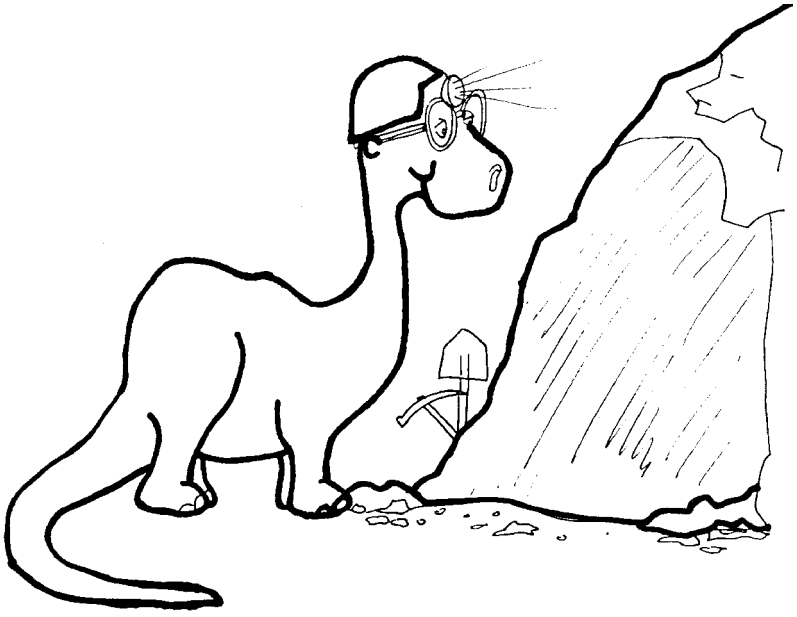
Rock Cycle

Understanding the Earth's Crust

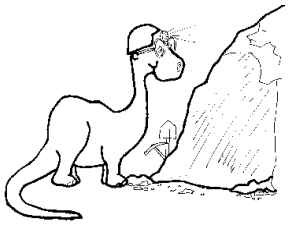
FIFTH GRADE

MINERALS



2 WEEKS
LESSON PLANS AND
ACTIVITIES

ROCK CYCLE
OVERVIEW OF FIFTH GRADE



CHEMISTRY

WEEK 1.
PRE: *Describing a chemical reaction.*
LAB: *Illustrating how molecules move.*
POST: *Comparing salt and sugar crystals.*

MINERALS

WEEK 2.
PRE: *Exploring minerals made of elements and compounds.*
LAB: *Discovering the different hardness of minerals.*
POST: *Analyzing why one mineral is harder than another.*

WEEK 3.
PRE: *Exploring how minerals are useful.*
LAB: *Analyzing minerals for their usefulness.*
POST: *Distinguishing colors derived from minerals.*

ROCKS

WEEK 4.
PRE: *Interpreting the different environments where rocks form.*
LAB: *Analyzing the origin of different sands.*
POST: *Comparing areas where sedimentary particles are deposited.*

WEEK 5.
PRE: *Exploring the creation of caves.*
LAB: *Examining different sedimentary rocks.*
POST: *Exploring the difficulties in identifying rocks.*

PAST LIFE

WEEK 6.
PRE: *Exploring paleontology.*
LAB: *Illustrating how fossils are preserved.*
POST: *Comparing the different eras of time.*

ROCK CYCLE - MINERALS (5A)

PRE LAB

Students learn about uses of minerals by lecture and internet.

OBJECTIVES:

1. Learning that minerals are made of elements and compounds.
2. Discussing the key characteristics of minerals.

VOCABULARY:

compound
element
mineral

borate minerals are used in detergent, steel, and fiber optic industries

MATERIALS:

Internet

BACKGROUND:

Elements and compounds are the building blocks of minerals. Minerals made of only one element are called NATIVE minerals (i.e., silver, gold, mercury, copper). Minerals composed of compounds are simply referred to as minerals (i.e., quartz, which is made up on silicon and oxygen). To be classified as a mineral, a substance must be:

a) INORGANIC - made from nonliving matter,

b) NATURALLY MADE -industrial diamonds and so-called "man-made" minerals are not true minerals,

c) CRYSTALLINE - the molecules that make up the substance are arranged in a set pattern salt, and

d) HAVE A DEFINITE CHEMICAL COMPOSITION - no other chemicals, elements or atoms, can be substituted into the structure.

PROCEDURE:

1. There are thousands of known minerals. In everyday language, there are many references to minerals. Have the students name several of these, and put them on the board. Here are examples:
   a. You need vitamins and minerals for a healthy body
   b. Mineral Oil
   c. Mineral Bath
   d. Mineral Spring Water

e. Shampoo enriched with minerals
f. Fortified with minerals
g. Natural energy from minerals
h. Fortified with vitamins and minerals
i. USDA recommended daily amount of vitamins and minerals


Making gold ingots, which determine the reserve wealth of a country.

2. Minerals are important in everyday life. Have the students compile a list of minerals and their uses on the board:

diamonds = jewelry
gypsum = used in plaster board
calcite = used in cement
quartz = watches, making glass and many more.

3. Instruct students to examine their homes and identify substances that may contain minerals.
Minerals are sometimes difficult to identify. The following lab centers around those key characteristics that can help identify minerals. It also discusses how some of those characteristics make minerals useful specific products in our society.

4. Instruct the students to find other uses for minerals by conducting an Internet search. They will be amazed at how many sites are devoted to minerals.

ROCK CYCLE - MINERALS (5A)

LAB

Students will test different minerals for their hardness.

OBJECTIVES:

1. Identifying mineral characteristics.
2. Determining the hardness of minerals

VOCABULARY:

cleavage
fracture
characteristic
hardness
mineral

copper

MATERIALS:

penny
steel nail
Rock Cycle - Minerals (5A)

BACKGROUND:

The obvious descriptive characteristics of a mineral such as size, shape, and color are not the only features that can identify that mineral. Geologists recognize a number of useful key characteristics for mineral identification. These include:

A. CRYSTAL FORM - The natural growth (shape) of a mineral.

B. FRACTURE AND CLEAVAGE -The way a mineral breaks. Fracture is irregular breakage. For example, quartz has a conchoidal fracture; it breaks along hollowed and rounded, uneven surfaces. Cleavage is a regular breakage that follows the atomic structure of a mineral. Cleavage results in smooth, planar surfaces. Different minerals may have one, two, three, four, or six cleavages.

C. HARDNESS - The mineral's resistance to scratching. It is controlled by the strength of atomic bonds within the mineral. Mineral hardness is rated from 1 (soft) to 10 (hard) on the Mohs hardness scale.

D. SPECIFIC GRAVITY - The density of a mineral relative to water.

E. STREAK - The color of a powdered mineral sample.

F. LUSTER - The way that a mineral reflects light. There are two types of luster. Metallic minerals look like shiny or rusted metal. Nonmetallic elements reflect light like glass or pearls or glue.

G. TASTE - Certain minerals like halite (salty) and sulfur (bitter) have characteristic "flavors."

H. MAGNETISM - The attraction of a mineral to a magnet.

I. REACTION TO ACID - The mineral reacts by “fizzing” with dilute HCl reacts with carbonate minerals.

Quartz has a hardness of 7.

This lab will deal with “hardness” which is one of the easiest characteristics to test. Hardness helps geologists determine the identity of some minerals when they are doing field work. For instance, if a steel knife cannot scratch a white or clear mineral, it is likely quartz. Hardness also can tell us something about the composition of minerals (how tightly the elements are bonded together). Formally, the hardness of a mineral is ranked by Mohs Hardness Scale (named after Austrian mineralogist Friedrich Moh), which lists 10 reference minerals that are arranged in increasing order of hardness. Note that this is a relative hardness scale; diamond is actually over four hundred times harder than talc.

Mohs Hardness Scale

1 = talc	6 = microcline (feldspar)
2 = gypsum	7 = quartz
3 = calcite	8 = topaz
4 = fluorite	9 = corundum
5 = apatite	10 = diamond

PROCEDURE:

1. Before lab, set up mineral specimen collections for each student group. You will need samples of gypsum, copper, mica, galena, calcite, dolomite, hematite, pyrite, feldspar, and quartz. Use the Rock Cycle - Minerals (5A) samples or samples of your own.

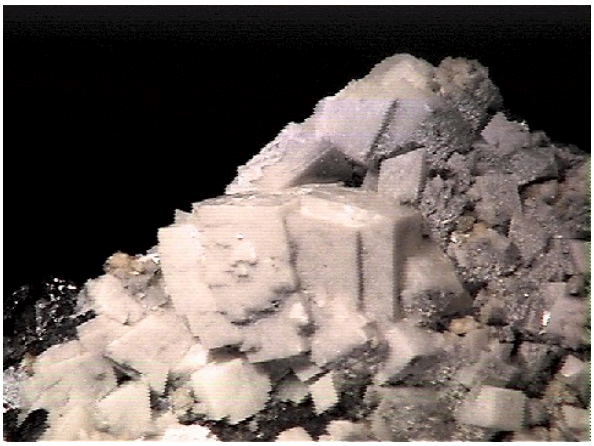
Do not include rocks with this lab. Since most rocks are composed of a variety of minerals, they cannot be classified on the Mohs scale. If you have not tested mineral hardness using a penny or a nail, you may wish to experiment before the lab starts. This will also help you guide the students to use the right amount of strength and pressure when scratching the minerals.

2. Explain the lab procedure from the student workbook. Let the students be geologists (or mineralogists) and create their own hardness scales using fingernails, pennies, and steel nails. You might want to demonstrate how hard it is to scratch the

minerals. Have the students "test" the mineral specimens. Sometimes samples can vary, so you should "discover" a key for the specific samples in advance.

3. Tally the students' results on the board and determine a hardness scale for the whole class. Emphasize that their results may differ because some people scratch harder than others and many minerals are "in between" soft and hard.

4. GENERAL ANSWER (using Rock Cycle - Minerals (5A): softness to hardest: gypsum, copper, mica, galena, calcite, dolomite, hematite, pyrite, feldspar, quartz.



Dolomite

ROCK CYCLE - MINERALS (5A) LAB

PROBLEM: How can you tell if a mineral is hard or not?
PREDICTION: _____
PROCEDURE: Let's try to figure out the hardness of the minerals in your collection. We will develop a hardness scale by using a fingernail, a copper penny, and a steel nail as standards. State whether the following minerals are softer than or harder than the fingernail, copper penny and the steel nail.

	SOFTER THAN	HARDER THAN
galena		
gypsum		
feldspar		
copper		
hematite		
dolomite		
mica		
quartz		
pyrite		
calcite		

CONCLUSION:
Make a scale from the softest mineral (1 is the softest) to the hardest (10 is the hardest).

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

ROCK CYCLE - MINERALS (5A)

POST LAB

Students compare hardness and cleavage.

OBJECTIVE:

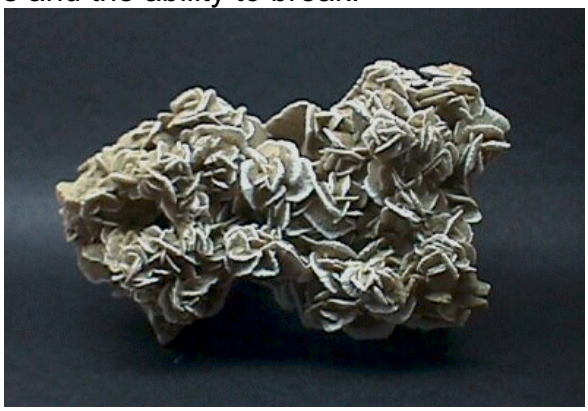
1. Analyzing why one mineral is harder than another.
2. Exploring the difference between hardness and the ability to break.

VOCABULARY:

cleavage
hardness

MATERIALS:

Googolplex or Zometool (optional)



Gypsum

BACKGROUND:

It is difficult to distinguish between the hardness of a mineral and the ease with which a mineral may be broken. Hardness refers to the ability to scratch the mineral's surface. However, some hard minerals, like diamond and quartz, break easily if dropped. Hence mineral breakage is different from hardness. Minerals break in two ways: fracture and cleavage. Fracture is irregular breakage. Cleavage is a regular breakage that follows the atomic structure of a mineral. Cleavage results in smooth, planar surfaces. Different minerals may have one, two, three, four, or six cleavages.

Mohs hardness scale is used by geologists to compare the hardness of minerals *only*. The scale arranges a series of minerals in order of increasing relative hardness, from 1 to 10. Note that this is a relative hardness scale; diamond is actually over four hundred times harder than talc.

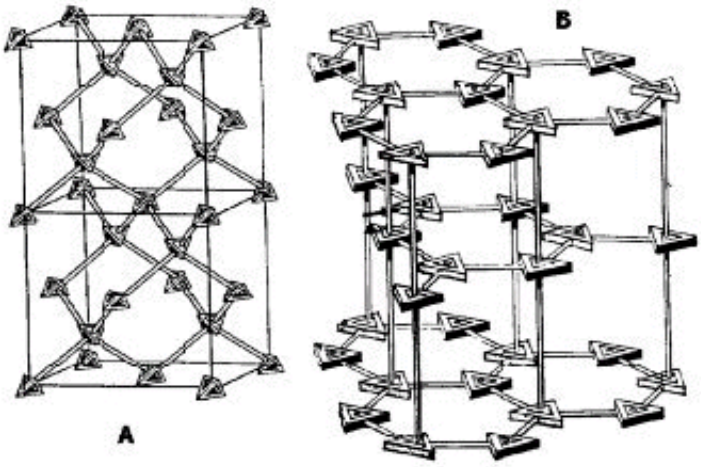
PROCEDURE:

1. Draw the Mohs hardness scale on the board. Ask the students which of their lab samples are part of the scale. Ask them if they think the scale is useful. Tell them that the scale works well in a laboratory, but in the field, a geologist would not have all 10 minerals available. Geologists usually use their fingernails and steel knives.

2. Explain that the Mohs scale does not explain why some minerals are harder than others. Ask students to draw a large person that weighs 250 lbs. and a muscular person that weighs 250 lbs. Ask them if one person is "softer" than the other. One person works out more, and the cells of that body combine tightly, giving him or her a different

appearance. The elements of some minerals do the same. The ones that are tightly bound together look different than do ones with looser bonds.

For example, in the illustrations below, (A) shows the atomic structure of carbon in a diamond, and (B) is the carbon arrangement in graphite. (A) is more compact than (B), hence it is harder. As an example, you can tell the students that when Superman squeezes a piece of carbon in his hand, it turns into a diamond. (Superman usually uses coal, which is not the right source of carbon, since the substance should be inorganic to be a real mineral.) If desired, have the students construct Googolplex models of graphite and diamond. Use the directions provided with the Googoplex models. You can also use the Zometool system to construct similar models.



Examples of crystalline structures

ROCK CYCLE - MINERALS (5B)

PRE LAB

Students write a creative essay on finding mineral wealth.

OBJECTIVES:

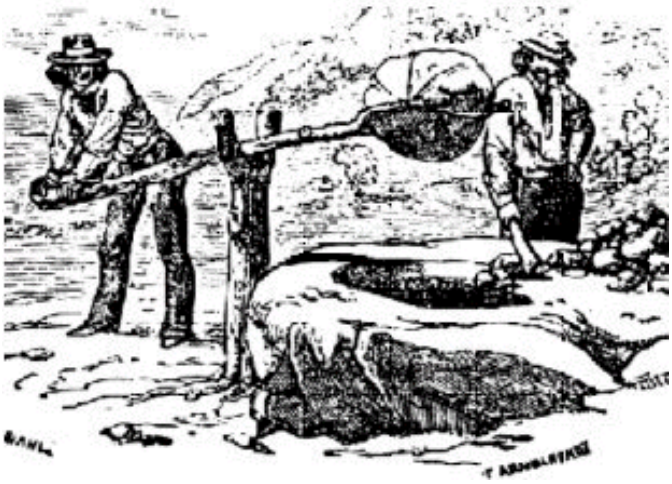
1. Exploring how minerals are useful.
2. Recognizing useful minerals.

VOCABULARY:

mineral
prospect
valuable

MATERIALS:

Internet



Early mining in California

BACKGROUND:

The search for minerals that can generate money, that are economically useful, is called prospecting. Valuable minerals are recognized by their key characteristics. For example, gold is a heavy, malleable, yellow metal; galena (lead ore) is dark gray, heavy, and metallic; magnetite is black, heavy, and magnetic; diamond is clear and very hard; and silver is bright grey color in color. Gold and silver were very important in the settlement of the west in the 1800's. Easterners and Europeans heard of the unbelievable wealth west of the Mississippi. Dreams of instant wealth drove hundreds of thousands of people to the promised land to prospect for minerals.

PROCEDURE:

1.Students have learned that minerals have certain characteristics. Some of these are important for economic reasons. Ask students to list the objects in their classroom that they think were derived from minerals. Included on this list could be: the walls (sheet rock from gypsum), pencil lead (graphite), watches (quartz), pipes (copper), cement (calcite), and salt (halite). In addition, some objects, like the black boards (slate or shale), chalk (limestone), and plastics are obtained from rocks or oil.

2. Using a map of the U.S., have students write a creative first person essay or journal on the excitement of prospecting for gold. They are to set the story in the East and write about traveling to California or Nevada in search of gold or silver. Point out to students the many obstacles like the Mississippi River, Sierra Nevada, rain, snow, and even thieves had to be overcome by the prospectors.

3. The students may have to research the history of the United States in the 1800's to get a realistic look at the Gold Rush. You may want to use the Internet to help find information. Useful sites include:

a) http://www.calgoldrush.com/ - a general site created for the Gold Rush Sesquicentennial.

b) http://www.goldrush.com/~joann/ - Women in the California Gold Rush

c) http://www.pbs.org/goldrush/ - links related to a PBS documentary. Good material for student projects.

4. If you are studying other historical eras you may want to see how minerals may have affected these societies. For example, the Mesopotamians (ancient Arabs) invented smelting and casting. Later, around 3000 BC, bronze was developed by adding tin to copper. Production of iron began around 500 BC.

ROCK CYCLE - MINERALS (5B)

LAB

Students discover products that are derived from minerals.

OBJECTIVES:

1. Analyzing minerals for their usefulness.
2. Evaluating the elements in minerals.

Red Dog Mine, Alaska, mined for tin.

VOCABULARY:

economic
mineral

MATERIALS:

Rock Cycle - Minerals (5B)

BACKGROUND:

Minerals are important in our society. They create many useful products. The following information can help make the products used in the lab more meaningful.

Silica gel is used to help keep products dry. The gel can keep water molecules away from a product, and then the product will not be exposed to or damaged by water. It is used is many powdered substances as a drying agent. Silica gel is a hydrated form of quartz.

Gypsum board, also called wallboard, sheet rock, or plaster board, is used for walls in home and businesses. In very old homes the walls were made with wood, metal netting, and plaster, which was composed of powdered gypsum. The invention of gypsum board, made it easy for construction workers to build walls. Now they simply put up wood frames and nail the gypsum board onto them. The workers then put a thin cover of plaster on the gypsum board, and the wall is finished.

Copper mine

Fish weights are used to get fish line into the water. Otherwise, it is so light that it would float. The lead in these weights makes the line heavy. Pennies were once made of pure copper, but to make them more resistant they are now made of a mixture of copper and other metals.

Porcelain is mainly made of powdered feldspar and clay. The powder is mixed with water, and then

fired, producing a hard, durable material. Porcelain makes excellent tiles, dishes, cups, and dolls, to name a few items.

Minerals have many uses in our society. You can add very easily to this lab as you learn more about how minerals are used. Some companies in the mineral industry have informational brochures that outline the use of their products. You may want to ask your students if their parents have any examples that you can add to your collection.

The goal of this lab is for students to see different products that are derived from minerals and to analyze the properties of minerals that make them useful. This list can help you provide information about certain minerals that your students may see in the lab. You may want to go over this material during your conclusion.

PRODUCT	MINERAL	PROPERTY
anything with lead	GALENA (PbS)	contains lead
sheet rock, plaster	GYPSUM ($CaSO_4$)	soft, breaks easily
ceramics	FELDSPAR (K, $CaSi_3$ O_8)	chemical composition
magnets, iron	HEMATITE iron ore (Fe_3 O_2)	magnetic
garden rock	DOLOMITE ($CaMgCO_3$)	hard, pretty
make up, glitter	MICA complicated SiO_3	shiny sheets
watches, glass	QUARTZ (SiO_2)	hard
cement	CALCITE ($CaCO_3$)	chemical composition
pipe, pennies	COPPER (Cu)	soft, resistant
sulfuric acid	PYRITE (FeS)	contains sulfur

PROCEDURE:

1. Students learned in the Pre Lab that minerals are very important in our world.

Point out that many products come from minerals, and that minerals come from mines. Contrast this with organic products, such as wooden tables. Ask the students the origin of gypsum board, pencil lead, faucets, pennies, polyester, and plastic. The minerals for these products are mined. (Polyester and plastic materials are derived from oil that is essentially mined!)

Almost all products used in this picture were mined.

2. Have the students predict which properties make the minerals useful. You can easily add other products to this lab.

ROCK CYCLE - MINERALS (5B) LAB

PROBLEM: Why are some minerals used in everyday products?

PREDICTION:_____

MATERIALS: silica gel, lead weight, wall paper, penny, concrete, porcelain, iron tie, landscape rock(s)

PROCEDURE: Look at the following substances and try to predict which mineral(s) are found in these products. Explain your answer.

	MINERAL	REASON
silica gel		
gypsum board		
lead weight		
wall paper		
penny		
porcelain		
iron tie		
landscape material		
concrete		

CONCLUSION: Which of the minerals are easy to identify? Which are hard?

_____
_____

ROCK CYCLE - MINERALS (5B)

POST LAB

Students look at paintings to determine which minerals may have been used to create different colors.

OBJECTIVES:

1. Distinguishing colors derived from minerals.
2. Comparing natural colors with those found in early paintings.

VOCABULARY:

pigments

MATERIALS:

paint colors
reference books on ancient art
Rocks and Minerals (Eyewitness Books) by R.F. Symes
Internet

hematite is used to make a red pigment

BACKGROUND:

Students are familiar with a world of color. They do not realize that the colors that we use today in crayons and other items are chemical "copycats" of colors originally made of finely crushed minerals. The first paints were produced by crushing colored rocks and mixing the powders with animal fats. Wax was also used (encaustic painting), dating back to ancient Greece. This incredibly durable medium was used to adorn not only sculptures, but murals, boats, and buildings. The Greeks also used wax paints in the earliest known form of easel painting.

Today's paints are a fluid suspension of crushed matter in a liquid film that converts to a solid film when a thin layer is applied to a metal, wood, stone, paper or other related material. Many minerals have been or are used as paint pigments. The color black is powdered coal. Dark blue is powdered lapis lazuli. Yellow is powdered pyrite. Vermilion (light violet red) is powdered cinnabar. Red is powdered hematite. Green is powdered malachite. Light blue is azurite. Very dark green is powdered green clay (which is technically a variety of different minerals). Gray is powdered molybdenite. White is powdered diatomite, which is also a rock). A number of these pigments are toxic to humans, so their use has been discontinued. In many cases, pigments derived from plants have been substituted for mineral colors.

PROCEDURE:

1. If you have access to art books that illustrate some of the great paintings of the

12th and 13th century, have the students compare the colors and see if they can decide what minerals the artists may have used to make them. The *Rock and Minerals* book should be available for comparing of colors.

2. You may want to give students an Internet research assignment that focuses on cave paintings. Have the students try and learn what minerals were used as pigments. Alternatively, have the students make a list of colors from minerals and then research other colors derived from plants.

Australian petroglyphs, “Mount Borradaile”