Earth Science – Grade 4
Minerals

Standards:
- Identifies the physical properties of minerals

Teacher Background

Minerals are pure substances and mix together to make rocks.

Rocks have a cycle and different types are formed by pressure and heat.

The surface of the Earth is always changing due to natural forces such as wind, rain, freezing, tectonic action etc.

Physical properties of a mineral (also a definition)

- It must occur naturally.
- It must be inorganic
- It must be a solid
- It must possess an orderly internal structure, that is, its atoms must be arranged in a definite pattern. (crystal)
- It must have a definite chemical composition (pure substance)

By this definition, diamonds are minerals, but cubic zirconia is not nor is lead crystal. (man made) Coal and pearls are not minerals (organic). Opal is not a mineral because it is not a crystal (it has a rounded shape because it has not internal structure and is called a mineraloid).

Inorganic means it is not made from or by any living things.

Orderly internal structure means that is has a repeating shape which gives it a distinct “crystal” pattern.

Definite chemical composition means it is made of only one kind of molecule. The fact that it is a pure substance gives each mineral particular traits such as hardness, luster, streak etc.
Lesson 1 – Minerals

Teacher background: After minerals are introduced and defined, this lesson will help students to understand crystal shapes and orderly internal structure. Samples of real minerals should be available to try and imitate.

Objective: To learn about crystal shapes and orderly internal structure

Materials: Pattern blocks
          pencil
          worksheet

Procedure:

1. Guide students through the use of the worksheet. The questions are:
   1. Please draw the shape of the blocks you are using

   2. Please put 4 different blocks together and draw that pattern. Does this
      represent a rock or a mineral? What is the most number of blocks that one
      block can touch?

   3. Please put 8 blocks together of the same kind and draw that pattern. What is
      the most number of blocks that one block can touch? Give the pattern a slow
      push from one side and watch if it easily changes shape. Is it strong?

   4. Please put 8 blocks together to make the strongest shape you can. Draw that
      pattern. Give this pattern a gentle push. Is it strong? If so, why is it strong?
      What is the most number of blocks that one block can touch?

   5. Choose a real mineral and try to make that shape using the pattern blocks you
      have.
      What is that mineral?
      Draw and name the shape you have made?

   6. Choose a second mineral and try to make that shape using the pattern blocks
      you have.
      What is that mineral?
      Draw and name the shape you have made?

   7. How many different shapes are your patterns made from? How many different
      things is a mineral made of?
Using Pattern Blocks, follow your teacher’s directions.

1. Please draw the shape of the blocks you are using.

2. Please put 4 different blocks together and draw that pattern. Does this represent a rock or a mineral? What is the most number of blocks that one block can touch?

3. Please put 8 blocks together of the same kind and draw that pattern. What is the most number of blocks that one block can touch? Give the pattern a slow push from one side and watch if it easily changes shape. Is it strong?

4. Please put 8 blocks together to make the strongest shape you can. Draw that pattern. Give this pattern a gentle push. Is it strong? If so, why is it strong? What is the most number of blocks that one block can touch?
5. Choose a real mineral and try to make that shape using the pattern blocks you have.
What is that mineral?
Draw and name the shape you have made?

6. Choose a second mineral and try to make that shape using the pattern blocks you have.
What is that mineral?
Draw and name the shape you have made?

7. How many different shapes are your patterns made from? How many different things is a mineral made of?
Lesson 2 - Mineral Identification Tests

Objective:
To determine the type of minerals based upon its characteristics

Materials:  Various minerals
            Mineral test kit (streak plates, hardness kit)
            Mineral ID Sheet

Procedure:
1. Test minerals for the following characteristics
   a. Color
   b. Luster
   c. Cleavage
   d. Hardness
   e. Streak
   f. Shape
Standards:
- Identifies the three categories of rocks and how they are formed

Teacher Background

Rocks are formed from a mixture of minerals. They are classified into three groups based upon how they were formed. These three groups form a rock cycle.

Http://www.learner.org/interactives/rockcycle/index.html
Some extension rock lessons on this site.

Notice that there are 3 types of rock and that any one type can turn into the other. The rock is either

- broken up (weathering and erosion) and put back together (compaction and cementation) which makes sedimentary rocks
- melted and cooled (magma) which makes igneous rocks
- put under heat and pressure (partially melts and then cools) metamorphic rock
Students should know the three types of rocks and the process necessary to make them. It would also be helpful for them to know places where these processes can occur. (i.e. melting in the Earth’s interior, weathering on the surface, cooling after magma comes out of a volcano etc)

Referring to the water cycle (3rd grade) is a good idea to help students understand a cycle. Plate tectonic movement is the force behind most of the rock cycle.

Lesson 1 - Teacher Demonstration

Objective: To simulate the changes that occur during the rock cycle

Materials: Sugar cubes
paper towels
Candle
tongs
Foil
Goggles for the teacher

Procedure:

1. Pass out sugar cubes to each of the tables
Examine the sugar cube with a hand lens. How is the sugar cube like sedimentary rock?

2. Crush the sugar cube into a powder. What part of the rock cycle does this represent?

3. The teacher will form a cup out of foil. Pour some of the crushed sugar into the foil cup.

4. Use the tongs to hold the foil cup over the candle flame. If this is done on a low table, students can gather around to observe the sugar begin to melt. What part of the rock cycle does this represent?

5. Set the foil cup down on a damp paper towel and let the sugar cool and harden. What part of the rock cycle does this represent?

6. Break the hardened sugar into pieces. What part of the rock cycle does this represent?
7. Draw the sugar rock cycle and label the type of rock and the processes to get there.

Add and label interior arrows to show how:

- Sedimentary can become metamorphic
- Metamorphic can become igneous
- Igneous can become sedimentary
Lesson 2 - Crayon Rock Cycle Lab

Teacher tip:
I would suggest using an iron rather than a candle to melt the wax, or the teacher could melt the wax for each group.

Objective: To learn how the different classes of rocks are formed

Materials: crayons and crayon sharpener
2 pieces of wood
candle
goggles
heavy duty aluminum foil
clothespin
Paper towel

Procedure:
1. Cut two pieces of heavy duty aluminum foil about 20 cm by 10 cm. Lay one inside the other so that you have double thickness.

2. Make crayon shavings by sharpening crayons with a crayon sharpener. Use different colored crayons. (These shavings will represent sediments.) You need enough crayon shavings of different colors to have a pile of "sediment" about 6 cm by 6 cm and 1 to 2 cm thick.

3. Place the crayon sediment inside the double thickness of aluminum foil and fold over. Fold the edges in so that all the crayon "sediment" is inside the foil and none can fall out.

4. Place the aluminum foil packet of crayon "sediment" between the two boards. Press on the board with your hands to flatten the crayon shavings.

5. Open the foil packet and examine your crayon "sediment". Record what you observe. What type of rock does this represent? (sedimentary rock)

6. Rewrap the crayon "rock" and place it between the boards again, but this time put them all on a hard floor. Now, each member of the group take a time to jump on top of the board to make more pressure. Examine your crayon rock again. Notice the changes and record what you see. What kind of rock have you made this time? (metamorphic rock)

7. Rewrap your crayon "rock" and bring it to your teacher to hold your packet over a candle with a clothespin. Heat for one minute or so.
8. Heat your crayon "rock" for several minutes. Let it cool, then unwrap your rock and place it on a wet paper towel. Record what you observe. What kind of rock did you make when you added heat? (igneous rock)

Conclusion:

Write in your journal how you made:
Crayon sedimentary rock
Crayon metamorphic rock
Crayon igneous rock

Lesson 3 - Types of Rocks and Their Characteristics

Objective: To determine common characteristics of each class of rock

Materials:
Various rocks of all three types

Procedure:

1. Give each group two types of sedimentary, metamorphic and igneous rocks.
2. Each group should try to determine one or two characteristics for each group.
   Consider patterns in the rock, luster, particle size, crystals etc.

Answers:
Try to get students to connect the characteristics with the processes that formed them.

Igneous – glassy -smaller crystals- sharp

Metamorphic – wavy, banded layers – crystals – no pores/spaces between particles

Sedimentary – particles – layers – different size particles – often contains fossils- may contain pores
Earth Science – Grade 4
Changes in the Earth’s Surface

Standards:
- Gives examples of how the Earth’s surface changes due to natural processes

Teacher Background

Rocks are regularly changed (in terms of geological time) by the following forces:

**Taken apart by**
- Weathering – from wind, water, temperature, chemicals and plants
- Erosion – carries the smaller pieces to a new location

**Rocks made by:**
- Volcanoes - Hawaii
- Rifts in the tectonic plates - mid-Atlantic ridge
- Edges of tectonic plates – Japan, Aleutian island chain
- Uplifting of tectonic plates – Rocky Mountains, Himalayas

Lesson 1 - Tectonic Plates

**Teacher Background:** Volcanoes are windows into how the Earth works. They occur because the Earth's rigid outer shell, the crust and upper mantle, is broken into a mosaic of plates that are in constant motion. Most volcanoes occur along the boundaries of the Earth's tectonic plates. More than half of the volcanoes that are exposed on land form a chain along the converging plates that encircle the Pacific Ocean. This chain is called the "Ring of Fire." Mount St. Helens is located in the "Ring of Fire."

**Objective:** to learn that the Earth’s crust is made of many small sections or plates

**Materials:**
- Plain outline map of the world [http://cse.ssl.berkeley.edu/lessons/indiv/coe/images/worldblank2.gif](http://cse.ssl.berkeley.edu/lessons/indiv/coe/images/worldblank2.gif)
Procedure:

1. Students will use the volcano map to map the location of the volcanoes on the blank world map. Use a triangle to symbolize the volcano.
2. After all the volcano’s are mapped, use the transparencies to make overlays of the world’s tectonic plates to place on top of the student made volcano maps

Discussion

1. After the students have completed their maps, lead a discussion. Are there volcanoes on every continent? (yes) How many of the volcanoes on their map are located within the shaded area, "The Ring of Fire?" (14)

2. Show the class the transparency of the "Plate Tectonics Map." Tell students that the outer layer of the Earth is broken into a series of 16 major plates and that the colored lines indicate the boundaries between these plates.

3. Next, superimpose the transparency of the plate tectonics map on the student made volcano map.

4. Ask students to observe the location of the volcanoes in relationship to the plates. Where do most of the volcanoes occur? They should observe that most occur near plate boundaries. Is the "Ring of Fire" located near plate boundaries?

5. Use this website and pictures http://egsc.usgs.gov/ib/pubs/teach-pack/volcanoes/poster/poster.html#posterfig2 to explain that rigid plates float on top of a softer layer of rock. As the plates move, they push together, pull apart, or slide past each other. Along two plate boundaries, magma comes to the surface and volcanoes can occur.

6. Explain that there are some volcanoes that occur in the interior of plates and not at plate boundaries. They occur over "hot spots" in the plates. Scientists do not know exactly why hot spots develop, but hot spots are places in the Earth's interior from which magma rises and erupts through the plate as it moves over the hot spot. Ask students which U.S. State is composed primarily of shield volcanoes? (Hawaii)

7. Is Mount St. Helens located in the "Ring of Fire"? (Yes)
Volcano resources

volcanoes map

Types of volcanoes
http://cse.ssl.berkeley.edu/lessons/indiv/coe/volcinfo.html

volcanoes list with longitude and latitude
http://www.volcano.si.edu/world/ in excel

Lesson 2 - Mount St. Helen’s Erosion

Objective: to learn how the Earth’s surface can change quickly

Materials: Science journal computer lab

Procedure:
1. Use the computer lab research the Mount St. Helen’s explosion
2. Put students into small groups to research how the volcanic explosion changed the following:
   - rivers
   - atmosphere
   - forest
   - soil
   - mountain
3. Have each small group report their findings to the class. This can be done orally, or with a poster, power point presentation or combination of these.