DOCUMENT RESUME

ED 111 661 SE 019 604

AUTHOR Abernathy, Sandra
TITLE Earth Science Unit for Second Grade: A Seed Crystal Approach.
PUB DATE Aug 75
NOTE 65p.

EDRS PRICE MF-$0.76 HC-$3.32 Plus Postage
DESCRIPTORS Curriculum; *Earth Science; Elementary Education; *Elementary School Science; Grade 2; *Instructional Materials; *Science Activities; Science Education; Science Units; *Teaching Guides

ABSTRACT

This teacher's guide to a second-grade earth science unit provides a range of activities, suggestions for classroom discussion, and open-ended questions suitable for each of the concepts developed. One of the central purposes of the unit is to develop independence and self confidence by encouraging the student to think through a problem clearly. The questions and activities give the student practice examining facts at hand and drawing logical conclusions in a nonthreatening atmosphere. For this reason, there are no tests at the end of each section. This is a seed crystal approach; its purpose is to begin building an accurate picture of the planet. Awareness, not mastery of concepts and terms, is the major objective. The first section of the unit, "Physical Nature of the Planet Earth," is conceptually oriented; the student learns facts about the planet and uses that information to solve a problem. The second section, "Physical Nature of Rocks, Minerals, and Fossils," is more concerned with application; the student learns a skill which is used to solve a problem. Also included is a section about careers in geology and paleontology. (Author/MLH)

A seed crystal:
A nucleus upon which
a structure of indefinite
size can be developed

EARTH SCIENCE UNIT FOR SECOND GRADE:

A SEED CRYSTAL APPROACH

by

Sandra Abernathy

New Mexico State University

Las Cruces, New Mexico

August 1975

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I. INTRODUCTION

"Science"--The word intrigues most second graders. Add to it "Dinosaurs," "Rocks," "Volcanos," and "Things That Go Bump in the Earth," and you have a sure-fire combination for a Second Grade Earth Science Unit. I taught a hazy Earth Science Unit when I taught in a self-contained classroom. Now I am the science teacher in a team-teaching situation and a "hazy unit" doesn't seem appropriate any more. Thanks to Professor Les Tofte of New Mexico State University Geology Department, my hazy background is clearer and, also thanks to him, my hazy unit has taken on a visible form because I completed this unit as a special problem during the summer of 1975.

My prime purpose as a teacher is to teach independence. I want a student to learn to think through a problem clearly and to have enough confidence in himself to try. Therefore, this unit has many questions and activities to give the student practice examining facts at hand and drawing a logical conclusion in a nonthreatening atmosphere. For this reason, there are no "tests" at the end of each section. This is a seed crystal approach; its purpose is to begin the building of an accurate picture of the planet. Awareness, not mastery of concepts and terms, is what is hoped for.

The unit was written for local use in the Mesilla Valley. The surrounding areas were used as examples of different rock origins and formations. The rock, mineral, and fossil samples are mainly from local sources. I hope, however, that the unit will not only stimulate interest in local areas but will also generate questions like these in some students' minds during, say, a summer vacation: "I wonder how old these rocks are?" "How were they formed?" "What lived here then?" "What kind of rock or mineral is this?" I also hope the unit will develop the skills necessary to test a rock or mineral and promote the feeling of confidence that "I can tell something about this sample!"

I tried to pack everything I thought might be useful in a second-grade Earth Science Unit into this unit--as many concrete explanations, demonstrations, and activities as possible. Ideas for extra, supplemental activities are included in Appendix B. Crystal-growing activities are described in Appendix A. The object in using this unit, then, is to choose those sections appropriate to the current group of students. Part A, "Physical Nature of the Planet Earth," is conceptually oriented--learning something about the planet and using that information to solve a problem. Part B, "Physical Nature of Rocks, Minerals, and Fossils," is concerned more with application--learning a skill which is used to solve a problem.

I am looking forward to choosing, changing, adding, and deleting during the next school year. The "goofs" I will make when trying this unit will merely show that I am as human as my students. "Goofs" are an excellent way to learn.

II. UNIT

OUTLINE OF EARTH SCIENCE UNIT FOR SECOND GRADE

A. Physical Nature of the Planet Earth
- I. Global aspects of the planet
  - A. Possible origin of the planet
  - B. Relative size of the earth
  - C. Structure of the planet
    - 1) Internal
    - 2) Three spheres
  - D. Age of the earth
  - E. Changing surface of the earth
- II. Forces acting on the earth's surface
  - A. Earth being worn away
    - 1) Weathering
      - a) Plant and animal life
      - b) Chemical change
      - c) Temperature change
    - 2) Erosion
      - a) Gravity
      - b) Wind
      - c) Animals
    - 3) Soils
      - a) All soils not the same
  - B. Earth being built up
    - 1) Sediment deposition
    - 2) Folding and faulting
    - 3) Volcanic action
  - C. Size of earth remains constant
    - 1) No subtraction or addition of material by forces acting on the earth

B. Physical Nature of Rocks, Minerals, and Fossils
- I. Rocks
  - A. Classification by origin and texture
    - 1) Igneous
    - 2) Sedimentary
    - 3) Metamorphic
  - B. Classification by density
  - C. Composition of rocks
- II. Minerals
  - A. Composition
    - 1) Single compound
    - 2) Crystalline structure

B. Properties
   1) Shape
      a) Form
      b) Cleavage
   2) Luster
   3) Streak test
   4) Solubility in acid
   5) Magnetic test
   6) Hardness test

III. Fossils
   A. Origin and definition
   B. Identification
   C. Dinosaurs as fossils

IV. Uses of rocks and minerals

V. Careers in geology and paleontology

VI. Experiences in identifying rocks and minerals

A. PHYSICAL NATURE OF THE PLANET EARTH

I. GLOBAL ASPECTS OF THE PLANET

Awareness Concepts

A. Possible origin of the planet--dust cloud theory

B. Relative size of the earth

C. Structure of the planet

   1) Internal--cross section

   2) Three spheres--lithosphere, hydrosphere, atmosphere

D. Age of the earth

E. Changing surface of the earth

Awareness Activities

A-E. Watch the movie, LC 1061, "Face of the Earth." Discuss the origin of the earth, the internal structure of the earth, the size and age of the earth, the building up and wearing down of the face of the earth.

B. Discuss the size of the earth, relative to us. Measure the circumference of a globe with string or tape. Draw the length on the board. Measure from Las Cruces to where the children have traveled. Draw the length on the board. Can you measure the length between Las Cruces and El Paso?

C-1. Discuss the internal structure of the earth and relative temperatures of the parts. The core is very hot and heavy. The mantle is liquid rock. The crust is cool, very thin, solid, brittle, and cracks. Blow up a balloon. Fold over the ends and secure them with a clothespin. Dip in plaster of paris. Let set until dry. Push on one side and plaster of paris skin will crack. Internal forces are pushing on the crust which is so thin, cool, and brittle that it cracks. Have the children draw a cross section of the earth using a pencil and string for a compass. Have them show the relative widths of each part. Have them label the parts and title the drawing. A wall chart will help them draw.

C-2. Discuss the three spheres of the planet with respect to altitude, pressure, and amount of oxygen. Show a chart with the three spheres labeled. Explain the derivation of the three names. Can you run as fast and as far in the mountains as here? Why? What about airplanes? How can they carry passengers safely at such high altitudes? What about astronauts? What do they need in space? What do divers need when they go deep into the ocean? Draw the conclusion that at the edge of the atmosphere there is little pressure from weight of air and gravity. At the surface of the earth there is what we need (amount and weight of air, gravity). As we go below the water level, the weight of air and water above us increases and the pressure increases. Do rocks weigh more than water? If they do, they would sink in water. What kind of pressure do you think you would feel if you were a rock deep underground? The weight of all that air and rock above you would be pushing down on you--crushing you. You would have to be very strong to withstand the pressure.

C2. Discuss the surrounding terrain--Organ Mountains, Mesilla Valley, ditch on the south side of the playground, slope of the playground, etc.

D. Discuss the age of the earth. Show a blank time line on a transparency. Have the children guess and mark on the time line; how old is the earth, when did man appear on the earth, when did the dinosaurs leave, when did life become evident on earth. When these ideas have been marked, superimpose an actual time line showing the above times.

D. Write the age of the earth on the chalkboard and use place value to read the number.

D. Discuss the relative ages of the rocks at these areas:

Organ Mountains - Tertiary - 40 million years old

Bishop's Cap - Late Mississippian - 320 million years old

Robledo Mountains - Middle Permian - 240 million years old

playground rocks (regolith, nonconsolidated elastic material) - 5,000 years old

E. Discuss the changing surface of the earth. Has the earth always looked as it does now? Does it change? Has this area always been a desert? (Where did the fossils come from that the fifth graders collect on their annual field trip?) Have the Organ Mountains always been as high as they are now? (They have risen a few inches in the last 40 years.) How could someone measure the rise of mountains? The Organ Mountains have lost several miles of rock above what you see now. What happened to it? How do we know it was once there? (Phaneritic rocks are the only form several miles underground.) How do we know how old rocks are? (Radiocarbon dating.) What happens when the wind blows, people walk, water runs, trees grow, rain falls? Why is the land not all flat? (These are questions to pose, not necessarily to answer at this time.)

II. FORCES ACTING ON THE EARTH'S SURFACE

A. EARTH BEING WORN AWAY

Awareness Concepts

1. Weathering--the surface is crumbled
    - a) Plant and animal life
    - b) Chemical changes--rainwater can rot rocks
    - c) Temperature change--heat and cold
2. Erosion--the surface is carried away
    - a) Gravity--the powering force for all downhill movements
        - 1) Water moving
        - 2) Glaciers
        - 3) Landslides

b) Wind

c) Animals

Awareness Activities

1-a. Discuss the strength of plant roots. Sidewalks can be lifted up by a tree root. Could plant roots break a rock? Mix plaster of paris to the consistency of cream. Let it set until it is firm (about 20 minutes). Place radish seeds on top. Place several thicknesses of wet paper toweling over them. Keep the toweling moist. Check how extensive the root system is after a few days.

1-a. Discuss earthworms eating soil and garbage and physically and chemically breaking it down.

1-b. Discuss the strength of plant seeds. What happens if seeds fall into a crack in the rock, it rains, and the seeds begin to swell and sprout? Pack seeds tightly into a glass jar. Fill it half full of water. Seal. Pack seeds tightly into a second glass jar. Fill it half full of water. Do not put a top on. Pack seeds tightly into a third glass jar. Do not put water in it. Place each jar in a separate sealed plastic bag. Let them stand overnight. What happened? Why? (Baby food jars and zip-type plastic bags work well.)

1-b. Discuss rainwater. What can it do to rocks? (Make holes in sand; talk about that later.) What about the Carlsbad Caverns? How many caverns have been there? How were they formed? There is a small amount of acid in rainwater and over a very long time it can dissolve some kinds of rocks and many form caverns. Place a spoonful of salt in a glass of water. Place a piece of gypsum in a second glass of water. Place a piece of limestone in a third glass of water. Place a piece of granite in a fourth glass of water. Use a separate spoon to stir the liquid in each glass. Check each day to see what happened. At the end of a week, look at the gypsum, limestone, and granite samples. Scrape them with a knife. Have they changed? (The water, if distilled water was used, could be allowed to evaporate to see if anything had dissolved.)

1-c. Discuss heat and cold. Can the change in temperature crack a rock? (Refer to First Grade Unit on the three states of matter.) What happens when something gets hot or cold (expansion and contraction)? What happens when water freezes? If a jar was filled with water and sealed and placed in the freezer, what might happen? What might happen to a rock with a crack in it that was rained on and then exposed to temperatures below 32°? Or a tree full of sap? Cast three cement 2-inch thick slabs (1/3 cement, 1/3 sand, 1/3 water) in milk cartons. Let set overnight. The next day place one slab outdoors; heat one with a candle or sterno and then sprinkle water on it (expansion-contraction); refrigerate the third and then pour hot water over it (contraction-expansion). What happened?

1-c. Discuss the rocks that rim a campfire. Are they cracked sometimes? Why would this happen? (Fire heats the rock; camper douses the fire with cold water.) Hold a marble (or small piece of obsidian) with forceps in a candle flame for at least 10 seconds. Then dump it into cold water. What happens? Hold a rock in the candle flame and then dump it into water. What happens?

1-c. Discuss the idea that a rock can be porous. Use a sponge as an example of a material that is porous. Place the sponge in a pan of water and watch the bubbles rise. Water is displacing the air. Place a porous rock in a pan of water. What happens? Place a non-porous rock in a pan of water. What happens?

1-c. Place porous rocks such as sandstone or gypsum plus a non-porous rock that have been soaked in water in a plastic bag in the freezer. With luck, there may be some signs of cracking in the porous rock.

2-a. Discuss rain splashing on the ground. What does the ground look like after a rain? Are there holes or humps in the ground? Construct two boxes. Fill with playground dirt. Smooth the surface. Place small flat rocks or bottle caps on the surface. Use the same amount of water for each application. Sprinkle water gently and close to the surface in one box. Sprinkle water hard and far from the surface in the second box. What happened? (Should be small pedestals where the rocks were; they should be higher where the heavier "rain" fell.) (The experiment can be run again with different amounts of "rain," and keeping the sprinkling distance the same, or keeping the rate of application the same.)

2-a. Discuss the results of rain-splash erosion. Have you seen a brand new house right after a rain? What did the outside walls look like right after a hard rain? (Dirty, muddy) What happened? Fill one box with dirt. Place a piece of sod (or start to grow rye seed a couple of weeks before) in the other box. Place splash card (3 x 5 cards mounted on Popsicle sticks) at the end of each box.

Sprinkle each box with the same amount of water from the same height. What happened? Use a different amount of water or a different height and compare results. Would you rather have dirt or grass next to your house? Why? Do you think you could tell something about what kind of rain fell by looking at house walls or fences? (pp. 156-159, STEM: Elementary School Science, Level 2, 1975)

2-a. Discuss rain erosion as it goes downward into the ground. Does rain erode the ground when it doesn't run off? Dig down in the playground dirt outside. (There should be larger particles for the first few inches than farther below, provided that the playground regolith was not hauled in by truck.) If a set of screens is available, a trowel of dirt on the surface and a trowel of dirt from a foot down could be sifted separately and compared, using bar graphs.

2-a. Discuss the force of running water. It can erode hills and mountains. Show pictures of the Organ Mountains. Make a hill of dirt. Run water down the side slowly. What happened? Increase the rate of application. What happened? (Dirt was moved.) What would happen if the hill was made of salt or limestone? (Would dissolve.) Is it just the force of the water acting on the land that erodes the land? What about the small pieces of dirt and sand the water is carrying? What are they doing to the land as they are being carried along? (Works like abrasive cleanser.)

2-a. Discuss the force of running water. It can smooth rocks. Show examples of water-smoothed rocks and tell from where they came. How did they become so smooth? Have they always been this smooth?

Smash rocks or brick. Add half of the pieces to one jar and the rest to another jar. Fill jars half full of water and seal. Do not shake one jar. Shake the other jar 100 times. Pour the pieces into two separate pans. Compare. Pour the contents back into their jars. Shake the second jar for another 500 times. Compare again. The liquid from each jar can be filtered through paper toweling or several layers of cheesecloth to compare the amount of "soil" made. How were the rocks worn down?

2-a. Discuss the force of running water. It can erode gulleys and canyons. Use the example of a rainspout (p. 156, STEM: Elementary School Science, Level 2, 1975). Show pictures of the Rio Grande (p. 92, Ginn Science Program, Level B, 1975) and the Grand Canyon. Discuss what a young river looks like. What happens to the sediment? How much sediment can a fast-moving river hold? A slow-moving river? In what part of the river would you find large rocks? Small rocks? Mud? Why? (pp. 88-101, Ginn Science Program, Level B, 1975)

2-a. Discuss the ability of different rocks to withstand erosion. Why do we have waterfalls? Make a hill of dirt with a water channel. Place a rock wider than the channel in the water's path. Run water down the channel. What will happen to a waterfall after a long time? What were the eroding forces? (Water moving over rock, small rocks moving over rock, possibly water dissolving the rock) Show pictures of Niagara Falls (pp. 120-121, Science: Understanding Your Environment, 1972). Discuss the composition of the falls. There is a layer of hard limestone, a layer of soft shale, then a layer of hard limestone. The water runs over the layer of hard limestone (slowly dissolving it), falls down the side, and undercuts the soft shale underneath. When it has undercut far enough, the limestone layer above falls down and the line of the waterfall moves back. People are worried that Niagara Falls will disappear so they stopped the river's flow in 1969 to see what could be done to stop the erosion.

2-a. Discuss the use of material to control erosion. What was put under the rainspout? Why? Have you seen erosion control projects when you have been camping? (Made with rocks, wire, and stakes) Why are concrete spillways used in earthen flood control dams? What do the flood-control dams do? What do beaver dams do?

2-a. Discuss the use of contour farming to slow erosion on hills. Fill the two soil boxes with dirt. Make furrows lengthwise in one box and crosswise in the other box. Tilt the boxes and sprinkle. Which box had more soil erosion?

2-a. Discuss the force of glaciers in eroding holes and valleys and in smoothing rocks. It is a very slow-moving, heavy, solid force.

2-a. Discuss gravity as the underlying force in physical erosion. It pulls the rain, running water, glaciers, rocks (landslides) down to a lower elevation. Ask if water can run uphill. Sprinkle water at the bottom of the dirt hill. Did the water run up to the top? Why not? What can you say about the beginning of a river and the end of a river? Will water run on a perfectly level spot? What does it do instead?

2-b. Discuss the force of wind. It is strong enough to pick up and carry sand and dirt. What do you feel when the wind is blowing softly? When it blows hard? What is it carrying when it blows hard? Explain sandblasting can be used as a way of cleaning buildings. Look at sandpaper. What is it made of? Rub a piece of wood. Rub a rock. What happened? Explain that some rock tumblers use different sized grit to polish rocks.

2-b. Discuss the force of the wind. Wind carries more sand and heavier sand closer to the ground. What picks the sand up? (Wind) What keeps the sand down? (Gravity) What force must the wind overcome? (Gravity) Where would you find the heavier sand in the air? (Near the ground) Which would pick up more sand, a fast wind or a light breeze? If the wind blew hard against a cliff for a long time, where might you see some erosion? (Near the bottom) Explain that in some areas telephone poles must have armor tacked on the first several feet of the pole to protect it from wind abrasion.

2-a-b. Compare the relative force of wind and water. Which can carry heavier particles? How were river sands, beach sands, and desert sands made? Which could be finest? Why? Which would probably be coarsest? Why?

2-c. Animals can be forces to help or help control erosion. Gophers are thoroughly disliked by farmers and the Bureau of Reclamation because they tunnel underground. Sometimes their tunnels go under borders and into irrigation ditches, causing washouts when the farmer irrigates. Look at the dirt that a gopher brings to the surface. Sometimes it will be very different from the surface soil.

Beavers may help control erosion by building dams and ponding the water.

III. SOILS

Awareness Concepts

1. All soils not the same
    a) Water-holding capacity--permeability
    b) Support capacity
    c) Particle size
    d) Growing capacity

Awareness Activities and Experiments

1-a. Soil permeability. Fill one cylinder (or peanut butter jar) with clay. Fill another with an equal amount of sand. Pour one inch of water on the top of each soil. Which soil allows the water to go through more easily? How far does it penetrate? Measure the depth with a ruler or tape. Which soil do you think would be better to grow plants? Why?

1-a. Soil permeability. Poke holes in the bottoms of three tin cans. Fill each can half full of sand or clay or loam. Set each can on a glass jar. Pour one cup of water into each can. Which allows the water through fastest? How much time did it take until the water began to drip through each can? How much came through? Measure by pouring the water into a measuring cup. Did the three liquids look the same?

1-b. Support capacity. Fill one dish with bentonite, a second with clay, and a third with sand. Saturate each with water. Place a weight (large nut or ball bearing) on top of each soil. Which nuts sink? How far do they sink? On which kind of soil would you like your house to be built?

1-c. Particle size. To identify soils, pick up a small amount of the soil, moisten it, and rub it between your fingers. Sand will feel gritty and clay will form a ball. Which sample is clay? Which sample is sand? Which has finer particles, sand or clay?

1-c. Particle size. Fill a jar half full of playground "soil." Add water, seal, and shake it. Allow the contents to settle. What happened? Can this experiment help tell how the soil was formed? What if all the soil was like the top layer? Or the bottom layer? Why would a road engineer want to use this test?

1-d. Growing capacity. Fill each of three dishes with sand, clay, or loam. Plant radish seeds. Meter the water used so each dish receives the same amount. What happened? Which was the best soil? Why?

1-a-d. Read and perform the experiments discussed on pages 52-64 in Science: Comparing Ideas, 1972.

B. EARTH BEING BUILT UP

Awareness Concepts

1. Sediment deposition--gravels, sands, and soils washed down by erosion and weathering

2. Folding and faulting

3. Volcanic action

Awareness Activities

1. Thought questions to bring out movement of particles

   a) Once upon a time, I was a part of a big rock on top of a huge mountain. Now I am a tiny grain of sand on a beach. What happened to me?

   b) Once upon a time, I was on the edge of a cliff. Now I am at the bottom. What forces made me fall?

   c) Once upon a time, I was a big jagged rock. Now I am a smooth pebble. Where am I and how did I get where I am?

   d) Once upon a time, I was part of the underground rock. Now I am floating around in the ocean, and the place where I was is called Carlsbad Caverns. What happened to me?

   e) Once upon a time, I was on the playground at University Hills School. Now I am near "A" Mountain. How big am I? How did I get here?

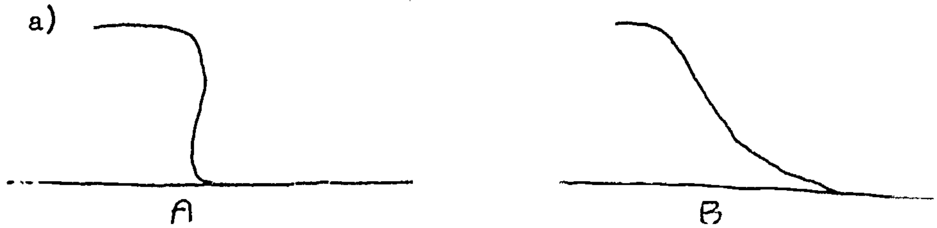
   f) Once upon a time, I was a big rock with a little tree growing next to me. Now the tree is huge and I am in pieces. What happened?

   g) Once I was a little pebble in a mountain stream. Now I am tiny and I am at the mouth of a river. What happened?

   h) Once upon a time, I was a rock on the side of the Organ Mountains. Now I make wood smooth. What happened?

1. Thought pictures to bring out that wearing down in one place leads to building up in another place - two transparencies, one superimposed over the other or two-colored dittos

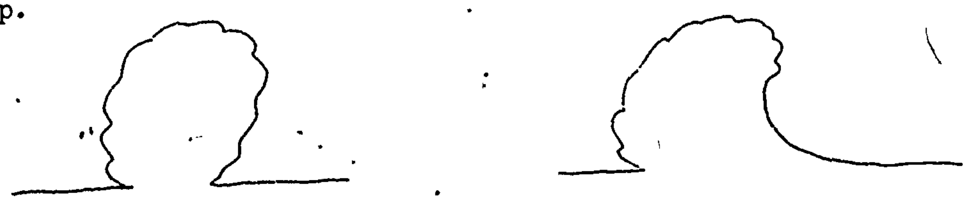
a)



What happened? What might have done it and how? Put a red

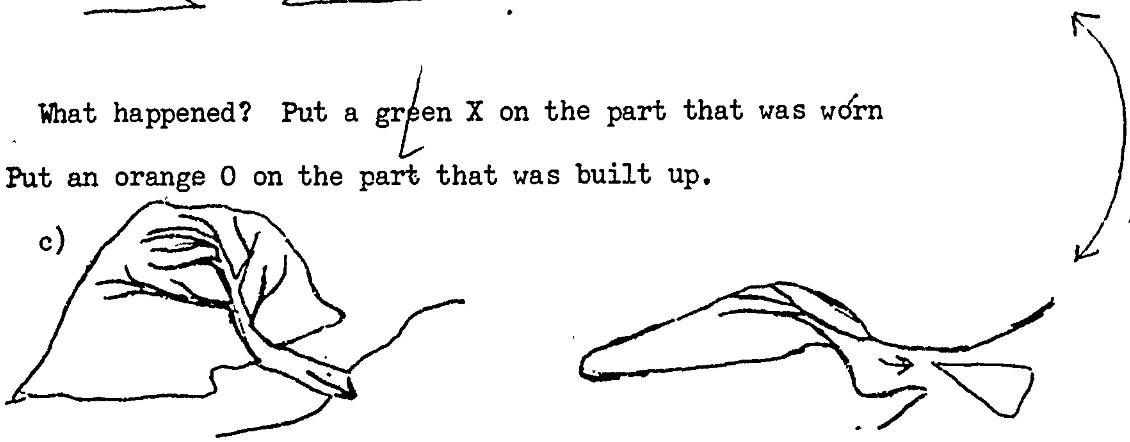
X on the part that was worn away. Put a blue O on the part that was built up.

b)



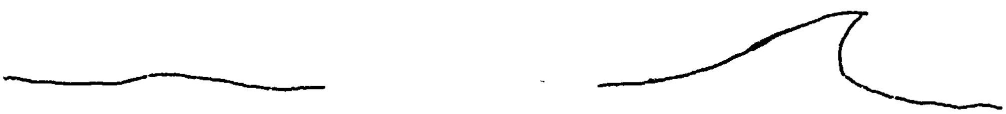
What happened? Put a green X on the part that was worn away. Put an orange O on the part that was built up.

c)



What happened? Put a brown X on the part that was eroded and a pink O on the part that was built up (anchored dune).

d)



What happened? Put a yellow X on the part that was eroded and a black X on the part that was built up (free-moving dune).

2. Discuss folding. Discuss the tremendous weight (pressure) of rock and air on the rock deep underground. The temperature at that depth is very high. The rock should be liquid at that temperature, but the pressure is so great that there is not enough space for the rock to expand, so it remains a very pliable solid. Because of internal pressures, the rock layers may be pushed out of place and folded, but they do not crack. Demonstrate with warm clay layers.

We can see the folding when the rock above the folding is worn away. Show pictures of folding in rocks. Emphasize that folding only takes place deep underground.

2. Discuss faulting. When rock is closer to the surface, it is much cooler and more brittle. When it is pushed out of place (stressed), it cracks or faults. Demonstrate with cold clay layers. One side may move over the other, or one side may slide away from the other. Demonstrate by sliding two triangular pieces of wood over one another. If the fault is well lubricated, the fault blocks will wiggle and jiggle, move up, down, or sideways, and no one will be aware of it. If the fault is sticky, the pressure will build up until the fault block comes unstuck with a jolt (earthquake). We live on one of the most active faults in the world. The mountains on the east and west are moving up very fast. (Fast means a couple of inches in 40 years.) How can we tell? If a fault is moving fast, is this a good place to feel earthquakes? The San Andreas fault is in California. California worries about earthquakes. What is wrong with the San Andreas fault?

3. Discuss volcanic action in relation to faulting. When the fault reaches down to the superheated solid rocks deep underground, the superheated rock can expand and become molten as it fills the crack, is forced up and out by the pressure of the superheated rock below.

3. Volanic action. Watch the movie, LC2030, "Earthquakes and Volcanoes." Discuss faults, earthquakes, and volcanoes.

3. Volcanic action. Make a model vocano erupt. Construct a volcano model from clay or paper mache, chicken wire and paint. Leave a small depression in the top. Line it with foil. Put a tablespoonful of ammonium dichromate crystals in the foil-lined cup. Turn the lights out, light the crystals with a match. Watch what happens. The effects can be seen more clearly if the volcano is set against a white background.

3. Discuss the life of a volcano. Have the children draw the life of a volcano in a sequence of pictures: flat ground, fault, fault block shifting, magma pushing up, cinder cone erupting, plugged, volcano.

3. Read the book, Birth of a Volcano.

2-3. Watch the movie, LC 2021, "Caverns and Geysers." Review limestone caverns and discuss the action of geysers. Radium Springs is an example of a real hot spring. Fayette Hot Springs, on the way to the City of Rocks, is another.

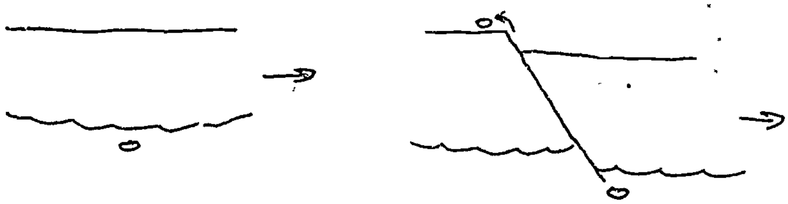
C. SIZE OF EARTH REMAINS CONSTANT

Awareness Concepts

1. The earth's particles are moved in wearing down and building up, but nothing is added or lost.

Awareness Activities

1. Discuss the life of a rock. Matter is very hot, pliable deep underground. It cools as it is brought to the surface and becomes brittle. It is exposed, worn away, settles into layers, hardens into rock, may be pushed underground and changed, and the cycle starts all over.



1. Discuss the balance betwen the building up and wearing down forces. Use number combinations in an equation as an example. The combinations may change any number of times, but as long as the total amount remains the same, the equation remains balanced.

Earth = 10

5 + 5 = 10

6 + 4 = 10

2 + 8 = 10

10 + 0   10

1. Balance between forces. Blow up a balloon. Fold over the end and use a clothespin to seal. Hold the balloon and poke it. What happened on the other side? Dip the balloon in plaster of paris and let dry. Poke the balloon. What happened? Why did cracks appear? Did the total amount of balloon change, or just the shape?

1. Balance between forces. Place clay in a pan. Mold a hill on one side. Push down on the hill. What happened to the hill and the valley? Make the clay level. Push on one side. What happened? Did the total amount of clay change?

B. PHYSICAL NATURE OF ROCKS, MINERALS, AND FOSSILS

I. ROCKS

Awareness Concepts

A. Classification by origin and texture

1) Igneous--fire born

a) Aphanitic--tiny crystals too small to see

b) Phaneritic--crystals big enough to see

c) Porphyritic--mixture of aphanitic and phaneritic

2) Sedimentary - layered material

a) Fine - shale, mudstone

b) Medium - sandstones

c) Coarse - conglomerate

3) Metamorphic - changed from pre-existing rocks

B. Classification by density

C. Composition of rock

1) External vs. internal

2) Ingredients - minerals and other natural solids - and qualities of rock

Awareness Activities: Igneous Rocks

A-1. Discuss the origin of igneous rocks by telling a story using the following concept-words: magma, country rock, extrusive, aphanitic, pluton, intrusive, phaneritic, ore-bearing veins, gem-stones. The story could be told with a flannel board, chalkboard, or transparency pictures:

Once upon a time, superheated rock was pushed up into the country rock, making a puddle called a pluton. Some of the rock found a fault or crack, expanded and melted, turning into magma. It followed the fault and came out at the surface of the earth, making a volcano. Some of the magma was sticky and ran on the ground, forming flows and malpais. Some of the magma was full of gas and was blown out of the volcano like coke comes out of a coke bottle that has been shaken. Both kinds of magma cooled quickly and formed very small crystals. These rocks are called extrusive or aphanitic rocks. Rhyolite, basalt, and lava rock are examples. Basalt lava is very, very hot, about 1000°-1200° C when it forms. It cools very fast since it is on the surface of the earth. It may cool ten feet deep in two years--that's fast.

Meanwhile, back at the pluton. With the relief of pressure, the superheated rock underneath expands, melts, and mixes. The rock ingredients solidify at different temperatures so different minerals form as the temperature of the pluton goes down. They are called intrusive or phaneritic rocks. It may take the pluton a million years to cool. When it gets cool enough that almost all of the rock is formed (and about the last rock to form are the granites about 820°C), there are some leftovers swirling around in the center. As the pluton cools, the outer areas contract and crack. The leftovers force their way into the cracks and crystallize there. The layers are called veins. Valuable metals and gemstones may be found in these veins. Rocks that solidify in a pluton cool more slowly and grow larger crystals.

Supportive Activities

A-1. Have children read pp. 1-18, Vol. 4C, True Science Library, 1963.

A-1. Show examples of igneous rocks such as granite, basalt, obsidian, peridote, lava, diorite, gabbro, volcanic tuff, syenite.

A-1. Show pictures of igneous rocks, SVE pictures, p. 28, Golden Exploring the Earth, Rocks and Minerals, "Igneous Rocks" booklet.

A-1. Show pictures of dikes, cinder cones, etc., pp. 26-27, Golden Exploring the Earth, Rocks and Minerals, charts.

A-1. Make a volcano erupt (Building up Forces).

A-1. Discuss identification of mountains of volcanic origin. They may be sculptured up and down. Examples in our area are: the Organ Mountains, Picacho Peak, Goat Hill.

A-1. Discuss identification of different igneous rocks. Can you see the difference between:

basalt - small crystals (aphanitic)

granite - large crystals (phaneritic)

diorite - large and small crystals (porphyritic)

Awareness Activities: Sedimentary Rocks

A-2. Discuss the formation of sedimentary rocks. Refer to erosion and layering of sediments. Are all sedimentary rocks made of rocks that settled? What happened to all the tiny animals that die in the ocean? What happened to the plants in swampy areas that die? Sometimes they are preserved and become individual fossils. Sometimes they form layers of coal (decayed plants). Sometimes they form oil that may be found in a rock or loose in a layer underground. Coal and oil are called fossil fuels. If you are looking for oil or coal, what kind of rock would you look for? Silver and gold ores are formed deep underground and are igneous rock. Why is gold found in river beds sometimes?

Supportive Activities

A-2. Have children read pp. 19-27, Vol. 4C, True Science Library, 1963.

A-2. Show examples of sedimentary rocks, such as limestone, chalk, coquina, shale, agate.

A-2. Show pictures of sedimentary rocks, SVE pictures, p. 32, Golden Exploring the Earth, Rocks and Minerals, "Sedimentary Rocks" booklet, etc.

A-2. Make sedimentary layers. Mix a half cup each of gravel, sand, and clay in a jar. Fill with water. Seal. Shake. Let it settle.

A-2. Make sedimentary rock model (three layers). Have individual milk cartons ready. Mix cement and water ("shale") and pour a thin layer into the bottom of the milk carton. Let it set. Mix lime plaster and water ("limestone") and pour a thin layer over the "shale." Let it set. Mix sand, cement and water ("sandstone") and pour over the "limestone." Let it set until completely hard. Peel off the milk carton and look at the layers.

A-2. Make a conglomerate model. Mix plaster, pebbles, sand, and water. Pour into individual milk cartons. Smooth the surface so the stones can be seen. Another name for conglomerate is pudding stone.

A-2. Discuss identification of mountains of sedimentary origin. They are usually flat on top. Examples in our area are: Bishop's Cap, Robledo Mountains, mesas in northern New Mexico, and the Sacramento Mountains.

A-2. Discuss identification of different sedimentary rocks. Can you tell the difference between:

limestone - fizzes (effervesces)(calcium carbonate)

conglomerate - coarsely sorted

sandstone - sandy, tiny grains of quartz

shale - fine

Any of these may fizz due to some calcite being present.

Awareness Activities: Metamorphic Rock

A-3. Discuss the origin of metamorphic rock. Refer to insect metamorphosis. Metamorphic rock is rock changed into another kind of rock by heat and pressure. Mix mica into playdough and stretch to show gneissic texture. (Pieces will arrange themselves into flat layers.)

Supportive Activities

A-3. Show examples of metamorphic rock:

limestone to marble

sandstone to quartzite

soft coal to anthracite

granite to gneiss

basalt to greenstone

A-3. Show pictures of metamorphic rock, SVE pictures, p. 35, Golden, Exploring the Earth, Rocks and Minerals, "Metamorphic Rocks" booklet, etc.

A-3. Thinking questions: Marble and granite can be found in the Organ Mountains. Marble is metamorphosed limestone. The Organ Mountains are igneous mountains. What does this tell us about the Organ Mountains? (Limestone means sediments were laid down. To have sediments laid down there must have been higher land for it to come from.) Marble would have been formed deep underground where great heat and pressure would be found. Granite would also be formed deep underground. So there must have been miles of rock above the rock of the Organ Mountains when it was formed.

Limestone might have oil impregnated in it. If it does, it will be dark-colored because of the oil. When this kind of limestone is metamorphosed into marble, it turns white. What happened? Why did the oil disappear? (Heat and pressure boiled off the oil.) Would the Organ Mountains be a good place to look for oil? Why not?

Awareness Activities: Density and Composition

B. Discuss identification of rocks by density. Measure the circumference of two rocks with a string. Measure the string lengths against a tape or ruler.

Measure several rocks with a string until two are found that have similar circumferences. Measure and compare the weights of the two rocks. Do the same size rocks weigh the same amount? Weigh several rocks until two are found that have similar weights. Fill two jars of the same size with water. Place each full jar in a separate dish. Place one rock in each jar. Measure the water that overflowed (displaced). That is the volume of the rock. Were the rocks the same when the weights were the same?

Experiment with several rocks until two are found that have similar volumes. Do they weigh the same?

Draw the conclusion that some small rocks may be heavy and some larger rocks may be light because of their density. The density of a rock is another way to help identify it.

$$\left(\text{specific gravity} = \frac{\text{wt. of sample in air}}{\text{wt. of sample in air} - \text{wt. of sample in water}}\right)$$

C-1. Discuss the composition of rocks. Are rocks the same inside as they look outside? Show an opened geode as an example. How would you break a rock to see what is inside? (Hit it with a hammer and crush it.) Have two children stand face to face together, one child with his back against a solid surface. Have another child push against the two children. Is this a sensible way to separate the children (break the rock)? This is like a hammer hitting a rock to crush it. Rocks are strong in this way. Have two children stand face to face sideways against a solid surface. Have another child make his hands and arms into a wedge and see if he can force the wedge between the two children. Can you break the "rock" this way? This works like a chisel or the narrow part of the hammer. It shears the rock apart. Rocks have layers too and rocks are not as strong in this way. How do you think the geode was opened? What would have happened if it had been hit with a hammer? How do you open an egg? (By hitting it on a narrow edge) Show a geology hammer, chisel, and goggles. Demonstrate how to hold the handle for most leverage, use of the hammer with and without a chisel. Stress safety factors in cracking rocks: Wear goggles to protect eyes from bits of flying rock; check to see where other people are before using the hammer.

C-2. Discuss the composition of rocks. Show a conglomerate rock. What are rocks made of? Conglomerate rock is made of several dissimilar smaller rocks. Show a piece of granite. Point out the different smaller particles. Explain that these are called minerals and name them (dark - hornblende, shiny - quartz, feldspar - dull).

Refer to the fudge idea. Rocks may be made up of several different ingredients. Minerals have only one.

Discuss the non-mineral content of rocks. Show samples of petrified wood, coal, fossil. Remind the children of the ancient origin of these types of rocks. Tell them these cannot be minerals. Ask them to tell why? (Once alive)

Discuss the qualities of a rock. Show several rocks. Are these rocks? Is water a rock? Why? (Liquid) Is grass a rock; it is solid? Why? (Living) Is your desk a rock; it is solid and non-living? Why? (Man-made) Conclude that a rock is solid, non-living, not man-made, may have several ingredients, was made of minerals and/or ancient, once living material that has changed.

II. MINERALS

Awareness Concepts

A. Composition

1) Single compound

2) Crystalline structure

3) Qualities of minerals

B. Properties

1) Shape

a) Form

b) Cleavage

2) Solubility in acid - vinegar

3) Luster

4) Streak test

5) Magnetic test

6) Hardness test - Moh's Scale

Awareness Activities: Mineral Composition

A-1. Discuss the composition of minerals. A mineral is made up of a single ingredient in the "fudge." Each mineral has special characteristics that make it different from other minerals just as people are different from dogs. A mineral may have different shapes and colors (show pictures of quartz, feldspar, and calcite groups), just as dogs come in different colors and shapes.

A-2. Discuss crystalline structure of a mineral. When the mineral cools slowly (how must it have been formed?), it will form crystals. Good crystals take hundreds of years. Crystals are formed like a block house - out of layers of blocks and mortar. However, it is a solid house. The crystal starts at the center as a seed crystal and grows in all directions. Show a model of a crystal made from gumdrops and toothpicks or made with leggos. The shape of the crystal can help identify the kind of mineral. Sometimes the "mortar" between the layers is not very strong and the mineral will break along a line. This is called cleavage. It is also a way to identify a mineral.

A-3. Discuss the qualities of a mineral. Show examples of minerals--talc, quartz, quartz crystal, feldspar, calcite mica, corundum, graphite, fluorite, calcite, salt. What is a mineral? (Single compound, never lived, not man-made, solid) Salt is a mineral. We mine it out of the ground where it was deposited by evaporation. (How was it probably made?) Pour some salt into a glass of water and stir. Is the salt still a mineral? Show sugar and a sugar crystal. Sugar is manufactured from sugar cane or sugar beet plants. Is sugar a mineral? Why not? (Man-made, from once-living material) Can a non-mineral have a crystalline structure?

Supportive Activities

A-1-2. Have children read pp. 33-39, Vol. 4C, True Science Library, 1963.

A-2. Show pictures of crystals, SVE pictures, Color Treasury of Crystals, 1972.

A-2. Watch the movie, LC 2130, "Crystal Gazing." Discuss the formation of crystals, what common substances have a crystalline form, and the beauty of crystals.

A-2. Grow crystals. For recipes, refer to Appendix A.

Awareness Activities: Mineral Properties

B-1-2. Review the ways to identify rocks and minerals already discussed: rocks by origin and texture and the kinds of minerals in them; minerals by density, solubility in acid; shape of a crystal and whether it has cleavage planes.

B-3. Discuss luster test. Show examples of metallic, non-metallic, silky, glassy.

B-4. Discuss streak test (p. 57, Minerals of the World, 1973). Show examples of congruent, noncongruent and colorless streaks on unglazed, white tile.

B-5. Discuss magnetic test. Demonstrate magnetic and non-magnetic minerals with magnet.

B-6. Discuss hardness test. Take two rocks and scratch one against the other. What happens? Minerals have different hardness. Demonstrate Moh's Scale. Emphasize that #4 is not necessarily twice as hard as #2, diamond is not the only mineral that scratches glass. (How does a glass windshield get pitted in a sandstorm?) because a diamond is extremely hard does not mean it is extremely tough. It is brittle and will shatter among its cleavage lines if it is hit or squeezed too hard (by the setting).

Supportive Activities

I-II. Watch the movie, LC 2081, "Minerals and Rocks." Discuss formation of three types of rocks, gathering and identifying rocks and minerals.

I-II. Have children read and do experiments, pp. 33-51, *Science: Comparing Ideas*, Unit 2, "Rocks, Minerals and Soils," 1972.

III. FOSSILS

Awareness Concepts of Fossils

A. Origin and definition of fossils

B. Identification of fossils

C. Dinosaurs as fossils

Awareness Activities

A. Discuss the origin and definition of fossils. Fossils are rocks. What are fossils? They are the remains of ancient plants and animals--rocklike. A fossil can be the shape (cast) of the original plant or animal; it can be the impression of the plant or animal (leaf impression, footprint impression); it can be the plant or animal changed to rock. If a rock is made of dead plants and animals and you can still see the original shape, what is the rock's origin? (Sedimentary) Where would you expect to find fossils, in the Organ Mountains or in the Robledo Mountains? Robledo because it is sedimentary.

B. Show examples of fossils. Discuss the names of the animals and parts of the animal that were fossilized. Use a chart to show animals and parts found in the Robledo Mountains. (This material is 240 million years old.) Give each child a margarine tub of dirt from the Robledo Mountains. Can you find the items on the chart? Who can find the most fossils? Who can find the smallest fossil? Who can find the largest fossil? Who can find a fossil no one else found? Can you find a fossil that is not on the chart?

C. Discuss dinosaur remains as fossils: dinosaur eggs, dinosaur bones, dinosaur footprints. Discuss the habitats of dinosaurs. Have children make dinosaur models of clay and place them in the correct habitat--water, land, cliff for gliding.

C. To become aware of the size of dinosaurs, mark the size of a dinosaur on the playground with chalk (length and height). Use the child-foot as a unit of measure. Give each child a foot ruler. Call out the number of feet needed. Have the children place their rulers in a straight line. Count the children to check whether the length is correct.

Supportive Activities: Fossils

III. Watch the movie, LC 2028, "The Age of Dinosaurs." Discuss the work of the paleontologist in studying the earth's past history.

A-B. Have children read pp. 40-47, Vol. 4C, True Science Library, 1963.

III. Make a cast of a leaf. Place modeling clay in a shallow plastic dish large enough for the leaf. Smooth. Rub vaseline over the clay and sides of the dish. Impress leaf and stem into the clay, vein side down. Prick out leaf with a pin. Pour plaster of paris the consistency of thin paste into the dish. Let set. Unmold.

III. Make a cast of a shell. Place clay in the bottom of an individual milk carton and smooth. Rub clay and sides with vaseline. Push shell into clay. Remove. Pour plaster of paris into carton. Let it set. Unmold. This could be used as a paperweight.

III. Make an impression of a leaf. Rub the inside of a shallow dish with vaseline. Place leaf, vein side up in the bowl, and rub with vaseline. Pour one cup of plaster of paris into the bowl. Let it set. Unmold. Remove leaf with pin.

C. Have children read pp. 1-48, Vol. 5A, True Science Library, 1963.

C. Research: Have children choose a favorite dinosaur. Use library books, dinosaur flash cards, charts, for research sources. Find out when the dinosaur lived, how much he weighed, his height and length, where he lived, what he ate, and something special about him. Draw an accurate picture of the dinosaur. Make a cover with title page information. Include the researched information and picture inside. Make a report to the class or report the findings to another class or grade. (See following page for example.)

IV. USES OF ROCKS AND MINERALS

Awareness Concepts

A. Rocks and minerals have many uses.

Awareness Activities

A. Discuss the ways rocks and minerals are used. Where did the objects in the room come from? objects at home? How did man change their original form? Where does the energy we use come from? gasoline, gas, electricity, etc.? Why are we looking at new forms of energy?

Supportive Activities

A. Watch the movie, LC 1156, "Treasures of the Earth." Discuss the earth's minerals and fossil fuel resources and how they were formed.

A. Have children read the book, Let's Read About Rocks. It discusses the uses of talc, graphite, lava, borax, iron, silver, tin, metals for coins.

A. Have children read pp. 72-83, Science for Here and Now, 1973.

MY DINOSAUR, ____________________

RESEARCH PAPER by ________________________

He lived (how long ago) ______________________________

He lived (where) ______________________________

He weighed ______________________________

His height was ______________________________

His length was ______________________________

He ate ______________________________

Something special ______________________________

____

____

It discusses the use of rock for building stones, concrete, plaster, clay, concrete block, porcelain, and metal for pipes and sinks.

A. Have children read pp. 39-57, Science Far and Near, 1959. It discusses the use of rock and clay soil in making building material, tools, sculpture, pots and dishes.

A. For further information, consult the Science Unit, "Materials and Energies of the Earth," Resource Units for Second Grade Science, 1964.

A. Research: Have children choose a rock or mineral and find out how it is used. The report could be written or could be a series of pictures of the ways the material is used. Include a title page and a picture of the original rock or mineral.

V. CAREERS IN GEOLOGY AND PALEONTOLOGY

Awareness Concepts

A. Geologists and paleontologists do many different things.

Awareness Activities

A. Discuss the different types of jobs available in geology and paleontology. A geologist may:

1) explore the earth for metal or oil.
2) work in mines.
3) become a gemologist and work with jewelry.
4) work in the space program finding out about other planets.
5) work with the highway department making roads.
6) work with environmental protection agencies on pollution or earthquake hazards.

7) work with the Corps of Engineers in studying river channels and building dams.

8) study ground water.

9) work with the government as a safety inspector for mines.

A paleontologist may:

1) study the earth's history.

2) dig up fossil bones and try to reconstruct the animal from which they came.

3) explore for oil and gas.

VI. EXPERIENCES IN IDENTIFYING ROCKS AND MINERALS

A. Section I.

Each activity in this section is independent of the others. The children may use the activities in any order. The activities will be placed randomly in the room. The children will have an answer sheet upon which to indicate their answers.

Materials needed are: hand lenses, vinegar, scale, 2 jars, water, 2 measuring cups, 2 dishes, geology hammer, possibly a chisel, goggles, white unglazed porcelain, Moh's Scale of Hardness set, magnet, set of identification cards, rock and mineral samples.

1. How many sides does the crystal have? Draw the shape.

2. Scratch the samples on one another. Line them up with the hardest sample on the right side. Write the letters down in order.

3. Use the hardness scale to find out where the sample fits. Remember if it scratches one and the next one scratches it, it is in between the two. If the sample and the number scratch each other, it is that number. Write the number down.

4. Do the samples have calcium carbonate in them? If they do, they will fizz when a drop of vinegar is put on them. Put a drop of vinegar on the samples. Write "yes" next to the sample name that has calcium carbonate in it. Write "no" next to the sample name that does not have calcium carbonate in it.

5. Look at the labeled samples. They are glassy, silky, waxy, metallic, resinous, or dull. What kind of luster do the unknown samples have? Circle the correct word next to the sample name on your answer sheet.

6. Scratch the samples on the piece of tile. What color is the streak? What color is the sample? Write your answer in the correct place. Color words that might help: white, yellow, pink, orange, red, blue, brown, black, green, silver, gold, turquoise, gray.

7. Look at the labeled samples. Look at the examples that show cleavage. Look at the sample that does not show cleavage. Look at the unknown samples. Draw a picture of the shape of 7A. Draw a picture of the shape of 7B. Which sample shows cleavage? Write "yes" next to the sample that shows cleavage. Write "no" next to the sample that does not show cleavage.

8. Look at the examples. Igneous rock is formed by cooling molten rock. Sedimentary rock is formed by layering. Look at the unknown sample. Draw it in its correct box.

9. Look at the texture of the igneous rocks. Aphanitic rock has tiny crystals. Phaneritic rock has crystals that you can see. Porphyritic rock has tiny and big crystals. Look at the unknown

sample. Draw a picture of the sample in the correct box. Show the texture.

10. Look at the texture of the sedimentary rocks. Shale is fine. Sandstone is sandy. Conglomerate contains different-sized particles. Look at the unknown sample. Draw a picture of the sample in the correct box. Show the texture.

11. Two materials may weigh the same but not be the same size. Think of a pound of feathers and a pound of lead. The material that is smaller is denser. Weigh each sample. Do they weigh the same? Put each sample into a full jar of water sitting in a dish. Measure the amount of water each sample displaced. Which sample is denser? Write your answer.

12. You may have the same amount of two materials, but they may not weigh the same amount. Think of a handful of feathers and a handful of rocks. The heavier material is denser. Put each sample into a full jar of water sitting in a dish. Measure the amount of water each sample displaced. Is it the same? Dry the samples. Weigh each sample. Which is denser? Write your answer.

13. Go outside with an adult, goggles, hammer and two rocks you brought to school. Crack your rocks and examine the inside. Is it different from the inside? Did your sample have cleavage?

14. Which samples are attracted to a magnet? Write "yes" or "no" next to the sample names on your answer sheet.

15. Look at the labeled samples. The shapes are rhombohedral, prismatic, pincoidal, cubic, or octahedral. Look at the unknown

samples. Which one does each look like? Circle the correct word next to the sample name.

B. Section II.

Place materials for streak test, luster, hardness, form (cleavage), magnetism, and Mineral Identification Key Set in different areas of the room. Give each child an unknown sample. Have him use the tests and the key to determine the identity of the sample. The child will have a worksheet upon which to put his findings.

C. Section III.

This section is similar to Section II except that the child identifies a sample that he has brought to school.

D. Section IV.

Have the child choose a rock or mineral he would like to learn more about. Find out its properties, origin, importance, use, where it is found. Draw a picture of it. Make a title page and cover. Use Mineral Identification Key, the World Book Encyclopedia, library books, Golden Exploring the Earth, Rocks and Minerals, 1974, Golden Stamp Book of Rocks and Minerals, 1968, etc.

IDENTIFICATION NOTEBOOK

FOR

EARTH SCIENTISTS

______(Name of Scientist)______

______(Date Used)______

Section 1

1. Write the number of sides. Draw the shape.

   ______

2. Write the sample names down in order:

   ________, ________, ________, ________
   soft   hard

3. Write the hardness number of the sample:

   ______

4. Write "yes" or "no":

   4A. ________

   4B. ________

5. Circle the correct word.

5A.	glassy	silky	waxy	metallic	resinous	dull
5B.	glassy	silky	waxy	metallic	resinous	dull

6. Write the color of the sample and the color of the streak for each sample.

   6a. sample color __________ streak color __________

   6b. sample color __________ streak color __________

7. Draw a picture of each sample in the corrext box. Write "yes" if it has cleavage. Write "no" if it does not have cleavage.

7A. ____________ 7B. ____________

8. Draw the sample in the correct box.

Igneous Sedimentary

9. Draw the sample in the correct box. Show its texture.

Aphanitic	Phaneritic	Porphyritic

10. Draw the sample in the correct box. Show its texture.

Fine	Sandy	Many sizes

11. Write the name of the denser sample.

____

12. Write the name of the denser sample.

____

13. Circle the correct answer.

Was the inside different? Yes No

Was there cleavage? Yes No

14. Write "yes" if the sample was attracted to the magnet.

Write "no" if the sample was not attracted to the magnet.

14A. __________

14B. __________

15. Circle the correct word.

15A. rhombohedral prismatic pincoidal cubic octahedral

15B. rhombohedral prismatic pincoidal cubic octahedral

Sections 2 and 3

Place a check mark next to the word that best fits your sample.

COLOR TEST

Blue ________

Green ________

Violet, purple ________

Colorless ________

Grayish, silver-white ________

Gray, black ________

White ________

Yellow ________

Tan, yellow-brown, brown ________

Pink, rose, red ________

STREAK TEST

White ________

Pale brown, and brown ________

Green and pale green ________

Black to medium gray ________

Red and pale red, and red-brown ________

Pale yellow, yellow-brown ________

Light gray ________

LUSTER TEST

Vitreous, or adamantine, glassy ________

Pearly, silky, greasy ________

Waxy ________

Metallic ________

Resinous ________

Dull or earthy ________

HARDNESS

Less than 2.5 ________

Greater than 2.5, less than 4 ________

Greater than 4, less than 5½ ________

Greater than 5½, less than 7 ________

7 or greater ________

CLEAVAGE TEST

Poor or none ________

Rhombohedral ________

Prismatic ________

Pinacoidal ________

Cubic or octahedral ________

MAGNETIC TEST

Magnetic ________

Magnetic and sectile ________

ENVIRONMENT

Igneous - plutonic

Volcanic lavas and tuffs

Hydrothermal

Pegmatite

Ordinary sedimentary

Quasi-sedimentary

Sedimentary - placer concentrates

Metamorphic - plutonic

Contact metamorphic - igneous instrusions

The name of the mineral might be ______________________________.

APPENDIX A

CRYSTAL-GROWING ACTIVITIES

CRYSTAL-GROWING ACTIVITIES

1. Growing crystals (p. 49, Science: Comparing Ideas, 1972):

Materials: rock salt, boiling water, jar and top, knotted string.

Pour boiling water into the jar. Add rock salt until it will no longer dissolve. Poke a hole in the cardboard inner seal of the lid and thread the knotted string through. Let string hang down in the solution. Seal. Wait three weeks.

2. Chemical gardens (p. 200, Science Experiences, 1952):

Materials: test tube rack, 4 test tubes, sodium silicate (water glass), iron chloride crystals (yellow), nickel nitrate crystals (green), cobalt chloride crystals (red-purple), beaker, graduate, glass stirring rod.

Measure 50 cc sodium silicate into beaker and 100 cc water and mix. Fill test tubes with mixture. Drop 2-3 crystals into each test tube: #1 yellow, #2 green, #3 purple, #4 one of each color. Do not stir. Watch.

Explanation: When the crystals are dropped into the mixture, sacks are formed around them. They are made of materials produced by the action of sodium silicate on the chemicals of which the crystals are made. Water then passes through the walls of the sacks and dissolves the crystals. As the crystals dissolve, the sacks grow upward. The more easily the crystals dissolve, the faster the sacks grow. A sack branches as breaks occur in its mass. The sacks soon become glassy and brittle. Commercial "Magic Rocks" work the same way.

3. Making crystals (p. 249, Science Circus, 1963):

Materials: piece of glass or glass pan, Epsom salts, water, magnifying glass.

Dissolve the salts in the water. Pour a few drops on the glass and let it evaporate in a warm place. Examine under a magnifying glass.

Other salts to use to compare crystal formation are table salt, photographer's hypo, white and yellow of an egg.

The commercial liquid painted on the back of fish tanks makes a crystalline structure.

4. Salt garden (p. 250, Science Circus, 1963):

Materials: dish, water, salt, vinegar, small porous stones or pieces of coal.

Place stones in the dish. Pour salt in warm water and stir until no more salt dissolves. Put a spoonful of vinegar in the water and pour over the stones in the dish. Watch.

In a few days the salt crystals will begin to grow and eventually will cover the stones with crystals. Salt water flows up through and over the stones because of capillary action. As it rises, it evaporates leaving the salt behind. Vinegar serves to take away oily spots on the stones that would interfere with free upward flow of salt water.

5. Making crystals (#5, Skillcards, 1966):

Materials: salt water, pan, hot plate, string, small iron nut, pencil, drinking glass, 2 spoons.

Tie the string to the nut and pencil. Check the length of the string in the jar. It should not touch the bottom. Remove. Boil the water and pour into the jar until it is two-thirds full. Add salt and stir until no more salt will dissolve. Suspend nut in the solution. Watch for one week.

6. Making crystals (pp. 107-108, Sourcebook for Elementary Science, 1971):

Materials: hot water, three shallow dishes, salt, sugar, soda, white cotton string.

Make a saturated solution of each material in each dish. Place string across dishes and let evaporate.

To make larger crystals, use copper sulfate, alum, or "hypo."

7. Making crystals (p. 47, Vol. 12, True Science Library, 1963):

Materials: Epsom salts, water, shallow tray.

Mix 2 tablespoons of Epsom salts and 4 tablespoons of water in shallow tray. Let evaporate.

8. Making crystals (pp. 47-48, Vol. 12, True Science Library, 1963):

Materials: 4 lumps of coal or charcoal the size of a tennis ball, 4 tablespoons of water, 4 tablespoons of non-iodized salt, 4 tablespoons bluing, 1 tablespoon household ammonia, flat dish.

Mix water, salt, bluing, and ammonia in a cup. Place coals in a flat dish. Pour liquid over them. Watch.

9. Making crystals (p. 48, Vol. 12, True Science Library, 1963):

Materials: 1 cup water, powdered alum, piece of string, paper clip, pencil, jar.

Heat water to boiling. Remove. Add alum until no more will dissolve. Tie paper clip and pencil to the ends of the string. Lay pencil across the top of the jar. Let the string hang down into the solution. Leave in undisturbed place. Watch.

10. Making rock candy crystals (p. 108, Sourcebook for Elementary Science, 1971):

Materials: 2 cups sugar, one cup boiling water, jar, string.

Stir the sugar into the boiling water. Suspend a clean string into the solution. Do not disturb until the crystals form.

To make the crystals larger, place them in a new solution. If the crystals bleed down, they are dissolving. If they bleed up, they will begin to grow again.

Emphasize that these crystals are not minerals.

11. For more crystal growing recipes:

Crystals and Crystal Growing, 1960:

Ch. 4, "Two Methods for Growing Crystals," pp. 93-107.

Ch. 5, "Twelve Recipes for Growing Crystals," pp. 108-119.

APPENDIX B

EXTRA ACTIVITIES

EXTRA ACTIVITIES

The ideas presented here are designed as game-type activities which may be used during free time or as part of a center to supplement the unit.

1. Word Cards (total group, small group):

   Word cards can be used in many different ways:

   Word recognition - "What's the Word?"

   Classification - "Find two words that go together. Tell why."

   "Find all the words that would go with ___."

   "Find a word that goes with ____."

   Definition - "Find the word that means ____."

   Syllables - "Find a word that has __ syllables." You clap the number of syllables. "Can you match it?"

   Alphabetizing - "Arrange the words in alphabetical order."

   Riddles - "I'm thinking of a _______. What is it?"

   "I have _________. What am I?"

   Rhymes - "Find a word that rhymes with ________."

   Make up a jingle and have children fill in the last word.

2. Concentration (two players):

   Use two sets of word cards.

   Use two sets of picture cards.

   Use one set of picture cards and one set of word cards.

3. Electric Board (two players):

   Words and pictures

   Words and definitions

   Pictures and definitions

4. Seek and Find (small group, individual).

5. Crossword Puzzle (small group, individual).

6. Riddle Cards (small group, individual).

7. Classification Game (two players):

   Place picture or object in the correct container or pocket.

8. Grid Game (total group):

   Leader begins with a blank grid on overhead. Child called on gives a location on the grid such as A-4. Leader looks at the key and writes in the appropriate letter or blanks out the space. When finished, there will be a finished crossword puzzle.

9. Game Boards (two to four players):

   Many different game boards can be constructed and children can use the same basic rules in playing with them. For instance, a game board for Part A could be a spiral path labeled "Journey to the Center of the Earth." Materials needed for the game are: game board, die, set of cards (word cards, combination cards, etc.), marker for each player. Basic rules are: First player throws the die, picks up the number of cards the die shows, answers the cards (says the words, tells the answer to the combinations, etc.) and moves his marker the number of spaces allowed (if he rolled a three and said two words correctly, he would move two spaces). The object of the game is to get to the finish line first.

10. Estimation - Spatial:

    Look, guess, and check:

    number of rocks that will fit in a given box;

    number of marbles in a jar;

    the length of an object, the width;

    compare two objects: Are they the same, different?

    weight of an object

11. Viewmaster Pictures (individual).

12. Filmstrips (small group, individual).

13. Charts, pictures, drawings.

14. Resource People.

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