Composition of the Earth: Minerals and Rocks

Objectives:

- Students will demonstrate an understanding of the relationship between minerals and rocks.
- Students will identify common minerals and rocks found in the earth's crust.
- Students will gain an understanding of the rock cycle and the part it plays in determining the formation of rocks and minerals.

I. The Knowledge Web

Materials:

Chart Paper
Tape
Markers

1. To begin this part of the geology unit, discuss with the students what they already know about rocks and minerals from past study and personal interest. Make a web of their knowledge on chart paper. Discuss the results of the webbing.

2. Elicit questions that they have and list them on a second piece chart paper and post that paper on the wall. Refer to it as the unit progresses.

3. If the connection has not already been made in the prior discussion, make the connections between rocks and minerals explicit:
   - Minerals are substances with a definite chemical composition and crystal shape
   - Rocks are made of one or more minerals.

Since this would include their pet rocks, the first job in learning about their pets is to determine what their pets are made from. This is their transition to mineral and then rock identification.

II. Mineral Identification

Materials:

summary of physical properties of minerals and how to test for them
mineral sets
hand lens
steel nail
glass slide
copper penny
streak plate
magnet
ultraviolet light, if you have one
hardness scale (from book)
field hardness scale (from book)
mineral identification key

1. Discuss with students their past experience with mineral labs. Remind them (or introduce, if necessary) that since minerals consist of one substance, they can be identified by their physical properties.

2. Give each student a copy of the physical properties review sheet. Briefly demonstrate each test on the sheet, or, if the students are knowledgeable, have students demonstrate the tests.

3. Give each pair of students a collection of numbered mineral samples, a key to minerals, and a small kit of simple tools. (penny, nail, hand lens, slide, streak plate, magnet). The students then determine the physical properties of the samples and use the key to determine their identity.

4. Although it is not a requirement for doing this activity, it can be very helpful to have a larger specimen of each sample that the students can look at if their own small sample does not yield enough information. These samples would be for observation only, not to be streaked, broken for cleavage checks, or otherwise damaged.

5. A suggested mineral set is:
    1. *Quartz*
    2. *Feldspar*
    3. *Biotite*
    4. *Muscovite*
    5. *Calcite*
    6. *Halite*
    7. *Galena*
    8. *Sulfur*
    9. *Fluorite*
    10. *Graphite*
    11. *Magnetite*
    12. *Pyrite*

Key to Minerals

1. A. Metallic Luster B. Non-Metallic Luster	go to 2 go to 5
2. A. Hardness greater than 4 B. Hardness less than 4	go to 3 go to 4
3. A. Black, magnetic B. Brassy yellow, cubic cleavage	Magnetite Pyrite
4. A. Lead pencil black, draws on paper B. Shiny grey, very dense, cubic cleavage	Graphite Galena
5. A. Hardness 6 or greater B. Hardness less than 6	go to 6 go to 7
6. A. Has clear cleavage planes B. Has fracture	Feldspar Quartz
7. A. Cleavage in flat thin sheets B. Cleavage not in flat thin sheets	go to 8 go to 9
8. A. Light to clear B. Brown to black	Muscovite Biotite
9. A. White to colorless; cubic, salty taste, harness 2.5 B. White, colorless; harness 3, double image, C. White, green, purple; hardness 4, glows with UV light D. Bright yellow, opaque, smells like matches	Halite Calcite Flourite Sulfur

Data Table for Mineral Observations

Mineral Number	Color	Luster *(metallic or non metallic)*	Cleavage or Fracture	Hardness	Streak color	Other properties	Name of mineral
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

Name:_____ Section: _____ Date:_____

Study Guide: Properties of Minerals

What is a mineral?

A substance must have these five characteristics to be considered a mineral:

- •Naturally occurring
- •Inorganic
- •Solid
- •Definite chemical composition (has a chemical formula, like NaCl)
- •Crystal structure

Minerals form when:

- •Magma or lava cool and solidify: The faster the cooling, the smaller the crystals
- •When the liquid, like water, they are dissolved in evaporates, leaving the mineral

Characteristic Properties of Minerals

Because minerals have a definite chemical composition, they can be identified by their characteristic properties. These properties are:

- Color: Some minerals, such as sulfur and malachite have a unique color. However, color is generally not very reliable by itself, since one mineral can have several different colors.
- Streak: Streak is the color of a line of powered mineral that is rubbed off on a rough surface, like a streak plate. The streak color may be different than the observed color of the mineral. It is always the same for the same mineral.
- Luster: Luster refers to how a mineral reflects light. The most essential differences is whether the mineral has metallic or nonmetallic luster.
- Hardness: Hardness is the ability of a mineral to resist being scratched. Moh's hardness scale assigns hardness numbers from 1, talc, the softest mineral, to 10, diamond, the hardest mineral. The hardness can be determined by trying to scratch a mineral sample with items of different hardnesses.
- Crystal Shape: Often the crystals in a mineral are too small to see, but when they are not, then they can help identify the mineral.
- Cleavage and Fracture: This property refers to how a mineral breaks. If it breaks along 1 or more smooth, definite surfaces, then it has cleavage. If it does not break along a clear surface, then it has fracture. This is NOT the same as having crystals. All minerals have crystals. This is about how the mineral breaks.
- Density: While useful, we will not be using density very much. Just to get you interested for next year, density has to do with the amount of matter in a given space. Ask me about the pound of feathers and pound of lead.
- Special Properties: Some minerals have special properties that can help identify it. Some of these include:
  - The mineral is magnetic
  - The mineral glows under a UV light (fluorescent)
  - The mineral has a unique taste (salt) or smell (sulfur)
  - The mineral makes lines, such as writing, appear double
  - The mineral is radioactive

III. The Rock Cycle

Materials: Whatever you choose to show to the students: see below

1. Discuss with students that since they now have a good idea what minerals are, it is time to look at rocks, such as their pet, and see how rocks are formed. Explain that what minerals make up a rock are among the clues that can tell them what the rock actually is.

2. Use any method you prefer to give a succinct introduction to the rock cycle: a video or DVD, a web site, a demonstration, posters, readings, or any combination you like. Stress that any rock can eventually become anything else given enough time, and that it is the ultimate in recycling. Also let them know that they will be coming back to the rock cycle in more detail when they look at the structure of the earth and what happens to it.

IV. Classifying Rocks

Materials:

Large samples of three basic groups of rocks
Student sets of rocks: include 6-9, in all three groups.
paper
hand lens
data recording chart

1. Have students devise a simple key or chart to differentiate among igneous, sedimentary and metamorphic rock. Essential points are:
   - ***Igneous:*** interlocking crystals, no clear layers, or looking like it cooled from lava or magma
   - ***Sedimentary:*** duller, sometimes softer, made from sediments which may be visible, often layered, may contain fossils
   - ***Metamorphic:*** interlocking crystals, often layered

2. Show students some large, easy to classify rock samples, and have them discuss whether the rocks are igneous, sedimentary, or metamorphic. Discuss their ideas as a class.

3. In pairs, give students a rock sample kit, hand lens, and the data recording sheet. Ask students to fill in the date table and determine whether each sample is igneous, sedimentary, or metamorphic. As in the mineral lab, it may be helpful to have larger samples of the small rocks in the student rock set.

4. Extension: Any student that wishes to go further than the classification into the three groups can be aimed towards the huge number of in print and online rock identification guides.

Data Table for Rock Observations

Rock Number	Observations	Check one:		
5.		Igneous	Sedim.	Metam.
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				

IV. Fossils and Geologic Time

1) Show students a representative sampling of different kinds of fossils. Challenge them to identify the nature of the organism or sign of an organism, and what material the fossil is currently composed of. Have students discuss what fossils can and can't tell someone about past life on earth.

2) If students are having difficulty how fossils could be formed, they can make simple mold and cast fossils with simple objects (leaves, shells, etc.) and plaster. To make a footprint or hand print, let the print harden before finishing,

3) Introduce the geologic time scale using visualizations. Using those and other visualizations, such as the Grand Canyon, challenge students to predict where the oldest fossils. Then, either using real or model fossils, have students use the geologic time scale to determine which fossils are most likely to be found in the lower layers and which are more recent.

4) In groups or pairs, students construct a geologic time line, using an appropriate scale. Include past earth events such as plate movements, formation of the oxygen atmosphere, beginnings of life, etc.).

V. Back To The Pets!

Materials:

Assorted guides to rocks and minerals
the tools from the rock and mineral labs

Each student brings his/her pet rock to the desk. Observe the rock again. Attempt to identify the minerals in the rock as best as possible, and the possible origin of the rock as to igneous, sedimentary, or metamorphic, or a combination of two or more groups. Students should give evidence for their decisions.