Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1989 Volume VI: Crystals in Science, Math and Technology

Children Actively Investigating Rocks and Minerals

Curriculum Unit 89.06.03
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PREFACE

These units have been designed to make your 'teaching assignments' in science easier. How? This is a science unit which is planned out for you with 1) lesson objectives, 2) strategies (a unified teaching plan for objective implementation), 3) classroom activities (I'll try to include three, if appropriate for this age level). Also, there will be a reading list for you, as well as for your students, (both student and teacher will read the same books). The first thing that you will notice about the Teacher's Guide is that it is set up as 'Journal Entries.' This will also coincide with the student's 'Journal Entries,' and both will coincide numerically: e.g., First Journal Entry-I for teacher and student, Second Journal Entry-II for teacher and student, etc. Also, *you may do these journal entries at your own pace* throughout the year. But do entries in consecutive order for continuity.

You will notice that the First Journal Entry is just getting the student's mind set to the fact that they are actually making a book to record what they're finding. And these findings are based upon what they have seen through their own eyes—facts.

This is the student's journal that will coincide with your Teacher's Guide. Although I have set it up one way, you certainly do not have to follow this method. Please remember that I am also writing this unit to fulfill a requirement with the Yale-New Haven's Teachers Institute and I have to follow a guideline. This scientific unit entitled "Children Investigating Rocks and Minerals—A Hands-On Investigation" is the first time elementary school teachers have been invited to participate in this academic-challenging endeavor.

As an elementary teacher I hope that you will not be offended by the detailed-basic instructions that I will be putting into the beginning of each 'Journal Entry,' but there are those who will be reading this unit who are far removed from the strict fundamental structural through discipline and organization, that is so inherent in our (elementary teachers) daily routine in order to train these young, often times untamed, minds.

You will also observe that language, math and reading have been incorporated in these Journal Entries. As you, the elementary teacher, know, we are always trying to overlap these core subject areas for continual reinforcement.

There is an important note to be made here, since we are dealing with scientific experiments, we will most likely be confronted with a few failures (both students and teachers). I personally find this to be a psychological plus, because in science you learn by your mistakes. This “fact” can also be carried over into the child’s classroom work. Except he will find making mistakes in science, which is more fun to correct and the rewards seen more readily. As we all know how we overcome life’s mistakes can often make or break a person, so make all mistakes take on a *positive approach* .

UNIT CONTENTS

“An Experiment In Weathering”
“Experiment in How Sedimentation Occurs”
“Granite and Rock (found on our New England Beaches)
“Sand”
“An Experiment in Making Sand”
“How to Test the Physical Properties of Rocks and Minerals” “Color in Rock”
“The Streak Test”
“Hardness Activity”
“Vinegar Test”
“Acid Rain”

Extra Activity

“Time—A Frame of Reference”

FIRST JOURNAL ENTRY-I

“Helping Students Set Up A ‘Scientific’ Journal”

Items Needed:

(1) Oak tag manila folders (schools should be able to supply these from their own stock)
(2) Three ring lined notebook paper. About 10 pages to start within each folder
(3) Punch three holes in folder and put in 3 clip pins to hold papers

(4) Books on crystals for children. (See Bibliography for students and teachers at the end of the *First Journal Entry* .)

LESSON OBJECTIVE:

To have students begin to set up, in an organized fashion, a record keeping journal:

(1) their observations and good description, preferably in writing.
(2) what occurred in the experiment; explain thoroughly, preferably in writing.
(3) what chemical, natural or synthetic, was used;
(4) apparatus used, including measurement devices;
(5) after each experiment, the student will, in three brief paragraphs (or more), state:
  a) what he learned from the experiment and
  b) in what way does this experiment relate to something in your everyday life.

This should be done at the end of all journal entries.

(6) new words learned *(Glossary)*

These six objectives should be clearly printed by each student in the front cover of the manila folder left side . In this way, they will always know what their guidelines are for each experiment.

Start a glossary list which will be posted for all to see (e.g. on a size of oak tag paper—like the multiplication table charge poster). Also I would have students make their own identical word chart in their journals with definitions from dictionary. (Use the noun definitions.)

You may want to start giving these words on student weekly spelling test .

FIRST JOURNAL ENTRY GLOSSARY WORDS*

(For Student Entry Books & Charts)

crys - tal

rocks

ob - ser - va - tion*

glos - s - ary

re - search

re - cord

*Initially, you may wish to put these new words on your glossary chart in syllables for easier pronunciation and less anxiety in poor reading.

BIBLIOGRAPHY (FOR TEACHERS AND STUDENTS)

Exploring Crystals , James Berry, Crowell-Collier Press, London.

Rocks and Minerals (The Science and Hobby Book of), Miriam Gilbert: Lerner Publications Company, Minneapolis, Minn.

Bibliography of An Atom , J. Bronowski, Millicent E. Selsam, E. M. Hale & Company, Eau Claire, Wisc.

Exploring Crystals , James Berry, Crowell-Collier Press, London. *Rocks and Minerals* , Illa Podendorf, Children's Press, Chicago, Ill. *Rock Collecting* , Roma Gans, Thomas Crowell, New York.

Guide to Field Identification—Rock and Minerals , Sorrel, Chas.

Bank Street Writing Activity File , Vol. 2, Scholastic, Inc., New York, NY. 1988.

Robinson, Marlene A. *Crystals—What They Are and How to Grow Them* . Philadelphia, Pa: Running Press, 1988.

**Wood, Elizabeth A. *Crytals—A Handbook for School Teachers* , 1972. Webster, David. *Science Lab, Inc.*

Rocks (Apple IIe) and Rock Kit, Science Lab, Inc. 75 Todd Pond Road, Lincoln, Mass. 01773.

Troll Associates (a sub. of Edu. Reading Services), Science reading in rocks and minerals, 100 Corporate Drive, Mahwah, MJ 07430, 800-526-5289.

Tell Me Why Series (VCR), "Gems, Metals and Minerals." Penguin Home Video/Prism Entertainment. 1987.

Minerology for Amateurs . Sinkankas, John.

**This indicates that you should have this book as a permanent reference while you are studying this section. (Librarians are very understanding if you explain that it coincides with a class project that may go beyond their due dates.)

SECOND JOURNAL ENTRY-II

"The Definition of a Crystal and How We Use Them Daily"

Items Needed:

(1) Redistribute students' journals
(2) Iced tea crystals or any crystals that student is familiar with to make soft drinks
(3) Bath crystals or Ivory flakes
(4) Grain(s) of table salt
(5) Magnifying glass

(6) Activity sheet on growing crystals will tell them all that is needed

LESSON OBJECTIVE:
The understanding that crystals are in our everyday living. The student, at the end of the lesson should:

(1) be able to find at least three other crystals in his everyday use.
(2) be able to understand that when we are talking about crystals, we are defining, specifically, about:
a) solid matter [1]
b) has a symmetrical surface: where opposite sides, if placed on a dividing line, would be equal to both sides of the line. Examples are also in the grade 4th math book in the '89-'90 New Haven math books.

c) is formed by the orderly, repetitive arrangements of atoms (atom: that which cannot be divided—in its smallest state).

Now it's time to give the students the title to put on the cover of their entry journals which will be:

Give some examples (orally) of the importance of record keeping and the people who keep such records:

Category *Reason*

weather	comparison—history
space	what is seen in outer space
astrologers	recording an eclipse/tracking comets

doctors . . recording your health progress

You should get a good discussion going with total class participation.

Now ask "What we would know about the before-mentioned categories if records were not kept?" Again, oral conversation to stimulate further interest for the sake of mental comparison/reasoning.

On the first page of their journal, have children write two or three paragraphs on the "Importance of Record Keeping." The first paragraph should start out "Keeping Records Is Very Important Because . . ." (Write on board.)

Items Needed : (If available, or have student look up mineral as you talk for an oral and visual association.)

(1) FLUORIDE—fluoride in toothpaste

(2) TALC—talcum powder
(3) HALITE—table salt
(4) GRAPHITE—pencil lead
(5) CHALK—chalk
(6) MICA—eyeshadow
(7) GYPSUM—wallboard and HEMATITE—nails
(8) CHALCOPYRITE—copper wire

(9) COAL—fuel Ask the class if there are any other ways we use rocks every day and see what they can add.

Put out any one of several of the books mentioned in children and teachers' bibliography, and let students look through them for a day or two. (Allow time for this, and use some incentive for them to finish, at least, two of these [or other] books.)

Before you start talking about ice tea crystals, etc., have your students look at a grain of table salt under hand microscope (5 x to 10 x g) to see that these little individual grains do actually have a particular shape (if they are not chipped or overly rubbed), you should see a perfect *cube* .

If you wish, after viewing the grain of salt and identifying that ice tea, etc. is made up of individual crystals you may wish to now grow your own crystal. (A salt crystal would be good.) A good word to use is *building blocks* at this point. It would also be good to rite this activity out on board so that children can copy it in their journals and encourage them to do this at home.

ACTIVITY: Growing a Salt Crystal. Needed:
2-1/2 cups table (or kosher) salt

1 cup water

12" of thread (cotton is good: do *not* use nylon)

pencil

wide mouthed glass jar, (peanut butter jar if handy)

cooking pan (1 qt.)

tape

paper towel

hot plate

1) Combine salt and water in a (for use on fire). Stir to first see how much salt can be dissolved by stirring. When the water holds all the salt it can at room temperature (let sit for 6 hours) you now have a saturated solution.

2) How heat the saturated solution. Do *not* boil. The remaining grains of salt will be absorbed into tho solution as it gets hotter (also continue to stir).
3) When all of salt is dissolved into the saturated solution, add more. Measure these amounts, You add tablespoon by tablespoon until the solution becomes thick, Now you have a super saturated solution.
4) Remove pan from stove to cool. About 5 minutes.
5) Tie one end of the thread around the middle of the pencil. Tape the other end of the thread to the bottom of the jar.

(figure available in print form)

6) Carefully pour the super-saturated solution into the empty jar.
7) Tape a piece of paper towel over the top to keep out the dirt.
8) Put the jar where everyone can see it WITHOUT moving it.
A sunny window is not ideal, but a high shelf area is much better.

If in a couple of weeks, CHECK YOUR JAR EVERY DAY AND HAVE A STUDENT ASSIGNED TO KEEP A RECORD (which should be located near the jar), if nothing happens, add a few grains of salt to act as rejuvenating "seeds." [2] Please refer to the books that are in the footnotes for this Second Journal Entry for further study and more depth. But if you do not have the time, I believe that you will have enough info to get a fun science project going. Remember you can always keep trying and learning from mistakes.

Another activity is to make shapes starting from the basic shape of the salt crystal which was a cube (cubic).

I have included the six basic crystal figures. [3] To have your students better understand how these single shapes (as they saw under the magnifying glass of the shape that makes up table salt); so do these shapes make up the under written gems or minerals of the six figures.

ACTIVITY
You (teacher) can enlarge these figures and use them as simple hanging decorations around the room.

You will do best using different colored construction paper for each figure.

Keep them up all year or re-do them for the various holidays to represent different facets of that particular holiday. E.i., at Christmas enlarge and run off the cubic figure and decorate it as Santa Claus. The idea is to make a permanent implantation in the student's mind that the smallest particle (usually unseen) is the beginning of something unimagined. So LOOK DEEP—INVESTIGATE!!

DON'T FORGET YOUR FIELD TRIPS!

SECOND JOURNAL ENTRY GLOSSARY WORDS

(For Student Entry Books & Charts)

sym - met - ri - cal

cube

a- tom

building blocks

sat - u - ra - ted so - lu - tion

ab - sorb

cu - bic (plus the other five basic shape of crystal words, if you use them)

Notes

[1] Berry, James. *Exploring Crystals* . London: Crowell-Collier Press, Chapter 2. [2&3] Robinson, Marlene. *Crystals—What They Are and How to Grow Them* . Philadelphia, Penn.: Running Press, Chap. 1, pp. 20-23, Chap. 6, pp. 68-79.

BIBLIOGRAPHY (FOR TEACHERS AND STUDENTS)

Same as in First Journal Entry.

FIELD TRIPS

1) Peabody Museum of Science Minerology Collection. Ms. Faller, 432-3141.
2) Jim Grandy (Minerologist for Children), 248-0440.

THIRD JOURNAL ENTRY-III

"Liquid, Gaseous and Solid State of Matter" (Where Do Crystals Appear in These Changes?)*

Items Needed

(1) Redistribute folder
(2) Water

(3) Refrigerator (or bring ice in a cooler) Use the New Haven Gd. 4 Science curriculum book, the chapter on *Weather* *, which will also incorporate the water cycle to further have the student see the relationship of crystals and how it changes in our everyday life.

ACTIVITY

1) If you have a sunny window, put a half a bowl of ice cubes in the window (pretend like it's a frozen lake as in the science text book).
2) Mark where the water is after the ice melts.
3) Watch it evaporate and see how far below the initial mark after a couple of days.
4) Have children express these steps orally or in writing as they relate to the weather chapter.

THIRD JOURNAL ENTRY GLOSSARY WORDS

(For Student Entry Books & Charts)

Create your own glossary from a science textbook.

Notes

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*This was purposely put in so that you (teacher) can see a definite relation between our curriculum in science and this unit.

BIBLIOGRAPHY (FOR TEACHERS AND STUDENTS)

New Haven Fourth Grade Science Book

FOURTH JOURNAL ENTRY-IV

"Introduction to Rocks"

Rocks are more a part of our daily lives than most people realize. One way to start students thinking about rocks and how important they are to us is by "teasing" them into realizing the different ways rocks are used every day.

ACTIVITY

Here are some examples of questions you can ask:

1) How many of you brushed your teeth this morning? You did it by squirting rocks all over your toothbrush, right? (from fluoride)
2) How many of you have babies in the house? When you change their diapers, do you dump rocks all over the babies to make them soft and dry? (talc rock—talcum powder)
3) How many of you like to each McDonald's french fries? Do you like them best covered all over with rocks? (halite)
4) At school do you write your papers with a rock? (graphite)
5) Do you write on the blackboard with a rock? (chalk)
6) Do some women rub rocks all over their eyes to make themselves look beautiful? (mica)
7) We build our houses out of rock walls which are held together by other rocks, correct? (gypsum—wallboard / hematite—nails)
8) Is it true that electricity travels to our houses through rocks? (chalcopyrite—copper wire)
9) Do some people burn rocks to keep themselves warm? (coal)

HOW ROCKS ARE FORMED

There are three types of rock, each formed in a different environment (weather, air, temperature). 1) HOT rocks (igneous) formed when hot, liquid rock (magma or lava) cools and hardens. 2) WET rocks (sedimentary) usually form in or near water when small particles of other rocks or sediments become cemented together. These rocks often indicate ancient seas and riverbeds, many rich in fossils of creatures that lived there millions of years ago.

The last type is 3) CHANGED rocks (metamorphic)—like a butterfly changes. These rocks form deep beneath the earth's surface when there is enough heat and pressure to change (but not melt) the different already-existing rocks and minerals.

(figure available in print form)

WHAT DID YOU OBSERVE FROM ROCKS?*

LIST THE COLORS OBSERVED	LIST WHAT COLORS WERE IN THE ROCK
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________
____________________________	____________________________

Are some of the colors shinier than others?

Make a list of each color and describe its lustre (shine). (Some good lustre words:metallic, matte, shiny, dull, pearly, and glassy.)

____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________

Make a list of ten words that describe your rock.

____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________
____________________________ ____________________________

ACTIVITY

Here it will be very helpful to use the *Rocks* software as stated in the bibliography. In this program, Mr. Webster is the very creative author of this software.

In it you will have four chapters. (1) Properties of rocks. (2) Names of different rocks (includes streak testing, also to find out the various hardness of rocks. (3) Uses of rocks. (4) Test on rocks.

It is highly recommended that you use this piece of software. It really pulls together the whole rock unit very concisely.

*EROSION AND SEDIMENTATION**

Right outside our school window, wind, water, heat, cold and gravity are forces that are constantly changing the earth. In the study of rocks, we become particularly aware of this.

Although a rock may seem to be something hard and indestructible, it is actually being changed constantly if it is on the surface of the earth. A rock is gradually crumbled (actually smashed) by the action of heat, cold, rain, snow, ice, and surface waters such as oceans. This eroding process is called WEATHERING.

In weathering, hot sun causes the surface of a rock to expand. Cold makes the surface contract. However, the surface does not expand and contract at the same rate all over, because of the different minerals in the rock.

Minerals react differently to heat and cold and expand and contract at different rates. The result is the rock begins to crack. In time, fragments of rock are broken off and washed away becoming smaller and smaller (we will experiment with this process at a later date) as they travel. Eventually they are deposited as layers of silt, sand and earth. And the whole process of rock formation begins again.

(Use with “Rock Cycle” sheet.)

(Use with “Rock Study” sheet.)

FOURTH JOURNAL ENTRY GLOSSARY WORDS

(For Student Entry Books & Charts)

ig - ne - ous

sed - i - men - tar - y

meta - morphic

surface

cy - cle

BIBLIOGRAPHY (FOR TEACHERS AND STUDENTS)

1Rock Collecting , Roma Gans, Thomas Crowell, New York.

2Tell Me Why Series (VCR), “Gems, Metals and Minerals,” Penguin Home Video/Prism Entertainment, 1987.

3Minerology for Amateurs , Sinkankas, John.

4Rocks (Apple IIe), Webster, David. Science Lab, Inc., 75 Todd Pond Road, Lincoln, Mass. (You may get this software from Tarah Cherry, Vincent E. Mauro School, 787-5969.) I also have the rock kit that goes along with the software.

FIELD TRIPS

Mr. Jim Grandy (minerologist) can take you on a two hour rock hunting exploration to West Rock. 248-0440

FIFTH JOURNAL ENTRY-V

"An Experiment in Weather"

Items Needed:

(1) Two plastic jar/lid (jug size)
(2) Brick fragments

(3) Field trip to beach ***OBJECTIVE*** How rain, wind, temperature (sun) wear on rocks.

ACTIVITY:

1) Fill the big plastic jug half full of water. Place the brick fragments (pieces) in the jug.
2) Four or five times a day one student can shake the jug 50 times. (This will stimulate the action of water erosion.)
3) At the end of the week, drain the water into another container. See how the amount of sediment that has formed in the bottom of the jug. Also examine the chunks of brick to see if the effects of erosion have taken place.
4) As an accompanying experiment, have each student bring in a rock from his/her own yard or neighborhood. Wash the rocks off and place them in the plastic jug and conduct the same experiment as described for the bricks.

5) At the end of the week, see how much sediment has formed. Did the rocks form less than the bricks? If so, why? Students should begin to see that changes in rocks occur very slowly.

Wind, too, can be a great weathering force. It can pick up fine particles of rock and carry them great distances. It can also hurl these same particles against other rock surfaces thus wearing them away abrasively (by constant rubbing).

Anyone who has walked on any beach has seen the power of wind and waves on beachside rocks. Mounds of smooth, rounded rocks and pebbles abound in certain areas. Once they were sharp, jagged chunks of rock. They (sand mounds) tell of thousands of years of tossing against each other, gradually wearing away to the almost polished looking stones.

EXPERIMENT IN HOW SEDIMENTATION OCCURS

Items Needed

(1) Plastic jar/lid
(2) Pebbles
(3) Sand
(4) Dirt

OBJECTIVE This activity will explore how layers of solid form from a mixture of solids and water.
Moving water carries solids (heavy rocks) as it flows. Heavier and larger solids (heavy rocks) drop to the bottom first. A rocky stream is a rocky stream because the heavier rocks are deposited by the moving water first while the lighter solids are carried along to deltas and swamps where the water is not moving fast.

Solid matter that settles to the bottoms of rivers, streams, lakes, and oceans is called SEDIMENT. Sediment can build up on the bottoms of bodies of water, and under great pressure from the weight of many layers, turns into rock. This type of rock is called SEDIMENTARY rock. A familiar example of sedimentary rock formations once under water is seen in the layers of rock in the Grand Canyon. (It would be good to show a picture of Grand Canyon walls here.)

Slowly add water to the jar until it is almost full, put the lid on tightly and shake the jar until contents are well-mixed.

Have the class observe the layers that form in the first minute. Set the jar aside and observe the results periodically. After 30 minutes, well-defined layers of solids should be seen. The finest solids will take several hours (or even overnight) to settle. Leave the jar untouched to see how long it takes for the water to clear completely.

FOR DISCUSSION:

1) Which layer formed first? What caused that layer to settle first? (The pebbles settled first because they were the heaviest.)
2) Which layer formed last? Why? (The soil settled last because it was the lightest.)
3) If the water had been moving, which solid would have been carried the furthest the fastest? (The soil because it is the lightest and easiest to move.)

GRANITE ROCK (found on New England beaches)

Items Needed
Field trip looking for granite rocks

One of the most common rocks in the world, and certainly in New England, is granite. It is the salt and pepper looking rock most of us can find right in our yards. It can also be pinkish colored and dotted with gray and black. Granite is an example of a “fire rock,” one that is formed from hot, molten rock within the earth’s surface.

The hot, liquid rock comes up to or near the surface of the earth and cools slowly.

Rocks are mixtures of many different minerals. Granite is a mixture of quartz, feldspar, mica, and hornblende.

Quartz is a very hard mineral which is found in granite, and gives granite its durability. Granite is used in buildings and cemetery monuments because it lasts a long time.

Feldspar, the principal ingredient of granite, can be gray, white, or pink and gives granite its color. Tiny sheets of mica give granite its sparkle, and hornblende (or black biotite mica) gives it its black spots.

You can tell how quickly granite cooled under the surface of the earth by how large the crystals of these different minerals are. The quicker it cooled, the smaller the crystals. Granite with big, fat spots of quartz and hornblende cooled very slowly. It might be interesting to compare different granite rocks students bring in to compare the size of the crystals.

ACTIVITY Look through a magnifying glass and seek the various granules in New England sand.

SAND

Items Needed

(1) field trip to the beach
(2) magnifying glass

(3) journals Most of the sandy beaches in New England (our part of the U.S.A.) are a mixture of grains of quartz, biotite, feldspar, mica, and hornblende. That is because these are the ingredients of our most common rock, granite. Quartz makes the clear crystals in the sand, biotite or hornblende are the black grains, feldspar makes the pinkish-beige grains, and mica is the tiny, flat flakes that glisten when the sun shines through the water.

A geologist can look at sand and tell from what kind of earth formations the sand originated. A coral reef (in the state of Florida) will make a different kind of sand than a granite coast. Volcanic rock area will produce a different looking sand than sand created by eroded seashells on a shell beach. Why? (Answer: a shell is not a rock.)

Look closely at the sand samples in this lesson using a hand lens or microscope (if available, or magnifying glass). On your observations sheet, list the colors you can see in the sand. Are they the same colors you can see in the weathered granite rocks? Where do you think the sand began?

AN EXPERIMENT IN MAKING SAND

Items Needed

(1) Enough zip lock bags for your class
(2) Variety of rocks

(3) Magnifying glass

OBJECTIVE Students will learn how erosion (a force moving rock, gradually wear it, in tiny particles, away).

1) Have students bring in 12 rocks that they have collected outside of school. (Try to find a variety of rocks.) Have them shake the bags vigorously (but not too vigorously to break bags). Support the bottom of the bag with one hand.
2) Have students dump the contents of the bags after a few minutes out on the desks keeping the contents in one small area.
3) Using hand lenses, examine the contents carefully to see if any sand was made. If so, see from which rocks the sand was made.
4) If the bags are still in good shape, do the activity again to see if a different kind and amount of sand is made using the remaining six rocks of the students collected.

SAND ACTIVITY SHEET

Items Needed (Field Trip, or get some sand at the beach for classroom)

Clear grains—glassy in texture Most likely quartz (near the ocean may be iron stained)

Milky grains—variety of colors, Most likely feldspar

pinkish, beige, white
Flakes—not round grains Most likely micas (white mica—muyscovite, black mica— biotite)
Dark grains Probably hornblende

Other colors Depending on location, could be garnets, amethysts, etc.

DIRECTIONS Spread a few grains of sand on a piece of paper. With the tip of your pencil, spread the individual grains into four piles.
60% quartz

30% feldspar

8% hornblende = granite broken down into sand granules
2% mica flakes

HOW TO TEST THE PHYSICAL PROPERTIES OF ROCKS AND MINERALS

Identifying rocks and minerals can be frustrating because many of them resemble others. It's a little like solving a mystery story, because there are a lot of questions that have to be answered before you can narrow down the suspects.

One way to introduce rock identification is to ask students how their parents recognize them. They will say by their hair color, facial features, eye color, height, weight, etc. (maybe even their smell!)

It's the same with rocks and minerals. Each has its own specific characteristics that make it what it is. In the following pages are tests geologists use to identify minerals. Physical properties such as crystal shape, hardness, color, magnetism, shine (or lustre), and cleavage (how a mineral splits or breaks), and streaking (what color mark it leaves), all help identify minerals.

Once students begin examining their rocks and minerals, they will soon see that a single test is rarely enough to identify a mineral. A geologist must look at many characteristics before making a decision.

COLOR IN ROCKS

We have all picked up a pretty rock and tucked it into our pocket. Rocks come in all kinds of beautiful colors, but color is the least dependable property when it comes to identification.

Some rocks and minerals are always one color—they are the easy ones to identify. For instance, pyrite and gold are always yellow. Basalt is always dark gray. However, some minerals and rocks come in different colors. An example is quartz, one of the most abundant minerals on earth. With just a trace of different chemicals, quartz, which in its pure form is clear like glass, can be found in just about every color in the spectrum.

Quartz can be purple (amethyst), pink (rose quartz), white (milky quartz), brown or black (smoky quartz), banded (agate), and many other hues and patterns. Yet each is still quartz! So color along is not a reliable way of determining what a mineral is. It is just a first step.

ACTIVITY Find rocks of all basic colors.

THE STREAK TEST

Items Needed: Rocks (various)
Did you know you do a "streak test" whenever you write on the blackboard with a piece of chalk? Using a pencil (graphite) on a piece of paper is also the same idea. Hopscotch on a sidewalk is another example of what a streak test accomplishes. The color of a powdered mineral may be different from the color of the

mineral itself, so the streak is a more definite clue than color. To make a streak or to "powder" a mineral, use a *streak plate, which is a piece of unglazed porcelain tile.*

If the mineral is softer than the tile, it will rub off and leave a trail of powder. There may be some surprises in the streak color. Pyrite, which is called "Fool's Gold" because of its resemblance to real gold, leaves a black streak on the streak plate. Gold leaves a yellow streak. A dark mineral may leave a streak that is much lighter. Biotite mica looks black but leaves a colorless streak. Chalcopyrite is gold but leaves a greenish-black streak. Try it with the children. What happens? Try another sample. Pull the rock or mineral specimen across the unglazed tile hard enough to leave a streak.

Examples: *MINERALS*	STREAK COLOR
Calcite	White
Feldspar	Colorless
Galena	Lead Gray
Graphite	Steel Gray
Gypsum (when available)	White
Halite	White
Hematite	Reddish-Brown
Quartz	C1ear
Sulfur	White
Talc	White

HARDNESS ACTIVITY

Students can try to determine hardness of different rocks and minerals by scratching them with different objects—very soft rocks can be scratched with the fingernail.

A good assortment of rocks for this activity for a broad range of hardnesses are:

Talc Gypsum— Calcite Feldspar

Graphite (when available) Kaolinite Obsidian

Pyrite Quartz Sulfur

1. Calcite. It has a hardness of three, which is fairly soft. Begin by having the students try to scratch the calcite with their fingernail. It is too hard to scratch with a fingernail. Next try a penny. The penny will scratch it, so according to the Mohs Hardness Scale (see below chart), calcit as a hardness of three.

This hardness scale is arranged so that each mineral will scratch the minerals that have lower numbers and will be scratched by all the minerals having higher numbers. For instance, #4, Fluoride, will scratch Calcite, Gypsum, and Talc, but will BE scratched by Apatite, Feldspar, Quartz, Topaz, Corundum, and Diamond.

If you don't have a copy of the Mohs scale with you, another way to check hardness is by using three common things: your fingernail, a copper penny, and a piece of steel.

¥ A FINGERNAIL SCRATCH HAS A HARDNESS SLIGHTLY OVER 2.0:

All minerals that can be scratched by your fingernail are less than 2.5.

¥ A PENNY SCRATCH HAS A HARDNESS OF ABOUT 3.5:

A penny will scratch all minerals less than 3.5.

¥ A PIECE OF STEEL SCRATCH HAS A HARDNESS OF ABOUT 5.5:

A piece of steel will scratch all minerals that are less than 5.5. Next, have the class try the quartz specimen. Quartz resembles calcite but is at the opposite end of the hardness scale. Again, begin with the fingernail test. Next, try the penny, then a nail. Next, try to scratch the nail with the quartz. The quartz should scratch the nail which means it has a hardness of 7. In other words, it is a pretty hard mineral. It will even scratch glass. Ask students to bring in small glass jars to see which minerals will scratch glass.

This is a good activity for “pairing and sharing” to see if two students agree on results.

VINEGAR TEST

Items Needed

(1) Medicine eye dropper or small squeeze bottles

(2) Quartz, limestone, kaolinite, calcite, marble, or chalk Geologists use weak hydrochloric acid to determine the presence of calcium carbonate, the prime ingredient of many sedimentary rocks. Vinegar will also react with those same rocks. It is included in the kit and has the advantage of safety! Here’s how to test for calcium carbonate.

Using medicine dropper or squeeze bottles, drop two or three drops of vinegar on rock or mineral sample. If it fizzes, it contains calcium carbonate.

A good group of rocks to use in this experiment is quartz, limestone, kaolinite, calcite, marble, and chalk.

Limestone is a sedimentary rock found where ancient seas and lakes once existed. It is made up of the shells and bones of long dead animals that once lived in those seas. Natural chalk is a form of limestone. Both will react strongly to vinegar.

Kaolinite looks a lot like chalk but has only a small amount of calcium carbonate in it. It may react only slightly or not at all with the vinegar.

Calcite is pure calcium carbonate and should react strongly to the vinegar test.

Milky quartz, which resembles calcite, will not react at all. It is not sedimentary, and even though it resembles calcite, has no calcium carbonate in it at all.

Marble was once limestone. It has been changed (and metamorphosed) under great heat and pressure. It may react less strongly to vinegar than limestone does.

The class can try this test with other rocks brought in to see if they react to the vinegar test.

CLASSIFYING ROCKS STREAK AND HARDNESS CHART

MINERAL	COLOR	STREAK	HARDNESS
Biotite (Mica)	green to black	uncolored	2 1/2-3
Calcite	white, grey, red, green blue, violet	white or greyish	3
Chalcopyrite	brass yellow	greenish black	3 1/2-4
Feldspar	white, bluish, grayish	uncolored	6
Fluoride	white, green, yellow blue, violet, red	white	4
Galena	lead-gray	lead-gray	2 1/2
Graphite	iron black to dark steel gray	steel-gray	1-2
Gypsum	usually white	white	1 1/2-2
Halite	colorless or white	white	5 1/2-6 1/2
Hematite	steel gray, red, brown	reddish brown	5 1/2-6 1/2
Hornblende	dark green to black	uncolored	5-6
Magnetite	iron-black	black	5 1/2-6 1/2
Pyrite	pale brass-yellow	greenish black	6-6 1/2
Quartz			
Rock crystal	colorless	uncolored	7
Amethyst	purple	uncolored	7
Smoky	smoky, black	uncolored	7
Rose	pink	uncolored	7
Agate	several colored, banded	uncolored	7
Jasper	red, brown, green	uncolored	7
Chalcedony	tan, white, blue	uncolored	7
Flint	gray, brown, black	uncolored	7
Sulfur	sulfur-yellow, honey-yellow	white	1 1/2-2 1/2
Talc	apple-green to white	usually white	1-1 1/2

ACID RAIN

This would be a good time to discuss how acid rain effects buildings and statues. Since acid rainfall sometimes can be the strength of pure vinegar, students can actually see the cumulative effect of it on limestone buildings, marble statues, etc.

On a rainy day, have the class collect a sample of rainwater. Try soaking chalk in it for several days to see if it has an effect on it.

(figure available in print form)

I would put this chart on the board and have students talk about it (acid rain). Another project would be a research paper for two or more of your best students to work on for a report to be read to the class.

FIFTH JOURNAL ENTRY GLOSSARY WORDS

(For Student Entry Books & Chart)

in - de - struc - ti - ble

weather - ing

a - bra - sive

con - stant

de - pos - it

min - e - ral

du - ra - ble

gran - i - ale

a - cid

neu - tral

ba - sic

am - mon - i - a

vin - e - gar

Notes

*I hope that this JE is so self explanatory that once you have read the books from JE 4 this and what I have written will be enough for you to teach a very exciting lesson(s). You may buy these rocks cheaply at "The Rock Garden," 981 State Street, New Haven, CT, 771-9997.

BIBLIOGRAPHY (FOR TEACHERS AND STUDENTS)

Same as 4th JE.

FIELD TRIP
A field trip to Yale University to tour the buildings will give your students a good idea of the effects of weathering on buildings.

Contact Lila Freedman—Dir. of Publications at Yale.

EXTRA ACTIVITY

TIME—A FRAME OF REFERENCE

1. Have students pretend a year passes each minute. An eleven year old person would have been born just eleven minutes ago. The United States would have been in existence only three hours. Christ would have lived less than a day and a half ago. The last glacier would have left New England just 8 1/2 days ago. The dinosaurs would have lived over 200 years ago:

Here are some other events and when they would have happened if one minute equals one year:

¥ 16 minutes ago humans landed on the moon (1969)
¥ 38 minutes ago transistors were invented (1947)
¥ 44 minutes ago aerosol sprays were invented (1941)
¥ 58 minutes ago television was invented (1927)
¥ 82 minutes ago the Wright brothers flew their airplane (1903)
¥ 86 minutes ago the telephone was invented (1899)
¥ 93 minutes ago the automobile was invented (1892)
¥ 124 minutes ago the Civil War began (1861)
¥ 209 minutes ago (3-1/2 hours) the United States was born (1776)
¥ 365 minutes ago (6 hours) the Pilgrims landed at Plymouth (1620)
¥ 8 hours ago Columbus discovered America (1492)
¥ 35 hours ago the Romans were at their height of power (146 B.C.)
¥ 2-1/2 days ago Stonehenge was built in England (1500 B.C.)
¥ 3 days ago the Pyramids were built (2615 B.C.)

The teacher: you may want to introduce, continue or modify this.

2. Evolution in a year—The dates below show Earth's evolution in terms of one 365 day year. Humanity's time on Earth is seen to be relatively short—ape-man appeared at 6:17 p.m. on December 31, and Christ was born only 14 seconds before the year's end.

a. January 1—Earth formed
b. March 30—simplest life begins
c. November 17—trilobites common
d. November 30—first fish

e. December 13—first dinosaurs
f. December 22—mammals diversify
g. December 30—first ape-man
h. December 31—birth of Christ