Rock Cycle Activities

by Deborah Hanuscin

The following activities were developed for use with upper elementary level students.

Igneous Rocks: Cooling Crystals

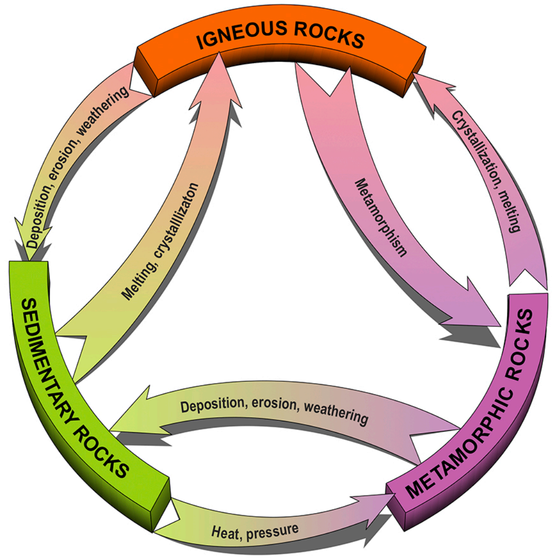
Concept: Igneous rock formation

Continued rise in temperature can eventually melt any rock until it is molten (called a magma). When the molten rock cools it forms an igneous rock. The size of the grains (crystals) in an igneous rock will depend on the rate of cooling. The faster it cools, the smaller the crystals.

Objective:

Students will be able to explain the relationship between rate of cooling and crystal size.

Materials:



- goggles
- hot plate or burner
- heat-resistant glass beaker
- oven mitts or beaker holder
- water
- Epsom salts (or alum)
- spoon
- two baby food jars
- pipe cleaners
- magnifying lens

Procedure:

1. Heat beaker of water until near boiling.
2. Stir in Epsom salts until no more will dissolve.
3. Pour the solution into two baby food jars.
4. Wrap two pipe cleaners around a pencil to form them into a shape that looks like a stretched spring. Remove them from the pencil and place one inside each jar.
5. Place one jar in the refrigerator to cool, and the other in a place in the room where it will not be disturbed.
6. Allow the crystals to form overnight, then remove the pipe cleaners and compare.

Questions:

1. How do igneous rocks form?

2. What do you notice about the crystals from the two solutions you made?
3. Why do you think they are different? Which one cooled more slowly?
4. How might the crystals or grains in an igneous rock differ because of how quickly the molten rock cooled?
5. Examine several igneous rocks and compare the grains. Which do you think were cooled slowly? Why?

Igneous Rocks: Molten Magic

Concept: Igneous rock formation

Continued rise in temperature can eventually melt any rock until it is molten (called a magma). When the molten rock cools it forms an igneous rock. The size of the grains (crystals) in an igneous rock will depend on the rate of cooling. The faster it cools, the smaller the crystals.

Objective:

Students will be able to describe how igneous rocks form.

Materials:

- goggles
- oven mitt
- powdered sulfur
- tablespoon (metal)
- heat source
- paper cup and plate
- magnifying lens
- water

Procedure:

1. Ask students how igneous rocks form and discuss the process with them.
2. Put on goggles and oven mitt. Slowly heat a tablespoon of powdered sulfur until it becomes a dark red liquid. Pour the melted sulfur onto a paper plate to cool.
3. Take another tablespoon of powdered sulfur and repeat the process. This time, place the melted sulfur into a paper cup of water to cool.
4. After both "rocks" are ready, place them side by side and compare. Use a magnifying lens to examine them closely.

Questions:

1. What can you observe about the rocks you made? How are the rocks similar? How are they different?
2. Break the rocks open and observe with a magnifying lens. Compare what you see.
3. Why do you think the rocks are different?

4. How do igneous rocks form?

Igneous Rocks: Igneous Mint Fudge

Concept: Igneous rock formation

Continued rise in temperature can eventually melt any rock until it is molten (called a magma). When the molten rock cools it forms an igneous rock. All three main types of rock (igneous, sedimentary, and metamorphic) can be melted to form magma.

Objective:

Students will be able to explain how igneous rocks form.

Materials:

- water
- 4 cups sugar
- 1¾ cups evaporated milk
- 1½ cups butter
- 12 oz package of chocolate mint wafers
- 16 oz package of marshmallows
- stove
- candy thermometer
- heavy, high-sided sauce pan
- measuring cups
- 13" x 9" x 2" pan
- butter (for greasing pan)

Directions: Butter the sides of the saucepan. Combine milk, sugar, and butter and stir until the sugar is dissolved and the mixture boils. Place candy thermometer into mixture and cook to soft ball stage (243° to 236° F). Remove from heat, then add mint wafers and marshmallows. Stir until blended. Pour immediately into a buttered 13" x 9" x 2" pan. Cut when cool and firm.

Procedure:

1. Prepare the fudge ahead of time according to the directions. Save an extra wafer and marshmallow to show students.
2. Ask students how igneous rocks form. (They are the result of magma, or molten rock, which has cooled.)
3. Show students the ingredients for the igneous rock fudge (marshmallow, wafers, etc.). Ask them to write their observations about these "rocks" in their science journals.
4. Pass out pieces of igneous rock fudge. Ask students to record their observations about these "rocks" in their science journals. You may wish for them to answer the questions below.

Questions:

1. How are the first "rocks" you were shown like the second?
2. How are they different?
3. What made the rocks change?
4. How do igneous rocks form?

Sedimentary Rocks: Sedimentary Snack Bars

Concept: Sedimentary rock formation

Sedimentary rocks are formed when weathering and erosion break down sedimentary, metamorphic, or igneous rocks into small bits, or sediments. These sediments are then transported (by ice, air, water, etc.). Once they have been deposited, the sediments may be buried by other sediments and lithified, or turned into rock, through compaction (pressure caused from the weight of sediments above) and cementation (sediments are "glued" together by minerals that precipitate out of water that was between the sedimentary particles when they were buried).

Objective:

Students will be able to describe how sedimentary rocks are formed.

Materials:

- ½ cup raisins
- ½ cup dried cranberries
- ½ cup dried apricots
- 1/3 cup dried figs
- 1 cup pitted dates
- ½ cup candied orange peel
- ¼ cup candied cherries
- 1 cup chopped walnuts
- 2-3 tablespoons orange juice
- large mixing bowl
- 8" x 8" x 2" baking pan
- margarine (to grease pan)
- grinder or blender
- measuring cups
- large spoon or spatula

Procedure:

1. Show ingredients to students. Tell them that these represent various types of rocks (igneous, metamorphic, sedimentary).
2. Place the "rocks" into the blender. This represents the physical weathering of the rocks into sediments. Ask students what type of rock is formed from sediments (sedimentary).

Explain that dissolved minerals are sometimes needed to form sedimentary rocks (add orange juice then mix together).

3. Ask students what happens to sediments before they become rock. Sediment is transported (carry the sediment over to the pan) and deposited (pour into the greased pan).
4. Ask students what happens to sediments once they are deposited (they are compacted). Use a spoon to mash the ingredients down, or cover the "sediments" with wax paper and place a book on top to simulate the weight of overlying sediments.
5. Ask students how long it may take for sedimentary rocks to form (hundreds or thousands of years!). Tell them that their sedimentary snack bars should be ready to eat tomorrow. Cover and refrigerate overnight.
6. The next day, cut the snack bars into squares and observe. You may wish to have students answer the questions below in their science journals.
7. Eat and enjoy!

Questions:

1. What do you notice about your sedimentary snack?
2. How has it changed from the original "sediments" you used to make it?
3. What holds the "sediments" together?
4. How did your "sedimentary rock" get its shape?
5. Explain how sedimentary rocks are formed.

Sedimentary Rocks: Make Your Own Sandstone

by Deborah Hanuscin

Concept: Sandstone formation.

Sandstone is formed through the processes of weathering, transport, deposit, burial, and lithification, as described in Sedimentary Snack Bars. It is made up of small (between .0625 mm and 2 mm) particles of sediment that are bound together by a cement.

Objective:

Students will be able to describe how sedimentary rocks are formed.

Materials:

- coarse sand
- two paper cups per student or group
- water
- Epsom salts
- magnifying lenses
- samples of sandstone (available from Indiana Geological Survey as part of the *Indiana Rock Set*)

Procedure:

1. Pour about one inch of coarse sand into a paper cup.
2. Pour about one inch of water in a second paper cup and add Epsom salts slowly while stirring until no more will dissolve.
3. Pour the Epsom salts solution over the sand in the cup. Stir well to mix.
4. Place the mixture where it will be undisturbed for several days until it is dry.
5. When it is dry, carefully tear the paper cup away from the sand.

Questions:

1. Describe what you observe. Use a magnifying lens to examine your "rock."
2. What is holding your rock together? Where are the Epsom salts?
3. Compare your rock to the sandstone samples. Which is harder? Why?

Sedimentary Rocks: Constructing Conglomerate

Concept: Conglomerate formation

Conglomerate is formed through the processes of weathering, transport, deposit, burial, and lithification, as described in Sedimentary Snack Bars. It is made up of chunks of sediment that are larger than sand-size (greater than 2 mm), such as pebbles, that are bound together by a cement.

Objective:

Students will be able to define conglomerate and explain how it is formed.

Materials:

- tablespoon
- fine sand
- paper cup
- pebbles
- coarse sand
- calcium hydroxide (slaked lime—available at hardware stores)
- water

Procedure:

1. Place several tablespoons of fine sand in a paper cup.
2. Add several tablespoons of coarse sand and pebbles and mix.
3. Add calcium hydroxide.
4. Add enough water to moisten the mixture and set the cup where it can remain undisturbed for several days.
5. After the water has evaporated, carefully tear away the paper cup.

Questions:

1. What is conglomerate? How does it form?
2. How does your conglomerate compare to other sedimentary rocks?

Metamorphic Rocks: Metamorphic Rock Cakes

Concept: Metamorphic rock formation

Metamorphic rocks are formed from sedimentary, igneous, or other metamorphic rocks. These rocks are subjected to intense heat and pressure. The heat and pressure is not quite enough to melt the rock, but it does cause the minerals in the rock to change in size or shape, or to combine with other minerals to form new or bigger minerals.

Objective:

Students will be able to explain how metamorphic rocks form.

Materials:

- electric griddle or frying pan
- pancake mix (just-add-water type)
- water for the mix
- oil for the griddle
- plates and napkins, spatula
- assorted foods, some that melt and some that don't: raisins, coconut, marshmallows, nuts, chocolate chips, berries, etc.

Procedure:

1. Allow students to observe each of the ingredients (including the pancake mix) before you combine them. You may wish to have them record these observations in their science journal. Tell students that these ingredients represent the minerals of the rock.
2. Ask students what two factors are needed to form metamorphic rock (heat and pressure).
3. Combine the ingredients to make rock batter.
4. Place the completed rock batter onto the griddle and flatten with the spatula. The griddle represents heat and the flattening with the spatula represents pressure.
5. When finished cooking, place the metamorphic rock cakes on plates and allow students to observe them after they have cooled. Students can then record their answers to the questions listed below.
6. After observing the rock cakes, eat and enjoy!

Questions:

1. What changes do you notice in the minerals of the rock?
2. Have some minerals changed and not others?
3. How are metamorphic rocks formed?

Metamorphic Rocks: Conglomerate Cookies Become Metamorphic Munchies

Concept: Metamorphic rock formation

Metamorphic rocks are formed from sedimentary, igneous, or other metamorphic rocks. These rocks are subjected to intense heat and pressure. The heat and pressure are not quite enough to melt the rock, but they do cause the minerals in the rock to change in size or shape, or to combine with other minerals to form new or bigger minerals.

Objective:

Students will be able to explain how metamorphic rocks form.

Materials:

- toothpicks
- paper plates
- cookie recipe:
  - 1 cup butter, softened
  - 1½ cup light brown sugar
  - ½ cup sugar
  - 2 eggs
  - 2 teaspoons vanilla
  - 2¼ cups flour
  - 1 teaspoon baking soda
  - ½ teaspoon baking powder
  - ½ teaspoon salt
  - 1 cup chocolate chips
  - 1 cup peanut butter chips
  - ¾ cup butterscotch chips
  - ½ cup nuts (your choice)
  - **Directions:** Preheat oven to 350° F. Cream butter and sugars. Beat in eggs and vanilla. Combine flour, baking soda, baking powder, and salt, and gradually add to creamed mixture. Stir in chips and nuts. Place in spoonfuls on greased baking sheets. Bake 10-12 minutes.

Procedure:

1. Have students mix the cookie dough according to the recipe. Explain that the ingredients represent various sediments (small bits of rock) that they are combining to form sedimentary rock. By mixing, they are compacting the sediments. This particular type of sedimentary rock would be considered a conglomerate. It is made up of large sediments like sand and pebbles (the chips and nuts). The sediments are so large that pressure alone cannot hold the rock together, but they are cemented with dissolved minerals (the dough).
2. Ask students what will happen when you add heat to this mixture. Tell students that when sedimentary rocks are exposed to intense heat and pressure, they become metamorphic rocks. The heat and pressure are not quite enough to melt the rock, but they do cause the minerals in the rock to change in size or shape. Some minerals may be flattened,

while others combine with surrounding minerals to form new or bigger minerals. While you will not be adding pressure to the cookies, you are adding heat with the oven. Spoon the dough onto the cookie sheets and bake.
3. When the metamorphic "rocks" are done, place them on a plate and ask students to "mine" them with toothpicks.

Questions:

1. What changes do you notice in the "minerals" of the rock?
2. Have some minerals changed and not others?
3. How are metamorphic rocks formed?

Physical and Chemical Weathering

Concept: Weathering

Two types of weathering are physical and chemical. In physical weathering, rock is simply broken down into smaller pieces. In chemical weathering, chemical reactions occur that create new substances.

Objective:

Students will be able to define and distinguish between physical and chemical weathering.

Materials:

- 2 pieces of chalkboard-type chalk
- white vinegar
- water
- mortar and pestle or hammer and plastic sandwich bag
- 4 small clear containers

Procedure:

1. Label the four containers A, B, C, and D.
2. Place half a piece of chalk into container A and cover with vinegar.
3. Place half a piece of chalk into container B and cover with water.
4. Crush half a piece of chalk (use the mortar and pestle or place in a baggie and use the hammer) and place it into container C.
5. Place half a piece of chalk in container D.
6. Place the four containers in a safe place where you can observe any changes over the next few days. You may wish to continue your observations for a longer period of time to allow the vinegar and water to completely evaporate.
7. Record your observations, including any visible differences or smells you notice.

Questions:

1. What changes did you notice in the chalk in each container? How do they differ from the original piece of chalk in container D?
2. Based upon your observations, which container represents a physical change?
3. Based upon your observations, which container represents a chemical change where some new material was created? What evidence is there?
4. Where might processes such as these occur in a similar way in nature?

Chemical Weathering

Concept: Chemical weathering

In chemical weathering of rocks, chemical reactions occur that dissolve the rock and create new substances. For example, when rainwater combines with carbon dioxide in the air or carbon dioxide from decaying organic matter in soil, a weak acid called carbonic acid is produced. When this slightly acidic water flows through cracks in limestone it chemically reacts with the rock, forming dissolved calcium and bicarbonate, which is carried away in the water. This action has the effect of dissolving the rock, which can eventually lead to the formation of a cave.

Objective:

Students will be able to describe the effects of chemical weathering on rocks.

Materials:

- clear plastic cups
- vinegar
- litmus paper or other acid/base indicator
- water
- small samples of limestone

Procedure:

1. Fill a cup halfway with vinegar. Place a strip of blue litmus paper in the vinegar, or add another indicator such as red cabbage juice. Observe the color change. The red or pink color indicates that vinegar is an acid. What other acids can you name?
2. Ask students how they think an acid may affect limestone. Why do they think this? Record any predictions.
3. Place a small piece of limestone into the cup of vinegar and allow to soak for several days, while observing. What do you notice happening?
4. Remove the limestone from the vinegar and observe carefully. How has the limestone changed? How might this process occur in nature? Explain.

Extension:

Use the indicator to identify other acids. Then repeat the procedure using the other acids with limestone and with other types of rock.

Physical Weathering: Stream Erosion

Concept: Stream erosion.

As rocks are transported by streams, they are bounced around and rubbed against each other. Over a long period of time, this can cause the physical weathering, or breaking down, of the rocks into smaller particles called sediments.

Objective:

Students will be able to describe what happens to rocks that are tumbled in streams.

Materials:

- hammer
- cloth or towel
- brick or brick-size piece of relatively soft sedimentary rock, such as limestone
- clear plastic cups
- coffee can or plastic container with tight lid
- water

Procedure:

1. Wrap a brick or piece of limestone in a cloth and break into small pieces with a hammer. These should be about the size of marbles.
2. Place several pieces in a clear plastic cup and label "0." Place the rest in the coffee can.
3. Fill the coffee can with the rock pieces half full of water and close the lid tightly. Shake vigorously 200 times.
4. Remove several pieces and place them in a clear plastic cup labeled "200."
5. Place the lid on the coffee can tightly, and again shake vigorously 200 more times.
6. Remove several pieces and place them in a clear plastic cup labeled "400."
7. What would happen if the rocks were shaken 600 times? Continue the process until no more rocks are left in the container.
8. Compare the samples in the cups. How are they different? What caused this? How is what you did similar to rocks being tumbled in a stream?

Physical Weathering: Wind Erosion

***Note:* Step 1 below will need to be done outdoors.**

Concept: Wind erosion

Some rocks that are composed of soft minerals or are composed of particles that are not well cemented may break down when struck by windblown sand or smaller-sized particles.

Objective:

Students will be able to describe what happens to rocks that are eroded by the wind.

Materials:

- pie pan
- fine sand
- electric fan
- extension cord (if no outdoor outlet)
- sheets of sandpaper, a "soft" rock such as limestone
- a "hard" rock such as granite
- various samples of rock

Procedure:

1. Place a pie pan of fine sand in front of an electric fan **outdoors**. Turn the fan on. What happens? What would a very strong wind do to the sand? What would happen if the sand hit some clay? What would happen if it hit a rock?
2. Rub a sheet of sandpaper across several different types of rocks. How is this like windblown sand striking a rock? How is it different?
3. Select a "hard" rock such as granite and a "soft" rock such as limestone. Rub each one with sandpaper 100 times and record your observations. What happened to each rock?
4. Repeat your observations using several types of rocks.

The force of the wind can change the surface of the earth on a small scale by removing materials and abrading rock surfaces. These conditions may be more noticeable where land is dry and unprotected by plants. For example, in the desert you may see rocks with their tops worn smooth.

Physical Weathering: Temperature Changes

Concept: Erosion of rocks caused by rapid temperature changes

Rocks subjected to rapid temperature changes may expand or contract, which may cause them to fracture. The fractures may then lead to further breakdown of the rock through other physical and chemical weathering processes.

Objective:

Students will be able to describe what happens to rocks that are subjected to rapid changes in temperature.

Materials:

- goggles
- oven mitt
- ice water
- pan
- heat source
- shale (or pieces of glass)
- tongs
- balloons

Procedure:

1. Blow up a balloon about half way. Place it in warm water or near a hot object. What happens to the balloon?
2. Place the balloon in ice water. What happens?
3. Put on goggles and oven mitt and use tongs to heat shale (or glass).
4. Drop heated shale or glass into a container of ice water. What happens? What does rapid temperature change do to some rocks? Why? Where might rocks be exposed to this kind of temperature change?

When heated, a substance expands because its molecules are moving faster and farther apart. The molecules themselves do not expand. In a similar way, cooling contracts a substance because its molecules move more slowly and closer together. Rocks that are exposed to sudden heating and cooling may be subject to uneven contraction and expansion. Such stress may cause them to break. This is one type of physical weathering.

Physical Weathering: Ice

Concept: Erosion of rocks caused by freezing and thawing of ice

As water located in a fracture of a rock freezes it expands. Repeated cycles of freezing and thawing may widen the fracture to the point of breaking the rock into smaller pieces.

Objective:

Students will be able to describe what happens to fractured rocks when water in the fractures freezes and thaws.

Materials:

- milk carton, paper cup, or similar disposable container
- freezer
- plaster of paris

- water
- scissors
- butter knife

Procedure:

1. Cut off the top of a milk carton or other container so that it forms a cup-like shape about three inches tall.
2. Prepare plaster of paris (follow directions on package) and pour into container.
3. Use the butter knife to cut a narrow one-inch-deep groove into the plaster before it dries. The groove should not touch the edges of the container. Allow to dry completely.
4. Carefully tear the container away to reveal your block. Measure the size of the groove (width and length). Fill the groove with water and place the block in the freezer.
5. After the water has frozen, remove the block and record your observations. Allow the ice to melt, then place in the freezer again. How many times do you have to repeat this process before the block breaks? Where might this process occur in nature?

When water freezes, it increases its volume. As freezing water expands and becomes ice, it exerts a force. This force may be sufficient to widen cracks in rocks and eventually break them apart. This is another type of physical weathering.

Physical Weathering: Plants

Concept: Erosion of rocks caused by plants

When plants grow in soil-filled cracks of rocks, their roots may push on the sides of the crack, widening it and eventually breaking the rock apart.

Objective:

Students will be able to describe what happens to a fractured rock when a plant begins to grow in the fracture.

Materials:

- milk carton or similar disposable container
- scissors
- plaster of paris
- bean seeds

Procedure:

1. Cut the top off of a milk carton to form a container about 2½ inches high.
2. Prepare plaster of paris according to directions and fill the container.
3. Push a bean seed that has been soaked in water just under the surface of the plaster and observe for several days.

4. Describe what you observe. What would happen if the beans were in the crack in a rock? What if they were the seeds of a tree, rather than a bean plant? Can plants break apart rocks?

When plants grow in cracks in rocks, their growing roots may produce enough force to break the rock.