

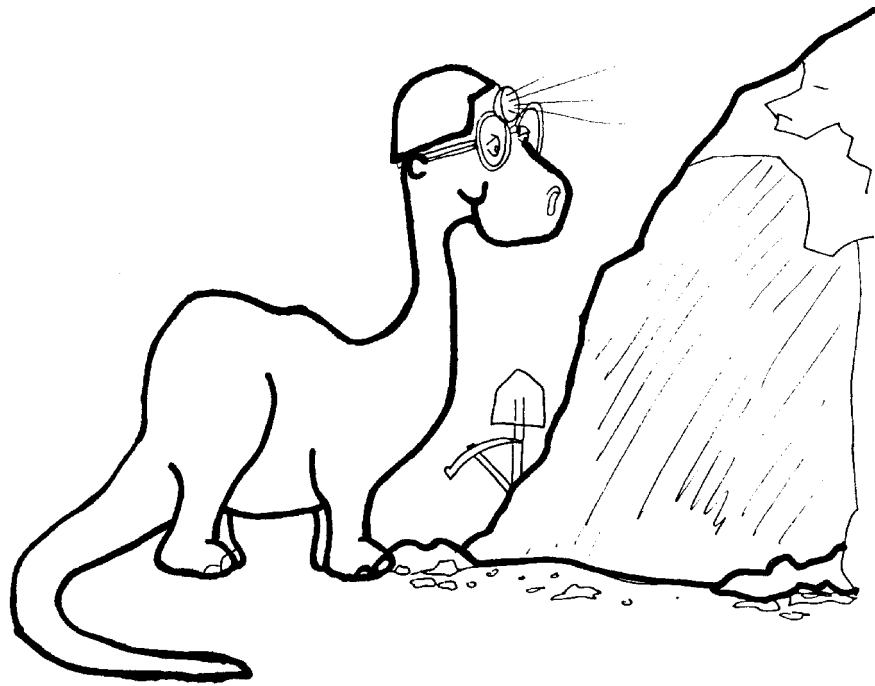


Rock Cycle

Understanding the Earth's Crust



FOURTH GRADE MINERALS



2 WEEKS
LESSON PLANS AND
ACTIVITIES

ROCK CYCLE OVERVIEW OF SECOND GRADE

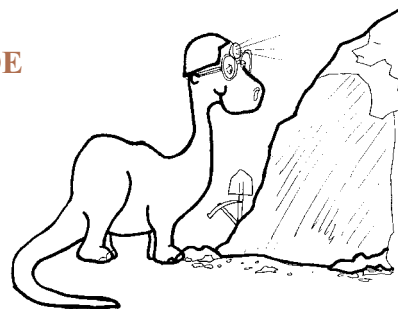
CHEMISTRY

WEEK 1.

PRE: *Analyzing the structure of the elements.*

LAB: *Investigating the chemical bonding of salt.*

POST: *Exploring the historical uses of salt.*



MINERALS

WEEK 2.

PRE: *Observing and describing key characteristics.*

LAB: *Exploring the characteristics of minerals.*

POST: *Comparing and contrasting mineral properties.*

WEEK 3.

PRE: *Exploring the different shapes of minerals.*

LAB: *Analyzing mineral shapes.*

POST: *Examining minerals that are gemstones.*

ROCKS

WEEK 4.

PRE: *Developing criteria to distinguish rocks.*

LAB: *Analyzing how different types of rocks are formed.*

POST: *Exploring the uses of rocks in the Indian culture.*

WEEK 5.

PRE: *Exploring parts of the rock cycle.*

LAB: *Analyzing and interpreting the shape of sand particles.*

POST: *Developing a story about rocks.*

PAST LIFE

WEEK 6.

PRE: *Reconstructing fossil organisms.*

LAB: *Discovering that "the present is the key to the past."*

POST: *Recognizing fossil bones.*

ROCK CYCLE - MINERALS (4A)

PRE LAB

Students use people to define
"key characteristics."

OBJECTIVE:

1. Observing and describing key characteristics.
2. Exploring observational skills.

VOCABULARY:

characteristic
compound
element
observation

MATERIALS:

specimens of calcite, halite, and quartz



Halite

BACKGROUND:

Minerals are composed of one or more elements. Since there are many elements, many combinations are possible; geologists have thus recognized thousands of different minerals. Minerals are important in a number of ways. Minerals are the building blocks of rocks. They are important to the world's economy. Minerals such as gold and silver can determine the wealth of a nation.

Other minerals are admired because of their beauty, such as rubies and emeralds.

Still other minerals are used in industry, such as chromite, a chromium ore, which is used to harden metals. Finally, minerals are very useful in everyday objects such as watches (quartz) and plaster (gypsum).

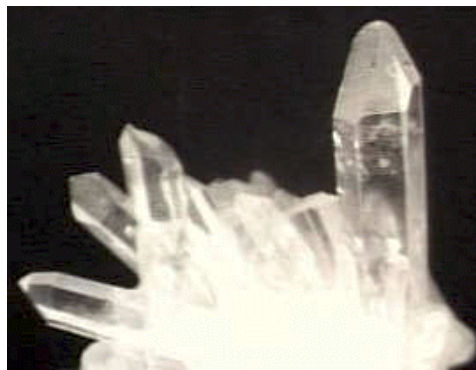


Calcite

A mineral is "a naturally occurring, inorganic element or compound with a definite chemical composition, a characteristic crystalline structure, and distinct chemical properties." For example graphite, which is made up of the element carbon, is soft, so it easily writes on paper. The "lead" in pencils is really graphite. Mica is composed of silicon, oxygen, iron, and aluminum. It forms very thin crystals that flake off into sheets. Mica is used

as glitter in some make up. Pyrite is an iron sulfide that has a metallic luster (shiny like

metal) and brassy color. Many people mistake this for real gold, hence its common name "fools' gold." Magnetite is an iron oxide is naturally magnetic and very dense.



Quartz

Key characteristics, are unchanging properties of a substance. They can thus be reliably used to identify that substance. Minerals have key characteristics. 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.

PROCEDURE:

1. Discuss the difference between the words "characteristic" and "key characteristics." You can illustrate key characteristics by asking the students how they can recognize you. Use the following chart for guidance.

How People Recognize Me Now	Characteristics That I Will Still Have in Twenty Years
<i>hair color</i>	<i>skin color</i>
<i>voice</i>	<i>mouth shape</i>
<i>height</i>	<i>Ear and eye shape</i>

2. Illustrate key characteristics using quartz, calcite, and halite. These minerals have very distinct key characteristics that the students can easily observe.

A. **Quartz:** Crystals always make a pointed pencil shape. It has 6 sides on terminal ends, resembling a prism. It is very hard (7 on the Mohs hardness scale). A steel knife will not scratch quartz. Quartz crystals are usually clear, but can occur in almost any color.

B. **Calcite:** Shows a rhombohedral crystal shape. This can be described as a "drunken" or tilted 3-dimensional rectangle. Calcite fizzes readily with HCl. It is soft (about 3 on the hardness scale) and is easily scratched with a knife. Calcite may be clear to yellow in color. When a clear calcite crystal is placed over an image or word, it appears doubled when viewed through the crystal. This is called double refraction.

C. **Halite:** Tastes like salt, because it is salt. Halite has a cubic crystal form, so it cleaves into perfect cubes. It has roughly the same hardness as calcite, and is colorless. Although taste is an important characteristic, caution students to avoid tasting minerals; some minerals have very unpleasant tastes.

3. Since these three minerals above can be clear in color, ask the students if color is a good key characteristic. Next, ask them how they would tell these minerals apart. Each of the minerals has its own key characteristics of hardness, shape, or taste. Color in this case is not a key characteristic.

ROCK CYCLE - MINERALS (4A)

LAB

Students look at minerals and determine key characteristics.

OBJECTIVE:

1. Exploring the characteristics of minerals.
2. Distinguishing mineral attributes.

VOCABULARY:

color
density
feel
hardness
shape
texture



crystals of feldspar

MATERIALS:

Rock Cycle - Minerals (4A), or use specimens of quartz, fluorite, pyrite, gypsum, calcite, mica, galena, feldspar, ulexite, and hematite
Periodic Table Placemats

BACKGROUND:

A mineral is "a naturally occurring, inorganic element or compound with a definite chemical composition, a characteristic crystalline structure, and distinct chemical properties". Minerals have to be naturally created or else they are classified as man-made substances. Minerals are the building blocks of rocks.

Most minerals have key characteristics that help in their identification. Halite (table salt), which is composed of sodium (element #11) and chlorine (element #17) is a good example. The key characteristics of halite are its cubic crystal shape, lack of color (it is clear) and salty taste. Knowing these characteristics helps identify halite.

PROCEDURE:

In the lab, the students will work at stations to begin to distinguish the key characteristics of minerals. These include color, hardness, density, crystal shape, texture and cleavage.

1. Prior to lab, cut the "Mineral Cards" for each station listing the questions that you

want the students to answer. Place the cards in front of the minerals. If the card asks the students to perform a test, such as scratching the mineral with a nail, make sure that the correct materials are available.

2. Using the Periodic Table Placemats, review the composition of each of the minerals in the lab. You can use the cards that accompany the specimens as a guide to composition. Direct the students to locate the elements on the periodic table as you tell them the "ingredients."

3. After students have completed the lab, discuss the specific key characteristics of each mineral. Use the information below as a guide.

QUARTZ is a naturally clear mineral. It can occur in almost any color, however, if it contains traces of other elements. Its natural crystal shape is 6 sided. Quartz is very hard (7 on Mohs hardness scale). It cannot be scratched by a steel knife or nail. Quartz is the most common mineral on the surface of the Earth. It is found in nearly every geological environment and is a component of almost every rock type. Quartz is used to make glass, electrical components, optical lenses, and abrasives. It is also used as a gemstone, ornamental stone, and building material.

FLUORITE breaks into 8 sided polygons (dipyramidal shapes). It has a hardness of 4 on the Mohs scale. Fluorite is prized for its glassy luster and rich variety of colors, including purple, blue, green, yellow, colorless, brown, pink, black and reddish orange. Most fluorite from the United States is clear to purple in color. The word fluorite comes from its use as a flux in steel and aluminum processing. Fluorite is also used as a source of fluorine for hydrofluoric acid and fluorinated water.



Fluorite

PYRITE shows cubic crystal forms. It has a metallic luster, and a distinctive brassy-to gold color. Since it is composed partially of iron, is very dense. Because of its color, pyrite is the classic "fool's gold." Pyrite has been mined for its sulfur content for use in defense and chemical industries.



Gypsum

GYPSUM crystals are tabular in shape. Gypsum ranges from white to pink in color. It is very soft, and can be scratched by a fingernail. Gypsum is one of the more common minerals in sedimentary environments. It often forms in desert areas where evaporation rates are high, by precipitation from highly saline water. Gypsum's uses include plaster, wall board, cement, fertilizer, paint filler, and ornamental stone.

CALCITE forms the rhombohedral and hexagonal prism shapes. It occurs in light shades of white, yellow, orange, blue, pink, red, brown, green, black, and gray. It may also be colorless. Calcite fizzes readily with HCl. It is soft (about 3 on the hardness scale) and is easily scratched with a knife. Calcite may be clear to yellow in color. When a clear calcite crystal is placed over an image or word, it appears doubled when viewed through the crystal. This is called double refraction.

MICA crystals occur in very thin sheets. This is an excellent example of a mineral with one cleavage; the sheets form along a plane of weak atomic structure in the mica crystals. Mica is used as a heat insulator. There are two common types of mica: a) biotite (black to brown color) and b) muscovite (clear, white, or silver in color). Mica is a common rock forming mineral; it is present in most igneous and metamorphic rocks.

GALENA forms cubic crystals with a characteristic stepped pattern caused by complexities in the mineral's crystal structure. Galena has a metallic luster, and is gray to silver in color. It contains large amounts of the element lead, so it is very dense. Galena is commonly mined and processed for lead, however, some galena crystals contain up to 1% silver. Galena is thus also an important source of silver.



Galena

FELDSPAR has a complex, roughly rhombohedral crystal shape. There are many types of feldspars including plagioclase (white) and orthoclase (pink-orange). Although opaque, feldspar crystals have a glassy luster. Quartz and steel will scratch feldspar. Feldspar is a common mineral in igneous and metamorphic rocks. Feldspars are used in making ceramics, as a building material, and as gemstones (the variety moonstone).

ULEXITE grows in fibrous crystals. This gives the mineral a special property; for complex optical reasons, images can travel along the fibrous crystals with little distortion. For this reason, ulexite is often called "TV rock," although it is a mineral. Ulexite is white, and a source of the element boron. Ulexite precipitates from lakes in arid regions due to evaporation. The lakes form only during rainy seasons due to runoff from nearby mountains. Ulexite is used to make some detergents, especially for washing clothes

HEMATITE crystals tend to be very small. This mineral is metallic; it may either appear as a shiny steel color or a dull red. When scratched on porcelain, hematite shows a red-brown streak. Hematite gets its name because of this color, from a Greek word meaning "blood-like." Ancient superstition held that large deposits of hematite formed from the blood that flowed into the ground after large battles. It contains large amounts of iron, so hematite is quite dense. Hematite is an important ore of iron and its red color lends itself well for use as a pigment.

MINERAL CARDS

<p>FLUORITE (Ca, F)</p> <ol style="list-style-type: none">1. Describe the shape.2. Describe the color.	<p>QUARTZ (Si, O)</p> <ol style="list-style-type: none">1. Describe the color.2. Describe the shape.3. Can you scratch it with a nail?
<p>GYPSUM (Ca, S, O)</p> <ol style="list-style-type: none">1. Describe the shape.2. Can you scratch it with your fingernail?	<p>PYRITE (Fe, S)</p> <ol style="list-style-type: none">1. Describe the shape.2. Describe the density.3. What other mineral looks like pyrite?
<p>MICA (Mg, Fe, Al, Si, O)</p> <ol style="list-style-type: none">1. Describe shape.2. Describe color.	<p>CALCITE (Ca, C, O)</p> <ol style="list-style-type: none">1. Describe the shape.2. What happens when you put calcite on top of a letter?
<p>FELDSPAR (K, Ca, Na, Si, O)</p> <ol style="list-style-type: none">1. Describe shape.2. Will a nail scratch feldspar?	<p>GALENA (Pb, S)</p> <ol style="list-style-type: none">1. How does galena feel?2. Describe color.
<p>ULEXITE (B, O)</p> <ol style="list-style-type: none">1. Describe ulexite on a picture?2. Describe color.	<p>HEMATITE (Fe, O)</p> <ol style="list-style-type: none">1. Describe color.2. Describe density.

ROCK CYCLE - MINERALS (4A) LAB

PROBLEM: Do minerals have key characteristics that help to identify them?

PREDICTION: _____

PROCEDURE: Examine and describe each of the following minerals. Answer the questions at each station.

	OBSERVATIONS AND ANSWERS
1. QUARTZ	
2. FLUORITE	
3. PYRITE	
4. GYPSUM	
5. CALCITE	
6. MICA	
7. GALENA	
8. FELDSPAR	
9. HEMATITE	
10. ULEXITE	

CONCLUSION: What types of characteristics should you look for in a mineral?

ROCK CYCLE - MINERALS (4A)

POST LAB

Students use gemstone placemats to look at cleavage

OBJECTIVES:

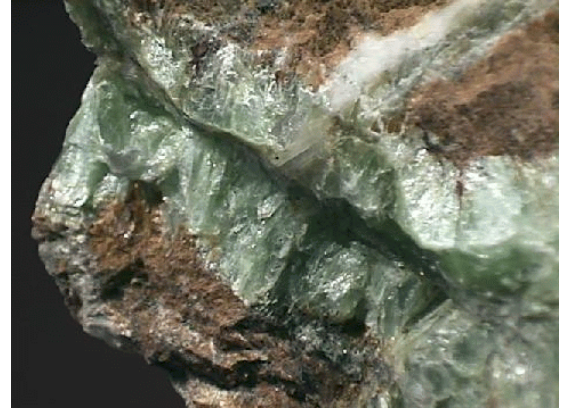
1. Comparing and contrasting mineral properties.
2. Investigating hardness, specific gravity, magnetism, and cleavage.

VOCABULARY:

cleavage
hardness
magnetism
specific gravity

MATERIALS:

Rocks and Minerals, by R. Symes
Familiar Rocks and Minerals of North America
Gemstone Placemats
Internet



talc

BACKGROUND:

Minerals can be identified by various properties. mineral characteristics the more they study and examine minerals. Characteristics commonly used to identify minerals include color, hardness, crystal shape, texture, cleavage, density (or specific gravity) and magnetism. The students should be familiar with at least some of these terms.

Cleavage is defined as the breakage of a mineral along planes of atomic weakness. Specific gravity is the ratio of the mass of a given volume of a mineral to the mass of an equal volume of water. Simply, specific gravity refers to how heavy a mineral feels (density).

Magnetism is a property of two common minerals, magnetite and pyrrhotite (both minerals contain iron.) This property is unique, and therefore, easily recognizable. Lodestone, which is the mineral

Students will become familiar with

Mohs HARDNESS SCALE

- (1) TALC (SOFTEST)
- (2) GYPSUM
- (3) CALCITE
- (4) FLUORITE
- (5) APATITE
- (6) ORTHOCLASE
- (7) QUARTZ
- (8) TOPAZ
- (9) CORUNDUM
- (10) DIAMOND (HARDEST)

magnetite, was used as a compass by early navigators.

Hardness refers to the resistance of a substance to being scratched. The Mohs Hardness Scale (named after Austrian mineralogist Friedrich Mohs) 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.

The Mohs scale is only one way to classify mineral hardness. A simpler method, often used by geologists during field work, is to classify minerals as harder or softer than a steel knife or a fingernail. For example, if you scratch the mineral with the knife and nothing happens, the specimen is likely quartz or feldspar. If your fingernail can scratch the mineral, it may be gypsum or less commonly talc.

PROCEDURE:

1. Use the Gem Placemats to help students discover the hardness of different gems, especially those gems that are minerals. Review the Gem Placemat with the students. Go over which gems are minerals. Remember a mineral must be inorganic, for example amber is not a mineral.

2. Have the students examine the hardness of the gems. They should observe that most gems are very hard. Ask them why. One reason is that durability makes minerals valuable. Since harder minerals tend to be more durable, most gems are hard. For example, diamond is highly priced because it is the hardest mineral.

3. You may want students to find out the hardness of the minerals that they used during the lab.

4. You may want the students to research more information about minerals. The recommended reference books explain many mineral characteristics, and have many excellent mineral images. Other reference books from the library can be used so students can discover properties of minerals.

You may also want to visit the web site: <http://mineral.galleries.com>, which has abundant information on minerals especially gems.

ROCK CYCLE - MINERALS (4B)

PRE LAB

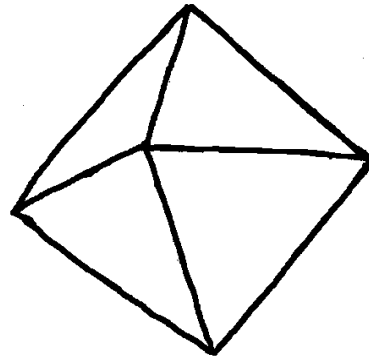
Students learn to draw geometric shapes.

OBJECTIVES:

1. Comparing shapes with geometric models.
2. Drawing mineral shapes.

VOCABULARY:

cubic
diamond shaped
element
mineral
pyramid
rhombohedron
rock
tabular



A dipyrmaid

MATERIALS:

geometric models

BACKGROUND:

The shape of a mineral crystal reflects the arrangement of atoms which compose it. The nature of this arrangement is affected by the size of the atoms and how they bond together. Mineral breakage is also determined by atomic arrangement; some minerals cleave along weak planes in the atomic structure.

It is important for students to be able to recognize geometric shapes in minerals. Many times geometry and science are taught independently. Therefore, students sometimes do not realize that geometry is a mathematical (or quantitative) way of describing the real world. For example, the shapes of mineral crystals and the mineral cleavage may be described by geometric terms. However, note that real mineral crystals rarely occur as perfect geometric forms.

Shapes help us recognize objects. Mathematicians give names to very specific shapes. This exercise teaches students four common shapes that are commonly seen in minerals.

PROCEDURE:

1. Draw the three geometric shapes on the board. Ask the students to identify

them. Illustrate the difference between a square and a cube and between a rectangle and a rhombohedron. Use geometric models if you have them available.

2. Have students practice drawing the shapes.

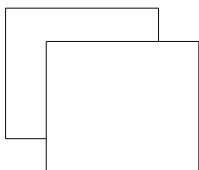
3. Give the students a copy of the quartz crystal model. After they cut it out, make sure the students fold each line before they glue it together. It will make assembly much easier. You may wish to have them color the model before assembling it.

INSTRUCTIONS FOR DRAWING GEOMETRIC SHAPES

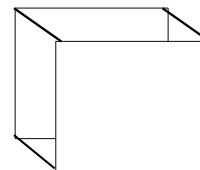
CUBIC



1. draw square



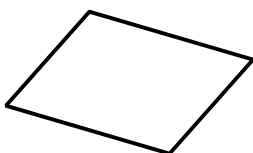
2. draw second square



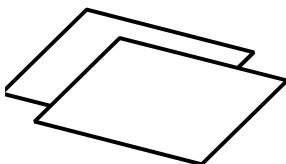
3. connect corners

RHOMBOHEDRAL

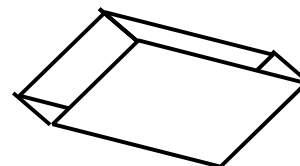
1. draw parallelogram



2. draw second



3. connect corners



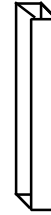
TABULAR



1. draw column

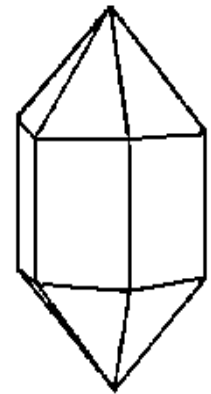
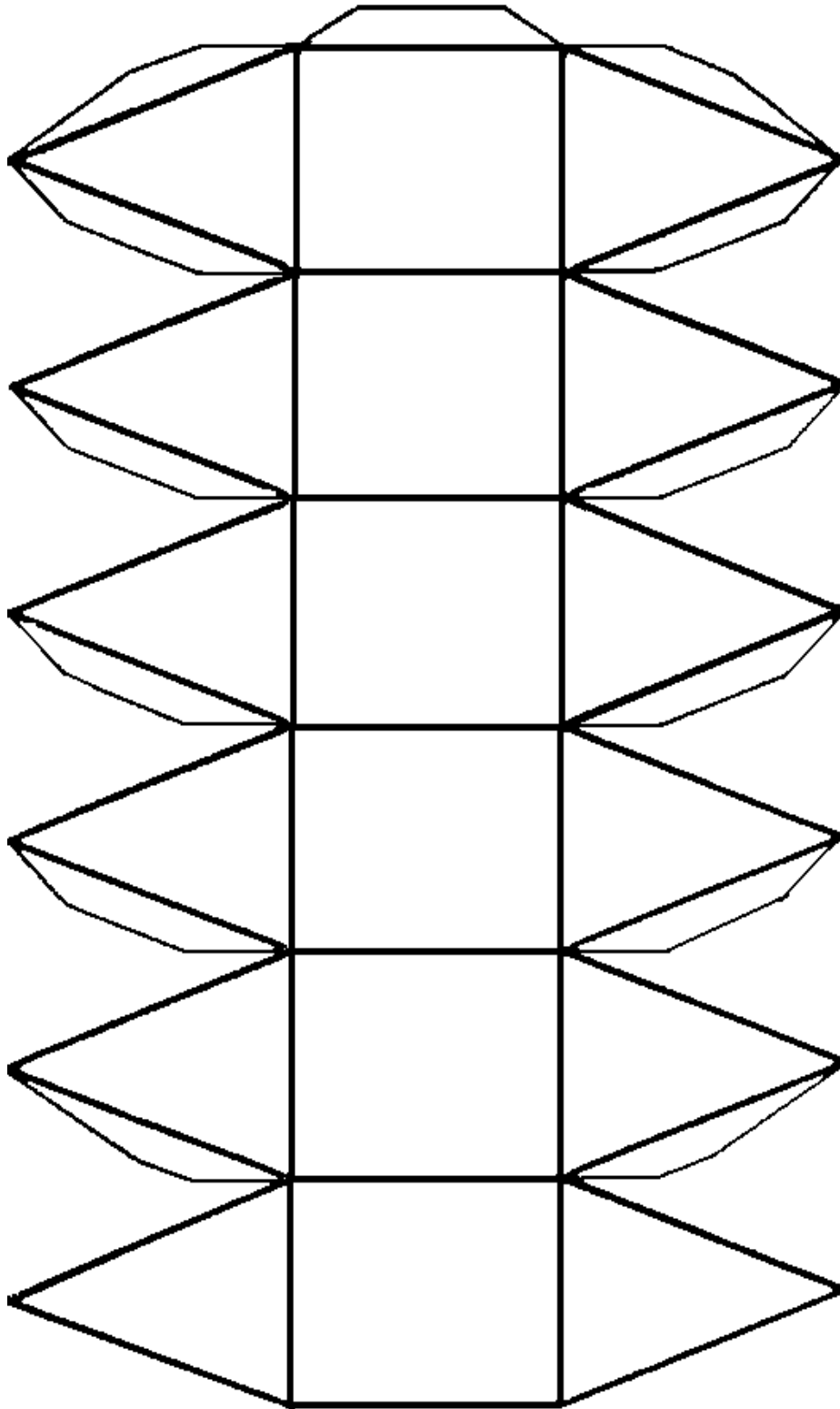


2. draw second column



3. connect corners

ROCK CYCLE - MINERALS (4B) PRE LAB



Quartz

ROCK CYCLE - MINERALS (4B)

LAB

Students determine the shapes of minerals in rocks.

OBJECTIVES:

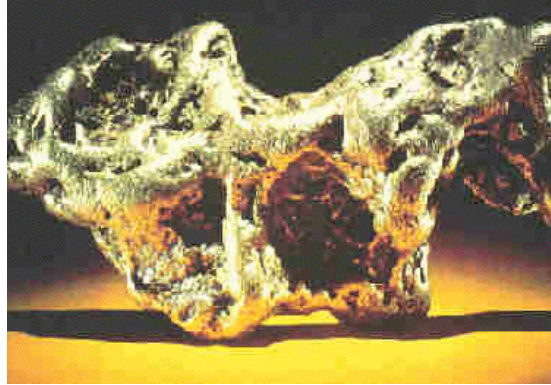
1. Analyzing different mineral shapes.
2. Interpreting the shapes of the minerals in a rock.

VOCABULARY:

crystal
geometry
shape

MATERIALS:

Rock Cycle - Minerals (4B)
Swift-GH Microscope or hand lens



Gold has neither a crystal form nor cleavage

BACKGROUND:

The crystal shape of a mineral may not be helpful in identifying that mineral in a rock. Most minerals in rocks grow in a confined space, in competition with other minerals, so they do not develop full crystal forms. You may see “faces” of the crystal that can give clues to its form, but not the entire crystal. For example, calcite may show some parts of its rhombohedral shape. When crystal shape is absent, other characteristics of minerals can help you identify them.

One such characteristic is cleavage. Cleavage is the tendency of a mineral crystal to split in definite directions (when a force is applied) producing more or less smooth surfaces. Cleavage is caused by weaknesses in the orderly placement of the atoms within a crystal. It is strictly a directional property, which can only occur in crystalline substances. Different minerals may have one, two, three, four, or six cleavages. The smooth surfaces in minerals within rock samples often indicate cleavage. Note that not all minerals show cleavage. For example, quartz breaks irregularly.

Two other useful characteristics are hardness and luster. Hardness is the ability of the mineral to resist scratching or abrasion. Luster is the way the 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. For example pyrite is metallic, quartz and rubies are vitreous or glass looking, turquoise is waxy, and feldspar is pearly looking.

PROCEDURE:

1. Set up minerals for students to identify. In addition, place samples of granite, rock salt, gypsum casts, and marble at stations with microscopes or hand lenses.
2. Make sure students know the geometric shapes covered in the Pre Lab. Remind students that the internal arrangement of the atoms reflects the outside appearance of the mineral.
3. Explain that minerals make up rocks. Tell the students that many of the minerals that they have seen in the lab can thus be found in rocks.
4. Have the students examine the minerals in the kit. Instruct them to draw the crystals or cleavage planes on the worksheet.
5. Next, have the students look at the rock specimens, and try to recognize the mineral samples they have just sketched. Place the rock specimens under the microscopes or have the students use hand lenses.
6. The students should discover that crystal shapes can aid in determining the minerals in a rock. They may also learn that some minerals in rocks, like quartz, do not always make those crystal shapes. Other characteristics, such as hardness or luster, can be used to identify these minerals.
7. ANSWERS: (1) quartz can be found in granite; (2) halite can be found in rock salt; (3) gypsum can be found in this "home" made by little flea-like animals from the San Francisco Bay; (4) calcite can be found in marble; (5) feldspar can be found in granite.

SHAPES OF CRYSTALS: quartz is a six-sided prism; halite is a cube; gypsum is tabular; calcite and feldspar are both rhombohedral.

ROCK CYCLE - MINERALS (4B) LAB

PROBLEM: Can the shape of a mineral in its crystal form help identify that mineral in a rock?

PREDICTION: _____

EXPERIMENT: You have different mineral crystals at your lab table. Draw the shape of the mineral crystals and then look at the associated rocks on the display table. Try matching the minerals with the rock specimens that contain them.

MINERAL NAME	DRAW SHAPE	DESCRIBE MINERALS
QUARTZ		
HALITE		
GYPSUM		
CALCITE		
FELDSPAR		

CONCLUSION: Which mineral shapes helped identify the minerals? Which did not? _____

ROCK CYCLE - MINERALS (4B)

POST LAB

Students observe and learn about birth stones.

OBJECTIVES:

1. Learning that some minerals are gemstones.
2. Discovering different birth stones.

VOCABULARY:

gem
mineral

MATERIALS:

Gemstone Placemats
Gem Display Kit



BACKGROUND:

Are all gemstones minerals? A mineral is an inorganic, naturally occurring substance with distinct chemistry and crystalline structure. Gemstones are materials that have an economic or aesthetic value. Therefore, not all gemstones are minerals. For example, amber is solidified tree resin, so it is not a mineral.

Gemstones can be classified as either amorphous or crystalline. Amorphous gemstones have no orderly internal atomic structure and no naturally occurring shape. Glass, amber, and opal are examples. Crystalline gemstones are minerals; they have a definite and regular internal atomic structure. Examples include garnet, emerald, and ruby.

PROCEDURE:

1. Most students are familiar with their birth month's gemstone. Poll your students and see if you can list the months and the gems just from their answers.
2. Using the table below, review birth stones with your students. In some cases, a month may have more than one gemstone listed. Also, when a mineral is very common it acquires a common name used by most people. Remember that the proper scientific name and the common name refer to the same substance with the same chemical composition.
3. The Gemstone Placemats and the Gem Display Kit can help students visualize these substances. Many of the gems in the Gem Display are real, but have flawed structures, so they are not particularly valuable.

BIRTH STONES BY MONTH

MONTH	GEM	COLOR	HARDNESS	MINED
January	garnet	red, brown, yellow	6.5-7.5	Russia, N.Y.
February	amethyst (quartz)	purple	7	Russia, Brazil
March	aquamarine (beryl)	green, blue	7.5-8	U.S.
April	diamond	colorless, pale yellow	10	Africa, Russia
May	emerald	deep green	7	Russia, Zimbabwe
June	pearl	white	N/A	oysters
July	ruby	red	9	India
August	peridot	green	6.5-7	Burma
September	sapphire (corundum)	blue	9	India
October	opal	iridescent	5-6	Hungary, Mexico
November	topaz	yellow	8	Russia, Brazil
December	turquoise	blue	6	U.S.