water. When the funnel is tight in the mouth of the jug the air cannot escape so the water will not go into the jug.

4. Demonstration   Air Has Pressure

Blow up a balloon until it can hold no more air and bursts. What causes the balloon to burst? Does air have pressure?

Fill a glass with water. Place a flat cardboard on top of the glass. Hold the glass with one hand, and the cardboard firmly with the other. Invert the glass over a sink or pan. Remove the hand holding the cardboard. Observe how the cardboard is held to the glass by air pressing against it.

Turn a bottle of water upside down in a pan of water. Does the water run from the bottle? What holds the water from the bottle? What holds the water in the bottle? (Air pressure on the surface of the water in the pan is 15 pounds for each square inch of water. This pressure holds the water up in the bottle.)



CONCEPT - Nearness to large bodies of water cause differences in climate.

1. Problem

   How do coastal cities compare in temperature, in the winter, with inland cities of the same latitude?

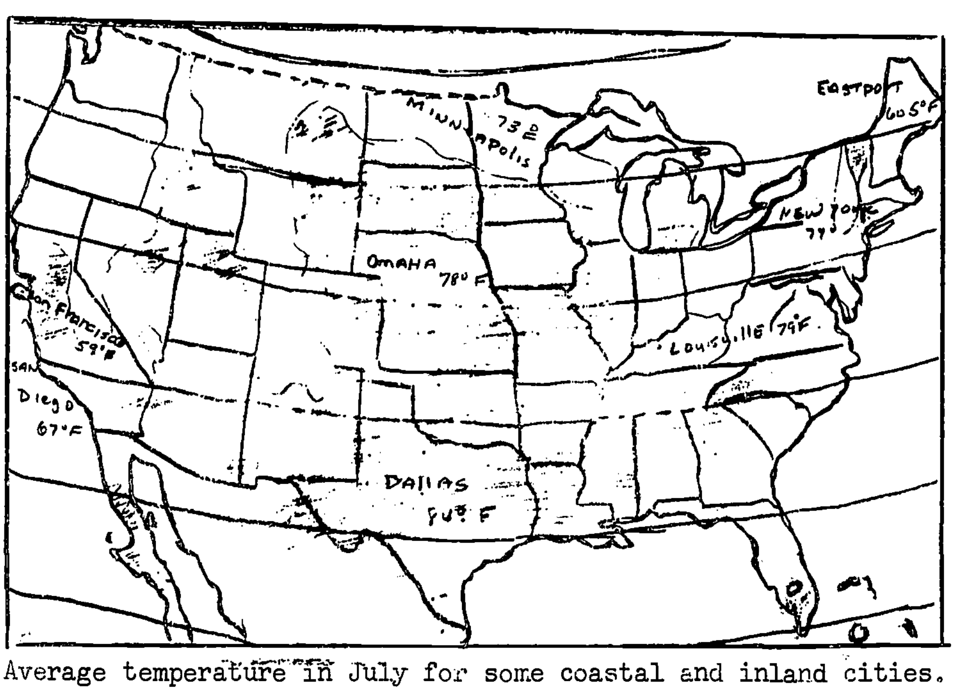
   Research

   a. Have children consult a physical map of the United States and select pairs of coastal and inland cities that has the same latitude and elevation.

   b. Have children consult an almanac to find average monthly temperatures for January for each pair of cities. They then make a map such as the one below to record monthly temperatures in winter for their pairs of cities.

   Note

   At the same latitude, coastal cities, are generally warmer.



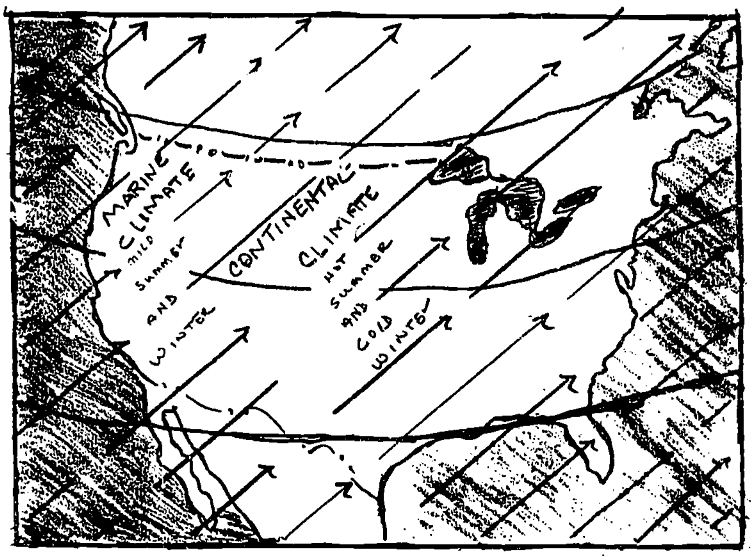
Average temperature in July for some coastal and inland cities.

CONCEPT - The west coast of the United States has cooler summers and warmer winters than the east coast.

1. Problem

Why does the west coast of the United States have cooler summers and warmer winters than the east coast?

Chart



The prevailing westerlies affect the climate

On the west coast the prevailing westerlies carry ocean air to the land, thus affecting its temperature in the ways indicated above.

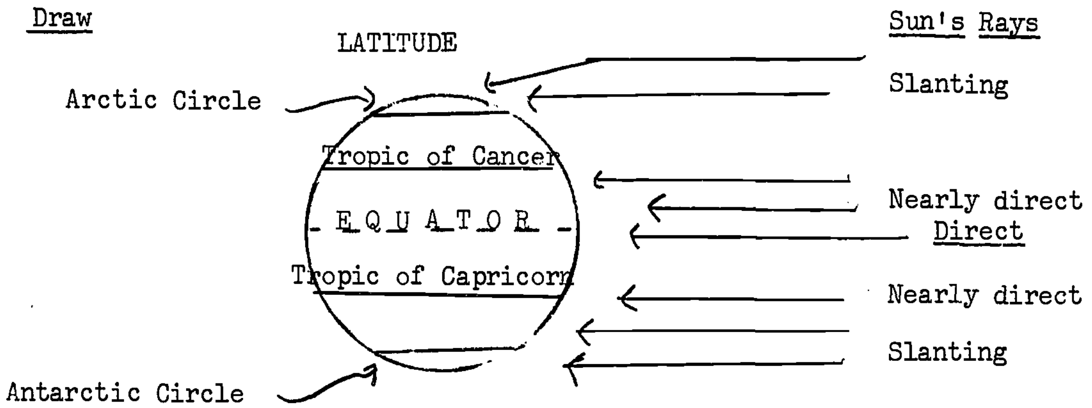
The prevailing westerlies blow across the United States in a generally west-to-east direction. On the east coast, as at New York City and Boston, the prevailing westerlies blow from the interior, bringing hot winds in summer and cold winds in winter. This gives the east coast a climate that more closely resembles the continental climate of the interior. The Atlantic Ocean, although close by, has less of a moderating effect on the coast because the winds are usually "blowing the wrong way," that is, from the land to the ocean.

CONCEPT - Climate is the average weather of a region over a long period of time.

1. Problem

What causes a region of the earth to have a certain climate?

Draw



Latitude affects the angle at which the sun's rays strike the earth.

2. Charts, Maps, or Graphs

Chart Ideas

Make a list of the ways in which the climate at the North Pole is similar to the climate at the South Pole. Make a list of the reasons for this similarity.

Illustrate and discuss the effects of large lakes and large mountain ranges on the weather and climate in different parts of our country.

Make a list of the way climate affects the way of life of people who live in humid, equatorial, jungle climate. Do the same for a cold, dry, arctic climate and for a hot, dry, desert climate.

Make a chart illustrating the factors which cause a desert climate to be formed.

CONCEPT - Climate is important to the way men, animals, and plants live in different regions.

1. Problem

How are men, animals, and plants affected by the climatic zone?

Materials

Plant (any type); ruler.

Procedure

Place a plant in the freezer. Check the growth of the plant for several weeks.

Results/Conclusions

The plant will not grow. The plant would die if it lived in a freezing polar climate.

Plants are affected by climatic zone.

2. Research

Have children find out where the larger populations of people are gathered. Compare this to the climatic zones. Put the information on a map of the world.

3. Collect

Have children collect pictures of the clothing worn by people in different climatic zones.

4. Demonstration Showing Climate Zones

Use a project or regular globe to identify the climatic zones of our world. Show that climate is an average of the weather conditions over a long period of time.

Discuss and study how climate affects the way of life in different parts of the world.

CONCEPT - Rays of the sun, that are directly overhead, heat the earth much more than slanting rays.

1. Demonstration   Showing Effect of Sun's Angle

Materials

Flashlight; piece of paper.

Procedure

Darken the classroom slightly. Hold the flashlight directly over the surface of the paper about one foot from the paper. Trace the outline of the projection of light on the paper. Take another sheet of paper and hold the flashlight at an angle from the paper; however, keep the distance the same as in the first case. Trace the outline of the projection of light on the paper.

Results

When the rays of light are directed at right angles to the paper, the area covered is smaller. The light is concentrated. Likewise, heat from the source is also concentrated. When the rays of light are at a slant angle, it covers a larger area. The light is spread over a large area. Likewise, the heat from the source is spread over a large area. Discuss this concept as it affects climatic zones of our world.

2. Demonstration   Showing Effect of Sun's Angle

Materials

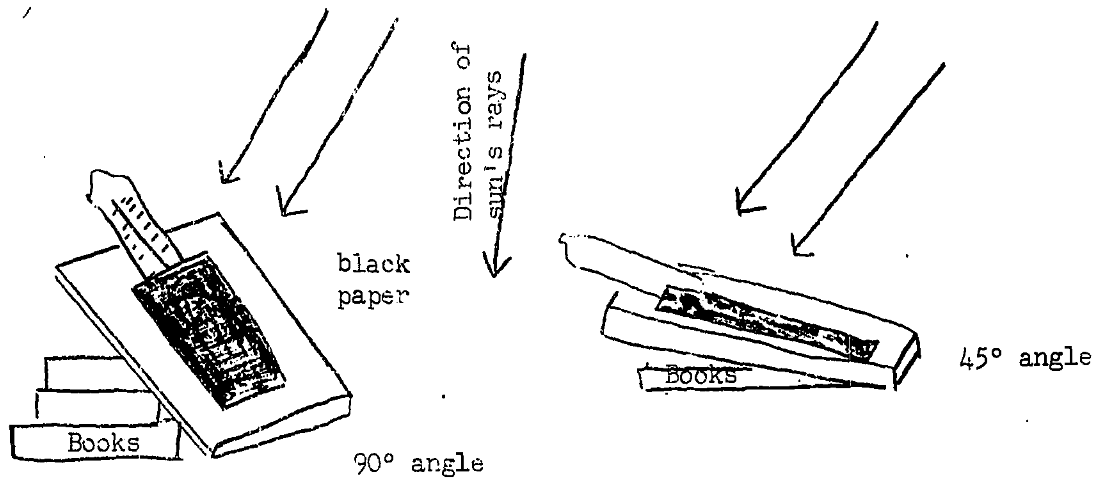
Two pieces of cardboard; two pieces of black paper; two thermometers.

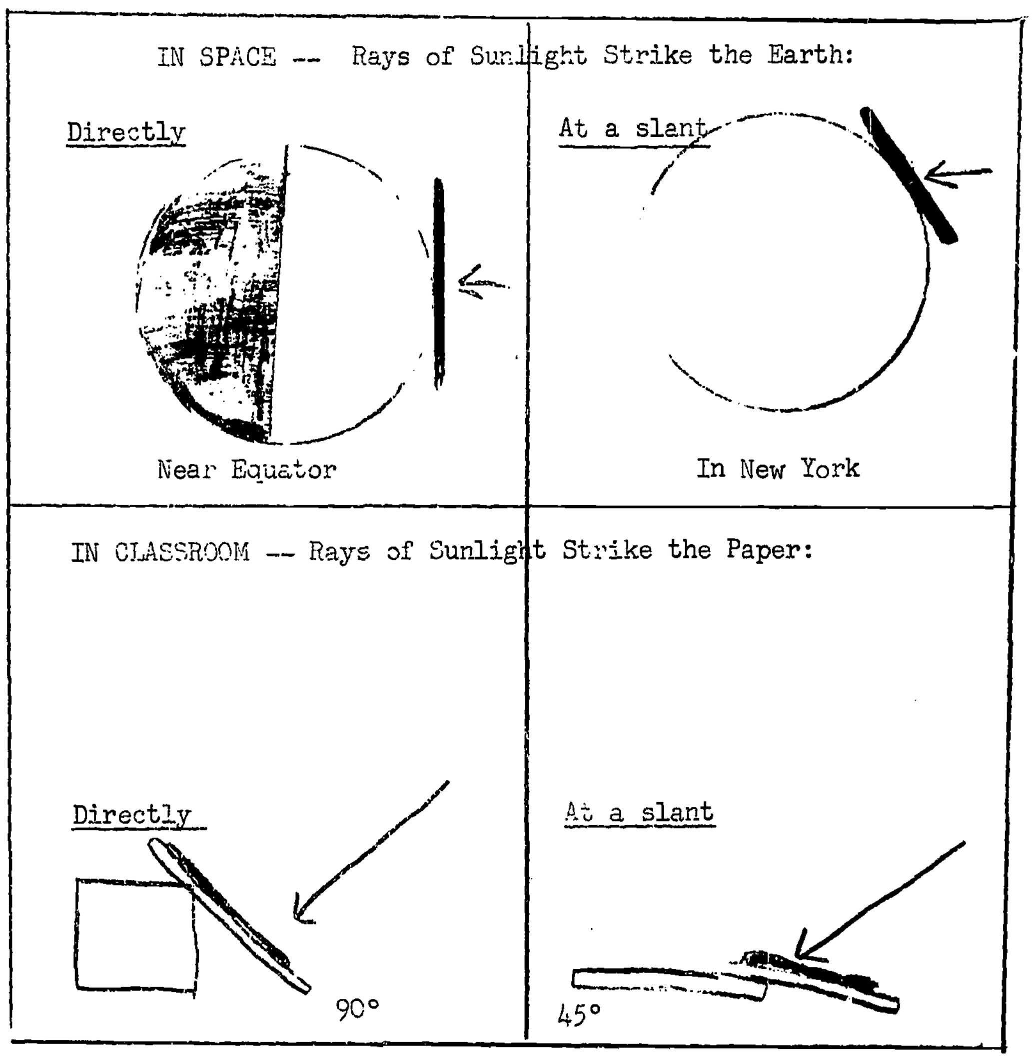
Procedure

Staple a sheet of black paper to each of the two pieces of cardboard. Place it in the sun, in positions that correspond approximately to that of the surface of the earth near the equator (90°) and the earth near New York City (45°). After a few minutes, feel each piece of paper. Check thermometers.

Results

The paper slanted at 90° receives the most direct rays from the sun and has the highest temperature.


Direction of sun's rays
black paper
Books
90° angle
Books
45° angle


IN SPACE -- Rays of Sunlight Strike the Earth:
Directly
At a slant
Near Equator
In New York
IN CLASSROOM -- Rays of Sunlight Strike the Paper:
Directly
At a slant
90°
45°

Evaluation

Included here are samples of evaluation items which could be used in developing your own informal testing program. These suggested types of items cover the particular science area that has been developed in this section of the handbook. This also means they could be used to help develop informal testing to cover large areas of information (monthly, mid-year, end of year testing). These are by no means complete tests as such. You will have to adapt and develop items to meet your particular class's own individual needs and differences.

Draw a line under the word or phrase in the parentheses that should be used to make a correct statement:

1. About one-fifth of the air is (nitrogen, oxygen, carbon dioxide).
2. (Nitrogen, Carbon dioxide, Oxygen) makes up 78 per cent of the air.
3. About 1/25 of 1 per cent of the air is (nitrogen, oxygen, carbon dioxide).
4. The gas (carbon monoxide, argon) makes up about 1 per cent of the air.
5. Air (does, does not) take up space.

A list of terms is given below. Select the term from the list that goes with each statement. Write the term in the space before the statement.

Tropical rain forest	Tropic of Capricorn	Desert	Polar climate
Savanna	Tropic of Cancer	Polar region	

1. (Tropic of Cancer) circle north of the equator.
2. (Tropical rain forest) hot and rainy the year around.
3. (Savanna) plain covered with thick grass.
4. (Tropic of Capricorn) circles south of the equator.
5. (Desert) very dry climate.

For each definition in Column A, find the word it defines in Column B. Number the same as its definition:

A	B
1. Layer of air closest to the earth	(3) atmosphere
2. Moving air	(5) stratosphere
3. Mass of air surrounding the earth	(4) ionosphere
4. Layer of air farthest from the earth	(1) troposphere
5. Middle layer of air	(2) wind

Draw a line under the word or phrase in the parentheses that should be used to make a correct statement:

1. The United States Weather Bureau is operated by the (local, federal) government.

2. The velocity of the wind means the (speed, humidity) of the wind.

3. The harder the winds blow, the (slower, faster) the little cups on the anemometer spin the wind vane.

4. The prevailing winds travel in a (northerly, westerly) direction.

5. Airports use a wind (stocking, tower) for the same purpose that a weatherman uses a wind vane.

Here are six weather instruments:

a. wind vane	b. anemometer	c. thermometer
d. hygrometer	e. radar	f. barometer

Place the right letter of one of these weather instruments in front of each phrase below:

(F) 1. measures air pressure.

(C) 2. measures the temperature of the air.

(A) 3. shows wind direction.

(E) 4. tracks severe storms.

(B) 5. measures the speed of the wind.

Vocabulary

One of the strongest keystones of scientific efficiency lies in its vocabulary. The scientist says things precisely, accurately, and briefly. Probably one of the greatest quarrels the science teacher may have with the elementary level teaching today is vocabulary. The science teacher can have no use for vocabulary that is not precise and accurate. Precision in vocabulary is necessary for understanding and meaning of the concept or process being learned.

The words listed below are the basic vocabulary for the indicated area of study. After each word has been introduced, its meaning is to be maintained and extended at each succeeding level of study.

adaptation
altitude
alto
anemometer
aneroid
angle
barograph
barometer
Beaufort scale
calibrate
cirrus
climate
cloud
cold air mass
condensation
conduction
cumulus
degree
dew
dew point
dropsonde
earth's axis
equator
evaporation
Fahrenheit
fog
front
frost
gale
gravity
hail
humidity
hurricane
hygrometer
hypothesis
International Geophysical Year
irrigation
meteorologist
middle latitude
nimbus
orbit
polar climate
precipitation
prevailing winds
purified
radar
radiosonde
rain
rain drop
rain forest
rain gauge
rain water
satellite
savanna
sea breeze
sleet
snow
stratus
temperature
temperature range
thermograph
trade winds
transmitter
tropical climate
underground water
warm air mass
water cycle
water vapor
wind
wind vane

Children's Books

Books are a very essential part of the instructional materials in elementary schools which provide superior learning experiences for children. The selection of these books poses a difficult problem for librarians, teachers, and administrators because the science field is broad and increasing in scope and elementary school science programs are varied in nature. Some of the more common specific difficulties in choosing books are: (1) finding materials which deal with the varied interests of children; (2) locating material which gives information correlated with the local school district's instructional guide: (3) finding books of appropriate reading difficulty; and (4) selecting the best books from the many available.

The following list gives help related to the first three difficulties presented. Indirectly, it also helps with the fourth difficulty, for the best books cannot be selected until they are located. Further, the brief annotations should be of help in determining which books may be best for a given class. Finally, time should be saved in the selection of the best list if some information about the reading difficulty of available books is provided. It is hoped that this list will suggest for elementary teachers books that are supplementary to basic text series, and that these books will have value either as sources of information or for recreational reading.

It is always hazardous to specify an exact grade placement for a book because of variations in pupil reading ability in any class group, and because of different uses made of books. Consequently, the lowest grade level for pupil use is indicated. At lower levels these same books may be useful if the teacher reads to the children.

This list has been adapted from the publication of Children's Catalog (1966).

Bell, Thelma Harrington Snow; with drawings by Corydon Bell. Viking 1954 55p illus $3 (3-6) "This book describes how snowflakes are formed, the types and sizes of the flakes. There is also an account of snowflake cousins---frost, rime, glaze, sleet, and hail. The book ends with the history of Stella---a typical snowflake---from its birth to the time it falls to earth. Children will find this 'survey of a little treated subject compelling....'"

----Thunderstorm; illus. by Corydon Bell. Viking 1960 128p illus $3 "The author investigates the nature, causes, and manifestations of thunderstorms. Dramatically and with interesting anecdotes, she describes the building of a thunderhead and types of thunderstorms, tells about early superstitions, recounts the experiences of men who have flown inside a thunderhead, explains what lightning is, and discusses the dangers and virtues of thunderstorms."

Bendick, Jeanne Lightning; written and illus. by Jeanne Bendick. Rand McNally 1961 61p illus $2.95 (4-6) "The author begins by telling her readers some of the myths, legends, and superstitions, about lightning in all parts of the world. Then she tells what lightning really is, how it is generated, what it can do, and discusses experiments with it. Finally, she tells us how to protect ourselves from it---what to do, and what not to do."

----The Wind; written and illus. by Jeanne Bendick. Rand McNally 1964 80p illus maps $2.95 (4-6) "The author presents 'scientific facts about wind telling how it starts, which way it will blow, its effect on weather, its partnership with water and with soil, how it can be used. She covers the different kinds of winds...There are (also)sections of (myths), wind, sounds, wind sayings and wind things.' For a book 'that is simply chock-full of diagrams, maps illustrations, this... volume is remarkably rich in fascinating and accurate weather information.'"

Black, Irma Simonton Busy Water; pictures by Jane Castle. Holiday 1958 unp illus $2.95 (1-3) "Beginning with rain falling on a high hill, rhythmic text and pleasing pictures trace the water cycle to tell where rain comes from and indicate some of the uses of water."

Branley, Franklyn M. Flash, Crash, Rumble, and Roll; illus. by Ed Emberley. Crowell 1964 unp illus (Let's-read-and-find-out Science Bks) boards $2.75 (1-4) "Thunder, lightning, and rain are formed in the earth's atmosphere. In this ...account of familiar natural phenomena, the author tells how an electrical charge builds up in a thundercloud until it produces a flash of lightning and explains why thunder is heard after lightning appears."

----Snow Is Falling; illus. by Helen Stone. Crowell 1963 unp illus (Let's- read-and-find-out Bks) boards $2.95 (K-2) "An explanation of what makes snow the shape of snowflakes, the appearances and uses of snow, and how it affects plants and animals."

Brindze, Ruth The Story of the Trade Winds; illus. by Hilda Simon. Vanguard 1960 68p illus maps boards $3.50 (4-6) "This 'book treats the discovery, riddles, and importance of the prevailing 'Trades' or 'steadies' to navigators, from Columbus on, and similarly, the importance of the Jet Stream to today's airplane pilots. Attention is given to the contributions of such scientists as Matthew Fontaine Maury, Edmund Halley, and Charles Darwin. Graphically illustrated in three colors, with diagram-maps showing direction of air currents. Good reading for the inquiring younger reader.'"

Fenton, Carroll Lane Our Changing Weather, by Carroll Lane Fenton and Mildred A. Fenton. Doubleday 1954 110p illus maps $3.50 (5-7) "A fairly simple explanation of weather phenomena and their causes. Air, heat, water, and earth, are explained, in relation the their effect on weather; certain aspects of weather such as clouds, haze, fog, rain, thunder and lightning, snow, dew and frost are explained; and at the end there is a section on weather prediction and how to read weather maps. The material is accurate."

Fisher, James The Wonderful World of the Air; diagrams (by) Isotype Institute and Bernard Myers; art (by) G. Leigh Davies (and others). Garden City Bks. 1958 68 p illus boards $2.95. First published in England with title: Adventure of the Air "The story of the earth's atmosphere--- how it came to be, how it behaves, and of what it is composed. He tells how the air became first a vehicle for life, and finally a challenger to man who has strived to understand it, and ultimately to conquer it through the triumphs of aviation. Like the other books in this series, this volume is oversize, with varied and profuse illustrations.... While interesting to read and wide in approach, the book is weakened by the fact that it attempts to be too comprehensive. It is a moot point whether gliding squids, arrows, heavier-than-air flight, satellites, planetary atmospheres and wind patterns are best approached together."

Gaer, Joseph Everybody's Weather (Rev. ed) Lippincott 1957 96p illus $4.95 (5-7) "Information is very brief and concerned with the importance of knowing what can be expected from the weather, weather signs, causes and characteristics of weather, and what is done about it."

Gallant, Roy A. Exploring the Weather; illus. by Lowell Hess. Garden City Bks. 1957 64p illus maps boards $3.25 (5-7) "The book begins by 'exploring' the different levels of air above the earth, the characteristics of various winds and the formation of clouds. Explanations follow of hurricanes, tornadoes, thunderstorms, air masses and air fronts. Developments in methods of predicting and recording the weather are described briefly."

Goudey, Alice E. The Good Rain; illus. by Nora S. Unwin. Dutton 1950 unp illus $2.86 (1-3) "From drought to the coming of rain and the effects of both on life in the country and the city told in simple text and pleasant illustrations. A useful book for nature study classes and for showing the interdependence of city-country life."

Hitte, Kathryn Hurricanes, Tornadoes and Blizzards; illus. by Jean Zallinger. Random House 1960 82p illus maps (Easy-to-read Science Bks) $1.95 (3-5) "After an introduction to a few basic principles of air and winds, the author explains how, why, and where violent storms take place, giving examples of some of the most famous of each, and breifly telling how weathermen work to warn the public."

Irving, Robert Hurricanes and Twisters; foreword by Ernest J. Christie; illus. by Ruth Adler and with photographs. Knopf 1955 143 p illus maps $3.95 "An unusually interesting, basic explanation of the causes, nature, behavior, prediction, and disastrous results of hurricanes and tornadoes, written in clear, straightforward style and illustrated with accounts of specific tropical storms as well as with diagrams and photographs."

Knight, David C. The First Book of Air; A Basic Guide to the Earth's Atmosphere; illus. with photographs and drawings. Watts, F. 1961 67p illus $2.65 (4-7) An "introduction to the earth's atmosphere--its composition, movement, importance to life, and the ways in which it is used for man's needs and comfort. Includes an explanation of the Van Allen radiation belts and the oxygen-carbon dioxide life cycle, weather information, and a discussion of air pollution and methods to combat it. Also includes a few simple experiments with air."

Larrick, Nancy Junior Science Book of Rain, Hail, Sleet & Snow; illus. by Weda Yap. Garrard 1961 62p illus (Junior Science Bks) $1.98 (2-4) "This book 'explains these kinds of precipitation, giving their causes, effects, occurrence. Defines 'evaporation,' 'condensation,' 'dew point,' and other terms, and gives the reasons behind natural wonders, such as the rainbow, hailstones, and 'seeing your breath.'"

Schneider, Herman Everyday Weather and How It Works. Rev. ed Pictures by Jeanne Bendick. McGraw 1961 194p illus maps (Whittlesey House Publications) $3.25 (5-7) "The what, why, and how of weather---heat, air and water, etc.--- plus instructions on making home weather maps, cloud seeding, rainmaking, and many experiments for the enthusiastic reader."

Syrocki, B. John What is Weather; pictures (by) William Tanis. Benefic Press 1960 45p illus maps (What is it ser) $1.80 (2-5) "In this discussion of weather, the author covers movement of air and its moisture and the causes of temperature and storms. He also describes types of clouds and weather instruments.

Tannehill, Ivan Ray All About The Weather; illus. by René Martin. Random House 1953 148p illus maps (Allabout bks) $1.95 (4-7) "In readable style and with scientific accuracy, the director of weather reporting and forecasting for the U.S. Weather Bureau discusses the factors of weather and the results of their interaction, and explains the work of weathermen in observing, measuring, reporting, predicting and warning."

----The Hurricane Hunters; illus with photographs. Dodd 1955 271p illus $3.50 "Slowly man has been able to study hurricanes and devise methods of giving warning of danger to specific areas. This author, an authority on the subject, describes the historical development of this technique. Much of the story is told by direct quotations from the presonnel of the Weather Bureau and military flyers who have done research on hurricanes. Good reading for... students whose interest in the subject may be aroused."

Wyler, Rose The First Book of Weather; pictures by Bernice Myers. Watts, F. 1956 63p $1.95 (4-7) "What makes the wind? Where does rain come from? What is a tornado? This book 'answers these and many other questions, and explains what makes the weather. Simple experiments and directions for making weather maps are included, with charts to help in home forecasting.'"

Zim, Herbert Lightning and Thunder; illus. by James Gordon Irving. Morrow 1952 $2.95 "How do thunderstorms form and why are there more of them on summer afternoons than any other time? How can the distance between a lightning flash and its observer be computed? Is lightning useful? Why can't it be harnessed for use as ordinary current? The author's explanations answer these and many other questions." "The brief text and many clear diagrams and pictures will appeal to middle-age readers and also prove helpful to adults trying to answer children's questions on this aspect of the weather."

Films

These films are available from the Central Audio-Visual Department. Contact your building A-V Coordinator to arrange for the use of these films.

All films should be previewed to determine suitability for use with your particular class.

Air All Around Us — 10 min. — B & W — Int.

On her way to school, Judy watches a tire being inflated at a gas station and when she reaches her classroom she asks her teaches how air can be squeezed into a tube. The teacher then demonstrates various properties of air, namely air pressure, contraction and expansion of air. These simple experiments are done with a medicine dropper, drinking from a straw, opening a can, and pouring from a vacuum jug.

Climate and the World We Live In — 13½ min. — Col. — Int.

This film shows the determining factors of climate, latitude, nearness of water, ocean currents, prevailing winds and mountain ranges. Further explained is the grouping of similar climate into major types, and regions of the world are represented to show how variations in climate affect human activities.

How Weather Is Forecast — 10 min. — B & W — Int.

This film shows the operation of a weather forecasting station, the instruments used to observe and record, the charting of weather maps, and forecasting. The importance of the forecasting to farmers, airplanes, fishermen and the inhabitants of flood areas is discussed.

Ocean of Air — 14 min. — Col. — Int.

The film uses animation and live action photography to portray importance of air to life on earth. It shows composition of and describes physical properties of air; and indicates why air is used to support life; shows how air has been used to provide power to aid man in various other ways such as cooling, cleaning and transportation.

Pressure And Humidity Part II (Weather-In-Action) — 10 min. — Col. — Gds. 5-6

Some of the most important news we ever receive tells us what our weather is going to be like, what is happening because of changing weather conditions. The film discusses pressure, barometer, evaporation, moisture, humidity, hygrometer, saturated, dew point, frost, clouds, fog, cirrus, stratus, cumulus, rain, precipitation, sleet, hail, snow, nimbus, nimbostratus, cumulonimbus.

Rain — 10 min. — Col. — Pri.

This is a film showing man's need for rain; it explains the water cycle by means of simple illustrations and terms. The phenomenon of the rainbow is explained.

Rainshower 14½ min. Col. Int.

The film is designed to provide practice in careful observation - to sharpen senses and awareness. Because it is a moving experience, it is especially useful for stimulating creative activity.

Temperature and Wind Part II (Weather-Air In Action)

8 min. Col. Gds. 5 & 6

Some of the most important news we ever receive tells us what our weather is going to be like, or what is happening because of changing weather conditions. Film discusses temperature, wind, moisture, pressure, atmosphere, prevailing winds and anemometer.

Thunder And Lightning 10 min. B & W Int.

The film explains the phenomena of thunder and lightning in simple terms, using this as a springboard for understanding static electricity; shows that by rubbing certain objects together we cause them to become charged with electricity; that all like charges repel and unlike charges attract, that in a similar manner clouds become charged, and that lightning results when they discharge. It also discusses protective measures against electrical charges.

Water In Weather 16½ min. Col. Gds. 3-6

What makes weather? Heat from the sun, the earth's atmosphere, land areas and water areas all work together as weather makers. The earth's atmosphere is a protective layer which filters out harmful rays from the sun. The film shows effects of water, snow or sand on weather.

Weather Scientists 13½ min. Col. Gds. 3-6

Thoroughly explains and demonstrates the comprehensive scope, technical skills and vital service performed by weather scientists. We follow the flow of weather data into the national headquarters of the U.S. Weather Bureau.

Weather Station, The 10 min. Pri., Int.

The film is built around the trip of a boy and girl to the local weather station in the company of Mr. Murray who is in charge of the station. Mr. Murray explains how the station works and of what importance it is to everyone.

What Makes Clouds? 19 min. Col. Int.

A close look is taken at a fog and at a cloud noting that both are composed of droplets of water. Where did the water come from? Evaporation and transportation and sources of invisible water vapor and their existence alone does not explain how the cloud forms from the vapor. An experiment with condensation produces fog in a bottle and the film concludes with an investigation of how condensation occurs in nature.

What Makes Rain? | 10 min. | B & W | Int.

The film introduces and explains the concepts of evaporation and condensation as they apply to the water cycle, through the device of a letter which the weatherman writes to a young boy. Animated drawings summarize the water cycle.

What Makes the Wind Blow? | 17 min. | Col. | Int.

A step-by-step search for the cause of a typical on-shore sea breeze at the beach is conducted. Possible explanations are first tried out in a laboratory model, then actually double-checked in a nature situation. Pressure differences are found to be associated with the normal daytime air movement. Principles established are then used to find the actual cause for a violent wind storm that blows off-shore at the beach. Larger and stronger air movements are also explained.

Whatever The Weather | 11 min. | Col. | Pri.

A delightful film treating weather in a child's language and from a child's viewpoint is the nature of this film. The script written in poetry form is perfect in creating the atmosphere suitable for the activity in the film.

Why Do We Need Air? | 13½ min. | Col. | Pri. Int.

The film explains to the young learner that we are air-breathing animals and need the components of the air to live.

Why Is There Weather? | 11 min. | Col. | Int.

The film describes the basic elements in our weather; discusses heat of the sun, and its effects on land and water. This leads to an explanation of air and its movements and how water is drawn into it.

Winds and Their Causes | 10 min. | B & W | Int.

Pete's model airplane crashes. He is determined to find out why; so, with Pete, we discover the facts behind thermals, cumulus clouds, and thunderstorms. Then the great winds of the earth are explained....on and off shore breezes...the easterlies, and westerlies. It is an excellent introduction to the subject of winds and their causes, so interestingly presented it compels further study.

PART II - LITHOSPHERE

LITHOSPHERE

Initiatory Activities

Have the children:

1. Build upon the natural leads provided by various science or social studies units in which concepts are developed that are applicable to the earth and its surface. Units on transportation, recreation, or chemical change may easily lead into one about the earth's crust.

2. Display a group of books about the earth and its resources on the science table.

3. Select stories to read aloud during the story hour which may provide leads into the unit. The story of Parcutin, the volcano that arose from a corn field in Mexico, may be appropriate.

4. Display news clippings that are appropriate; for example the completion of a new dam. Discuss the effects the dam will have on the community.

5. Capitalize upon incidental experiences that members of the class may have had.

6. Tell or read stories concerning what people once thought about the shape and size of the earth.

7. Share experiences of visits to such places as Carlsbad Cavern, Yellowstone National Park, or Grand Canyon.

8. Bring postcards, Viewmaster reels, and photographs that have been collected during their trips.

9. Display jackets from books about the earth and its surface.

10. 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 the pictures may be in question form, to encourage the use of reference books to find the answers.

Developmental Activities

CONCEPT - Minerals can be identified by their physical and chemical characteristics.

1. Problem

   How can minerals be identified? (Streak)

   Materials

   Unglazed porcelain tile (1 piece for every three children if possible), files, samples of different minerals.

Procedure

Place a display of different mineral specimens on a table. Have the children:

a. Discuss what they observe about each specimen by looking at it.

b. Conduct the following activity:

(1) Rub a sample of pyrite or chalcopyrite across the unglazed porcelain tile. What happens?

(2) Make their own discoveries of streaking by rubbing the other mineral specimens on the unglazed pieces of porcelain tile.

(3) Work in small groups. What did you discover?

(4) Make a list of minerals, to include the minerals' external color and streak.

(5) Answer the following questions:

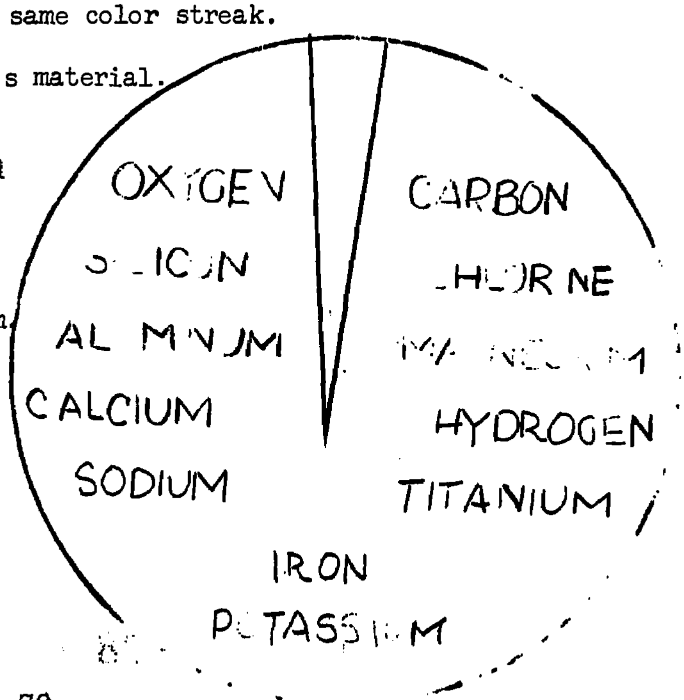
(a) What is the most common color of the streaks?
(b) Would a white streak be a conclusive test for identification?
(c) Are there any streaks that seem to be a distinctive color?
(d) Can these streaks noted above be used for identification?

Conclusions

The color of the powder or streak of a mineral is not always the same as the external color of the mineral. A streak test is one means of identifying minerals but in most cases it must be used with other tests, since many minerals have the same color streak.

Circle represents the Earth's material.

Ninety-nine per cent of the Earth's material is composed of only twelve elements: oxygen, carbon, chlorine, silicon, calcium, aluminum, magnesium, hydrogen, sodium iron, titanium and potassium.



THE EARTH'S MATERIALS

2. Problem

How can minerals be identified? (Luster)

Materials

Samples of different minerals.

Procedure

Have the children:

a. Observe how each specimen of a mineral reflects light (luster).

b. Discuss this characteristic as a means of identification.

c. Develop a luster guide of common minerals.

   (1) What is meant by transparent?

   (2) What is meant by opaque?

Conclusions

Minerals reflect light in different ways. If a mineral transmits light it is called "transparent"; minerals that let no light pass through are called "opaque."

3. Problem

How can minerals be identified? (Color)

Materials

Samples of different minerals.

Procedure

Have the children:

a. Observe the color of the various minerals.

b. Record the colors of the various minerals on a chart.

c. List separately the minerals that have a variety of colors.

   (1) Can the color test be used to identify these minerals?

   (2) Do any minerals have characteristic colors that might be used for identification?

Conclusions

The color of a mineral is a result of the light that is reflected from the surface. This color may be affected by impurities in the mineral. The color of a mineral may be useful in identification; but it cannot be used alone, since many minerals have more than one color.

4. Problem

How can minerals be identified? (Cleavage)

Materials

Magnifying glass, hammer, knife, samples of different minerals.

Procedure

Have the children:

a. Discuss what is meant by "cleavage."

b. Discover "cleavage" for themselves by prying into a piece of mica with a knife.

c. Take the mica:

  (1) Split it into sheets.

  (2) Discuss in what way the sheets separate.

  (3) Feel the smoothness of each sheet.

  (4) Answer the following questions.

    (a) How many different examples of parallel planes can be seen?

    (b) What is the nature of the cleavage surface?

d. Strike a sample of galena with a hammer. (Observe safety precautions - Place galena in a paper bag or wrap it in cloth before breaking it.)

  (1) What is the cleavage of galena?

  (2) How many directions of cleavage are there?

e. Strike a sample of calcite with a hammer. (Observe safety precautions.)

  (1) What is the cleavage of calcite?

  (2) How many directions of cleavage are there?

f. Observe other minerals to see if cleavage can be detected by looking for shiny surfaces.

Conclusions

Cleavage is the tendency of some minerals to break in smooth parallel planes. It varies in completeness and perfection. It may be in one, two, or three directions depending upon the mineral.

5. Problem

How can minerals be identified? (Fracture)

Materials

Hammer, chipped glass, Indian arrowhead, obsidian, samples of different minerals.

Procedure

Have the children:

a. Discuss what is meant by "fracture."

b. Discover "fracture" for themselves by striking a piece of obsidian with a hammer. (Observe safety precautions.) What does the broken surface resemble?

c. Break a piece of glass by striking it with a hammer? (Observe safety precautions.) What does the broken surface resemble?

d. Observe what happens to the various minerals upon breaking to determine which ones have distinctive fractures.

   (1) What kind of fracture does asbestos have?

   (2) What kind of fracture does clay have?

   (3) What kind of fracture does quartz have?

   (4) What kind of fracture does an Indian arrowhead have?

Conclusions

Fracture is a description of the broken surface of a mineral that has no cleavage.

6. Problem

How can minerals be identified? (Hardness)

Materials

Knife blade, penny, steel file, window glass, samples of different minerals.

Procedure

Have the children:

a. Discuss what is meant by "hardness."

b. Discover hardness of a fingernail, a steel file, a penny, and a knife blade. How are they listed in order of increasing hardness?

c. Experiment with the hardness of minerals.

   (1) What minerals will a thumbnail scratch?

   (2) What minerals will a penny scratch?

   (3) What minerals will a knife scratch?

   (4) What minerals will a file scratch?

d. Develop a chart of their findings.

Conclusions

The hardness of minerals is always constant for the same mineral and this is a good means of identification. Hardness is usually indicated by a number from 1 to 10, with number 1 representing the softest and number 10 the hardest. Minerals that have the higher number will scratch those lower on the scale, for example a mineral of hardness (9) will scratch a mineral of hardness (8). By using object of known hardness, such as a penny, a knife, the fingernail, and a steel file, it is possible to estimate the hardness of unknown minerals.

CONCEPT - Crystals are solids with a natural geometric form.

1. Problem

How are crystals formed?

Materials

Table salt, microscope or magnifying glass, microscope slide, shallow dish, test tubes or small jars, medicine dropper.

Procedure

Have the children:

a. Study some salt crystals on a piece of paper.

(1) Look.

(2) Feel.

(3) Describe their findings.

b. Put some salt crystals on a glass slide and observe the crystals under a magnifying glass or a microscope.

(1) What is the shape of a salt grain?

(2) Do they all look alike?

c. Place some grains of salt in a test tube half full of water.

(1) What happened to the grains?

(2) Can you see them when they are dissolved?

(3) Can you tell that there is salt in the water by looking at it?

(4) How can you tell that salt is in the water?

d. Dissolve more salt in the water.

(1) What happens to the height of the liquid in the test-tube?

(2) Why did it rise?

e. Add more salt until no more will dissolve. Why will no more salt dissolve in water?

f. Pour a little of the saturated salt solution on a microscope slide and project the image of the slide, using a filmstrip projector.

g. Notice the formation and growth of the crystals as the image is projected on a screen.

   (1) Where does the growth first appear?

   (2) Why does the growth first appear along the edge?

   (3) Why does the water evaporate so rapidly?

   (4) What is formed on the slide?

   (5) What shape do they have?

   (6) How do they differ from the salt crystals first observed?

   (7) What happened to the water?

Conclusions

As salt solutions evaporate, the particles of that salt form crystals with characteristic geometric shapes. The rate of evaporation affects the size of the crystals. A slow rate of evaporation will result in larger crystals. Crystals are formed in nature by slow evaporation of a liquid that contains dissolved salts. A saturated solution is one that contains all the dissolved substance it can hold.

2. Demonstration

Materials

Table salt, drinking glass, piece of string, pencil.

Procedure

Have the children:

a. Make a glass of salt water.

b. Tie a string on a pencil.

c. Lay the pencil across the glass so that the string dangles in the salt water.

d. Watch the crystals form (Try sugar, alum, or copper sulfate).

e. Use hand lens to observe the sizes and shapes and colors of the crystals.

Conclusions

When conditions are right, the particles which make up a mineral may arrange themselves in patterns that form flat-faced, regularly shaped solids called crystals, which may vary in appearance.

3. Draw

Have the children draw different shaped crystals.

CONCEPT - A rock is any natural material that makes up part of the Earth's crust.

1. Problem

What are igneous rocks?

Materials

Igneous rocks: basalt, obsidian, pumice, granite, and gabbro; magnifying glasses.

Procedure

Have the children:

a. Discuss the meaning of igneous rocks.

b. Examine the rocks carefully - small groups.

c. Discover as much as they can about each rock.

d. Discuss their findings.

(1) Which rocks have minerals large enough to be seen without a magnifying glass.

(2) Which rocks have minerals so small they cannot be seen even with a magnifying glass?

(3) What is unusual about pumice?

(4) What is the reason for all the holes?

(5) Which of the rocks are darker in color?

(6) Which are light in color?

e. Develop a key to identify the five igneous rocks.

Conclusions

Igneous rocks can be grouped into a key, which can be later used to identify these rocks. Very-fine grained rocks cooled rapidly; coarse-grained rocks cooled slowly. Pumice is an extremely light rock, cooled very rapidly. Gases contained within the molten rock as it hardened produced holes.

2. Problem

What are deposited sedimentary rocks?

Materials

Clay, sand, fine gravel, sandstone, conglomerate, shale, water.

Procedure

Have the children:

a. Discuss the meaning of sedimentary rocks.

b. Examine the sample of sandstone, conglomerate, and shale.

c. Discover as much as they can about each sample.

   (1) Look.

   (2) Feel.

   (3) Discuss ideas concerning formation.

d. Mix together one-half cup each of clay, sand, and fine gravel.

e. Put mixture in the quart jar and add two cups of water.

f. Shake the contents and then allow the mixture to settle.

g. Examine the mixture through the glass and compare this mass with the rocks.

   (1) In which are the grains more compacted?

   (2) Why?

   (3) How would the three rocks be classified according to size of grain particles?

Conclusions

Some sedimentary rocks are formed of deposited grains pressed together by subsequent layers and then cemented together. Shale resulted from very fine particles being pressed together; sandstone is the result of cemented sand grains; and conglomerate is formed from various sized particles, some of which may be quite large, then cemented together.

3. Problem

What are precipitated sedimentary rocks?

Materials

Pint jar, water, salt, limestone, chert or gypsum.

Procedure

Have the children:

a. Make a saturated solution of salt, by dissolving as much salt as possible in one-half cup of water.

b. Allow the solution to evaporate for several days.

c. Examine the resulting salt formation.

   (1) Where is the salt found?

   (2) What color is the salt?

   (3) Why were the crystals not visible in the saturated solution?

d. Compare the salt with precipitated rocks like limestone, chert, and gypsum.

   (1) Which is the harder, the salt or the precipitated rock?

   (2) Why is it harder?

Conclusion

Particles in precipitated sedimentary rocks were once dissolved in water and later precipitated out of solution.

4. Problem

What are metamorphic rocks?

Materials

Shale and slate, limestone and marble, sandstone and quartzite, water, medicine dropper, magnifying glass, diluted hydro-chloric acid.

Procedure

Have the children:

a. Observe the display of rocks.

b. Examine the rocks using magnifying glass.

c. List their findings.

d. Discuss the shale and slate.

    (1) What are the characteristics of each?

    (2) Compare the two rocks.

e. Discuss what has been discovered about the rocks.

f. Examine the limestone and the marble.

    (1) What are the characteristics of each?

    (2) Compare the two rocks.

    (3) Test the two rocks with the acid.

g. Examine the sandstone and the quartzite.

    (1) What are the characteristics of each.

    (2) Compare the two rocks.

Conclusions

Metamorphism is a process by which rocks become changed by heat and pressure. This change alters their appearance and makes them harder and more compact. Metamorphic rocks are harder than sedimentary rocks from which they come.

CONCEPT - Soil composition occurs in infinite varieties.

1. Problem

Is the formation of ice one of the physical processes that weather rock?

Materials

Flat-sided glass bottle, cloth wrapping, water, refrigerator.

Procedure

Have a child fill the bottle with water and put the top on securely. Wrap the bottle in a cloth (to prevent the shattered glass from dropping into the refrigerator). Put the bottle in the freezing compartment of the refrigerator. After 24 hours, remove the bottle and examine it.

Results

What can be observed? (The bottle will probably be cracked.) Why is the bottle cracked? (Pressure was exerted upon it.) What caused the pressure? (The force exerted by the ice as it expanded.) Why did the ice exert force? (As water freezes, it expands and takes up more space.)

Guide the children's thinking as they apply their findings to what might happen out-of-doors. As water in a crack of the rock freezes, the rock is split farther apart because the ice takes up more space than the liquid did.

Conclusions

Therefore, water expands when it freezes and may enlarge the cracks in the rocks, and eventually breaking the rocks into smaller pieces. The expanded water as it becomes ice is strictly a physical process, since no chemical change takes place.

2. Problem

Is the variation in temperature one of the physical processes that weathers rock?

Materials

Frying pan, clear glass marbles, cold water, hot plate.

Procedure

Have the children examine the six clear marbles and observe how easily they can see through them. Have the children make certain there are no cracks in the marbles. Now have the children place the marbles in a frying pan and heat the marbles over the hot plate for about five minutes. Allow the marbles to roll into a glass of cold water while they are still hot.

Results

After they have cooled, remove them and have the children examine them once more. How are they different? (They now contain many cracks.) Compare them with the unheated marble. (The unheated marble is still clear.) Why did the heated marbles crack? (The sudden cooling cracked the marbles because of the sudden contraction of the glass. As the glass gets hotter, it expands; as it cools, it contracts.)

Conclusions

Relate this experiment to rocks that expand when heated by the sun and contract when the temperature drops at night. Describe how the sudden temperature change, especially noted in deserts, produces a cracking of the rocks. This is called weathering.

3. Problem

Does loamy soil contain large amounts of water?

Materials

Spring balance, tin can, several one quart pans with covers, hot plate, samples of different garden soils.

Procedure

Have the children number the samples and examine each sample carefully. You may want to write the following questions on the blackboard to direct the children's examinations. Do the samples show differences in color? Do they feel the same? How else do the samples differ? After the children have made their observations have them weigh and record the weights of each sample. The children must be cautioned to be accurate in their weighing measurements. To obtain the weight of the soil, the weight of the empty container must be subtracted from the weight of the soil and the container. After each sample has been weighed, have the children place each soil sample in a pan and keep in an oven at 350° F for an hour. If no oven is available, they can improvise by placing the soil in a large loosely covered ceramic bowl, and allow the soil to heat for several hours. How do you know that water escapes form the soil during this heating? (The soil looks and feels dry after heating. Since the water boils at 212°F. and the oven was set at 350°F., the water in the soil must have boiled away.)

Results

Have the children remove the dried soil sample, weigh the sample as before, and record the weight. Was there a loss in the amount of moisture in the sample? (Yes) How much of a loss? (It will vary with each sample.) Have the children record their findings by making a graph, showing the percentage of moisture in the various samples. The percentage of moisture is equal to the weight loss divided by the weight before drying. What might make the difference in water content in the various samples? (Soil found near a surface or underground supply of water, soil that has been recently irrigated, and soil taken from a protected, shaded area that allows minimum evaporation will all have large water contents.)

Conclusions

Loamy garden soil can hold considerable water.

4. Problem

Does loamy soil contain a detectable amount of humus?

Materials

Propane burner, porcelain container or crucible, garden soil, spring balance, or tray balance scale.

Procedure

Number and dry the samples, as in previous activity, or use the same dry samples that were prepared in the previous activity. Have the children weigh the empty crucible or procelain container. Then have them to place a dry sample in the container. Weigh the dry soil in the container. Subtract the weight of the empty container from the weight of the container and soil. This gives the weight of the dry soil alone. It is important to get accurate readings and keep accurate records on all problems involving measurements. Apply heat to the samples for at least fifteen minutes.

Results

Is there any change in the soil? (Some particles may flame, some may smolder and give off smoke, and there may be a change to gray coloration.) Allow the container to cool. Have the children weigh and record the weight of each soil sample. Was there a loss of weight for each soil sample? (Yes) How much? (It varied with each sample.) Why was there a weight loss? (Humus is made up of decomposed organic matter. Organic matter contains carbon, which will burn if strongly heated and gives off gas as an end product. As the humus burns, the weight of the soil decreases.) Why are there differences in the humus content in the various samples? (Humus content varies, depending on closeness to trees, shrubs, and other plants, on the application of fertilizers, and on the amount of animal life near the location.) Have the children make a graph similar to the one made in the last activity for percentage of water content, to show the percentage of humus in each soil sample.

Conclusion

Loamy garden soil contains a measurable amount of humus. Humus is composed of decayed organic matter from living things. Organic matter burns when strongly heated.

5. Problem

Does loamy soil contain particles of sand?

Materials

Heated soil from previous problem, sand, sandpaper, magnifying glass, microscope, samples of loamy soil, wire screen.

Procedure

Have the children examine the samples of sand. (Some of the best sand for this activity is washed aquarium sand. It is made of larger particles and is easily procured in pet shops.) Point out that sand is made of small rock particles varying in size from 1/12 inch to 1/400 inch and that sand may be made of different minerals. Questions such as the following may be helpful as they examine their samples: Are sand grains the same shape? (No, they have many shapes.) Are the grains the same size? (No, they vary in size.) Have the children sift the sand grains through a fine wire screen. What does this tell about the size of the grains? (Those that pass through are smaller than the size of the openings.) What colors are observed among the sand grains? (White, black, and red among other colors.) Why are the sand grains of different colors? (Because of different minerals found in sand) Have a child pour about one tablespoonful of sand into a glass of water. What happens to the grains? (They sink to the bottom.) Is sand more dense or less dense than water? (More dense)

Discuss with the children that sand may have some properties related to the way light passes through it. These are called optical properties. Matter is said to be transparent, translucent, or opaque. Point out that a transparent object is one through which light passes easily and which can be seen though. (Clear glass window is an example.) A translucent object is one through which light passes, but which one cannot see through. (Frosted glass is an example.) An opaque object is one through which light does not pass and which cannot be seen through. (Iron is an example.) Have a child place some sand grains on a printed page and examine the grains with a magnifying glass. What optical properties do they show? (Many are translucent, most are opaque, some may be transparent.)

Develop the idea that some minerals have magnetic properties, or characteristics. For example, some iron ores are attracted to a magnet just as an iron nail is attracted. Place a strong magnet on some sand particles and determine the number of particles out of a given sample of particles that are magnetic. Examine with a magnifying glass some of the particles found on sandpaper. How do these grains differ from the grains of sand from another source? (The grains on sandpaper are probably much more uniform in size and color.) How is this explained? (Sandpaper is prepared by gluing only a certain size and kind of sand particles to a paper backing.) Examine some loamy soil and some samples of heated soil from the previous activity, with a magnifying glass or microscope.

Results

What size, shape, and color do the particles have? Do they have any magnetic properties? Discuss with the children what they think made the differences in sand particles.

Conclusions

Loamy garden soil has sand particles in it that may exhibit various physical properties, such as optical and magnetic properties.

6. Problem

Does the depth of loamy soil vary from area to area?

Materials

Various areas of loamy soil, shovel.

Procedure

Take the children to an area where they can examine the soil. Carefully dig up some of the soil. Lay it on a sheet of newspaper spread on the ground. You may want the children to work in small groups, each group examining a shovelful of soil. Ask the children what they think contributes to the humus in the soil in the location. Is there any evidence to support their hypothesis? (They should look for evidence of leaves, roots from grass plants, or perhaps insect bodies.)

Let the children find the depth of the surface soil by digging to the point where the dark humus soil ends and another soil type begins. The underlying soil type can be identified by color and texture (size, compactness, and composition of particles).

Results

Why would the soil have a greater depth of loam in a forest than in the region of a sand dune? (The forest area accumulates the leaves and other organic matter at a faster rate than the area near the sand dune.)

Go to other areas available for examination. Examine the soil in a prairie area. What does the prairie contribute to the richness of the soil? (Decayed grass and roots.) How deep is the prairie soil? Perhaps the children might also examine the soil of the marshland. The class may wish to prepare a chart showing the various areas, such as garden soil, prairie soil, forest soil, and marshland.

Conclusions

Loamy soil varies in depth in different areas. The amount of organic material applied to the area will influence the depth of loam.

7. Problem

What is a soil horizon?

Materials

Tall cylindrical jar, shovel.

Procedure

Have the children dig a hole into some garden soil. As they dig downward, do they notice a change in the soil? (They should.) In what ways does the soil change? (There is less humus. There is also more clay in some cases.) Develop the idea that mature or well-developed solids have typical profiles or sequences of layers. Children may know that all soils have the same types of layering, but there is considerable variation within the layers.

Conclusions

Explain that each layer, or "horizon" as it is called, is designated by a letter A, B, C. The "A" horizon is the topsoil and is usually rich in humus and organic material. The "B" horizon, or subsoil, is beneath the "A" horizon and frequently contains clay and iron materials. It is less rich in organic materials and humus. The bottom part of the "B" horizon may be quite hard and compact because of the accumulation of clay. The "C" horizon lies just above the hard rock and just below the "B" horizon. It consists of weathered rock particles. With the samples that the children have collected, they can make their own miniature soil profiles. Have them place the different soils into the tall cylindrical jar with the "C" horizon on the bottom and with the upper part of the "A" horizon on the top. Adhesive tape or small gummed labels can be used to identify the horizons on the jar. Have the children observe the profile for any differences in the soil. Are there any color changes? Does the texture change? To illustrate that soils differ in different locations, have the children observe soil profiles in different areas. Have them compare colors. (Some soils may be quite red and others black or gray.) Is the depth of each horizon the same? (No, some soils may have almost no "A" horizon and a very long "B" horizon. Others may have a greater "A" horizon.)

8. Problem

What are the comparable rates of permeability of sandy, loamy, and clay soils?

Materials

Samples of sandy, loamy, and clay soils; three glass chimneys; fine mesh wire; measuring cup; string; water.

Procedure

Discuss with the children that soils differ in the degree to which they will allow water to move through them. Mention that this characteristic of allowing water to pass through is called permeability; it refers to the rate at which a liquid will pass through a substance. Have the children set up the problem as follows: Attach a fine wire-mesh screen to the bottom of each glass chimney. Fill one chimney half full with sand, another half full with loam, and the third half full with clay. Pour one-half cup of water into each. Have the children observe what happens, using a stop watch to determine the time it takes the water to permeate the samples. They should keep a record for each sample.

Conclusions

Which sample did the water pass through first? (Probably the sand, then the loam, and last, the clay.) Why did the sand have the greatest permeability? (The grains did not hold back or absorb the water particles.) Which type of soil will have the least "holding effect" on rain water -- sandy, loamy, or clay soil? (Sandy soil, because water permeates the sand faster than the loam or clay.) Why is forest soil generally moist? (It has a greater amount of humus, which tends to hold moisture.)

9. Problem

Are clay particles larger than sand particles?

Materials

Microscope or magnifying glass; fine wire-meshed strainer or hobby shop ceramic strainer; clay samples; sand grains.

Procedure

Give each child some sand and a sample of dry clay. Have each child rub some particles from the dry clay and compare the size of clay particles with the size of the sand particles. Which are smaller? (Clay particles are much smaller.) Have the children compare the ease with which clay particles and sand particles pass through a fine wire mesh strainer. Have the children examine the particles of clay and sand under a microscope or magnifying glass to compare their relative size and shape.

Conclusions

Do the clay particles vary? (Yes, both in shape and size.) Slowly add some water to the clay sample and observe the results. (The clay takes up the water and becomes gummy and compact.) What happens when water is added to the sand sample? Is there a difference in behavior between the two samples? (Yes, the water passes right through the sand, and the grains still remain separated.) Which would be better for growing plants, sand or clay? (Sand, because clay would form a hard compact mass through which the roots could not penetrate.)

10. Problem

Does soil vary in degree of acidity or alkalinity?

Materials

Red and blue litmus paper or Hydrion paper, water, six different soil samples, seven test tubes, medicine dropper, filter paper, funnel.

Procedure

Review with the children what they have learned: that besides differing in the sizes of their particles, soils differ in many other respects, including color, composition and texture. An additional way in which soils differ is called pH, a term indicating the amount of acidity or alkalinity of a liquid. Acid substances such as vinegar and lemon juice have low pH. Alkaline, or basic substances such as ammonia or baking soda have a high pH. Discuss with children that pH can be determined by using an indicator such as litmus paper. Blue litmus paper, for example, turns red in the presence of an acid; red litmus paper turns blue in the presence of a base. Another pH indicator is Hydrion paper, which has an indicating range of 1 to 11. A pH value of 7 indicates that the sample is neutral, that is, neither acidic nor alkaline. A value lower than 7 indicates an alkaline or basic condition. A color chart accompanying the paper indicates the pH through color comparisons.

Select soil samples from various locations and place the samples in labeled test tubes - one level teaspoonful of soil in each test tube. Add three medicine droppers of water to each test tube. Shake and allow each to mix instead of allowing it to settle. If a filter paper is used, the test is made on the liquid that filters through the paper and not on the material remaining on the filter paper. Test the clear water with blue and red litmus paper or Hydrion paper.

Conclusion

Several children may want to prepare a chart to show the conditions of the soil samples as acid, basic, or neutral. Some children may ask why some soils differ in the characteristic of acidity. (Underlying rocks may make a difference. Fertilizers and decompositions of organic matter may also alter the pH condition.)

11. Problem

Can the acidity of soil be artificially controlled?

Materials

Acid soil samples, test tubes, water, powdered limestone, litmus or Hydrion paper.

Procedure

Discuss with the children the importance of changing the acidity of some soils. Some plants will grow better in a more basic soil. For this reason it may be desirable to change the pH of the soil. Suggest that it is possible to bring about such a change. Have each of several groups of children select a sample of an acid soil. Have them place this sample in a test tube, and add several medicine droppers of water and shake. (Water must be added, for indicators do not react in a dry state.) Allow the soil to settle or filter the mixture through a filter paper. Then test the liquid with blue litmus paper or Hydrion paper. If the blue litmus paper turns red, the soil is an acid soil. If the color of Hydrion paper is of the range lower than pH 7, the soil is an acid soil. Have the children secure some powdered limestone or crush some limestone with a hammer, being careful of flying chips. Have them place one teaspoonful of powdered limestone in a test tube, add two medicine droppers of water and shake. Let the mixture settle and test the liquid with red litmus paper or Hydrion paper. What does the test indicate? (A base, or alkaline condition.)

Conclusions

Have the children collect about one teaspoon of water from the acid soil mixture. Add to it some limestone water, one drop at a time, testing the solution with blue litmus paper or Hydrion paper after each drop is added, until the acid condition changes. Record the number of drops it takes to produce a change for each of the soil samples. Why does it take more drops to produce a change in certain soil samples? (The soil is more acid.) How do you know when the acid condition changes? (The color of the indicator - the litmus paper or the Hydrion paper changes.) Why do farmers add powdered limestone to their soils? (To change the soils from acid to basic condition.) Why do they want the soils to change from an acid condition? (Certain crops grow better in a non-acid soil.)

12. Problem

Do many kinds of animal life exist in the soil?

Materials

Soil sample, magnifying glass, alcohol or Formalin solution, preserving bottles.

Procedure

Discuss with the children that besides being acidic or alkaline, the soil may have animal life of various kinds in it. Explain that the kind and amount of plant and animal life in soils varies in different soils. The important thing is that this life is often a factor that can change the make-up of soil.

Have the children examine the surface of a square yard of soil. Note any earthworm mounds, anthills, or other signs of animal activities. Carefully remove the surface plant life and examine the soil for further signs of animal life. You may want to preserve in an alcohol solution the forms of animal life found at the different depth (on or beneath the surface). Snails, slugs, and earthworms can be preserved in a 6% - 8% Formalin solution. Insects, spiders, and other jointed-leg animals can be preserved in an 85% alcohol solution. Present the question to the children: How do earthworms enable more air to enter the soil? How do they turn over the soil? Does their eating of soil particles change the composition of the soil? Do their droppings and dead bodies change the composition of the soil? To get an idea of the great amount of soil earthworms bring up to the surface, the class can weigh the amount of soil found in an earthworm mound or the mound of a raised anthill. They should count the number of such mounds in a square yard and then try to estimate the weight of soil turned over in an acre.

Conclusions

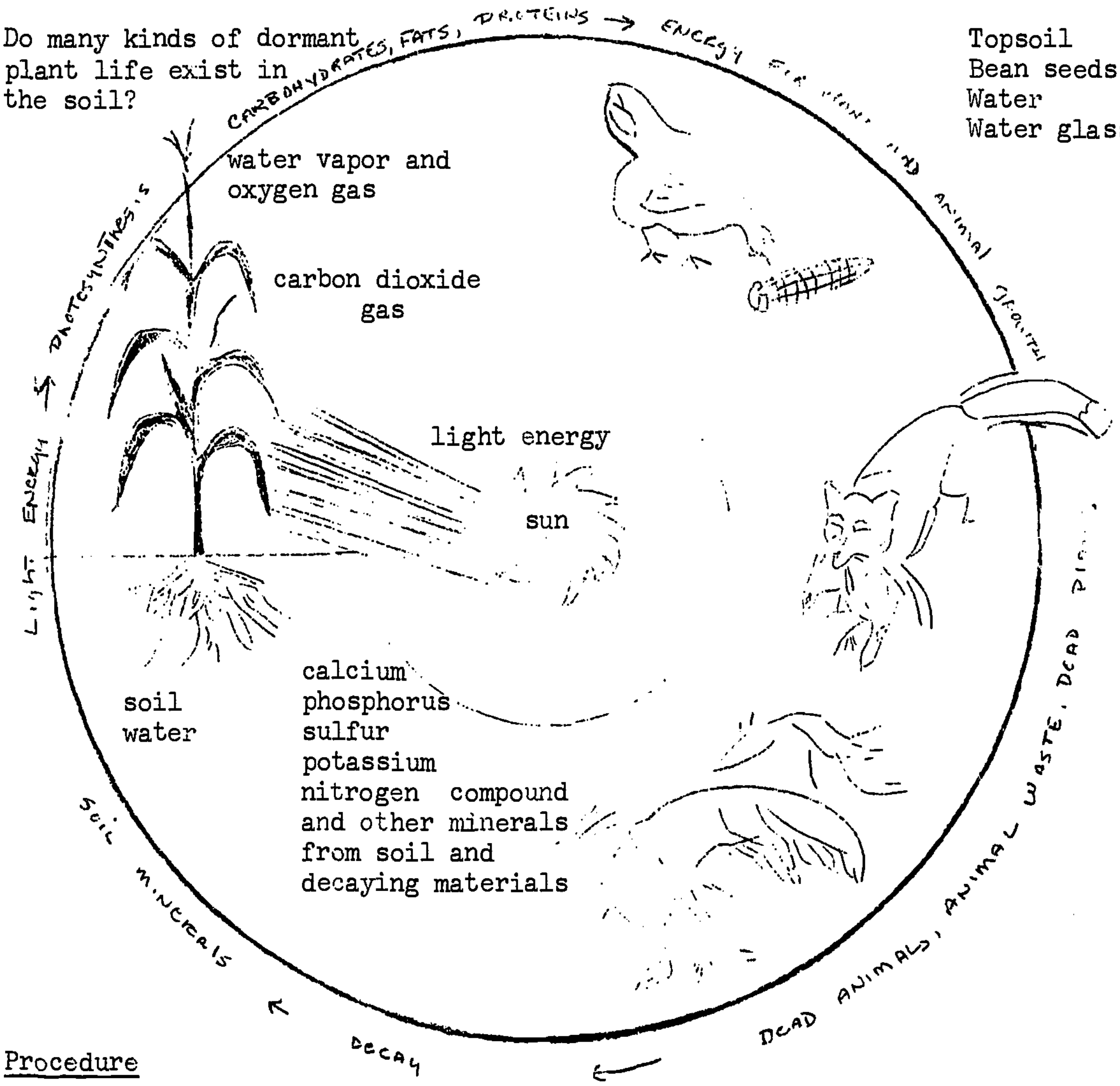
Many kinds of animals live in the soil. Their activities change the texture and composition of the soil. Earthworms, for example, are important in keeping the soil texture loose and in adding a certain amount of organic material to the soil.

13. Problem

Do many kinds of dormant plant life exist in the soil?

Materials

Topsoil
Bean seeds
Water
Water glass



Procedure

Discuss with the children that animal life is not the only type of life that can be found in soils. Suggest that they investigate the soil for the presence of any plant life. Have members of the class take samples of topsoil during the dormant winter period. They should provide the samples with moisture, warmth (room temperature), sunlight, and observe the kind and amount of plant growth that appears.

Conclusions

Why did this growth not take place before? (Favorable conditions for growth were not present.) What factors were probably the most important? (Moisture and temperature) Have the children soak the bean seeds in water for 24 hours and then place the bean seeds in a glass filled with soil, so that the seeds are visible. What is the growth that often forms around the seed? (It is fungus, which is mold.) What is the source of the fungus? (Spores dormant in soil.)

Soils contain much plant life that does not appear until the conditions are favorable for its growth.

CONCEPT - The varieties of soil affect plant and animal life.

1. Problem

Does the amount of compaction vary in different types of soil?

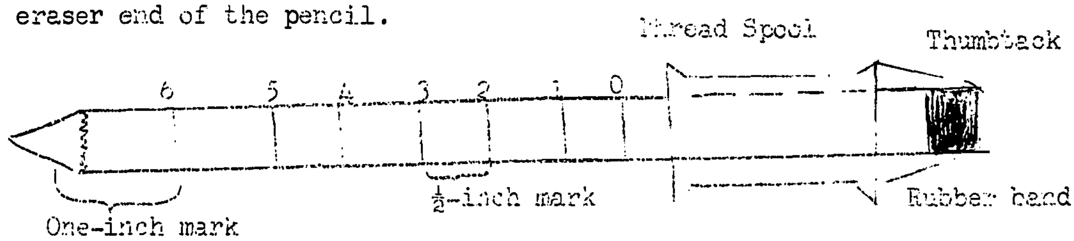
Materials

Empty thread spool, thumbtacks, pencil, rubber band.

Procedure

Soil compaction is a term used to describe the degree to which the soil is packed down. Whether there is an ideal amount of soil compaction for best plant growth is not known. The amount of soil compaction for maximum plant growth depends on many factors --- type of plant being grown, the amount of moisture available, the depth of planted seeds, and the type of weeds growing nearby.

Have the children mark equal spaces on a pencil (or length of doweling) with a point sharpened at one end. Put an empty thread spool over the eraser end of the pencil.

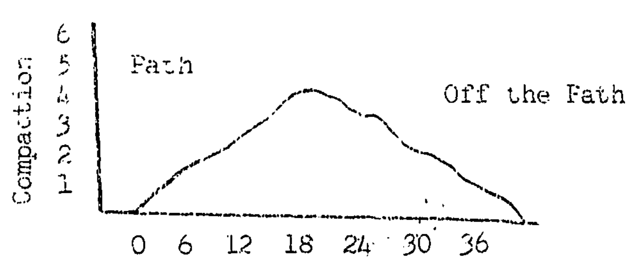


Holding on to the spool (which is attached to the pencil as in the above picture) push the pencil point into a field about two feet from a dirt road or path. Record the effort required to push the gauge to the one-inch mark (near the point of the pencil,) by noting how many spaces the spool moves down the pencil.

Conclusion

The rubber band will stretch proportionally to the amount of compaction of the soil. The lower the number on the pencil (Ex: 1 or 2) the less the compaction of the soil. The higher the number on the pencil (Ex: 5 or 6) the greater the compaction of the soil. Repeat the process at six-inch intervals until the soil on the other side of the path is reached. Record the results, using a graph.

Example:



2. Problem

Does the rate of water intake determine the amount of water that runs off?

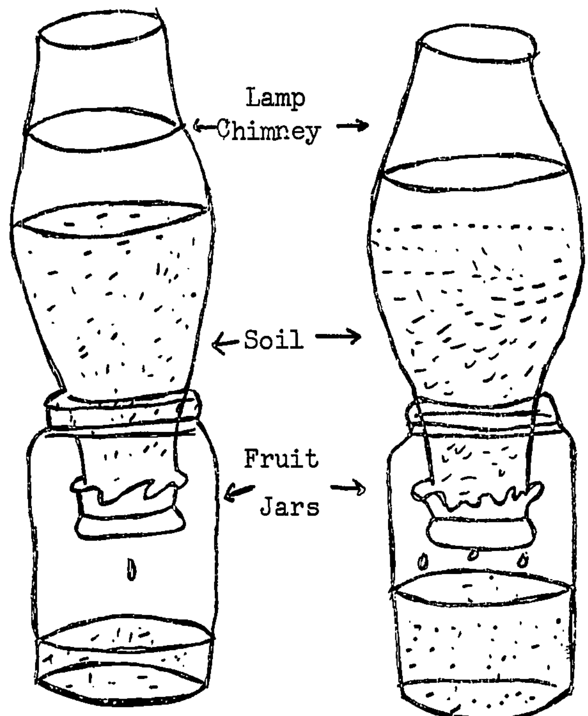
Materials

Four chimney lamps or transparent cylinders, four pieces of cotton cloth (approximately 10" square), soil material (sand, silt, clay, humus), and water.

Procedure

Tie a cloth over one end of each of the four transparent cylinders such as chimney lamps (one-quart milk cartons may be substituted). Fill each 3/4 full with a different dry soil material (sand, silt, clay, humus). Use peat moss if humus is not available. Gently pack the soil as you fill the columns. Add water to one column. Measure the distance the water penetrates every fifteen seconds. Plot the distance and time on a graph. Repeat the above procedure for each soil material. Plot the data for other types of soil.

Compare the rates of water intake. Be sure to do this experiment in one day so moisture in the air will not be a factor.



Materials

Two quart jars, humus soil, cultivated or fully exposed soil, container for measurement.

Procedure

Fill a quart jar with woodland top soil rich in humus. Fill another quart jar with ordinary cultivated or fully exposed soil. Slowly fill both jars to the brim with water, measuring the amount poured into each jar. Which kind of soil absorbed the higher percentage of water?

Materials

Six large fruit or vegetable tin cans, board approximately 4" x 1" x 12", watch with second hand, hammer, 12-inch ruler, pencil and paper, quart measure, two gallons of water.

Procedure

Cut the bottom from one end of the can just below the rim. This leaves a sharp edge that will drive into the ground easily. Cut out the other end, leaving the rim for added strength.

Try to locate places of varying ground cover and soil type. Mark the outside of each can 2" from the end without the rim. In each of the spots you have selected, set a can so that each end closest to the 2" mark is on the ground. Place a board on each can and tap with a hammer until the 2" mark is level with the ground. Do not disturb the plant material or soil in the can. Add one quart of water and then complete the following record:

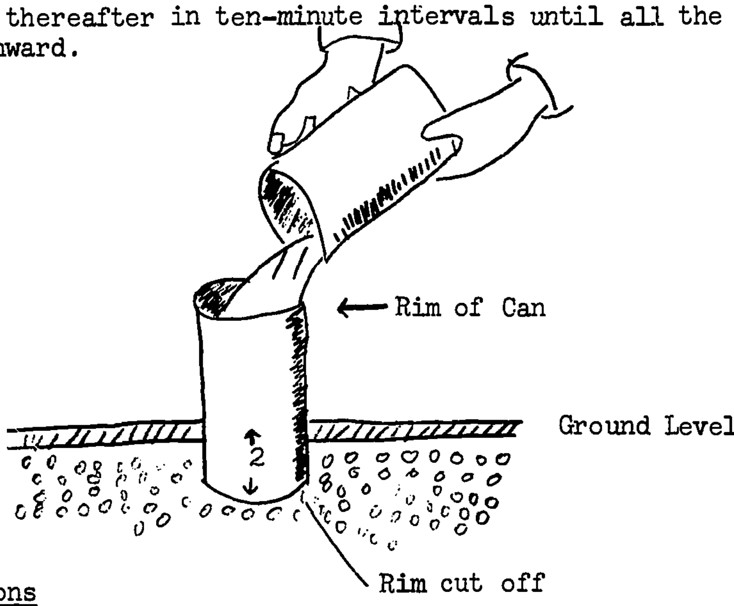
(1) Place -- identify it as grazed, or ungrazed, burned, cultivated, etc.

(2) Condition of the soil.

(3) Presence of leaves and sticks.

(4) Time the water was added.

(5) Measure the water that has moved downward at the end of ten minutes and thereafter in ten-minute intervals until all the water has moved downward.



Conclusions

The more water that the soil absorbs, the less there is to run off. There are other advantages to soils that take in water readily. Much of the rain that falls during heavy rainfall soaks into the soil and is stored for use later on. Plants need air in the soil for the best root development and growth. Water movements in the soil brings better air circulation. When water enters the soil, air moves out and is replaced by fresher air as soon as the soil pores are again free of water. The way soil has been managed has a lot to do with how fast it takes in water. Farmers who grow grasses and legumes (e.g. bean, pea, peanut, and clover) in crop rotations, help their soil to take in more water and thus prevent much erosion.

3. Problem

What are the retention rates of ground water in various soils?

Materials

Vegtable can, balance or spring scale, aluminum foil oven, Bunsen burner, soil.

Procedure

Obtain the weight of a soil sample subtracting the weight of an empty metal can from the weight of the same can containing soil sample. Record these in the table like the one following. Heat the can in an oven at a temperature of 225° to 250° F. until the soil is dry. (To make a simple oven for classroom purposes, fold aluminum foil into a rectangular prism (box shaped). Place the can containing the soil in the "oven" and heat the oven with a Bunsen burner.)

Calculations:

a. Calculate the weight of the dry soil in the can.

b. Calculate the weight of dried soil from the original weight of the soil.

c. Calculate and record the percentage of water in the soil.

Example:

Water In Soil

Soil Type	School Grounds
a. Weight of empty can	88 gm
b. Weight of soil and can	385 gm
c. Weight of soil	297 gm
d. Weight of dry soil and can	325 gm
e. Weight of dry soil	237 gm
f. Weight of water	60 gm
g. Per cent of water	20 %

Formula for calculations: To calculate percentage of water, divide the weight of the water by the weight of the soil and multiply by 100.

$$\frac{F}{C} \times 100 = \%$$

Conclusion

Measuring retention rates of ground water in various soils helps to understand soil characteristics.

4. Problem

Can soil be made from rock material?

Materials

Limestone, sandstone, building bricks, concrete.

Procedure

Rub two pieces of limestone or fine sandstone together. Pieces of building bricks or concrete can also be used. Notice how long it takes to rub off even a few fine particles.

Materials

Limestone, pan of ice water, hot plate.

Procedure

Heat a small piece of limestone over a hot plate. Dip it quickly into a pan of ice water. The rock should break as it contracts rapidly after its expansion by heating.

Materials

Limestone, vinegar, hot plate.

Procedure

Put some small pieces of limestone in a little vinegar. Heat the vinegar on a hot plate and notice how bubbles form on pieces of stone. These bubbles are carbon dioxide gas made from carbon and oxygen released from the limestone by a chemical change in the rock. This is one way in which rocks are broken down into soil.

Conclusions

The various forces of nature can break down rocks into soil material.

5. Problem

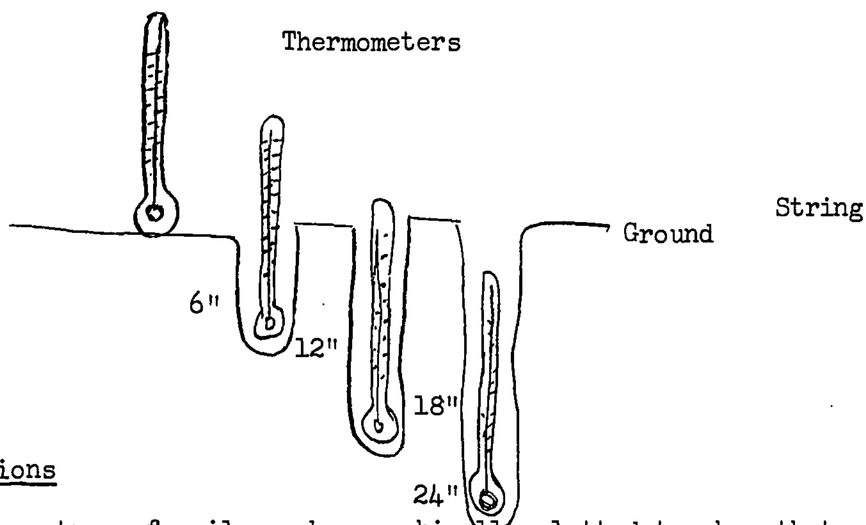
Does the temperature of soil vary with depth?

Materials

Metal rod, hammer (or dowel), ruler, thermometer.

Procedure

Use a thin metal rod and a hammer or a dowel to make holes in the ground six, twelve, and eighteen inches deep. Measure the temperature at the top of the soil and at these depths. Plot the temperature and depth data on a graph. Repeat the measurement at differnet times of the day under different weather conditions. Does soil conduct heat well?



Conclusions

The temperature of soil can be graphically plotted to show that temperature varies with depth.

6. Problem

Do living organisms have a marked effect on the characteristics of the soil?

Materials

Three large heavy shopping bags, ruler, spade, six or more small bottles with lids or corks, magnifying glass, one ¼" screen material, sheet of white paper.

Procedure

Measure off an area one foot square and collect soil to depth of 2" to 3" in different areas. Examine the samples on sheets of white paper (¼" screening material might prove helpful in filtering the soil samples.) Put the organisms of the similar types in the jars. Suggest questions: Which soil type has the most life? Is this related to water intake? Is it related to looseness of soil (43,560 sq. ft. in an acre -- calculate animal life on one acre).

Conclusion

The soil is the home of innumerable kinds of plant and animal life.

7. Problem

Does water erosion make for loss of valuable soil?

Materials

Three tall narrow bottles.

Procedure

After a rain, fill the bottles with water from small streams. One might be a stream flowing through a woodland, another through a planted area. Allow all three to settle for a few days making observations each day. Which sample held the most soil?

Materials

Two large pie or cake pans, topsoil, water.

Procedure

Build two separate mounds of topsoil. With a twig, make furrows running up and down the hill and on the other make furrows going around the hill (contours). Sprinkle lightly the same amount of water on each mound. Check the amount of soil that is washed from each mound and the amount of water that runs off.

Materials

Two large pie or cake pans, topsoil, straw (or grass), water.

Procedure

Build two separate mounds of topsoil. Be sure both mounds of topsoil are smooth. On one mound, place straw or grass, and leave the other bare. Sprinkle water lightly on each slope and note which one loses the most soil and water.

Conclusion

Contour plowing and ground cover or mulch help reduce the loss of topsoil.

8. Problem

How does varying soil composition affect plant growth?

Materials

Three flower pots (styrofoam cups), top soil, subsoil, seeds (bean), water.

Procedure

Fill one flower pot with topsoil, another with shallow subsoil (taken directly below where the topsoil was obtained), and the third with deeper subsoil (obtained from the same place). From the same packet, plant a few seeds in each of the flower pots, being sure each pot gets the same conditions of light and water. Observe the rate of growth and general appearance. Students can draw conclusions and write reports on the activity.

Materials

Five flower pots (styrofoam cups), soil, bean seeds, water.

Procedure

Plant five beans in five different pots of varying soil. Water the seeds and place them in the sunlight. Keep record of plant growth and development. Students will draw conclusions and write reports on the activity.

Conclusions

Plants take all their mineral nutrients from the soil. The minerals found in the soil, except those added in the form of fertilizer, depend mainly on what was in the rock from which the soil came. In general, soils that are above average in organic matter are more productive than soils low in organic matter.

9. Problem

How is water in the soil used by plants?

Materials

Lump of sugar, ink, dish.

Procedure

Put a lump of sugar in a dish which has a little ink in the bottom. The ink will rise in the sugar at once. In the same manner water and the mineral solution move through soil to furnish plants with the moisture they need. This is known as capillary water.

Materials

Celery, food coloring, water, drinking glass.

Procedure

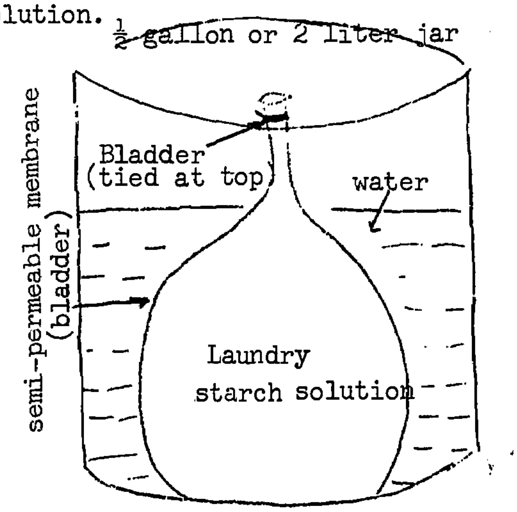
To show how water moves upward into plant roots, place dark food coloring in a glass of water. Put a small plant in the solution and see how the plant is colored as it takes up the water. Celery is a good plant for this experiment.

Materials

A one half gallon jar (or two-liter beaker), iodine, starch, water, semi-permeable membrane.

Procedure

Fill a large jar ($\frac{1}{2}$ gallon or 2-liter beaker) with water. Test the water for the presence of starch. To do this, one may add 3 to 5 drops of iodine. If starch is present, the water will turn blue. The water will not discolor if no starch is present. Into this jar of water, place a semi-permeable membrane (bladder) filled with a boiled laundry starch solution.



Allow this membrane and solution to stand in the jar filled with water for two or three days. Now test the water for the presence of starch. (Showing absorption)

Conclusion

Moisture moves through soil in all directions, even against gravity. This movement is caused by the attraction water molecules have for each other as well as the attraction between water molecules and soil molecules.

CONCEPT - There are many forces that cause the surface of the earth to change.

1. Problem

How does the formation of mountains change the surface of the earth? (Folding action)

Demonstration

Spread several Turkish towels or rags on a table or desk. These towels represent the rock layers in the earth. With a hand at either end of the towels gently push toward the center. The children will see that folds appear and the distance between the points of pressure will shorten. This will help show that pressure on the earth's surface bends the rock layers often forming mountains and thus changing the surface of the earth.

Demonstration

Using a piece of plastic about three feet long, spread the plastic on a table or desk. Explain to the children that the plastic represents the layers of rock in the earth's surface. Placing one hand at either end of the plastic, gently apply pressure toward the center of the sheet. The plastic will begin to bend in the shape of an arch, which represents the mountain. Explain to the children that although this phenomenon can be demonstrated in the classroom in a matter of minutes the actual process of forming a mountain takes millions of years and tremendous amounts of pressure.

Demonstration

To demonstrate how mountains are formed by folding, have children put eight or ten sheets of heavy blotting paper one upon the other. Explain that each sheet may represent a layer of rock. Have the children lay the blotting paper flat on the desk and push at the sides of the pile. Have the children watch the folds appear, and imagine that the folds are mountains. This activity may be done with towels as well.

Demonstration

Spread soft clay on a flat surface -- making the clay about two inches thick. By putting pressure on the clay and pushing toward the center of the clay, the children will see the process of folding taking place. This is a demonstration that each child can do at his or her desk.

2. Problem

How does the formation of mountains change the surface of the earth? (Faulting action)

Demonstration

Spread some clay on a flat surface -- have the clay fairly dry so that it will crack. Gently push the clay up on one side making an upfold or anticline. As the pressure increases a break will occur in the upfold and will be pushed over the nearby surface. As the pressure continues the rising mass will be pushed far over the nearby surface forming a gentle slope on one side and a steep incline on the other.

Demonstration

Using two pieces of thick cardboard or pieces of slate, lay them side by side so that they are very close and look like one piece. Apply pressure to one piece keeping the other stationary. A crack will appear and one piece will slide over the other demonstrating the formation of a mountain by faulting.

Demonstration

If there are any mountains nearby that you know were produced by faulting, take the children to see the actual thing. They will be able to observe the gentle slope on one side and the sharp incline on the other. This should not be done until one of the above mentioned demonstrations has been done.

Demonstration

To demonstrate faulting and to feel how two surfaces moving in opposite directions pull on each other,have the children put the palms and fingers of their hands as tightly together as possible. Still pressing them tightly together, tell the children to push one hand over the other. Ask the children whether they feel the skin pull a little and whether they feel any extra warmth. Explain that this is similar to the slipping along a fault line.

3. Problem

How does volcanic action change the earth's surface?

Research

Have the children read material on volcanoes, how they begin, erupt, and build up a cone. After reading and collecting pictures of volcanoes, both dormant and alive, have them draw diagrams of the above mentioned process and write short compositions that will later be put in a scrapbook.

Model

Make a skeleton of a volcano from chicken wire, leaving it open on one side. Cover this frame with papier-mâché or plaster of paris. On the side that is hollow put in the cone and other insides of a volcano. Put this on a table where all the children can see it along with material explaining how a volcano begins, erupts, and builds up to a mountain over the ages.

Research

To help the children further their understanding of volcanic mountains do the following activity. Divide the class into groups; have each group read about one of the famous volcanoes. Volcanoes to be studied might include: Mt. Etna, Vesuvius, Paricutin, Kelauea, Stromboli, Mauna Loa, Krakatao and Mt. Pelee. Each group should write a report to be given orally. Have the children locate the mountains studied on a map or globe.

Bulletin Board

Have the children collect pictures of volcanoes from newspapers, magazines and postcards. Pictures can be used to prepare a bulletin board display or scrapbook. Label the pictures according to location of volcanoes and type of cones.

Chart, Maps, or Graphs

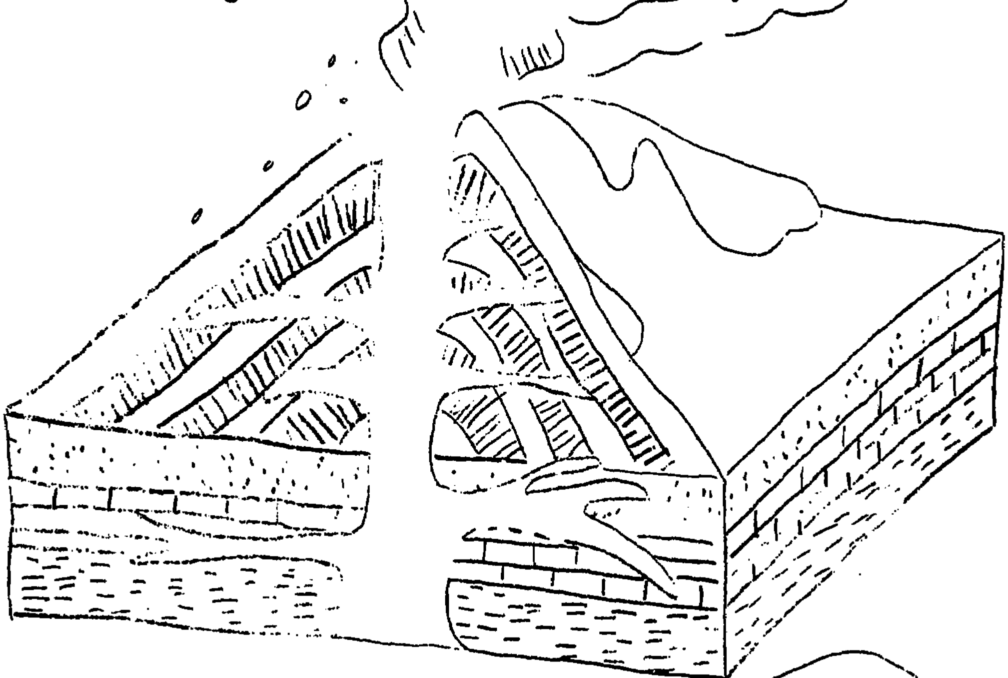
Have the children find out which islands have been formed by volcanoes. Volcanoes and volcanic islands should be located by children on maps and globes. Have the children make a large map of the world and draw in volcanoes and volcanic islands where they are located.

Draw

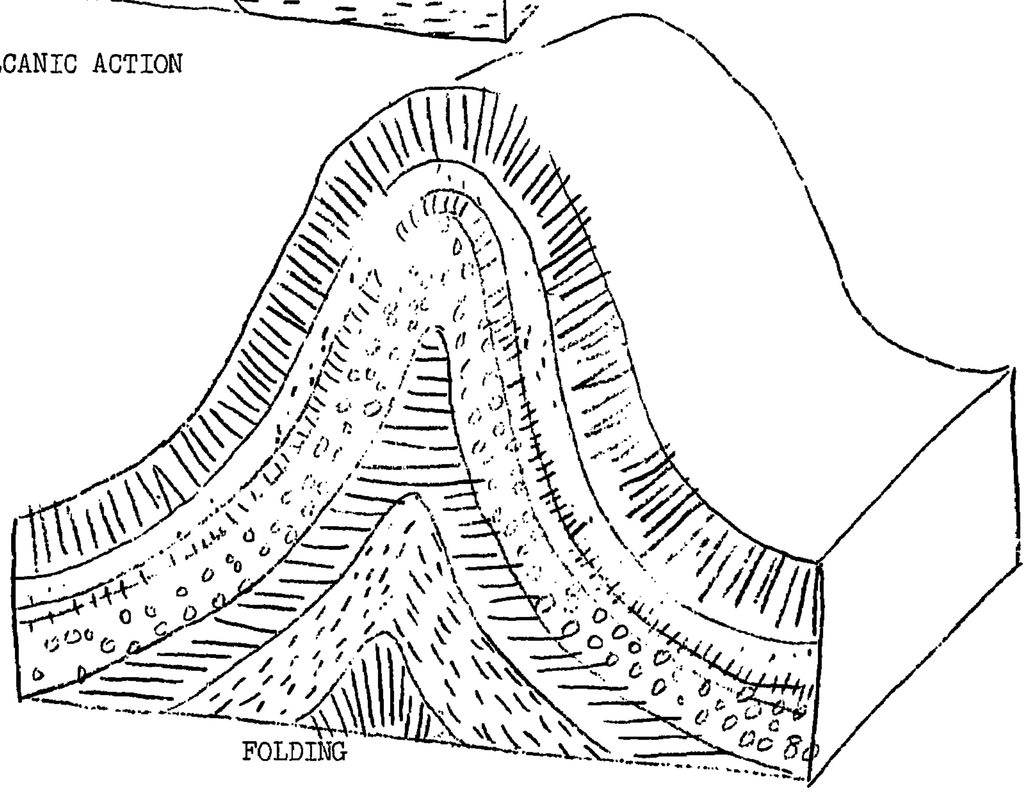
To help the children understand the difference between a lava cone and a cinder cone, show a cross-section diagram of each to the class, and have the children note the difference between them.

Discussion

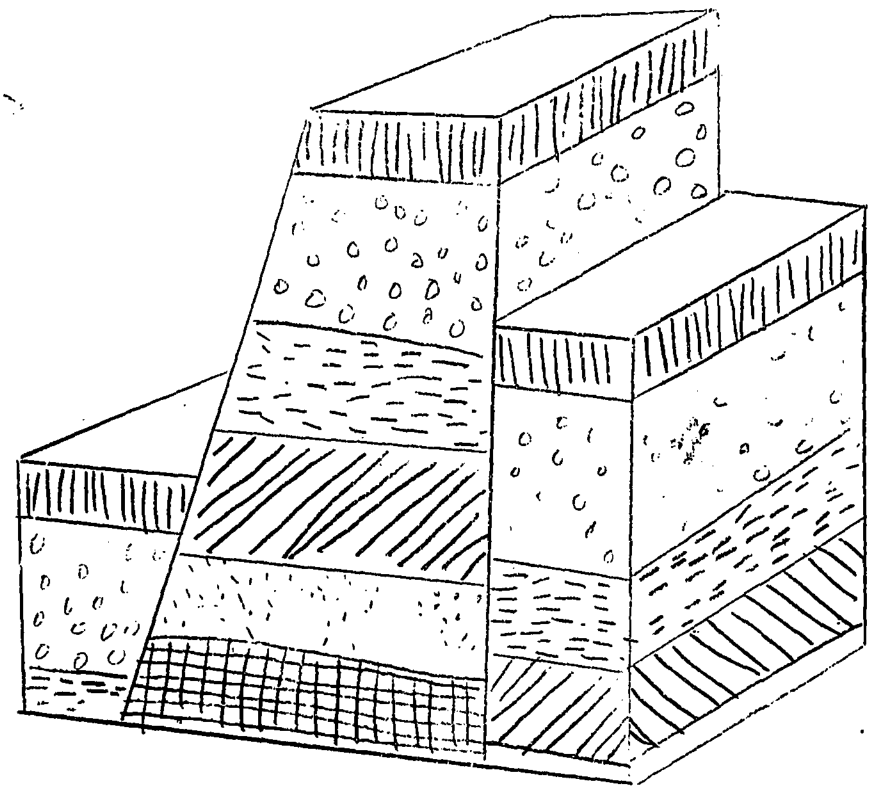
Have the children discuss the ways in which volcanoes give us greater knowledge about the earth even though they are destructive in many ways.



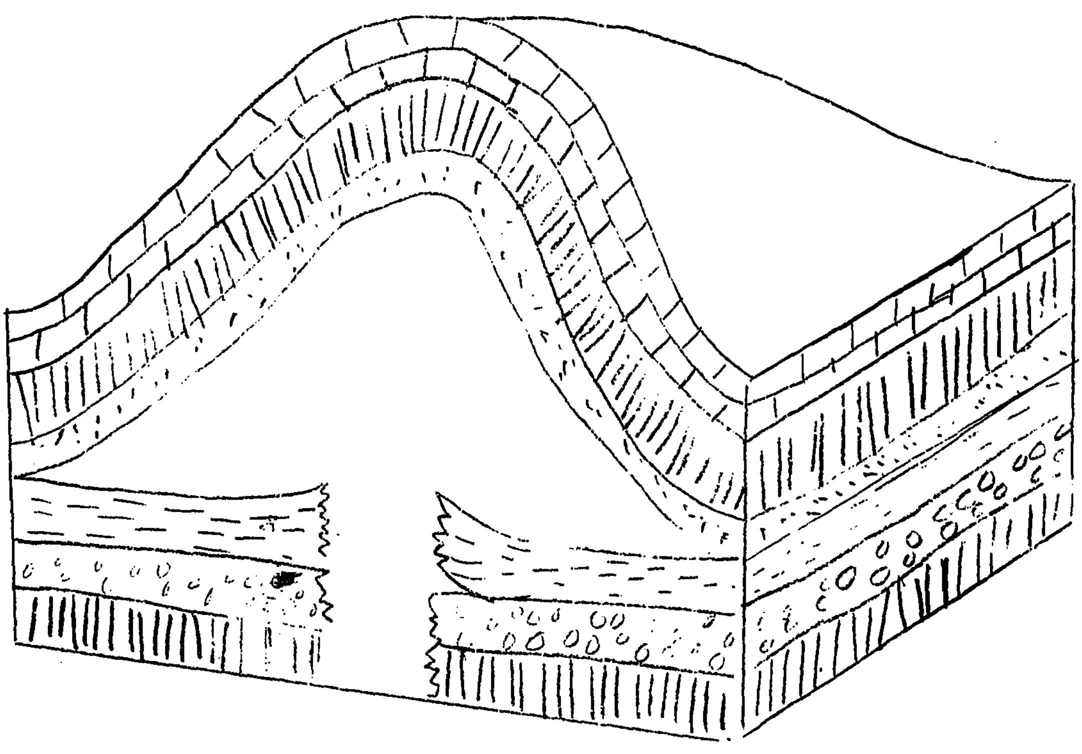
VOLCANIC ACTION



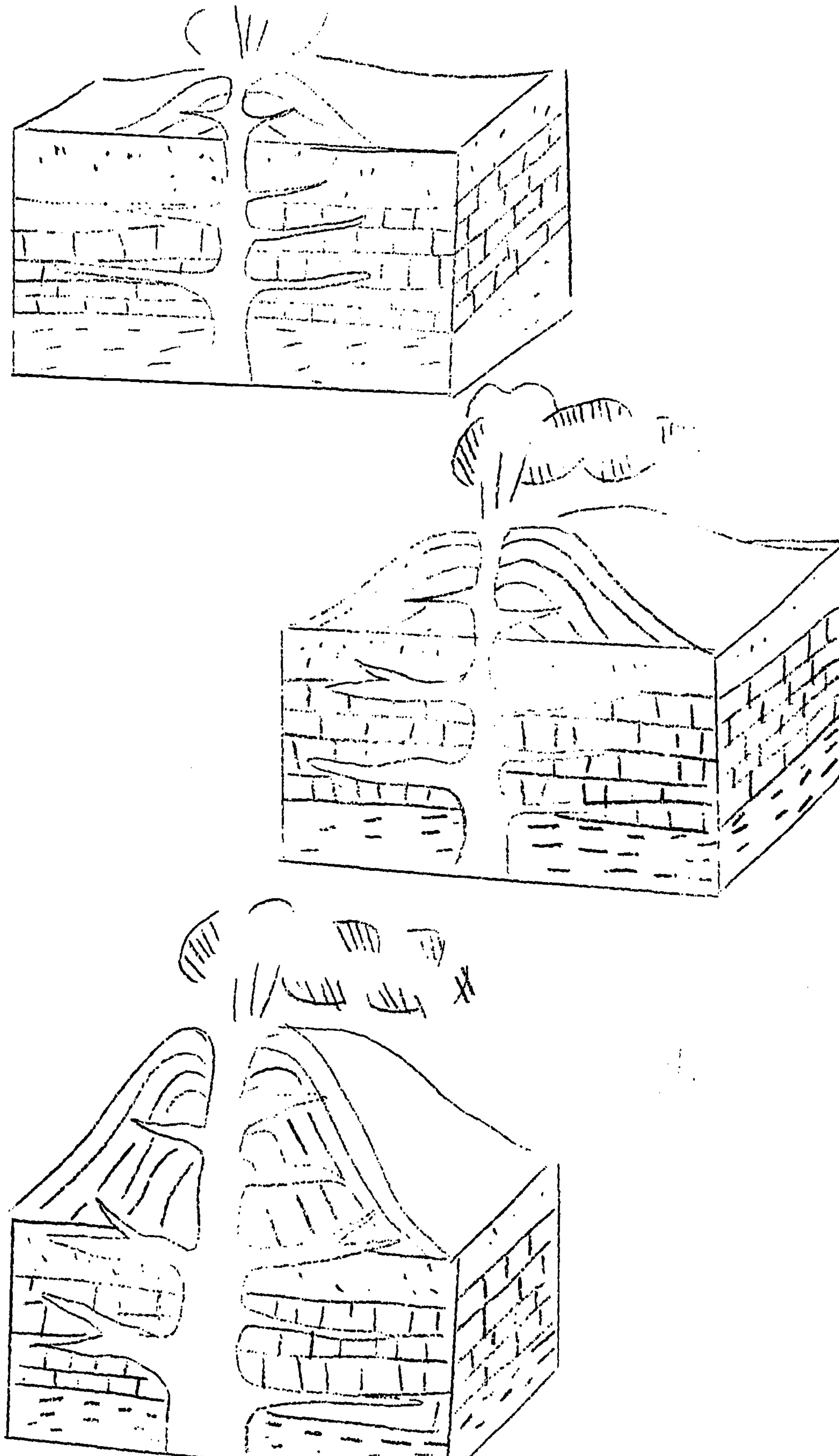
FOLDING



FAULTING



FAULTING



FORMATION OF A VOLCANIC MOUNTAIN

4. Problem

How does erosion by rain water, streams, and rivers change the surface of the earth?

Construct

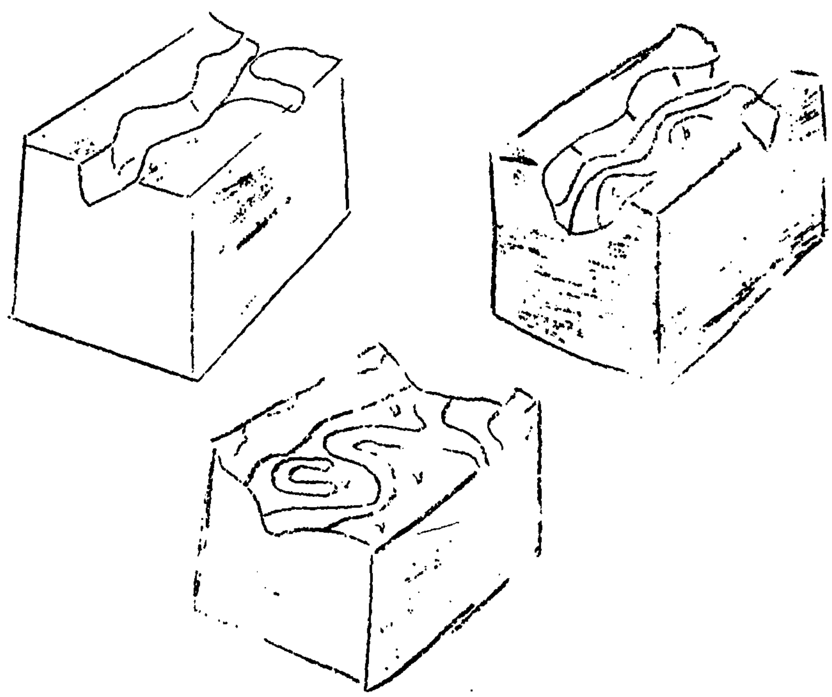
Build a mound out of damp earth or sand using it to represent a hill. Have the children slowly pour or sprinkle water over the "hill" and see what happens. They will discover that gullies are formed and the "hill" is worn away. It must be explained to the children that hills and mountains are not made only of soil, but also of rock and the process of erosion takes a great deal of time although they have been able, in the classroom, to demonstrate this in a matter of minutes.

Observe

If there is a stream or river nearby take the children there. Have them observe how the water has eaten away the banks or the sides of the stream. If there is no stream or river nearby have a film or filmstrip shown to the children about the effects of erosion on the earth.

Construct

To show how erosion by water carries soil from one place to another, build a hill or slope from clay, let it harden and then by pouring water over it the children will see that the clay is eroded and deposited at the bottom of the slope or carried even farther away if a stream is made to run near the clay hill. They will see that the "stream" carries the clay along with it and deposits it elsewhere.



EROSION BY A RIVER

Observe

Look at some sand through a magnifying glass or a microscope. The children will see that some of the bits of sand have sharp edges. When the wind blows against the rock year after year, the rock is slowly worn away by the sand.

Observe

To show that falling water has force and wears away rocks, have the children notice the soil under a dripping outdoor faucet. Explain that it has been moved by the dripping water. Sometimes a stone is placed under an outdoor faucet. If the stone has been there a long time, it may have a rounded-out spot in it where water has fallen on the stone so many times that it has worn away the rock. Explain that the beds of some streams are often made of smooth rocks as well as pebbles and soil. The moving of these streams, with its load of sand and pebbles, keeps wearing these smooth rocks. Sometimes round holes called potholes are formed in these rocks.

Discussion

Explain that as water falls over a rocky edge year after year, rock is loosened. After a while a piece of rock will break off and fall into the stream below. This continues on year after year, and gradually the waterfall moves upstream; i.e., the ledge over which the water falls keeps breaking off.

Demonstrate

Demonstrate that moving water causes stones to tumble over one another and become smooth. Have the children collect stones from streams to bring into class. Some of the stones will be sharp and jagged, and some should be smooth. Explain that when these stones were first broken off rocks, they all had sharp edges, but water helps smooth stones. A fast-moving current causes the stones to tumble over one another and as they do this, small pieces are broken off. After a while the stones become smooth. Explain that this wearing smooth of the rocks may take many years.

Demonstrate

Show how water wears rocks: break up a piece of soft rock with a hammer, and put some of the pieces of broken rock in a glass jar that has a screw top. Fill the jar half full of water, and screw on the top. Shake the jar a hundred times or more. Have the children notice what happens to the water and what happens to the pieces of rock. Take the pieces of rock out of the jar, and place them beside the pieces that were not shaken in the water. Ask the children how the rocks have changed. Make a filter from a piece of towel, and pour the water that was in the jar through the filter. Have the children notice that there is a change in the water as it goes through the filter. Children should examine anything left in the towel. Put the piece of towel in a warm place until the water evaporates. After the water has evaporated have the children examine what is left on the paper. Discuss where the deposit came from.

Demonstrate

Demonstrate that running water carries soil with it.

a. Put the same amount of water into two glass jars, and put a handful of garden soil into each one. Shake one jar. Then have the children compare the water in both jars. Ask the children whether the still or moving water becomes muddy.

b. Make a pile of soil on the science table. Make little holes in the bottom of a can and fill the can with water or else use a sprinkling can to sprinkle the pile of soil and notice where some of the soil goes.

c. If possible, take a walk with the class beside a small stream. Have the children notice that the current is stronger in some places than others. Children should notice where rocks and pebbles are being deposited or where fine material is accumulating. Ask the children if they have ever seen a stream after a heavy rain and noticed that it was very muddy.

Demonstrate

Demonstrate that running water carries soil if the soil is not protected by plant growth.

a. Put several layers of newspaper in the bottom of two flat wooden boxes. Fill the boxes with soil to within one inch of the top. Plant grass in one of the boxes. Water both boxes each day. Let the seeds grow until the grass is about two inches in height. Take both boxes out-of-doors. Prop each box with a brick under one end so that the box slants. Now water the box in which the grass is growing. Hold the watering can about a foot above the high end of the box. Have the children notice that some soil is washed out of the box. Catch the water in a pan when it runs out of the box. Let the water evaporate, and have the children notice how much soil is left in the pan. Do the same thing with the unplanted box. Have the children notice how much more soil is moved by the water.

b. Have the children look for places in the neighborhood where soil has been washed away by running water. If possible, take some photographs of these places. Discuss with the class whether the soil was protected by plants.

Discussion

Discuss the signs of erosion. Examine the school playground for evidence of small gullies, sheet erosion, anddeposits of soil and debris in various forms.

Discussion

Discuss with the children the many types of erosion by water. Have the children collect pictures of various types of water erosion and bring them to class for a bulletin board display or science notebook. The children should bring in pictures of gulleys, deltas, seashores, waterfalls, sheet erosion, and others. Discuss each picture with the class as to location and how the erosion occurred.

Demonstrate

Demonstrate the manner in which water deposits and sorts soil after having carried it. Place two cups of soil in a large glass jar, and add water so that the jar is nearly full. Stir the material. Then set the jar aside for a few minutes. Have the children examine the water and notice that the heavier particles (pebbles and sand) have settled to the bottom first and formed a layer. Above this layer should be a layer of very fine material (silt and clay). Above this layer will be muddy water and humus (decayed plant and animal material). Have the children examine the jar over a period of a week and notice that the humus material settles down on top of the silt and the clay.

Demonstrate

Demonstrate the process of sheet erosion. Fill a pan with soil to the top. Put two or three coins or flat stones on the soil. Set the pan outdoors on a rainy day, and have the children note what happens. Explain that if there is nothing to break the force of the raindrops, the soil is splashed about and mixed with water. As the water flows away, it takes some of the soil with it. A bare field loses some of its soil this way during every rain, and this loss is called sheet erosion. Year after year, sheet erosion goes on, and a field loses more and more topsoil. Have the children look for pictures of this type of erosion to show to the class and to put on the bulletin board.

Demonstrate

Demonstrate how rivers pick up sand and gravel as they flow and deposit this as sediment in river beds, on banks, or at mouths of rivers as deltas.

a. Have the children look at maps that show where rivers flow into seas or oceans, and tell them to find as many deltas as they can. Discuss in each case where the delta was formed.

b. Have the children make a delta in a pan of water. Cut out one end of an old tray or cake pan. Fill the tray with sand, and set the tray on boards so that the open end empties into a pan of water. Have the children pour water very slowly on the sand to make a small stream of water. A delta should be formed in the pan of water.

5. Problem

How does wind erosion change the surface of the earth?

Observe

After a snowstorm (the snow representing sand or topsoil) have the children observe what the wind does to the snow. They will see that in some places the snow drifts and in others it is blown clear. Explain that this is what happens to dry soil over the years. If it is an area where there is no snowfall take them where there is sand, a beach or desert, and they will be able to observe the same thing.

Demonstrate

To demonstrate wind erosion in the classroom, fill a sand box with about one to three inches of sand or dirt. Place some twigs in the sand near one end of the sandbox. At the other end of the box place a small electric fan and turn it on. The children will see how the sand is blown away from some areas and deposited in another area.

Demonstrate

Demonstrate that dust can be made from rocks. For this activity two stones are needed. One should be softer than the other one. Rub the two stones together,and have the children observe to see whether any dust results. If both stones are hard, only a little dust will result. If one stone is softer, such as sandstone or limestone, a small pile of dust will result.

6. Problem

How does ice in the form of glaciers change the surface of the earth?

Research

Have the children find out if the area in which they live was covered by the last great ice sheet that spread over North America. If it were, take them on a field trip and they will be able to find evidence of it scratched in rocks, huge boulders in the middle of a field, or fields covered with rocks which were deposited when the ice receeded.

Observe

Have the children observe the ice in a river or stream to see how it chips away the banks when it begins to break up. They will see that bits of soil and rock are broken away from the banks and carried downstream enlarging the stream.

Demonstrate

To show that freezing water can break things, completely fill a small bottle with water. Place the bottle inside a paper sack and place it in the freezer of a refrigerator. After a few hours, possibly a day, remove the bottle from the sack and examine it carefully. Allow the ice to melt; the bottle should be broken. The reason the bottle breaks is that water when it freezes expands. When pores and cracks in a rock become filled with water during cold weather, they are broken apart by the expansion of the freezing water.

Research

Have the children work in groups to do research on one of the following: (a) How is a glacier formed? What kinds of glaciers are there? (b) Find out the names of existing glaciers today, and make a map showing where they are located. Gather as much information about them as possible. (c) Make a map showing how much of our country was covered with ice when the ice had advanced as far southward as it was to go. Draw in with dotted lines the lakes and falls which were formed as a result of the ice sheet. (d) How fast does a glacier travel? What are the contributing factors in glacial movement? How do glaciers change the surface of the earth? Give examples Each group should prepare a written report or explanation to be handed in and given orally in class. Class discussion should follow.

Research

Have the children do research on glaciers to find how glaciers are formed, how many times ice had advanced over the earth and how far it advanced each time, and what lakes and falls were formed as a result of the advance of an ice sheet. Have the students make a map showing how much of our country was covered with ice when the ice sheet has moved as far southward as it was to go. Have the children locate on a map the lakes and falls which were formed as a result of the advance of the ice sheet.

Demonstrate

Demonstrate what wind is. Explain that we live at the bottom of a deep ocean of air called the atmosphere. Air cannot be seen, but objects can be seen that are carried by air. Have the children recall things they have seen the air carry: e.g., smoke, clouds, paper, leaves, etc. Air can also be felt. Have the children recall having felt the force of the wind against their faces on a windy day. Perhaps some of the children remember having felt stinging particles of sand pelt their skin on a windy day at the beach. Explain to the children that air can be felt especially when there are currents in it, and these currents are called wind.

Demonstrate

Demonstrate that wind carries soil. On a windy day, have the children notice the dirt blowing around on the school playground. Dirt from the playground may accumulate in airways and in protected corners, and visibility may be impaired. Ask the children whether they have noticed any of these things before.

Discuss

Discuss wind abrasion. Explain that wind changes the surface of the earth by blowing rock particles against rock surfaces. This process is called abrasion, and it has a definite wearing-down effect regardless of the size of the particles. Explain that not only does wind-driven soil wear away rocks, but also wears away anything in its path. Paint may be scratched off a car by wind-driven sand. Sometimes the windshields on cars are so badly scratched in a sand storm that one can't see through them. Paint may be scoured off walls of buildings by wind-driven sand. If pictures are available, show them and discuss them with the children.

Demonstrate

Demonstrate that wind moves the soil about, but most of this soil is loose soil, i.e., soil that is not held down by grass, trees or other plants. The following activity will show how grass helps hold down the soil so that wind will not blow it about so easily. Put several layers of newspaper in the bottom of two flat wooden boxes. Add soil to each box, filling the box to within one inch of the top. Sprinkle grass on the soil in one box, but not in the other. Now smooth the soil. Have the children water the soil in each box every day, and pull up any plants that may sprout in the unplanted box. When the grass is about two inches in height, the experiment is ready to be conducted. Wait for a still day, and do not water the boxes on that day. Take the boxes and an electric fan out-of-doors. A long extension cord will be needed so that the fan may be turned on outside. Set the box with the grass seed in front of the fan and level with it. Put some bricks under the planted box if necessary to make it high enough. Turn on the fan, and have the children notice that some of the soil is blown away. Remove the planted box, and put the unplanted box in its place. Turn on the fan, and have the children notice how much more soil is blown away from this box. Discuss the result.

Bulletin Boards

Have the children bring in pictures of glaciers for a bulletin board; display and label them according to location.

Scrapbook

Have the children make a scrapbook of pictures and articles about glaciers from magazines and newspapers. The children may also bring in pictures of U-shaped valleys of glacial origin to be placed in the scrapbook, along with other pictures which show the evidence of glaciers; e.g., glacial scratches in the rocks.

7. Problem

How do geysers and hot springs contribute to the change of the earth's surface?

Research

Have the children read information on hot springs and geysers in their textbooks and magazines. After they have read the information have them draw diagrams of the inner parts of a hot spring or geyser. Also, have them make a collection of these phenomena to be placed in a scrapbook.

Research

Have the children find out the areas of the world where hot springs and geysers are found. Have the children write short compositions on hot springs and geysers, what causes them, why they are found in certain areas and not in others, and what the deposits that are formed around the openings contain.

Discussion

Ask if anyone in the class has been to Yellowstone National Park. If so, have him tell the class what he saw there. Show the class pictures and slides (if available) of geysers and hot springs at Yellowstone National Park. Ask if anyone in the class knows why these things happen. Have the children do some research on the hot springs and geysers at Yellowstone and prepare reports to be handed in and given orally. The reports should include diagrams and pictures (if possible) which may be used for a bulletin board display.

Discussion

Discuss where geysers and hot springs may be found besides at Yellowstone National Park. Have the children bring in pictures of hot springs and geysers and put them on the bulletin board labeling them according to location.

Demonstrate

Demonstrate how a geyser erupts. Have the children watch coffee boil and percolate in a percolater. Take the percolater apart, and explain that the water boils due to the heat from the hot plate just as the water boils underground due to the heat from hot rocks underground. The steam that is formed forces the water up through the tube in the percolater just as steam forces the underground water up through the tube in the rocks. Reference to a cross-section diagram of a geyser will help to make the explanation clearer. Explain that the energy in the steam is strong enough to push the water high into the air. After the water has been pushed out of the geyser tube, the geyser quiets down again until the tube fills up with water again.

Discussion

Discuss with the children, with the help of a cross-section of a geyser, how the geyser erupts, or have the children make a cross-section diagram of a geyser with labeled parts and write an explanation of how the geyser erupts.

8. Problem

How does the force of gravity change the surface of the earth?

Demonstrate

To demonstrate the force gravity has, to cause things to fall and shatter what it falls on, drop a cracker from waist height to the floor. The cracker will shatter, and if it falls on another cracker it will cause that one to shatter also.

Demonstrate

Demonstrate that gravity is important in the large-scale general movement of loose soil and rocks toward a lower level. Put two boards on a table resting one end of each board on a pile of books so that one has a steeper incline than the other. Put copies of the same book at the top of each incline. Have the children note which one slides down faster.

Demonstrate

Demonstrate that gravity is an earth-changing factor because it makes it possible for rocks to fall, thereby being shattered and possibly shattering other rocks:

a. Have a child let go of a ball, and have the class note that the ball falls. Explain that the gravity of the earth pulls on the ball and makes it fall.

b. Have a child drop a piece of hard dirt in a box and note what happens. Have the children explain why this happens; i.e., gravity causes the piece of dirt to fall and break into pieces.

c. Place a piece of hard dirt in a box, and have a child drop a rock on it. Have the children note that gravity causes the rock to fall with enough force to break the piece of hard dirt into pieces.

Demonstrate

To demonstrate the importance of gravity in the large scale movement of loose soil and rock, use building blocks. Pile the blocks up in a random manner, the blocks represent soil and rocks, and dislodge one somewhere near the middle. The blocks above the one dislodged will tumble to the floor, thereby illustrating to the children that when a rock becomes dislodged on a mountain side it will start a slide toward the bottom. This is one way in which the mountains fall and are rebuilt over the ages, and thereby changing the surface of the earth.

9. Problem

How does weathering of rocks, which results in soil formation, change the surface of the earth?

Collection

Have the children make a collection of rocks and study them to see if they can find evidences of weathering on the rocks. The most apparent will be those that has "rock rust" visible on their surfaces. Have them label the rocks as to the kind of weathering that is apparent on their surfaces.

Observe

Gather some rocks that have an iron content. Expose these rocks to water, rain, and air and watch for evidences of weathering. The children will delight in watching the rocks to see who can be the first to discover "rock rust" on their surfaces. They will be able to scrape this "rock rust" off and this will demonstrate how the rock can be broken down into soil by weathering.

Collection

Have the children make a collection of rocks on which lichens are growing. Have them scrape off some of the lichens. Have them notice that bits of rock flake off with the lichens.

Observe

Show that there are differences in rocks by having children bring in various rocks for a table display. Have the children label the rocks by name and description. Have the children examine the rocks for form, color, and hardness. Have the children compare the different rocks as to characteristics.

Charts, Maps, or Graphs

Develop a chart showing sediments and resulting sedimentary and metamorphic rocks. Examples should be listed, and children should write a brief explanation of the formation of sedimentary and metamorphic rocks.

Sediment	Sedimentary Rock (formed in presence of water)	Metamorphic Rock (changed by heat and pressure)
shells	limestone	marble
sand	sandstone	quartzite
mud	shale	slate
plants	soft coal	hard coal
molten rock	granite	gneiss
molten rock	granite	schist

Children may wish to bring in samples of the rock for a display table set up with heading like their charts.

Demonstrate

Show that sedimentary rocks form in layers by performing the following activity. Fill a large jar about three-fourths full of water. Put in a few small stones and two cups of pebbles and soil. Stir well and allow the contents to settle. After several hours or a day examine it. Observe it at intervals for a week or more. Have the children note how the materials have settled. (Pebbles at bottom, next smaller particles, light materials at top, thus giving the appearance of layers.)

10. Problem

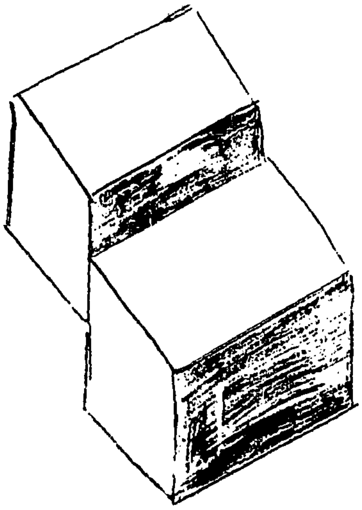
How do earthquakes cause a change in the earth's surface?

Collect

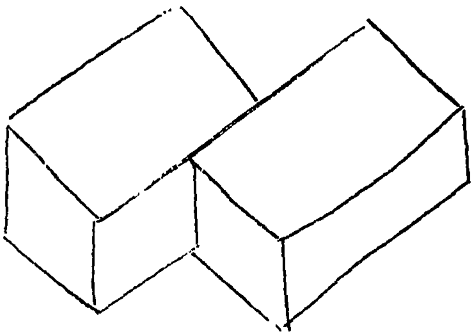
Have the children collect pictures and articles and make a scrapbook. By studying pictures they will be able to learn a great deal. If possible see if they can suggest an experiment on the action of an earthquake.

Demonstrate

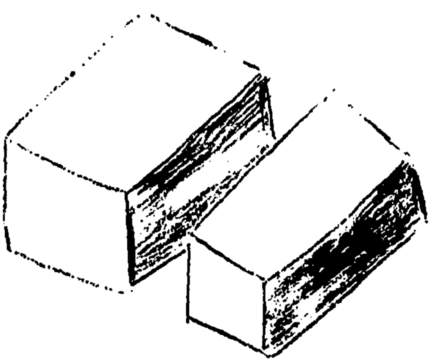
Using a long strip of hard plastic, apply strain on one end. If the strain is great enough the plastic will break under the tension and faulting will occur. The children will be able to see from this demonstration that this essentially is what happens when the crust of the earth is under a strain and an earthquake occurs.



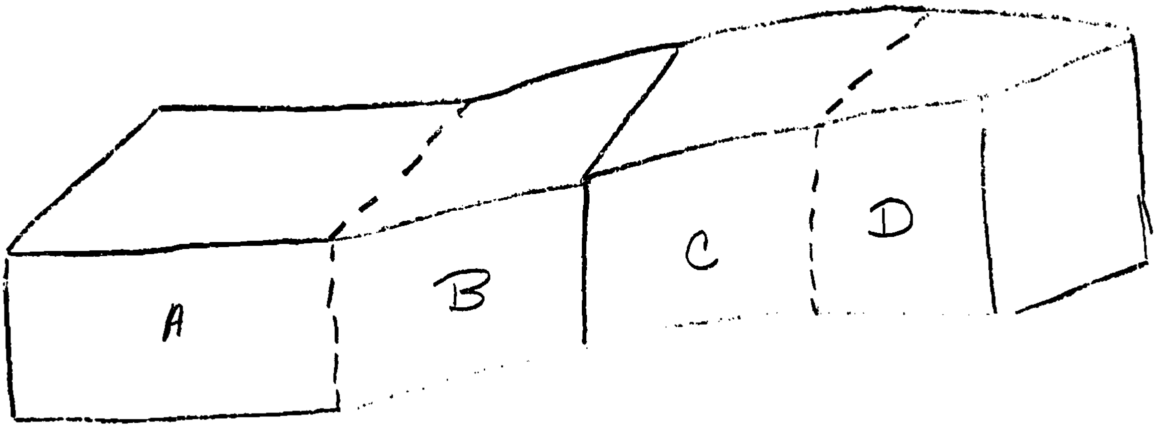
VERTICALLY



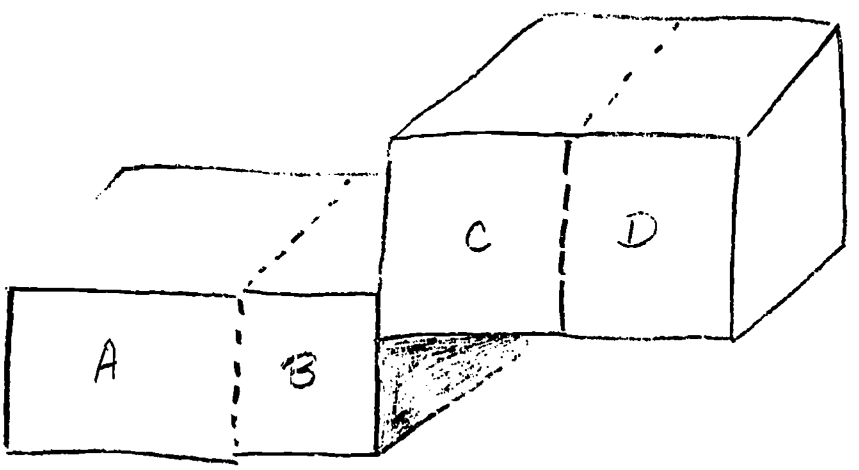
HORIZONTALLY



SIMULTANEOUSLY IN BOTH WAYS



CRUST OF EARTH UNDER GREAT STRAIN



CRUST OF EARTH AFTER AN EARTHQUAKE HAS OCCURRED

Demonstrate

Demonstrate the shaking or rolling movement in the earth's crust during an earthquake. Tap a fish bowl of water, and have the children note that there are vibrations in the water, even through they can't see the glass bowl vibrate. Explain that the vibrations are transferred from the glass to the water, and small waves are set up. Likewise, vibrations in the earth's crust are caused by sudden movements, and the vibrations move in waves away from a pebble when it is dropped in a pond. Ask how many children have dropped a pebble in a pond or puddle and noticed ripples traveling in circles away from the pebble.

Demonstrate

Demonstrate how a seismograph records tremors that are not strong enough for us to feel. Suspend a weight from a wooden-horse support, and stand the support on a table so that the weight is free to swing like a pendulum. Tie a pencil to the weight so that it just touches a sheet of paper on the table. When the weight is hanging quietly, bump the table. Have the children note what happens. Pile some books on the table, and when the weight is again at rest insert another clean sheet of paper. Walk across the floor, and have the children see if this affects the weight. Explain that a seismograph is mounted below the ground level on solid rock, and it is affected by the slightest movement of the layers under the surface as well as by strong vibrations.

Charts, Maps, or Graphs

Have the children make a map showing earthquake zones. Point out locations of seismographs on the map.

Demonstrate

Demonstrate how faulting occurs during an earthquake. Have one of the children gradually bend a thin strip of wood. Ask him if he can feel a strain on the ends. Have the child let go of one end and note that it snaps back with considerable force. Now have the child continue to bend the strip of wood and note what happens. Explain that the strain reaches a point where the wood can't bend further and it breaks. The broken pieces snap away from each other. Explain that something similar happens to rock layers when they are put under stress during an earthquake.

Discuss

Discuss with the children all of the ways in which earthquakes are useful and all the ways in which they are harmful, and make a list of each (e.g.,They give us information about the nature of the interior of the earth and about forces which cause the movements of rocks. They are harmful in that they cause the destruction of life and property.)

Scrapbook

Have the children make a scrapbook of any pictures and articles found in newspapers and magazines about earthquakes.

11. Problem

How does the action of the ocean often change the shore line and therefore change the surface of the earth?

Observe

If the children live near the ocean or a bay, take them to the beach to see how the waves wear away the land. This can best be seen after a storm, i.e., hurricane. Point out to them how the force of the breaking waves break the land away from the shore.

Demonstrate

The action of breaking waves wearing away the shore line can be demonstrated in the classroom by using a large tub, some sand or soil, and a small electric fan. Build a shore line in one end of the tub and fill the tub with about five inches of water. Place the fan at the other end of the tub and turn it on. Waves will be created and beat against the "shoreline" breaking parts of it away. This will demonstrate to the children the action of the ocean on the land.

Observe

If possible have the children watch a film showing the effects of the ocean on the shore line of the earth. There are many films made from newsreels after a severe storm. If it is not possible to obtain a film have the children collect articles and pictures of the action of the ocean.

Demonstrate

Demonstrate that the ocean moves sand and pebbles:

a. Have the children bring in pictures of seashores and sand bars. Explain that during a storm, wind whips the ocean's water in huge waves and moves the water on the bottom as well as the water near the top of the ocean. The huge waves push up stones from under the water onto the beach where some of the stones are left by the moving water. They will stay on the beach unless a high tide takes them out to sea again. Sand bars appear and disappear as sand is moved by the water from one place to another. Sand bars may also appear and disappear along lake shores, and may be formed where a river or stream flows in a curve. Pictures brought in by the children for observation and discussion may be useful for a bulletin board display.

b. Discuss whether any children have gone to the seashore for the summer. Have them describe what the beach looked like before and after a storm. Discuss where the pebbles and seaweed came from and how they came to be deposited on the beach.

Discuss

Discuss with the students that various land forms develop in a shoreline. It may be low, flat and sandy, or high and rocky with perpendicular cliffs. Some shore lines are constantly changed by the action of waves. This is especially true during periods of storms. To show how shore lines are different, visit a beach if possible, and observe what kind of a beach it is and be able to describe it. If there is no beach near the school, stories and pictures brought in by the children may be used to show the different kinds of shore lines.

Demonstrate

Demonstrate that waves have force. On a windy day have the children observe the way in which waves beat against the shore of an ocean, a lake, a river, or even a tiny pond. Have the children bring in pictures of waves created by high winds or hurricanes for observation and discussion. Children may wish to use these pictures for a bulletin board display.

12. Problem

How does the shifting of sea-level change the surface of earth?

Demonstrate

Many times in the ages past the sea-level has sunk several hundred feet exposing land masses not known to exist. Using a large tub of water, some rocks to represent land mass and a rubber tube to release some of the water in the tub this can be simply demonstrated in the classroom. Place some rocks in the tub, and fill the tub so that the rocks are covered by about two or three inches of water. Using the rubber tube, let the water out until the rocks are exposed. This will demonstrate to the children the sinking of the sea-level and the exposure of "new" land masses.

Demonstrate

The above demonstration can be reversed to show the rising of the sea-level and the disappearance of land masses.

Research

Have the children read about the rising and falling of the sea-level. The last shift of sea-level was a downward movement. This is most evident in the Samoan Islands where many rock benches were exposed that were previously covered by the ocean. If possible have the children collect pictures and write compositions to be placed in a scrapbook at a later time.

13. Problem

How does chemical weathering change the earth's surface?

Illustrate

Illustrate chemical weathering by putting one piece of iron in a dry place, i.e., near a radiator or other sources of heat indoors, and put another piece of iron in a damp place. Have the children watch from day to day to see which rusts first. Explain that iron is gradually combining with oxygen and water from the air just as other elements combine with oxygen and water from the air in the process of chemical weathering.

Demonstrate

Demonstrate that when rock is broken up into smaller pieces, there will be more surface area exposed to oxygen, carbon dioxide and water for weathering. Take two small blocks and place them together to make one large block. Have the children examine the blocks carefully to notice how much surface area there is. Then take the blocks apart, and have the children notice that there are now two more sides providing surface area than there were before. Thus when rocks are broken up into smaller pieces, more and more surface area becomes available for attack by the forces of weathering.

Demonstrate

Demonstrate that plants may be chemical weathering agents. Discuss with the children that very small plants, such as lichens, cause rocks to wear away. If the children have ever scraped lichens off rocks, they will have noticed that small pieces of rock chipped off too. Discuss that these plants, the lichens, cause chemical changes in the rocks. Then the rocks crumble. If it is possible to find a rock with lichens on it, bring it to class. Have the children scrape the lichens off and note what happens. Explain that plants take certain minerals from the rocks in their life processes, and, as they decay, give off acids which hasten the chemical decompostion of rocks. Explain that plants also help to retain moisture, and thus again assist in chemical decomposition.

Discuss

Discuss that weathering softens rocks so that eventually they may crumble and become soil. Have the children bring in many different kinds of rocks. Have the children crumble the rocks with the pressure of their hands. Some rocks should crumble easily, and some should be hard and resistant. Explain that the pieces that crumbled easily were probably exposed for some time to the action of the atmosphere and were softened by weathering.

Discuss

Discuss with the children that buildings and houses are subject to weathering. Thus the outside of buildings are treated to prevent weathering. Ask the children what they think is used as a protective covering on frame houses. Explain that paint can also be attacked by heat, cold, and gases in the atmosphere. Ask the children to describe experiences they and their families may have had with paint on their homes or cars.

14. Problem

How does mechanical weathering change the earth's surface.

Discuss

Discuss how mechanical weathering may be caused by man, animals, and plants. Ask the children to think of ways in which plants, animals and man break up rocks. Perhaps the children have seen a tree which broke up the sidewalk as it grew. Explain that animals crush soil materials with their claws and hoofs as they move about. Children may recall having seen men using modern machinery to break up rocks in construction and mining activities. Perhaps the children may recall having seen old stepping stones or old stone steps which have been worn away by many feet that have walked over them year after year. If there are such examples in the neighborhood of the school, the class might take a trip to see these things, or someone might bring in pictures of them.

Demonstrate

Demonstrate that heating and cooling or alternate expansion and contraction is a mechanical weathering agent.

(a) Put water in an ice-cube tray, and have the children notice the flat smooth surface of the water. Put the tray in a refrigerator or other cold place to freeze the water. After the water in the tray is frozen, have the children notice that the ice cubes are not smooth on top; there is a little peak on each one. Explain that the peaks formed because the water expanded when it froze, and the only place it could go was upward.

(b) Put a bottle of milk in the freezer or out-of-doors (if it is cold enough to freeze). After it has frozen, have the children notice what has happened to the cap on the bottle. The bottle cap is likely to have been pushed off by the frozen milk. Explain that the milk contains much water, and as it froze, it expanded; the only place it could go was upward.

(c) Fill a jar with a screw top full of water and screw the top tightly. Put the jar in a heavy cloth bag, and place it in a refrigerator or in a shady place out-of-doors if the temperature is several degrees below freezing. Have the children observe the jar in the bag after the water has had time to freeze. Explain that the water in the jar expanded when it froze, and since there was no empty place in which the water could expand, the jar cracked from the pressure of the frozen water.

(d) Using plaster of paris, make a block with a crack in it. Pour water into the crack in the block, and leave it to freeze. After it has frozen have the children notice what happened to the crack. Explain that when the water froze, it expanded and made the crack in the block larger. All of these activities serve to demonstrate the following explanation. Very often there are cracks in rocks, and when rain falls, water gets into these cracks. If the temperature then falls below 32°F., the water freezes and pushes the rocks slightly apart. On a warm day the ice will melt, but during the night, the water may freeze again and push the rocks farther apart. Little by little, the rocks may be broken apart.

Demonstrate

Demonstrate that plants are powerful mechanical weathering agents. In a small pot of good soil, have the children plant about ten corn or lima bean seeds. Children should water the seeds, put the pot in a warm, sunny place and lay a piece of heavy cardboard on top of the pot. In a few days young plants will begin to show above the soil. As they grow taller, they will push the cardboard up. Explain to the children that the stems of plants are powerful as they grow. Sometimes tree seeds fall into cracks in rocks, and if there is enough soil in the crack, a seed may begin to grow. Year after year, the roots grow longer, and the stem grows taller. Slowly the growing tree forces the rock apart. The crack gets wider and wider, and finally the rock is completely broken apart by the growing tree.

Demonstrate

Demonstrate that rocks can be broken by being struck or rubbed by other rocks and thus undergo mechanical weathering.

(a) Rub two rocks together. If the rocks have sharp edges, show that rock rubbing can make the two rocks smooth. Rub the rocks together over a sheet of white paper and have the children note the particles which have rubbed off. Have the children examine what has been accumulated on the white paper with a magnifying glass and describe the material that has come off the rocks. These particles are small bits of rock.

(b) Have the children look for smooth rocks to bring to class. Ask the children how they think the rocks became smooth. Discuss with the children the forces that cause rocks to rub together.

Demonstrate

Demonstrate how rocks can absorb water and thus undergo mechanical weathering. Have the children put some pieces of rock in a pan of water and let the rocks soak for about twenty minutes. Then have the rocks removed, and have the children try to wipe them dry. Have the children note that in spite of wiping, the rocks remain moist. Ask the children why they think the rocks remain moist, and explain that this is because the rocks are porous and water has saturated them. If the water in the rock freezes, the rock may break apart, and thus it has undergone mechanical weathering.

Evaluation

Included here are samples of evaluation items which could be used in developing your own informal testing program. These suggested types of items cover the particular science area that has been developed in this section of the handbook. This also means they could be used to help develop informal testing to cover large areas on information (monthly, mid-year, end-of-year testing). These are by no means complete tests as such. You will have to adapt and develop items to meet <u>your</u> particular class's own individual needs and differences.

<u>Answer the following</u>:

1. What are some of the forces that help break rock into small pieces?

   (heat and cold, flowing water, ice, plants)

2. From what is soil formed?

   (From rock that has been broken down into tiny pieces; from decayed matter)

3. Why do we say that the surface of the earth is always changing?

   (Because running water forms canyons and valleys, deltas are formed, rocks are always being broken down into small pieces, mountains wear down.)

4. Why can we build great, heavy buildings on the surface of the ground without having them sink into the ground?

   (Under the surface there is solid bedrock which can support the buildings.)

5. Why are sidewalks, bridges, and train tracks built with little spaces between the sections?

   (All of these expand when they get hot in the summertime. The spaces provide room for this expansion.)

<u>Fill each blank with a word taken from the following list. (You will need to use some words more than once.)</u>

rock metamorphic igneous magma sedimentary mineral

1. <u>(Sedimentary)</u> rock is formed under water.
2. <u>(Igneous)</u> rock is produced by fire and heat.
3. <u>(Metamorphic)</u> rock has been changed in some way by heat or pressure.
4. Any substance that is not a plant or an animal is a <u>(mineral)</u>.
5. Marble is a kind of <u>(metamorphic)</u> rock.

Draw a line under the word or phrase in the parentheses that should be used to make a correct statement:

1. Conservation is the (wise, wasteful) use of natural resources.

2. Natural resources include plant and animal life, minerals, and (merchandise, soil).

3. The earth's surface (is constantly changing, stays much the same).

4. (One half, three fourths) of the earth's surface is covered with water.

5. Changes resulting from such things as freezing and thawing are changes from (natural, man-made) causes.

Complete each of the sentences by drawing a line under the correct word or phrase that belongs in the blank spaces:

1. An ore is a ____________ combined with other substances.

   clay stone food metal

2. ____________ is our most important metal.

   Copper Zinc Iron Aluminum

3. Steel is made principally from ____________.

   bauxite limestone pig iron tungsten

4. ____________ has probably been used by people longer than any other metal.

   Iron Copper Steel Aluminum

5. ____________ is valuable because we can make it into very light but strong alloys which do not rust easily.

   Gold Silver Steel Aluminum

Think of a word that completes correctly each sentence and write it in the blank space:

1. The solid rock under the surface of the earth is called (bedrock).

2. If things get bigger when heated, we say they (expand).

3. Many things get smaller when they are cooled. We say they (contract).

4. The force that pulls things down is (gravity).

5. The materials carried by flowing water is called (sediment).

From the list pick the words that are needed to complete the story and write them in the correct places.

Limestone Sandstone Pudding Stone Sedimentary Clay Igne

There are many kinds of rock. A rock formed by pebbles sticking together is called (pudding stone). Rock that forms in layers is called (sedimentary) rock. A rock that can be tested by using an acid is (limestone). A type of rock used as a building material is (sandstone). A material that becomes hard and rock-like when baked is (clay).

Here are five conservation suggestions; mark out the ones that are wrong.

1. Plow around or at right angles to the slope of the land.
2. Cut down trees, plow the humus under, and expose the land to wind and rain.
3. Plant strips of grass in contours around a sloping field.
4. Rotate crops to keep the soil fertile.
5. Allow a field to lie fallow for a year.

Number these Ages in the order in which they occurred in the earth's history:

(4) Age of Dinosaurs
(5) Age of Mammals
(3) Coal Age
(1) Age of Trilobites
(2) Age of Fishes

Underline the word that is the best answer to the question.

1. What covered most of the earth's surface early in its history?

   land plants water

2. What has given us information about the earth's early history?

   books records rocks

3. What has given us the information about the early plants and animals?

   fossils calendars letters

4. What does the word "dinosaur" mean?

   "dug up" "saber-toothed" "terrible lizard"

5. What did the dead plants and animals which were pressed down in the early swamp become.

   sand coal mud

Put a check (✓) before each thing that causes a rapid change in the earth's surface.
Put an X before each thing that causes a slow change in the earth's surface.
Draw a line through anything that does not cause a change in the earth's surface.

_X_ glaciers   _X_ wind   _✓_ water

_✓_ volcanoes   _X_ gravity

Draw a line under the right answers

1.	The earth is always changing.	Yes	No
2.	Fossils are remains of animals, never plants.	Yes	No
3.	Trilobites lived in the early forests.	Yes	No
4.	Some dinosaurs could fly.	Yes	No
5.	All dinosaurs were meat-eating animals.	Yes	No

Place a T in front of each true statement. Place an F in front of each false statement:

(T) 1. Clay is formed from eroded rocks.

(F) 2. Bakelite is a natural plastic made by insects.

(T) 3. Charles Hall used an electric current to separate aluminum from bauxite.

(T) 4. We get the raw material for synthetic rubber from crude oil after fuels have been extracted from it.

(T) 5. Celluloid, shellac, nylon, and lucite are all plastic materials.

Place a T in front of each true statement. Place an F in front of each false statement.

(T) 1. Magma is a mixture of minerals.

(F) 2. Basalt is a kind of precious metal.

(F) 3. Aluminum is made from a mineral called hematite.

(F) 4. Conglomerate and shale are igneous rock.

(F) 5. The outer layer of the earth is a heavy rock called granite.

Vocabulary

One of the strongest keystones of scientific efficiency lies in its vocabulary. The scientist says things precisely, accurately, and briefly. Probably one of the greatest quarrels the science teacher may have with the elementary level teaching today is vocabulary. The science teacher can have no use for vocabulary that is not precise and accurate. Precision in vocabulary is necessary for understanding and meaning of the concept or process being learned.

The words listed below are the basic vocabulary for the indicated area of study. After each word has been introduced, its meaning is to be maintained and extended at each succeeding level of study.

absorb
aeration
altimeter
anthracite
artesian well
bauxite
bedrock
bituminous
calcium
canyon
carbon dioxide
carbonic acid
aelestial navigation
chalocite
clay
claybed
clorination
condense
conservation
contour plowing
contrast
constructional force
dam
dead reckoning
delta
destructional force
dinosaur
doldrums
earthquake
erosion
expand
fault line
feldspar
field
filtration
fizzle
flood
folding
foot print
fossil
freeze
galena
geologist
glacier
granite
gravel
gravity
Gulf Stream
gypsum
hardness
hematite
hornblende
hydraulic mining
igneous rock
ionosphere
irrigation
Japan Current
kiln
knot
latitude
lava
lava flow
law of universal gravitation
levee
lichen
lignite
lime
limestone
limewater
lode
longitude
loran
magma
magnetic pole
magnetite
mass
manganese
mantle
meridian
metamorphic rock
mica
mineral
nonporous
obsidian
oil
ore
panning
petroleum
pillar
placier
pollution
porous
prevailing wind
pudding stone
pumice
radar
rock
sandstone
scoria
seawater
sediment
sedimentary rock
seismograph
sewage
sextant
shale
shell
soil
spear
sphalerite
spring
stalacite
stalagmite
stagnant
subsoil
temperature
topsoil
tsunami
uranium
vein
vinegar
volcano
water
water table

Children's Books

Books are a very essential part of the instructional materials in elementary schools which provide superior learning experiences for children. The selection of these books poses a difficult problem for librarians, teachers, and administrators because the science field is broad and increasing in scope, and elementary school science programs are varied in nature. Some of the more common specific difficulties in choosing books are (1) finding material which deals with the varied interest of children: (2) locating material which gives information correlated with the local school district's instructional guides; (3) finding books of appropriate reading difficulty; and (4) selecting the best books from the many available.

The following list gives help related to the first three difficulties presented. Indirectly, it also helps with the fourth, for the best books cannot be selected until they are located. Further, the brief annotations should be of help in determining which books may be best for a given class. Finally, time should be saved in the selection of a "best" list if some information about the reading difficulty of available books is provided. It is hoped that this list will suggest for elementary books that are supplementary to basic text series, and that these books will have value either as sources of information or for recreational reading.

It is always hazardous to specify an exact grade placement for a book because of variations in pupil reading ability in any class group, and because of different uses made of books. Consequently, the lowest grade levels for pupil use are indicated. At lower levels these same books may be useful if the teacher reads to the children.

The following list was adapted from the publication Children's Catalog, 1966.

Adler, Irving Dust; illus. by Ruth Adler. Day 1958 122p illus map $3.50 (5-7) "A simplified explanation of dust, its nature, its effects, its relationship to light, weather, climate and the soil, its effect on health and its occurrence. in space."

Allen, Hazel Up From the Sea Came an Island; illus. by Marilyn Miller. Scribner 1962 unp illus $2.75 (3-5) "The island began long ago as a mountain standing deep in the sea. After a span of millions of years, it one day thrust its peak above water. Hazel Allen tells the story of the island's transformation into a beautiful place where Keoki and his family can live."

Ames, Gerald Planet Earth; text by Gerald Ames and Rose Wyler; illus. by Cornelius De Witt. Golden Press 1963 105p illus maps boards $3.95 "An account of the explorations and discoveries made by scientists who study the planet on which we live. With this book to guide them, young readers will accompany scientists into the laboratory and on field trips, discovering how gravity, magnetism, radiation belts, volcanoes, earthquakes, glaciers, ocean tides, currents, winds, and weather affect the Earth and its surrounding space."

----The Earth's Story, Gerald Ames & Rose Wyler in cooperation with the American Museum of Natural History. Creative Educ. Soc. 1962 224p illus (Creative Science Series) $4.95 "A concise description of the various phenomena that have gone into producing the earth's crust: What the crust is made of, and how it has been formed, broken down and re-formed; How mountains have been built: Earthquakes, volcanoes and erosion of rocks: How fossils of early living things record chapters of the earth's story: The use of rocks and their products by man: Ores and minerals and their processing. Much of the story is conveyed through carefully selected photographs and artists conception of earlier times."

Andrews, Roy Chapman All About Dinosaurs; illus. by Thomas W. Voter. Random House 1953 146p illus maps (Allabout Bks) $1.95 (4-7) "In a brief, readable account the well-known scientist, explorer and former director of the American Museum of Natural History discusses fossils and scientific methods of fossil hunting, describes the various kinds of dinosaurs, reconstructs the world in which they lived, and recalls some of his own fossil hunting expeditions and discoveries in the Gobi Desert."

----All About Strange Beasts of the Past; illus. by Matthew Kalmenoff. Random House 1956 146p illus map (Allabout Bks) $1.95 (4-7) "An excursion into the fascinating world or prehistoric animals, illuminated with accounts of the author's own expeditions. Strange animals such as the beast of Batuchistan and the Glyptodont, as well as the better-known mamoth, mastodon, and early horse are described."

----In the Days of the Dinosaurs; illus. by Jean Zallinger. Random House 1959 80p illus maps $1.95 (3-6) For millions and millions of years, the world belonged to the dinosaurs. Here Dr. Andrews tells about these strange animals and describes a hunt for fossils in the Gobi desert in Asia. "The information in the author's All About Dinosaurs (listed above) is presented here in less technical and less comprehensive form. Simpler language and better illustrations should appeal to the slightly younger or slower reader."

Bloch, Marie Halum Mountains on the Move: illus. with drawings by Robert Gartland and photographs. Coward-McCann 1960 96p illus maps $3.50 (5-7) An "introduction to geology for the teenager in which the adventures and misadventures of earth's surface and the life upon it are carefully detailed. In spite of the title, the book is concerned with more than mountains. The mountains move because rivers of water and ice wear them down and the pressures of the heated interior force them up, and Mrs. Bloch finds it necessary to discuss glaciers and volcanoes as well. Nor does she stop with the earth's surface, for a discussion of earthquakes inevitably leads her to the earth's deep interior. This is a good beginning in geology."

Blough, Glenn O. Discovering Dinosaurs; pictures by Gustav Schrotter. McGraw 1960 48p illus (Whittlesey House Publications) $2.75 (2-5) A "simple explanation of the work of paleontologist in reconstruction the skeletons of prehistoric animals and in deducting from the evidence how and where these huge creatures must have lived. There is some information about the animals."

Brindze, Ruth The Story of Gold; illus. by Robert Bruce. Vanguard 1955 64p illus boards $3.50 (4-6) "A brief story of man's search for gold and some of the results which the search had had on the spread of civilization. The emphasis is on ancient times and on the California gold rush, with brief mention of other gold finds in this country in Australia, and in Alaska."

Buehr, Walter Volcano! Written and illus. by Walter Buehr. Morrow 1962 95p maps $2.90 In scientific terms, the author "describes the underground conditions that cause volcanoes. He tells why some are found in places as cold as Iceland, and shows how their occurrence follows a definite geographical pattern. He also points out that in some ways, such as fertilizing land and creating valuable products like diamonds, volcanoes can be extremely helpful to man."

Burt, Olive The First Book of Salt; illus. with photographs. Watts, F. 1965 65p illus $2.65 (3-5) "The author has packed a wealth of fascinating information on salt--what it is, where it comes from, how it is obtained, who needs it, and the many unusual ways salt was used in different periods of history. Interesting old pictures and good photographs highlight the text."

Colbert, Edwin Harris Millions of Years Ago; Prehistoric Life in North America; illus. by Margaret M. Colbert. Crowell 1958 153 illus $3.50 (5-7) "Dr. Colbert takes the reader with him on a fossil-hunting expedition. He shows how the paleontologist interprets his findings and adds to the body of knowledge gathered by scientists. He describes life on this continent in the days of early fishes in the subsequent days of ancient land dwellers, of great dinosaurs and of the mammals that followed the dinosaur."

Collins, Henry Hill The Wonders of Geology, by Henry Hill Collins, Jr. Putnam 1962 127p illus (The Wonder of Science Lib) $2.50 (5-7) This "description of the natural forces that change the shape of the earth and a brief outline of earth's history (concludes) with an explanation of how to use basic geological facts for fun while learning more about this science...Illustrated with photographs and line drawings."

Cormack, M.B The First Book of Stones: pictures by M.K. Scott. Watt, F. 1950 93p illus map $1.95 (3-5) "For children and for adults who want a brief introduction to the common varieties of rocks. Some information about the formation of rocks is included and much about making and keeping a collection but the feature that will endear the book to boys and girls, is the author's ability to make rock collecting sound such fun. The illustrations are beautiful and informing. Of particular interest is the double page spread on the earth's history. Children will love and learn much from this new 'First Book' and so will their parents even if... they never had the slightest interest in geology before."

Crosby, Phoebe Junior Science Book of Rock Collecting Garrard 1962 64p illus (Junior Science Bks) $1.98 (2-4) "Describes many common rocks and tells how they were formed and where they are found. Explains the continual building up and tearing down of the earth's crust. Many helpful hints for the amateur rock collector."

David, Eugene Crystal Magic; pictures by Abner Graboff. Prentice-Hall 1965 unp illus $3.50 (k-2) This book shows "just what crystals are, what they look like and what children can do with them. Most of the illustrations are clear and childlike ....The vocabulary is well chosen for listening in the preschool or for the second-grade reader."

Epstein, Sam All About the Desert, by Sam and Beryl Epstein,; illus. by Fritz Kredel. Random House 1957 148p illus maps (Allabout Bks) $1.95 (4-7) "Concentrating on dry deserts, with only a brief description of cold, salt and wet deserts, the authors discuss the characteristics of deserts in general, the kinds of plants and animals to be found in them and some of the uses that mankind has made of deserts. At the end, the major deserts of Africa, Asia, Australia, North and South America are described in some detail. The material is interesting and well-handled both for reference and for general reading purposes. Straightforward style in good print make the book useful for almost any age from fourth grade up. Information appears to be accurate, although there are no indications of sources. Fritz Kredel's illustrations and maps and charts amplify the text."

Fenton, Carroll Lane Riches From the Earth, by Carroll Lane Fenton & Mildred Adams Fenton; illus. by the authors. Day 1953 159p illus $3.75 "Explanation of elements and compounds; rocks, ores, and minerals resources, from aluminum to zinc. Discovery, makeup, history, refining process, and practical use of each mineral."

Fisher, James The Wonderful World; The Adventures of the Earth We Live On Art Editor: F.H.K. Henrion. Doubleday 1954 66p illus $2.95 An "illustrated history of the changes on the face of the world, and in the creatures of the world since the earth began,and of the kinds of life man leads in different climates and under different geographical conditions."

Gans, Roma The Wonder of Stones; illus. by Joan Berg. Crowell 1963 unp illus (Let's-read-and-find-out Science Bks) boards $2.75 (1-3) This "will appeal more to second-graders, although advanced first-graders could read it. The text explains well the composition of various rock formations, but the illustrations for the most part, are confusing. There is a predominance of turquoise blue, and to most children this will suggest the seaside."

Goetz, Delia Deserts; illus. by Louis Darling. Morrow 1956 64p illus maps "A simple introduction to the desert lands of the world, describing their formation, the weather conditions, and ways in which nomadic tribes, and desert animals and plants adapt themselves to their rigorous environment."

----Grasslands; illus. by Louis Darling. Morrow 1959 62p illus maps $2.94 The author "covers three world areas of grasslands. The prairies of North and South America and Russia have been turned from grass to agriculture crops. The Steppes, which are high semi-arid plains found in almost all the continents, are used mostly as grazing lands for animals. The last area is the savanna, which is tropical and is located in Africa and Brazil. Cattle and coffee crops are connected with this type of region, animal life, native trees and flowers, and the types of people throughout the world who live and utilize these areas are also a concern of this book."

----Islands of the Ocean; illus. by Louis Darling. Morrow 1964 64p illus boards "In a simple graphic text the author makes clear the difference between continental and oceanic islands, explaining the continental shelf and volcanic and coral formations. Unusual examples of island plants and animals and of the people of isolated islands--Easter Island; Tangier, off Maryland--and of visitors to Cocos of 'Treasure Island' fame, are described in particularly interesting chapters. Louis Darling's illustrations ...add much to the atmosphere and scientific matter of the content."

----Mountains; illus. by Louis Darling. Morrow 1962 64p illus $2.94 (3-6) Contents: Beliefs about mountains; Mountains of the world; How mountains are formed; Mountain climates; Transportation; Wealth from the mountains; Men of the mountains; Rest and recreation; Highest mountain peaks of the continents. "In addition to the clear explanation of the 'how' and 'where' of mountain formation, there is also sufficient information about the manifold values of mountains. The vivid writing, coupled with the abundant illustrations, makes this an enjoyable and informative book."

----Swamps; illus. by Louis Darling. Morrow 1961 63p illus $2.95 (3-5) The author "describes the ways in which swamps form and change, the differences between kinds of swamps and their flora and fauna, and some of the ways in which men have adapted to swamps."

----Tropical Rain Forest; illus. by Louis Darling. Morrow 1957 64p illus, map "The climate, vegetation, insect, bird, and animal life, the valuable products and the primitive people of the tropical rain forests of the world are described in clear and vivid text and soft, forest green."

Irving, Robert Volcanoes and Earthquakes; illus. by Ruth Adler and with photographs Knopf 1962 123p illus maps $3.19 (4-7) A "study describing the various kinds of volcanoes and earthquakes and giving examples and historical accounts of the most devastating ones. Examines the scientific basis for understanding their activity and point out need for continued research."

Jensen, David E. My Hobby Is Collecting Rocks and Minerals. Children Press 1960 122p illus $3.95 A guide "for older boys and girls ...Identification methods (are) presented with the aid of tables indicating the properties of various rocks and minerals. Practical suggestions are given for different kinds of equipment, for arranging and caring for a collection, and for simple experiments. There is an extensive appendix, which contains a list of museums, a bibliography, and a list of the minerals to be found in each of the United States and each province of Canada."

Lauber, Patricia All About the Planet Earth; illus. with drawings by Lee J. Ames and with photographs. Random House 1962 142p illus maps (Allabout Bks) boards $1.95 "In addition to a thorough treatment of the theories and facts about the evolution of the earth and the origin of the continents, mountains, and deeps, the author delves into the causes of earthquakes, volcanoes, and atmospheric phenomena. Many recent discoveries such as the Van Allen radiation belt are covered."

----Junior Science Book of Volcanoes; illus. by Matthew Kalmenoff. Garrard 1965 64p illus map (Junior Science Bks) $1.98 (2-4) Partial contents; What causes volcanoes; What comes out of a volcano; Plateaus and mountains; Kinds of eruptions; Studying volcanoes; Volcanoes and man. The book begins with the dramatic story of Paricutin "told in some detail. Good three-color pictures, large print, good binding. Valuable as high interest, low reading level book."

Loomis, Frederic Brewster Field Book of Common Rocks and Minerals of the United States and Interpreting Their Origins and Meanings (Rev) Putnam 1948 352p illus 73 plates (Putnam's Nature Field Bks) $3.95 "With 47 colored specimens and over 100 other illustrations from photographs by W.E. Corbin and drawings by the author."

Marcus, Rebecca B. The First Book of Glaciers; illus. with photographs. Watts, F. 1962 65p illus maps $2.65 (4-6) "The story of glaciers--how they are born, how they develop, how they do their varied work on the land and how they eventually die. Here also are clear explanations of what glaciers leave in their wakes--drumlins, moraines, eskers, kames, drowned valleys, and many more."

-----The First Book of Volcanoes and Earthquakes; illus. with photographs and diagrams. Watts, F. 1963 illus map $2.65 "The origin and effects of earthquakes and volcanoes, with information on fissures, geysers, hot springs, magma flow, the science of seismology, and other geological topics."

Marshack, Alexander World in Space; The Story of the International Geophysical Year. Nelson 1958 176p illus maps $4.95 "Describes the background and development of the International Geophysical Year, 1957-1958, in terms of the major natural phenomena to be studied during the year: the seas, ice, air, magnetism, the solid earth, ionosphere, and the sun. The last chapter deals with earth satellites."

Milne, Lorus J. The Mountains, by Lorus J. Milne and Margery Milne and the editors of Life-Time, Inc. 1962 192p illus map (Life Nature Library) $3.95 "The text depicts mountains in all sizes, shapes, climates, derived from varied geological processes. Also described for the wilderness life, natural history and civilizations of mountainous areas."

Pearl, Richard M. Wonders of Rocks and Minerals; illus. with photographs, Dodd 1961 63p illus (Dodd, Mead Wonder Bks) $3.00 (3-6) This book "deals with crystals, ores, metals, gems, meteorites, and other aspects of our mineral kingdom. The kinds and classifications of these substances, places where they occur, how to study them and ways to build a collection--both in the field and at home are covered."

Podendorf, Illa The True Book of Rocks and Minerals; pictures by George Rhoads Childrens Press 1958 48p illus $2.50 (2-4) "Simplified introductory material, illustrated in color and in black and white. The author discusses the ways in which the different kinds of rocks are formed, giving examples of each kind; she (also) describes the fossil imprints."

Pond, Alonzo W. Deserts: Silent Lands of the World Norton 1965 157p illus map An "Account of many of the desert areas of the world: physical origins, climates, plant and animal life as well as measures humans have employed in surmounting the many hazards involved in living and working in the desert. We are also given a look into the possible future of these arid regions as the world population expands."

Poole, Lynn Volcanoes in Action; Science and Legend (by) Lynn and Gray Poole ill. with photographs; lone drawings by Gustav Schrotter. McGraw 1962 79p illus map $3 (5-7) The authors present "a discussion of the Ring of Fire around the Pacific Ocean and continue with a....history of the world's volcanoes. The many extinct, latent and active volcanoes which lie around the Ring tell us much about the formation of our planet Earth."

Pough, Frederick H. All About Volcanoes and Earthquakes; illus. by Kurt Wiese Random House 1953 150p illus maps (Allabout Bks) $1.95 "The author, former curator of physical geography and minerals at the American Museum of Natural History explores the occurrences and causes of volcanoes and earthquakes, reporting on some of the more spectacular of these phenomena. He describes the different kinds of volcanoes and points out their beneficial aspects, described the kinds, detection, and measurement of earthquakes, and indicated what man can do by way of protection against volcanic eruptions and earthquakes.... Illustrated with pictures, maps, and diagrams."

Ruchlis, Hy Your Changing Earth; illus. by Janet and Alex D'Amato. Harvey House 1963 40p illus (A Science Parade Bk) $2.50 (1-4) "Beginning with the origin of the earth and solar system, the author tells how the land, sea, and air developed, how mountains formed and changed, and how landscapes are transformed as a result of natural forces."

Sander, Lenore The Curious World of Crystals; illus. by John Kaufmann. Prentice Hall 1964 64p illus (P-H) Junior Research Bks) $3.25 (4-7) An "introduction to crystallography giving adequate background material about the forms of matter and giving clear explanations of the qualities that distinguish crystalline structure. The text describes the way in which crystals grow and gives instructions for simple home demonstrations in which crystals can be grown. The author does not go into too much detail about molecular structure: she refers briefly to some of the identification techniques and to some of the uses of crystalline substances. The illustrations vary in usefulness."

Shuttlesworth, Dorothy The Doubleday First Guide To Rocks: illus by James Caraway Doubleday 1963 30p illus boards $1.50 (2-4) The author "tells what the various rocks are, how they are formed, where they can be found, and the characteristics of each kind. Color illustrations on every page show what each type of rock looks like. Scientific names, definitions and pronunciations appear in a glossary."

----The Story of Rocks; illus. by Su Zan N. Swain. Garden City Bks. 1956 56p illus $2.95 (5-7) Another "title to add to the collection of books on rocks and minerals. Profusely illustrated in color and designed to help in rock identification, the book deals with classification, formation, kinds, properties testing, uses, and geographic location, and suggests ways of collecting rocks and storing and exhibiting the collection. Includes a state-by-state listing of abundant rocks and minerals."

Sootin, Harry The Young Experimenters' Workbook: Treasures of the Earth by Harry and Laura Sootin; illus. by Frank Aloise Norton 1965 59p illus $3 (4-7) In "organized steps the reader is led to explore and discover for himself basic truths about materials from the earth. Some of the experiments involve tests for hardness and acid, others demonstrate the properties of granite, limestone, salt, etc."

Sterling, Dorothy The Story of Caves; illus. bv Winifred Lubell. Doubleday 1956 121p illus $3.50 (5-7) "An inviting book which explores the fascinating subject of caves-- how they are formed, kinds, underground formations, plants and animals life, what caves reveal of the prehistoric past, and the work or archaelogist and speleogist. A few words of caution are set down for prospective young cavers, and a list of American caves open to the public is appended. Informal, lively text and attractive, informative illustrations on almost every page."

Syrocki, By. John What Is A Rock; pictures (by) Lucy and John Hawkinson, Benefic Press 1959 44p illus (What is it Ser) $1.30 (2-4) "A very simple explanation, largely pictorial, of the geologic formation and wearing-away of rocks, the fossils to be found in rocks, and the uses made of rocks."

White, Anne Terry All About Our Changing Rocks; illus. by Rene Martin. Random House 1955 142p illus (Allabout Bks) $1.95 (4-7) A book "which presents theories of the origin of rocks, kinds of rocks, how they are formed and are constantly changing, and tells how to identify minerals. The final chapter describes some common rock-forming minerals.

----All About Mountains and Mountaineering. Random House 1962 144p illus maps (Allabout Bks) $1.95 (5-7) "The story of the world's great ranges and the men who met their challenges. The author describes the different types of mountains and explains how they were formed. He then considers in detail the Alps, the Rockies, the Andes and the Himalayas."

Wyckoff, Jerome The Story of Geology; Our Changing Earth Through the Ages; illus. with photographs and with paintings by Williams Sayles. Harry McNaught and Raymond Perlman. Golden Press 1960 177p illus maps $4.95 "An Account of the science of the earth's crust. Describes the slowly working forces that made the earth what it is today and gives a glimpse of what may come in the future ages." Contents: Changing earth; Reading the rocks; The zone of fire; The shaping of the land; Ground water; Lakes and swamps; The ways of rivers; Rivers of ice; New rocks from old; Lands rising and falling; From sea bottoms to the clouds; When earth trembles; The changed rocks; The making of minerals Wandering poles--and continents; Seacapes; Graveyards."

Zim, Herbert S. Rocks and Minerals; A Guide to Familiar Minerals, Gems, Ores, and Rocks, by Herbert S. Zim and Paul R. Shaffer; illus. by Raymond Perlman. Golden Press 1956 160p illus maps (A Golden Nature Guide) $2.99 First published by Simon & Schuster A pocket "handbook that is educational for amateurs and useful for quick reference, for professionals. Introductory materials on the earth and its rocks gives basic geological information, and activities for amateurs are suggested in identifying, collecting and studying rocks and minerals. Colored diagrams and pictures of specimens aid in identification. Descriptions (of over 400 specimens) include information on formation structure, use and importance."

----What's Inside the Earth? Illus. by Raymond Perlman. Morrow 1953 30p illus maps $2.75 (4-7) "Answers briefly many commonly asked questions (about geology). With clear diagrams and twenty-four point type for small children and alternating pages of more detailed information in smaller type for adults, there are explained such mysteries as mines, caves, wells, earthquakes, volcanoes, and mountains."

Films

These films are available from the Central Audio-Visual Department. Contact your building A-V Coordinator to arrange for the use of these films.

All films should be previewed to determine suitability for use with your particular class.

Copper Mining	14 min.	Col.	Gds. 5 & 6

At a huge open-pit mine ore is mined by the use of heavy equipment and transported to a mill. The processes of milling and smelting are shown until blister bars containing 99% pur copper ore are obtained. The film emphasizes the vast amount of raw materials that must be mined to extract the valuable remaining metal.

Dinosaur Age	13 min.	Col.	Int.

Opens with a diorama of dinosaurs and then shows two paleontologist at work in the field. Fossil bones are found. Shows the making of a plaster cast, carrying into the museum, and assembling the skeleton. An artist draws a sketch to aid in making a model. Details of the Plesiosuarus, Brontosaurus, Stegosaurus, Tyrannosaurus, and Trachodon are shown by means of models.

Earthquakes and Volcanoes	13 min.	Col.	Int.

Presentation of causes of earthquakes and volcanoes, and the relationship between them. Fire and gases from the inner earth boiled and erupted millions of years ago; probable cause of earthquakes and volcanoes is the aftermath of cooling. Drawing of inner composition of earth is shown.

Earth, The: Changes in Its Surface	11 min.	Col.	Int.

An erupting volcano, as shown in the film provides dramatic proof that the surface of the earth is changing. There are, however, other forces not so apparent that are also causing changes in its surface. These forces, both internal and external, are explained and visually demonstrated. Many geological phenomena are shown and defined; anticline, sycline, batholith, solfatara, fault, geyser, weathering, and others.

Earth, The: Its Ocean	13½ min.	Col.	Int.

A comprehensive study of a scientific area of growing importance is presented in a clear, easily understood manner. This film reveals the growing pattern of the ocean's surface, the living and non-living things in the waters, the nature of the ocean floor, and the influence of the ocean upon man. The roles of modern scientists - oceanographers, marine biologists, and others - are shown as they work to gain more knowledge of the earth's vast, deep oceans.

Earth, The: Its Structure	11 min.	Col.	Int.

Animated drawings present most widely accepted theory of the formation of the earth and solar system. Through simple sketches, clear shots of various geological phenomena, and laboratory demonstrations, we examine the structure of the surface and the interior of the earth; core, mantle, and crust. The latter region is discussed in detail.

Evidence For The Ice Age 19 min. Col. Int.

Anomalies such as glacial moraine deposits, polished striated rock, stray boulders and abandoned drainage channels, contrasting sharply with today's landscapes are examined and offered as evidence that an ice age did exist. These strange features explain former glacial ice and its distribution which, in turn, give an accurate picture of the size and shape of a prehistoric ice sheet.

Finding Out About Rocks $13\frac{1}{2}$ min. Col. Pri. Int.

Film shows in graphic, step-by-step, live action sequence how the pleasant land we know today evolved from the great mass of rock and water that was the early planet. It illustrated how the pounding action of the surf, freezing temperatures, shifting winds and simple plants combined with the force of gravity to break up rocks into sand, and to form soil.

Fossils Are Interesting 10 min. Col. Int.

Animation is used to show the changes which have occurred in the earth and the animals inhabiting it. Explains the formation of sediments and building up of the ocean floor in relation to fossils. Shows children exploring rock for fossils and the types of tools to use. Fossils of a plant and fish, mineralized wood, and a shell are prepared for exhibition and properly identified.

Great Lakes Area: Men, Minerals, & Machines 17 min. Col. Int.

The film shows how large deposits of iron ore and coal, plus cheap water transportation combined to create the building of a large industrial complex in the Great Lakes region; pictures large scale mining of taconite in the Mesabi range; shows steel formed into car bodies in Detroit.

Great Plains, The 15 min. Col. Int.

The film defines and describes a region that covers one sixth the area of the continental United States. The characteristics of the physical and cultural environments are pointed out. Man's adaptation to scarce water resources is emphasized. The film tours the length of the Great Plains of the United States from Minot, North Dakota to Del Rio, Texas. The film pictures the vast empire of ranching, farming, and mining that has replaced the Great American Desert.

Iron Ore Mining 13 min. Col. Int.

Animated maps show the location of the principal sources of iron ore; film shows operations in a typical open pit mine in Minnesota. The processes of removing the ore, transporting, classifying and sorting it are illustrated. Film also exhibits transportation methods. (Good photography)

Meaning of Conservation 11 min. Col. Int.

In this film we see what is being done to maintain our country's resources and natural beauty by limiting hunting, fishing, building dams, planting trees and developing new farming methods.

Rocks That Form On the Earth's Surface 16 min. Col. Int.

This film is designed to help students investigate sedimentary rocks - to discover where they come from, what they are made of, and how they are formed. With carefully selected visual examples and demonstrations, the film explores some of the ways in which sediments are produced, transported, accumulated, and hardened into sedimentary rock by processes which can be observed on land and in shallow water.

Rocks That Originate Underground 23 min. Col. Int.

This film explores the origin of igneous and metamorphic rocks. Geological conditions are reconstructed for the purpose of investigating the growth of the crystal forms which give birth to underground rocks.

Treasures of the Earth 10 min. Col. Int.

A fully animated film that visualizes some of the ways that minerals have been deposited in the earth. An introduction reviews forces acting on the earth's crust and the resulting changes. The film then shows how minerals are concentrated as a consequence of these changes by being deposited in veins, by washing into stream beds and low areas, by seeping through the earth in solution. It describes how oil was trapped in the earth's folds and how coal was formed.

Understanding Our Earth: Glaciers 10 min. B & W Int.

Glaciers from Alaska, the United States, Canada and Europe are shown to orient the audience to the many kinds of glaciers and how they are formed. Visual instruction also covers the formation of icebergs, and the significance and impact of glaciers during the ice age. Evidences of glaciation are seen in glacier lakes in the Rocky Mountains, soil in the Middle West, glacial drift in New England, and the Matterhorn peak in the Swiss Alps.

Understanding Our Earth: How Its Surface Changes 10 min. B & W Int.

Acquaints the students with the forces which build up and wear away the earth's surface over long periods of time. Scenes of wind, water, volcanic eruptions and lava flow, and of the geologic evidence offered by various formations reinforce the key concepts of the film.

Understanding Our Earth: Rocks and Minerals 11 min. B & W Int.

The three classes of rocks, igneous, sedimentary and metamorphic are related to the natural conditions that produced them. The various uses of rocks and minerals in their state are explained.

Understanding Our Earth: Soil 10 min. B & W Int.

The film explains the soil profile (topsoil, subsoil, loose rock and bed rock), the elements of soil (sand, decaying plants and animal matter, and clay), the processes of soil making (the breaking down of rock into fine particles by erosion and plant matter decaying into humus), the types of soil throughout the United States, and the importance of soil conservation.

What's Inside the Earth 14 min. Col. Int.

We have learned what's inside the earth by digging holes, studying volcanoes, and recording earthquake vibrations with seismographs. Scientists tell us the earth has three regions; a thick rock crust upon which we live, a thick mantle of solid heavy rock, and a very hot and heavy inner core.

Why Do We Still Have Mountains? 20 min. Col. Int.

This film will engage students in a fresh look at the land they live on by considering the seeming paradox that erosion should long ago have carried away all the land above sea level down into the oceans. The film explores several methods how mountains are formed and examines the evidence associated with the uplift of the earth's crust.

PART III - HYDROSPHERE

HYDROSPHERE

Initiatory Activities

Have the children:

1. Display new clippings about a dam that is to be completed in the near future. Discuss the effect the dam will have upon the community.

2. Capitalize upon incidental experiences of the class that may lead into the unit.

3. 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 the pictures may be in question form, to encourage children to use books to find the answers.

Developmental Activities

CONCEPT - Water is vital in man's life. It is almost everywhere.

1. Problem

   How much of our Earth really is water?

   Materials

   Globe of the earth.

   Procedure

   How much water is there on the Earth's surface? Which covers a greater area, land or sea? These are two questions that could be placed on the blackboard which the children can be asked to answer. Then place the globe on a table in front of the children and have them observe the different colors on the globe. What color represents water? (Blue) What colors represent land? (Colors other than blue or white) If there is an area shown in white, what does it represent? (Snow and ice) Where do you find the ice covering? (At the North and South Poles) Which color covers the greater area of the globe? (Blue) Is there more land, water, or ice covering our Earth? (Water) Have the children estimate what percentage of the Earth's surface is covered by water. (About 71%) Have them suggest ways of measuring the area covered by water.

   Conclusion

   Water covers the greatest part of the Earth's surface. About 71% of the Earth's surface is water.

2. Problem

Is there water in the food that we eat?

Materials

Apples, lettuce, potatoes, bread, crackers, hot plate, test tube, glass plate.

Procedure

Discuss with the children where water can be found. Some children may suggest that the food we eat contains water. Encourage them to give further thought to this concept. Suggest that there are ways in which to test their ideas. Have the children bring small quantities of various kinds of foods to school for testing. Discuss with the children their ideas of testing for the presence of water. It may be suggested that a small quantity of food be placed in a test tube and heated slowly. When a cool, square piece of glass is placed over the mouth of the test tube, small droplets of water will be seen forming on its under surface. The amount of water will depend upon the amount of water that is present in the food being tested. Some foods have very little moisture in them (dried beans or rice) and will show little, if any, moisture on the glass surface. This food will appear harder or it may become dry and powdery after testing. Another method of testing would be to have the children place pieces of food on a piece of paper, trace around the food, and place the paper and the food in a warm place. After a few days, the children will observe that the food has shrunk from loss of moisture. Have the children weigh the food before and after this experiment to see if there is a difference in weight.

Conclusions

Water is found in most of the foods we eat. The drying of foods is accompanied by shrinkage and a loss of weight.

3. Problem

Is water vapor present in the air that people exhale?

Materials

Mirror, test tube and test tube holder, water, hot plate, two-hole cork, 2 glass tubes, calcium chloride, glass tubing.

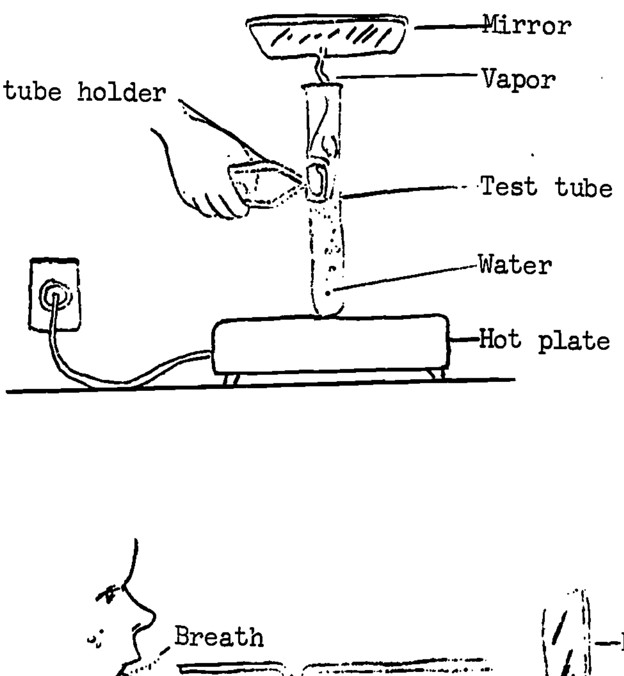
Procedure

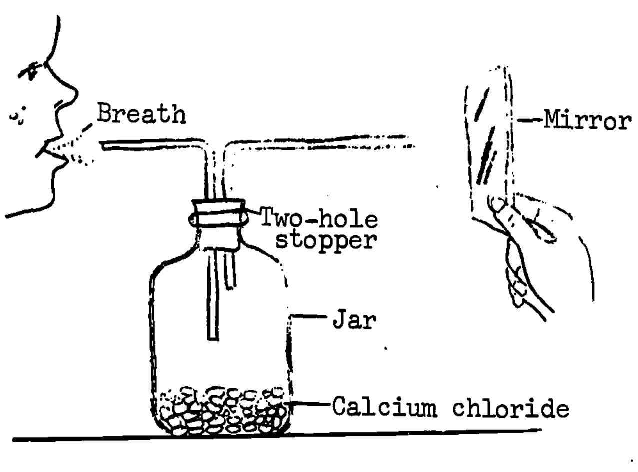
Have a child fill a test tube half full of water. Using a test tube holder, heat the tube over a hot plate. Point the open end of the tube toward a mirror an inch away. What happens? (The mirror becomes clouded.) What causes this change? (Moisture adheres to the surface of the mirror.) Dry the mirror and have a child hold it close to his mouth and blow on it. What effect is observed? (The mirror again becomes clouded.) What causes this change? (Moisture from the child's breath adheres to the mirror.)

Make the suggestion that there is a way in which the moisture can be removed from the breath before breathing against the mirror. Discuss the theories that the children might suggest in regard to this statement. The moisture can be removed by blowing through a right-angle tube into a jar of a chemical called calcium chloride. Set up the jar as illustrated, with another right-angle glass tube through which the dried air can be forced. Have the children discuss why the air coming from this jar does not cloud the mirror. What has the chemical done? (The calcium chloride acted as a drying agent and removed the water vapor.)

Conclusions

Water vapor is present in the air that people exhale. It is this moisture that clouds the glass.





CONCEPT - Water is a chemical compound composed of the elements hydrogen and oxygen. All compounds have definite properties that can be examined, such as boiling point, freezing point, and color.

1. Problem

What is the viscosity (resistance to flow) of water?

Materials

Water, maple syrup, honey, 4 test tubes with corks, test-tube holder, hot plate.

Procedure

Fill one test tube half full of water, another half full of maple syrup, and a third test tube half full of honey. Turn each test tube upside down and observe what happens to each liquid. (Each liquid moves to the other half of the test tube) How did the liquids get to the other end? (They flowed to the other end of the test tube.) Did each liquid flow with the same speed? (No) Which liquid flowed to the other half of the test tube most rapidly? (The water) Which liquid flowed to the other half of the test tube least rapidly? (The honey) Develop the meaning of "viscosity." Fill another test tube half full of honey. With the test-tube holder heat the honey over a hot plate. After the honey has been warmed, place a cork in the end of the test tube and turn the test tube upside down. Observe the rate of flow of this honey and compare it with the honey that was not warmed. What does heating the honey do? (Heating makes it less viscous.)

Conclusions

Water has the ability to flow. Some liquids flow with difficulty and are called viscous. Honey is an example of this. Heat can cause honey to lose some of its vicosity.

2. Problem

What is the density of water?

Materials

Spring balance, calibrated in grams; tin can, 16-ounce capacity; water; wire; graduated cylinder, calibrated in cubic centimeters (cc).

Procedure

Punch two holes in the tin can and suspend it by a wire from the spring scale. Weigh the can and the wire and record the weight. Have a child accurately measure out 100 cc. of water in the graduated cylinder and pour the water into the can. Weigh the can of water and record the weight. Observe that the weight of the water is equal to the difference between the second weight recorded (water + can + wire) and the first weight recorded (can + wire).

For Example:

Weight of can, wire, and water	=	150 grams
Weight of can and wire	=	50 grams
Weight of 100 cc of water	=	100 grams

Estimate the weight of 200 cc of water (200 grams). What is the weight of 1 cc? Measure out 1 cc of water and weigh it. (Each cubic centimeter weighs 1 gram.)

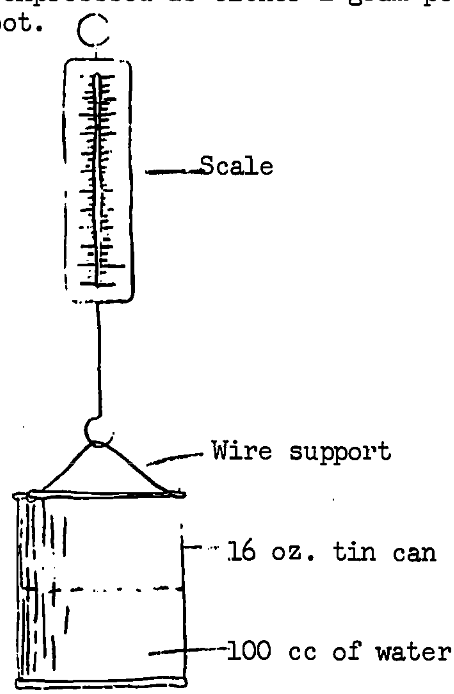
Density is weight per unit volume. What is the density of water? (One gram per cubic centimeter) Have the children work out mathematically the density of water in pounds per cubic foot. To do this, they will have to know the following relationships:

1 cubic foot	=	28,322 cubic centimeters
1 pound	=	453.59 grams

Knowing these relationships, then proceed in the following way. If 1 cubic foot of water is equal to 28,322 cubic centimeters of water, and 1 cubic centimeter weighs one gram, then 1 cubic foot of water weighs 28,322 grams. Since 1 pound is equal to 453.59 grams, then the weight of 1 cubic foot of water (in pounds) will be equal to 28,332 divided by 453.59, or 62.4 pounds. Therefore, the density of water can also be expressed as 62.4 pounds per cubic foot.

Conclusions

The density of water canbe expresssed as either 1 gram per cubic centimeter or 62.4 pounds per cubic foot.



3. Problem

Does the density of different liquids vary?

Materials

Graduated cylinder, calibrated in cubic centimeters; tin cans, 16-ounce capacity; spring balance, calibrated in grams; glycerine; wire; alcohol; other liquids; olive jar.

Procedure

Measure 100 cc of glycerine into a tin can in the same manner as the water was in the preceeding activity. Determine the weight of the glycerine. What is the weight of 100 cc of glycerine? (126 grams) What is the density of glycerine? (1.26 grams per cubic centimeter?) Repeat the activity using the alcohol in place of the glycerine. What is the weight of 100 cc of alcohol? (80 grams) What is the density of alcohol? (0.8 grams per cubic centimeter) Which is more dense, glycerine or water? (Glycerine) Which is more dense, alcohol or water? (Water) Now have the children dry the glass and fill it to the mark with glycerine. How much glycerine is this? (The same as the measured volume of water 100 cc) Weigh the glycerine and the jar. What is the weight of the glycerine? (Subtract the weight of jar from weight of glycerine and jar.) Divide the weight of the glycerine by the weight of an equal amount of water. This gives the comparative weight of glycerine to water, or the specific gravity of glycerine. (Note that the specific activity is equal to the density if the density is measured in grams per cubic centimeter.) Have the children repeat the procedure to find the specific gravity of other liquids, such as alcohol.

Conclusions

The density of liquids varies. Water is used as a standard to compare the densities of other substances. This comparison is the specific gravity of a substance. Specific gravity is equal to the weight of a substance divided by the weight of an equal volume of water. A substance with a specific gravity greater than 1 is more dense than water. The greater the specific gravity, the denser the substance.

4. Problem

What is the boiling point of water at sea level?

Materials

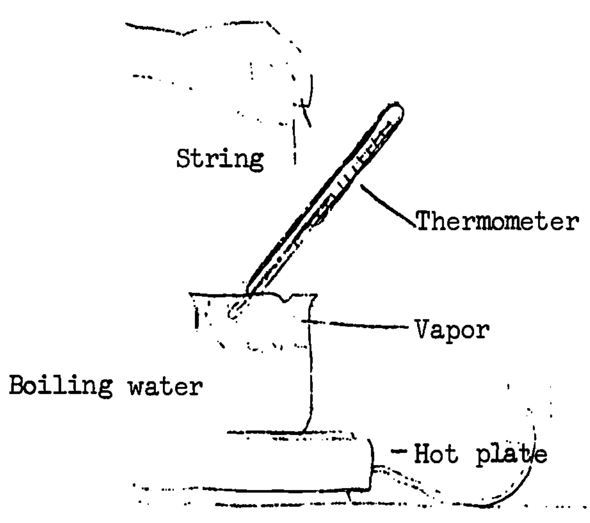
Thermometer registering over 100° Centigrade or 212° Fahrenheit, beaker of water, hot plate.

Procedure

Have the children determine the boiling point of water for their location. Have the children place some water in a beaker and boil it on a hot plate. Suspend a laboratory thermometer in the vapor, just above the boiling water. Read and record the temperature. Why is the figure probably slightly under 100° C? (Because the air pressure is probably less than that at sea level - 14.7 pounds per square inch.) Would the temperature of boiling water be higher or lower than 100°C on a mountain? (Lower than 100°C) Would it take a longer time or shorter time to cook potatoes on a mountain? (Longer) Why? (The water would not become as hot before it boiled at the higher altitude.) What is the principle of a pressure cooker? (It allows the water to become hotter before it begins to boil and thus cooks things more rapidly.)

Conclusions

The boiling point of a substance is the temperature at which the liquid state changes to the gaseous state. The boiling point will vary depending upon the pressure exerted above the water's surface. At high altitudes the pressure is lower and the boiling point is correspondingly lower.



5. Problem

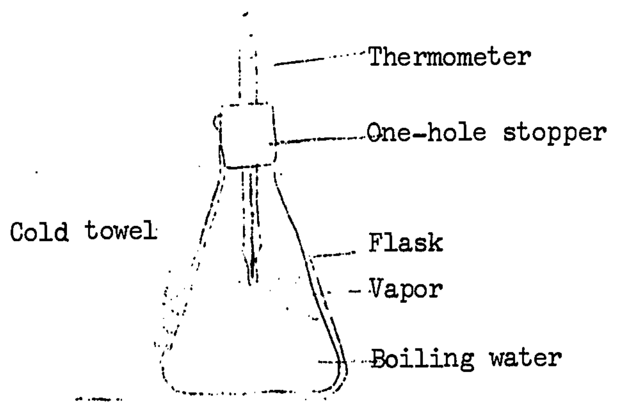
How can the temperature at which water will boil be lowered?

Materials

Pyrex flask with a one-hole stopper, water, towel, hot plate, laboratory thermometer.

Procedure

Fill the flask about one-quarter full, with water. Boil the water in the flask on the hot plate. Place a thermometer in the vapor just above the boiling water. Read and record the boiling point of the water. Now carefully push a moistened thermometer through the one-hole stopper. (Moistened glassware can be pushed through rubber more easily.) The thermometer should be pushed far enough through to reach the point just above the surface of the boiling water. Carefully remove the flask from the hot plate. What happens? (The water stops boiling.) Why? (There is no longer enough heat at that pressure to cause it to boil.) Place the cork and the thermometer into the mouth of the flask. Then place a towel that has been soaked in cold water around the sides of the flask. What happens? (The water begins to boil.) Why? (The water vapor inside the flask condensed the water again; creating a lower pressure above the water, with the lessened pressure the water will boil at the lower temperature.



Conclusions

Reduced air pressure over the surface of the water will lower the boiling point.

6. Problem

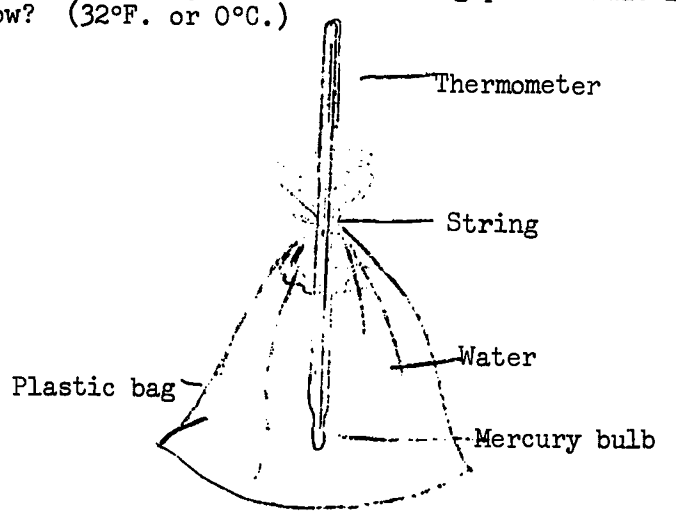
What is the freezing point of water at sea level?

Materials

Plastic bag, refrigerator, shallow pan, water, laboratory thermometer, string, paraffin, glycerine, dry ice, olive oil, alcohol, mercury.

Procedure

Place some water in a plastic bag, inserting a laboratory thermometer so that the bulb is suspended in the water, and tie a string around the top of the bag (the top end of the thermometer should be sticking out.) Place this apparatus in a freezing compartment. Read and record the temperature. How would you account for the fact that the reading might be below 0°C. or 32°F? (Once all of the water has frozen, the ice can become cooler if the freezer unit is set at a temperature below 0°C.) Remove the plastic bag around the ice block and allow the block to stand in a shallow pan until it begins to melt. Read the temperature of the thermometer after the ice block has been raised just to its melting point. What is the temperature reading now? (32°F. or 0°C.)



Compare the freezing point of water with that of other liquids. Obtain and try some of the other liquids listed above. The following table gives the freezing point of these liquids.

Liquid	Freezing Point	
	Centigrade	Fahrenheit
Alcohol	-117	-179
Glycerine	17	63
Olive Oil	2-6	35-43
Paraffin	55	131
Mercury	-39	-38

7. Problem

How can the freezing temperature of water be lowered?

Materials

Salt, laboratory thermometer, water, plastic bag, string, refrigerator, alcohol, shallow pan.

Procedure

Put enough salt into a plastic bag full of water to make a saturated solution. Place enough salt in the bag so that some crystals will not dissolve, but instead will remain on the bottom of the plastic bag. Place a thermometer in the bag and tie the neck of the bag with a string so that the thermometer is sticking out. Place this equipment in the freezing compartment of a refrigerator. When the solution has frozen, remove the plastic bag from the refrigerator. Let the block of ice stand in a shallow pan until it begins to melt. Read and record the temperature of the mixture when it just reaches the melting point. Is there any difference between this temperature and that of the frozen water without the salt? (Yes, the salt-water block of ice is at a lower temperature.) Why? (Adding salt to water lowers the freezing point.) Discuss this concept and its relationship to oceans. Is this advantageous? Why? Mix certain amounts of alcohol and water together to see if they can freeze the mixture using the -80°C temperature of a mixture of dry ice and alcohol. To help children apply their learnings, ask, "Why does your father put alcohol or antifreeze in the car radiator during wintertime? (The alcohol or antifreeze lowers the freezing point of the water. Therefore, the water will not freeze and damage the radiator.)

Conclusions

When salt is dissolved in water, the freezing point of the water is lowered. A mixture of alcohol and water also has a lower freezing point that that of pure water.

8. Problem

What is the cohesiveness of water? (tendency of substances to stick together)

Materials

Water, mercury, wax paper, medicine dropper, magnifying glass.

Procedure

Give each child a small square of wax paper. Fill a medicine dropper with water and place a few small drops on each piece of wax paper. Do the drops make the paper wet? (No) Have children push some of the drops together. What happens? (The water sticks together as larger drops.) What shape do the drops take? (They are ball shaped.)

Do they all have the same shape? (No, the smaller ones are more spherical, the larger ones are flatter.) What happens when two small spherical drops are brought together. (They form a larger and flatter drop.) Have the children discuss what would happen if a larger, flatter drop was separated into two small droplets. Have them try it. Discover if other liquids exhibit cohesion, too. Repeat the same procedures as outlined above using mercury (or mineral oil).

Conclusion

Cohesion is the tendency of substances to stick together. Water shows a cohesive force, but this is not as great as the force exerted by many other liquids. (Attraction of like particles for each other.)

9. Problem

What is surface tension?

Materials

Razor, dish of water, needle, petroleum jelly.

Procedure

This can be observed by gently placing a thin, double-edged razor on the surface of a dish of water. The same thing can be done with a sewing needle. Lay the objects flat upon the surface. (Smearing a little petroleum jelly on the metal will make it easier to perform the demonstration.) What is observed? (The metal makes a little depression in the water but does not break the surface.) Press on the blade and on the needle. What happens now? (The water surface is broken and the objects sink.) What does this show about the surface of the water? (The forces acting on the surface particles must be different from those acting on the particles in the interior.)

Conclusions

The surface of the water acts like an elastic membrane. This elasticity of the surface is called surface tension.

10. Problem

What is the property of adhesion?

Materials

Water, capillary tubes or glass tubing, Bunsen burner, 2 pieces of glass about 2 x 2 inches.

Procedure

Fill a beaker about half full of water. Place some capillary tubes in the beaker. (Capillary tubes are glass tubing having inner diameters of very small size.) If none are available, draw your own glass tubing into thinner tubes. This is accomplished by slowly rotating a glass tube in a propane or Bunsen burner flame while the tube is pulled at each end. The tube will stretch slowly to form a narrower tube. Remove it from the flame and break the tubing at convenient lengths with a file.) What happens to the water in the tubes? (It rises.) Why? (Water adheres - is attracted - to the sides of the tube.) In which tubes does the water rise the highest? (In the thinner tubes.) Why? (The amount of adhesion does not change with smaller diameters, but the amount of water it must act on is less. Therefore, the smaller amount of water can be pulled up higher.) Develop the understanding that the adhesive quality of water is very important in plant life, since it partially explains how water gets to the top of tall trees. Plants such as trees and shrubs have tiny capillary tubes within the roots and stems that carry the water up the plant.

Conclusions

Adhesion is the attraction that unlike particles have for each other. The rise of water in capillary tubes illustrates this adhesion.

11. Problem

How do the adhesive properties of water and other liquids compare?

Materials

Mercury, 2 glass plates, rubber band, syrup, honey, sealing wax, ruler, bowl, alcohol.

Procedure

Fasten a rubber band to the center of a 2 x 2 inch piece of glass with sealing wax and then place the glass on the surface of a bowl of water. Stretch the rubber band, pulling the glass from the water. Measure the distance the rubber band stretches before the adhesive force is disrupted. Record the distance in inches from the top of the rubber band to the surface of the water when the glass is finally lifted from the water. Try this same demonstration using syrup, honey, and alcohol in place of the water. Observe and record the findings of each. How do the results compare? Which shows the greatest amount of adhesion to the glass? Which shows the least?

Conclusions

Water does not adhere equally to all substances. Different liquids show a variation in their adhesion to different materials.

12. Problem

Is water transparent to light?

Materials

Water; vinegar; mercury; 4 test tubes; newspaper.

Procedure

Fill one test tube with water, another with vinegar, a third with mercury, and leave the fourth containing only air. Place a newspaper in back of each tube and have a child read through the test tubes. Can they read through each? (They can read through the water, vinegar, and air.) Why can they not read through the mercury? (Light is not transmitted through this fluid.)

Conclusions

Transparency is the ability to transmit light readily. A substance is opaque if it does not transmit light. Water and air are transparent fluids, but not all fluids are transparent.

CONCEPT - The cycle of evaporation (the changing of a liquid into a gas), condensation (the cooling of the gas forming collected particles of matter), and precipitation (the falling of water particles as rain, hail, sleet, or snow) is called the hydrologic cycle, or water cycle.

1. Problem

What is evaporation?

Materials

Water, chalkboard, sponge.

Procedure

Wet a sponge with water and have one of the children use it to wet the chalkboard in a large circle. Where is the water that was on the sponge? (Some of the water is on the chalkboard.) How can you tell that water is on the chalkboard? (The chalkboard looks wet.) Is the chalkboard wet? Have a child feel it. Observe what happens to the water on the chalkboard. (It disappears.) Does the water all disappear at the same time? (No, some disappears before other parts.) Where does the water go? (Most of the water goes into the air although some might go into the chalkboard.) Can the water be seen in the air? (No.) Then how do you know that the water is in the air. (See experiment explaining how to tell the relative humidity in the air.)

Conclusion

Evaporation is the process by which liquids change into vapors.

2. Problem

Do some liquids evaporate more rapidly than others?

Materials

Alcohol; glycerine; tablespoon; crayons and paper; 4 saucers; water; mineral water.

Procedure

Measure one tablespoon of water and place it in a saucer. Show the importance of having the same kind and size of saucers and the same amount of each liquid in the saucers. Place a label in front of each saucer, showing the name of its contents. Allow the saucers to sit at room temperature for 24 hours. At the end of this period have the children observe the results. (Only the alcohol and water have disappeared completely.) What has happened to these liquids? (They have evaporated into the air.) What form have they taken in the air? (They have taken the form of invisible vapor.) What happened to the other two liquids? (A large portion of the glycerine and the mineral oil remained in the saucers.) Why did they not disappear? (These liquids do not evaporate or turn into a gas as rapidly as alcohol and water.)

Conclusions

Some liquids turn into a gas, or evaporate, very rapidly; others evaporate slowly.

3. Problem

What is the effect of air motion upon the rate of evaporation of water?

Materials

Paper hand fan; chalkboard; water; sponge; watch with second hand.

Procedure

Have four children go to the chalkboard and have each child make two chalk circles on the board, each about as large as a dinner plate. Give each child a folded piece of construction paper - about 8" x 8". Have each child wet the inside of both of his circles with a wet sponge. Then instruct the children to fan only one of their circles with the paper fan to see which circle loses its water first. When the water disappears it is said to evaporate. Which circle of water evaporates first? (The circle that is fanned.) Why? (Because fanning removes the moist air above the circle, replacing it with dry air into which the particles of water can escape more easily.) Have one child act as a timer to record the time it takes for evaporation to take place. Why do some circles take longer to evaporate? (More water was present, or less fanning was done.) Where did the water go? (It went into the water as invisible vapor.)

Conclusions

Moving air over water increases the rate of evaporation. Air over water becomes moistened, making it more difficult for evaporation to occur. Wind removes this moist air and replaces it with drier air.

4. Problem

How does heat affect the rate of evaporation of water?

Materials

Hot plate or radiator, 2 beakers or Pyrex dishes, stopwatch, water, tablespoon.

Procedure

Ask one of the children to place a tablespoonful of water in a beaker or Pyrex dish and place it on a hot plate or the radiator. Have another child place another dish containing the same amount of water on a table away from any source of heat. Have a child using a stopwatch, record the time the experiment began and the time that the water evaporated from each of the dishes. From which dish did the water evaporate first? (The dish that was heated.) Why? (Increasing the temperature of the water particles helps them to "escape.") Where did the water go? (It went into the air as an invisible vapor.)

Conclusions

Heating water increases the rate of evaporation.

5. Problem

How does water vapor precipitate as rain?

Materials

Glass or can of ice water; teakettle; hot plate; water.

Procedure

Observe what is happening as water is boiled in a teakettle over a hot plate. What is happening? (A cloudlike formation occurs as the water vapor coming out of the spout of the teakettle is cooled.) How is it cooled? (By coming in contact with the cooler air around it.) What happens to this cooler air around it? (It turns into a cloudlike formation.) What happens to the cloud? (It disappears, and others form from more cooled vapors.) What makes the cloud disappear? (The particles separate and dissipate into the air.) Have the children place a glass or can full of ice water in front of the spout of the kettle. What happens now? (Water droplets form on the glass or can.) What happens to the droplets? (They get bigger until they are so large that they fall as precipitation.

Conclusions

When water droplets accumulate enough mass through the condensation of water vapor, they fall as raindrops.

6. Problem

How can the mechanism of the water cycle be shown?

Materials

Gallon jars (paste, mustard, or milk) or aquariums; garden soil; small plants; crushed limestone; living moss; glass covering.

Procedure

Have some of the children bring to school a gallon jar with a large opening. (If gallon jars are unobtainable, aquariums can be substituted.) Then place some crushed limestone rocks on the bottom of the jars. (Limestone helps keep the soil from becoming too acid.) Place three inches of soil above the limestone and add some living moss or small fern obtained from the florist. Add enough water so that the soil is moist. Finally, place a piece of glass over the top of each terrarium. After a few days, small droplets of water should be observed clinging to the sides of the glass or hanging from the top of the glass. Where did the water come from? (From the moistened soil and plants.) How did the water get there? (It evaporated, and the vapor was cooled by the glass to form water droplets.) Must water be added to the terrariums? (Not much, if any at all, as the moisture stays within the container.)

Conclusions

A sealed terrarium can represent the water cycle in nature. Water evaporates and turns to vapor. When it is cooled, it condenses, forming particles of water.

CONCEPT - Water has many uses and is necessary to plant and animal life.

1. Problem

What factors affect water pressure?

Materials

No. 10 tin can or tall fruit juice can; water; nail; hammer ruler; small corks.

Procedure

Explain to the children that one of the factors involving pressure on liquids is depth. Have a child use a nail and a hammer to make one hole near the top of the can, one in the middle, and one near the bottom. Plug each hole with a piece of cork. Fill the can with water and have one of the children pull out the bottom plug. What happens? (The water comes out.) Why? (Water is heavier than air and is pulled down by gravity.) Measure with a ruler and record the horizontal distance from the can to the point to which the water is forced. Replace the plug. Have a child fill the can with water to the same level as before and remove the middle plug. Measure the horizontal distance this stream of water is forced from the can and record the measurement. Repeat with the top cork and measure. What is observed? (The lower the outlet, the greater the pressure and the greater the distance the water is pushed.) Why is there greater pressure on the bottom? (The height of the water is greater above the bottom hole than it is above the top hole.)

Conclusions

Pressure of water is partially controlled by the height of the water above it.

2. Problem

How can water be purified for drinking?

Materials

Pond water; filter paper; funnel; test tube; microscope; microscope slide; medicine dropper.

Procedure

Examine a few drops of pond water under the microscope. Is plant or animal life observed? (Some protozoans or algae may be observed.) Now take some filter paper, fold it in half, then in half again, open it up to form a cone, and then place it in a moist funnel. Place the end of the funnel in the test tube. Pour some of the pond water in the funnel. What happens to the water? (It passes through the filter paper.) The filtered water comes out and passes into the test tube. What is the appearance of the water? (It is clear.) Examine some droplets of this water under the microscope. Is there any sign of plant or animal life? (No.) Why not? Discuss the possibility that the water still might have some living things in it that are not visible through the ordinary microscope, so water should be boiled or have chemical added to it before being used for drinking.

Conclusions

Filtering water helps to purify it by removing dirt particles and tiny organisms. Chemicals are usually added to water to make it completely safe for drinking by killing any harmful things in it.

3. Problem

What is meant by "hard" water?

Materials

Epsom salts, water, table salt, soap solution, 2 test tubes or olive bottles.

Procedure

Dissolve a teaspoonful of Epsom salts in a quart of warm water. Can the Epsom salts be seen? (No, the salts are dissolved.) How can it be proved that the salts are still there? (Evaporate a tablespoonful of the solution in a Pyrex test tube by placing the tube over a hot plate. Note the white powder that remains.) Fill one of the test tubes with the solution and half of the other test tube with rain water. (Rain water is soft water, because it is free of dissolved minerals.) Both of the liquids should be at the same temperature. Into each test tube empty one-half a medicine dropper of soap solution. The soap solution from a soap dispenser can be used, or a solution can be made by chipping a cracker-size piece of soap into a pint jar of rain water. Shake each test tube twenty times, while holding the thumb over the opening. What happens in each tube? (There are a few suds in the test tube with the water containing Epsom salts- the hard water. There are more suds in the test tube containing rain water - soft water.)

Conclusions

Hard water contains much dissolved mineral matter. Soap suds form with difficulty in hard water.

4. Problem

How can hard water be softened?

Materials

Borax; Epsom salts; water; soap solution; beakers; washing soda; cotton cloth, petroleum jelly.

Procedure

To a quart of rain water add a teaspoonful of Epsom salts to make the water hard. Pour some of this hard water into a beaker until it is half full and then add three medicine droppers of soap solution to it. Cut a 6-inch square of cotton cloth. Rub petroleum jelly on the cloth and get the cloth dirty by rubbing it on the floor. See that the dirt is equally distributed and then cut the cloth in half. Try to wash one piece of the cloth in the beaker of hard water that contains the soap. Pour some of the hard water into a beaker so that it is about half full. Make a softening agent by mixing five teaspoonfuls of washing soda in a glass of warm water. Allow the mixture to settle, add the soap mixture to the hard water. What happens? (The mixture turns cloudy.) Allow it to settle overnight. What happens to the cloudy mixture? (It turns clear, and the precipitation settles.) (The minerals have precipitated out of the solution.) Add three medicine droppers of the soap solution. Wash the other half of the dirty cloth in this solution. Does the cloth get clean? (Much cleaner than when the hard water was used.)

Conclusions

Washing soda will soften hard water by precipitating the minerals out of the solution.

5. Problem

Can forms of plant life be found in surface water?

Materials

Pond water; magnifying glass; microscope; microscope slides; medicine dropper.

Procedure

Collect some water containing green scum from a pond, lake, or stream. Use a magnifying glass to examine the green plant life. Then observe the green scum more closely with the use of a microscope. What is the composition of the scum? (It is probably composed of tiny strands or filaments of algae.) What color is observed? (Green) This green color is due to the pigment chlorophyll. Chlorophyll is necessary in the manufacture of food and giving off of oxygen into the water and air during the process of photosynthesis. How is the chlorophyll distributed in the filaments? (In some it is in spiraling bands. In others it may be dotted.)

Conclusions

Many forms of plant life are found in water. Some plant life is dependent upon water and is not found on dry land.

6. Problem

Do some forms of microscopic animals live in water?

Materials

Pond water; microscope; microscope slides; medicine dropper.

Procedure

Use the medicine dropper to remove a few drops of the water. Place the drops on a microscope slide and observe the water through the microscope. Some slipper-shaped, one celled animals called paramecia, some bell-shaped animals called vorticellae, or some funnel-shaped animals called stentors may be seen. There are many more animals, too, that may be seen.

Conclusions

There are many forms of animal life in stagnant water.

Evaluation

Included here are samples of evaluation items which could be used in developing your own informal testing program. These suggested types of items cover the particular science area that has been developed in this section of the handbook. This also means they could be used to help develop informal testing to cover large areas of information (monthly, mid-year, end-of-year testing). These are by no means complete tests as such. You will adapt and develop items to meet your particular class's own individual needs and differences.

Answer the following:

1. Why is water so important to us?

   (Water is needed for drinking, cooking, bathing, transportation, recreation and as a habitat for many plants and animals.)

2. Why is irrigation useful?

   (It makes it possible to grow crops on otherwise barren land.)

3. How can water from a reservoir be made to flow upwards without a pump?

   (By having the reservoir higher than the place to which the water is going. The water will then flow upward in any sections of the pipe that slant upward.)

4. What happens to most underground water?

   (It returns to the ocean by way of streams and rivers.)

Complete the following sentences.

1. In seawater, sound travels at a speed of about (4,800) feet per second.
2. The ocean covers about (70) per cent of the earth's surface.
3. An ore that contains aluminum is (bauxite).

Write a brief but complete answer to each of the following.

What are two important causes of ocean currents?

(a. When masses of water of different temperatures meet, currents can result because the cooler water is heavier and sinks. b. When masses of water of different densities meet, currents can result because the denser water sinks.)

Write the number of each word group in column A in the space before the item in column B that it best matches.

A		B
1. High water table	(3)	a. Erosion
2. A hole down to the water table	(1)	b. Swamp
3. Washing away of soil	(5)	c. Desert
4. Porous layer sandwiched between nonporous layers	______	d. Shaft
5. Low water table	(2)	e. Well
	(4)	f. Artesian formation
	______	g. Forest

Think of a word that correctly completes each sentence and write it in the blank space.

1. Water that evaporates into the air becomes (water vapor).
2. The travel of water from the earth to the air and back to the earth is called the (water cycle).
3. Water can be stored in places called (reservoirs).
4. Carrying water in ditches or pipes to dry fields is called (irrigation).
5. Water in the air may return to the earth in the form of (rain, snow, sleet).

Underline the correct answer in each of the following sentences:

1. The number of elements that have been found in seawater is about

   a. 20 b. 50 c. 60 d. 100

2. Atmospheric pressure at sea level is about ________ pounds per square inch.

   a. 10 b. 15 c. 20 d. 25

3. A scientist who studies the causes of ocean currents is a(n)

   a. hydrographer b. paleobiologist c. metallurgist d. microbiologist

A list of terms is given below. Select the term from the list that goes with each statement. Write the term in the space before the statement.

Sediment	Qualitative analysis	Plankton	Core sample
Nodule	Quantitative analysis	Fungi	

1. (Qualitative analysis) - to find what substances are present.
2. (Nodule) - lump of metal from the bottom of the ocean.
3. (Quantitative analysis) - to find how much of a substance is present.
4. (Core sample) - sediment layers from the bottom of the ocean.
5. (Plankton) - tiny living things in the sea.

Vocabulary

One of the strongest keystones of scientific efficiency lies in its vocabulary. The scientist says things precisely, accurately, and briefly. Probably one of the greatest quarrels the science teacher may have with the elementary level teaching today is vocabulary. The science teacher can have no use for vocabulary that is not precise and accurate. Precision in vocabulary is necessary for understanding and meaning of the concept or process being learned.

The words listed below are the basic vocabulary for the indicated area of study. After each word has been introduced, its meaning is to be maintained and extended at each succeeding level of study.

absorb
cloud
current
dam
density
ditch
dissolve
evaporate
evaporation
filtration
flood
fog
gravity
instruments
irrigation
nonporus
ocean
oceanographer
pollution
porus
precipatation
pump
pumped
purified
reservoir
salt
temperature
tunnel
underground water
water
water cycle
water table

Children's Books

Books are a very essential part of the instructional materials in elementary schools which provide superior learning experiences for children. The selection of those books poses a difficult problem for librarians, teachers, and administrators because the science field is broad and increasing in scope, and elementary school science programs are varied in nature. Some of the more common specific difficulties in choosing books are (1) finding material which deals with the varied interests of children; (2) locating materials which give information correlated with the local school district's instructional guides; (3) finding books of appropriate reading difficulty; and (4) selecting the best books from the many available.

The following list gives help related to the first three difficulties presented. Indirectly, it also helps with the fourth, for the best books cannot be selected until they are located. Further, the brief annotations should be of help with the fourth, for the best books cannot be selected until they are located. Finally, time should be saved in the selection of a "best" list if some information about the reading difficulty of available books is provided. It is hoped that this list will suggest for elementary teachers books that are supplementary to basic text series, and that these books will have value either as sources of information or for recreational reading.

It is always hazardous to specify an exact grade placement for a book because of variations in pupil reading ability in any class group, because of different uses made of books. Consequently, the lowest grade levels for pupil use are indicated. At lower levels these same books may be useful if the teacher reads to the children.

The following list was adapted from the publication, Children's Catalog, 1966.

Adler, Irving Rivers (by) Irving and Ruth Adler. Day 1961 480 illus maps $2.39 (3-5) "Explains the formation of rivers and effects of erosion, weathering, and the water cycle. Methods of controlling and using a river's power also are mentioned."

Bartlett, Margaret Farrington Where the Brook Begins; illus. by Aldren A. Watson Crowell 1961 unp illus (Let's-Read-and-Find-Out Science Bks) Boards $2.95 (K-2) "Brooks begin in all kinds of places--in swamps and ponds and springs. A brook is very little when it begins. When little brooks meet, they become big brooks or rivers. Where the water in a brook comes from, and how the brook gets bigger is described in rhythmic words and pictures."

Brindze, Ruth All About Undersea Exploration. Random House 1960 145p illus map (Allabout Bks) boards $1.95 (5-7) "This book illustrated with photographs tells of the exploration of the ocean by helmet and Scuba divers, by bathyscaphe and submarine. It describes the scientific research of seagoing oceanographers and discusses the equipment and discoveries of undersea archeologists, photographers, oil geologists, and cable experts.'

----The Gulf Stream; illus. by Helene Carter Vanguard 1945 62p illus maps boards $3.95 (4-7) "Beginning with Columbus and the first speculations about the mysterious objects which came floating from the West, the author tells how the Gulf Stream affected the discovery and exploration of the New World, how man later studied it, and how it affects American and European weather, climate, and navigation."

-----The Rise and Fall of the Seas; The Story of the Tides; illus. with photographs and diagrams by Felix Cooper. Harcourt 1964 96p illus maps $3.50 (5-7) The author tells "how sun and moon draw up the oceans to produce the tides and their amazing variations in height and depth, how tides are measured and predicted, how men have made use of them in the past and may in the future, and . . . how earth and air, too, are subject to tidal motion."

Buehr, Walter World Beneath the Waves; written and illus. by Walter Buehr. Norton 1964 112p illus map $3.25 (4-6) "In a stimulating introductory book on oceanography Mr. Beuhr explains the characteristics of the earth's ocean and their relationship to all life on earth. He describes the vast ocean bottoms and marine, vegetable, and animal life from the microscopic to the largest specimen."

Cook, J. Gordon Exploring Under the Sea; drawings by Leslie Haywood. Aberlard-Schuman 1964 159p illus $3.75 An account of underwater diving, its methods, and equipment, including "the story of the diver's dress from the initial clumsy attempt to those in constant use all over the world. The development of the submarine is traced . . . (How) early diving bells and underwater (rooms) have led to the bathysphere is also described."

----The First Book of the Ocean, by Sam and Beryl Epstein: pictures by Walter Buehr. Watts, F. 1961 72p illus maps $2.65 (3-6) "The authors discuss waves, tides, and the different kinds of currents; the ocean floor and the instruments that measure it are explained with clarity. Marine plants are described briefly, marine animals more extensively; ocean exploration and the devices used for this are described and illustrated. A final section proposes some of the future developments of marine resources for food."

Feravolo, Rocco V. Junior Science Book of Water Experiments; illus. by Lewis Zacks. Garrard 1965 64p illus (Junior Science Bks) $1.98 (3-4) "The mysteries of water--where it comes from, of what it is made, how it behaves, why it falls as rain, are explained . . . . The book shows how to use . . . everyday objects to perform experiments that let the child see for himself the properties of water."

Fisher, James The Wonderful World of the Sea. Garden City Bks 1957 68p illus maps boards $2.95 (5-7) "This is an oversize book profusely illustrated with maps and pictures in color. Coverage is broad rather than deep, since the author surveys many aspects of the sea. The formation of the oceans and their relationships to wind, sun and other natural forces and processes are told in an excellent introductory chapter. Evolution of animal life and the varieties of the species that now exist are next outlined. The remainder of the book treats of man and the sea: the progress in navigation, exploration and utilization of the natural resources of the sea."

Gans, Roma Icebergs; illus. by Bobri. Crowell 1964 unp illus (Let's Read-and-Find-out Science Bks) boards $2.75 (1-3) The author describes these huge islands of ice, "tells how they are formed and what they mean to sailors, how they finally disappear and why there are always new icebergs to replace them."

Holsaert, Eunice A Book To Begin On Ocean Wonders, by Eunice and Faith Holsaert; illus. by Leonard Kessler, Holt 1965 unp illus boards $2.75 (1-3) This book "presents an account of the many wonders of the ocean--from the strange plant and animal life to the deep sea boats devised by man to study these phenomena."

Lane, Ferdinand C. All About the Sea; illus. by Fritz Kredel Random House 1953 148p illus maps (Allabout Bks) $1.95 (4-6) "How the sea began, the story of tides, what the ocean floor is like, description of the creatures to be found in or near the sea, and man's use of the resource of the world's oceans, are all a part of the material in this book."

Poole, Lynn Danger! Icebergs Ahead! By Lynn and Gray Poole. Random House 1961 81p illus maps (Easy-to-Read Science Bks) $1.95 (3-5) "Written with great simplicity and good organization of material; photographs, maps, and diagrams... The authors describe glacial flow, iceberg formation, and the movements of iceberg in ocean currents. Several chapters discuss the work of the International Ice Patrol in locating, reporting, and bombing icebergs."

Richards, Leverett G. Ice Age Coming? The Story of Glaciers, Bergs and Ice Caps Day 1960 128p illus maps $3.50 (4-6) "Describes the great ice age, the recent movement of glaciers, man's adjustment to and use of ice and glacial phenomena, the formation, dangers, and effects of icebergs, methods of investigation, and possibility of another ice age. With a glossary of special terms."

Riedman, Sarah R. Water For People; illus. by Bunji Tagawa Rev. ed. Aberlard-Schuman 1960 Maps illus map $3 "Describes the importance of water to human life, discussing its origin, properties, forms, uses, power, water and weather, water supply, shortages and conservation."

Schloal, G. Warren The Magic of Water, by G. Warren Schloat, Jr. Scribner 1955 unp illus $2.97 (2-5) "By means of photographs and diagrams, the author gives a general description of the composition, use and value of water. He also suggests a few easy experiments, such as the construction of a simple water wheel to demonstrate water power."

White, Anne Terry All About Great Rivers of the World; illus. by Kurt Wiese. Random House 1957 150p illus maps (Allabout Bks) $1.95 (5-7) "An explanation of rivers in general, then descriptions of five specifically; the Nile, Amazon, Yangtze, Volga, and Mississippi. The influence of rivers on civilization is incalculable, and Mrs. White touches on many of their most outstanding contributions. She has obviously done much research . . . Considering that this is easy enough for many fifth graders to enjoy, it does a remarkably good job of explaining what rivers are, how they came to be, and how they affect man. A well-written book to read for pleasure, as well as in connection with study."

Films

These films are available from the Central Audio-Visual Department. Contact your building A-V Coordinator to arrange for the use of these films.

All films should be previewed to determine suitability for use with your particular class.

Finding Out About the Water Cycle	$13\frac{1}{2}$ min.	Col.	Gds. 3-6

When the spring near their camp runs dry, two children seek help from the Forest Ranger and learn about the effect of a dry season on the Water Table and how the water cycle works. Live action, animation and art are combined to clarify the concepts presented.

Great Lakes: How They Were Formed	11 min.	B & W	Int.

The film uses animated drawings and live action photography to depict the work of glaciers in forming the Great Lakes thousands of years ago; clearly defines the present day drainage of the Lakes and the physical characteristics of Niagara Falls. Photography of the Lakes and of the region around the Falls illustrates topographical changes now occurring.

Problem With Water Is People, The	30 min.	Col.	Int.

Film examines the potential crisis in the nation's most vital natural resource, water. Viewers of this film are taken along the course of the Colorado River, and into cities, town, factories and farmlands across the nation, depicting the use and abuse of our water supply in a variety of ways.

Water and What It Does	10 min.	Col.	Int.

Presents through simple experiments the various properties and characteristics of water. Spotlights a drop of water as seen through a microscope, stressing movement of molecules. Experiments show evaporation, condensation, expansion, and water power.

Water Cycle	10 min.	B & W	Int.

The film tells the story of the endless cycle of water from earth to sky to earth; reveals seepage, formation of the water table, movements of ground water, and the circulation of water on the earth's surface.

Water - Lifeblood of the West	$12\frac{1}{2}$ min.	Col.	Int.

The film shows irrigation projects built by the Government in various parts of the country. Projects included are the Roosevelt Dam in Arizona, Elephant Butte Dam in New Mexico, Boulder in Arizona and Grand Coulee on the Columbia River. The dams shown are used primarily for storing water for irrigation in semi-arid western areas. Emphasis is placed on Hoover Dam between Arizona and Nevada.

Waves On Water 16 min. Col. Int.

Did you know that even though wave forms travel at a good rate of speed, the water does not move? By using large experimental tanks, waves refraction (waves approaching shore bend to conform to coast-line) is explained. Documentary evidence is presented proving that the seismic sea waves which crossed the Pacific Ocean in April, 1946, were directly associated with an underground earthquake that took place near the Aleutian Islands.

Water, Water, Everywhere 10 min. B & W Int.

The experiences of twelve year old Jimmy describe how water evaporates. Playing at the edge of a pool he realizes that plants, animals and all living things require water. He sees water fall from the clouds during a thunderstorm. He wonders what happens to the water in wet clothes drying on a line, a dried up puddle, and empty bird bath. He wonders about steam as his mother irons. He learns how invisible water gathers in the air, forms clouds, and descends to earth in many forms.

Wise Use of Water Resources $13\frac{1}{2}$ min. Col. Int.

The film illustrated concepts relating to properties of water, its abundance, value as a natural resource, its use for consumer supply.

Wonders of Water 12 min. Col. Int.

Uncle Bob solves the mystery of H_2O for his young friends. He uses electrolysis equipment in a dramatic way to separate water into hydrogen and oxygen; introduces the student to molecules and the nature of gases. The water cycle is discussed; evaporation and condensation are explored.