

Lesson 4 – Rocks Rock!

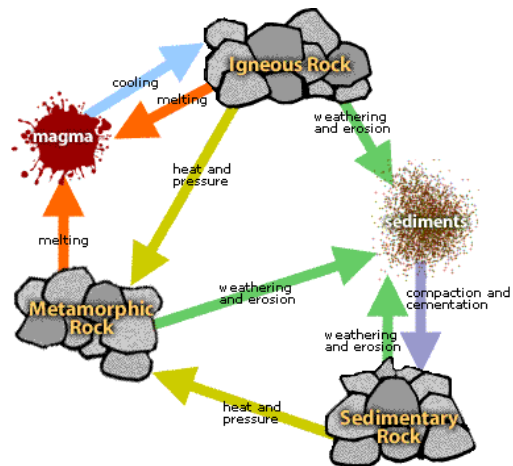
Lesson Overview:

Students will become familiar with rocks, minerals, and be introduced to the rock cycle.

Objectives:

Students will be able to:

1. Explain the difference between rocks and minerals.
2. Compare and contrast igneous, metamorphic, and sedimentary rocks.
3. Demonstrate the rock cycle.



Standards Addressed:

National Science Education Standards: 5th-8th grade

- Content Standard D: Earth and Space Science

International Society for Technology in Education Standards for Students:

- Creativity and Innovation
- Research and Information Fluency

Duration of Lesson/Time Requirement: 40 minutes

Materials Required:

Cookie/picture of a cookie

Samples and/or pictures of a variety of rocks and minerals

Igneous rocks – basalt, granite, obsidian

Sedimentary rocks – conglomerate, limestone, sandstone

Metamorphic rocks – gneiss, marble, quartzite

Picture of a volcano

Picture of a butterfly or frog

Diagram of the rock cycle (<http://www.learner.org/interactives/rockcycle/diagram.html>)

Journey through the Rock Cycle Station Labels (5)

Journey through the Rock Cycle Dice or Board Game Dice with keys (5)

Journey through the Rock Cycle Student Worksheet (1 per student)

Map of the longest caves in the United States created in Lesson #2

Classroom Technology:

Computer with Internet connection and projection capabilities and/or SMART Board

Relevant Websites:

<http://www.learner.org/interactives/rockcycle/diagram.html>

<http://www.nationalatlas.gov/articles/geology/types/sedimentary.html>

Set-Up:

Prior to the start of class set up "Journey through the Rock Cycle". To do this set up five stations around the classroom. Cut out the signs and label the stations: magma station, sediment station, igneous rock station, metamorphic rock station, and sedimentary rock station. Set out one die at each station. You have two options to use for the dice:

1. Cut out each die pattern. Assemble dice by folding along the lines and taping the edges together. Place the correct die with the correct station.
2. Use board game dice instead of cutting out and assembling the paper dice. Each number will correspond to an action. Print out the dice keys and place them along with a die at the corresponding stations.

Procedure:

Introduction

Hold up a cookie or a picture of a cookie. Ask the students what it is. Ask the students to raise their hand if they like cookies. Have a few students share their favorite type of cookie. Ask the students what makes one type of cookie different from another (the ingredients!).

Hold up a rock or a picture of a rock. Ask the students what it is. Write the word "rock" for the students to see. Ask the students what rocks are. Explain to the students that rocks are the building blocks of the earth. Tell the students that rocks are kind of like cookies.

Ask the students if all rocks are alike? What makes them different? Tell the students that, just like cookies, rocks are also made up of ingredients. Write the word "mineral" for the students to see. Ask the students what minerals are. Tell the students that rocks are made up of a number of ingredients called minerals. Some rocks are different from others because they have different ingredients, different minerals.

Explain to the students that rocks are naturally occurring aggregates (collections) of minerals. Explain to the students that a mineral is a pure substance with a unique crystal structure. Minerals naturally occur as a consequence of natural processes in or on the Earth and they are not made in a laboratory. Minerals are made of inorganic (non-living) matter and can be represented by a chemical formula or symbol.

Explain that minerals are the building blocks of rocks. Rocks can be composed of several types of minerals or just one type of mineral. Pass around several examples of rocks and minerals if available.

Activity #1

Tell the students that the earth's crust is made up of dozens of different types of rocks, but each forms in one of three ways. Briefly describe the 3 types, or classes, of rocks to the students. Pass around examples of each rock type if available for the students to compare/contrast.

1. **Igneous** – Draw a picture of a volcano or show the students a picture of a volcano. Ask them what it is. Explain to the students that before lava erupts from a volcano it exists as a

hot molten material known as magma beneath the Earth's crust. Tell the students that *igneous rocks* are formed when magma cools and hardens. Explain that when magma or lava cools very quickly, no crystals form and the rock looks shiny and glasslike. Sometimes gas bubbles are trapped in the rock during the cooling process, leaving tiny holes and spaces in the rock. Examples of this rock type include basalt, granite and obsidian. Show the students examples and/or pictures of igneous rocks if available.

- 2. Sedimentary** – Explain to the students that some rocks are layered. Most of these rocks get their start as wind, ice, and water wear down rocks into bits of sand, soil, mud, pebbles, clay, and other loose sediment. As this sediment washes into rivers, lakes, and oceans, it piles up, layer upon layer. Have several students come up and demonstrate layering by creating a “hand pile”. Each hand represents a different layer of sediment. Explain that over time, the pressure on the bottom layer increases. Ask the students with their hands on the bottom of the pile if they feel the pressure building up. Explain that the sediment compacts and cements together to form solid rock. When rocks form in this way they are called *sedimentary rocks*. Generally, sedimentary rock is fairly soft and may break apart or crumble easily. Sand, pebbles or stones can often be seen in sedimentary rocks and they are usually the only type of rock that contains fossils. Examples of this rock type include conglomerate, limestone and sandstone. Show the students examples and/or pictures of sedimentary rocks if available.
- 3. Metamorphic** – Write the word “metamorphic” on the board. Ask the students if they know what it means. If they are not sure have the students try to think of a word like it. If they need a hint say the word “butterfly” or “frog” and/or draw a picture of a butterfly or frog. The students should be familiar with the word “metamorphosis”. Ask them what “metamorphosis” means. Tell them that just like a caterpillar changes into a butterfly or a tadpole changes into a frog some igneous and sedimentary rocks change into different rocks because of extreme heat and pressure within the crust of the earth. These rocks are called *metamorphic rocks*. Metamorphic rocks often have ribbon-like layers and may have shiny crystals, formed by minerals growing slowly over time, on their surface. Examples of this rock type include gneiss, marble and quartzite. Show the students examples and/or pictures of metamorphic rocks if available.

Activity #2

Display a diagram of the rock cycle. One can be found on the website:

<http://www.learner.org/interactives/rockcycle/diagram.html>. Explain to the students that wind, water, and ice are continually wearing away igneous, metamorphic, and sedimentary rocks and processes within the earth are creating new rocks every day. This process is called the rock cycle and can be attributed to James Hutton, the 18th century founder of modern geology. Tell the students that rocks are continually changing from one type to another and back again, as forces inside the earth bring them closer to the surface where they are weathered, eroded, and compacted, and forces on the earth sink them back down where they are heated, pressed, and melted. Explain to the students that the elements that make up rocks are never created or destroyed but are constantly being recycled. By studying rocks and how

they “recycle”, scientists can learn more about how the earth itself is changing, and how life has changed over time.

Briefly explain the rock cycle to the students.

If a SMART Board is available this can be done using the “Interactive” found on the website <http://www.learner.org/interactives/rockcycle/diagram.html>. If using a SMART Board the students can come up and select the animation to play before, during or after discussing each rock cycle component. If a SMART Board is not available the image can be projected for the class to view and the educator can select and play the animations.

Explain to the students that rocks change from one type to another over long periods of time. Tell the students that the way rocks change depends on a variety of processes that are always taking place on and under the earth’s surface. Briefly describe the following processes to the students and play the animation associated with each.

Heat and Pressure

Ask the students what happens to cookie dough when you put it in the oven? Explain that the heat in the oven produces changes in the ingredients that make them interact and combine. Without melting the dough, the heat changes it into a whole new product – a cookie!

Explain to the students that a similar process happens to rocks beneath the earth’s surface. Tell the students that due to the movements in the crust, rocks are frequently pulled under the surface of the earth, where temperatures increase dramatically the farther they descend. Between 62 and 124 miles (100 and 200 kilometers) below the earth’s surface, temperatures are hot enough to melt most rocks. However, before the melting point is reached, a rock can undergo fundamental changes while in a solid state – morphing from one rock type to another without melting.

An additional factor that can transform rocks is the pressure caused by tons of other rocks pressing down on it from above. Usually heat and pressure work together to alter the rocks under the earth’s surface. This kind of change, which results from both rising temperature and pressure, is called metamorphism, and the resulting rock is a metamorphic rock.

Melting

Ask the students what happens to a chocolate bar when it gets very hot. It melts!

Explain to the students that the same thing happens to a rock when it is heated enough. The high temperatures required to melt a rock are generally only found deep within the earth. Tell the students that the rock is pulled down by movements in the earth’s crust and gets hotter and hotter as it goes deeper. It takes temperatures between 1100 and 2400 degrees Fahrenheit (600 and 1300 degrees Celsius) to melt a rock, turning it into magma, or molten rock.

Cooling

Ask the students what they would do to turn a melted chocolate bar back into a solid? It could be cooled by putting it into the refrigerator until it hardens. Explain to the students that similarly, liquid magma also turns into a solid (a rock) when it is cooled. Any rock that forms from cooling of magma is an igneous rock. Tell the students that there are two different types of igneous rocks.

Explain to the students that when magma rises deep from within the earth and explodes out of a volcano, is it called lava, and it cools quickly on the surface. Rock formed in this way is called *extrusive igneous rock*. It is extruded, or pushed, out of the earth's interior and cools outside of or very near the earth's surface. Extrusive igneous rocks are also sometimes referred to as *volcanic rocks*.

Ask the students what would happen if the magma doesn't erupt from the volcano, but instead gets pushed slowly upward toward the earth's surface over hundreds, thousands, or even millions of years? Explain to the students that this magma will also cool, but at a much slower rate than lava erupting from a volcano. The kind of rock formed in this way is called *intrusive igneous rock*. It intrudes, or pushes, into the earth's interior and cools beneath the surface. Intrusive igneous rocks are also sometimes referred to as *plutonic rocks*.

Weathering and Erosion

Show the students a picture of a dandelion and ask them what it is. Ask the students what dandelions rely on to separate their seeds, carry them, and deposit them elsewhere (the wind).

Explain to the students that all objects on the earth's surface are exposed to the wind, along with many other elements – water, the sun, temperature changes. Over time, these factors wear objects down and break them apart. The resulting bits and pieces of materials are called sediment. Sediment is then transported by wind and water, often ending up far from where it started. These processes of breakdown and transport due to exposure to the environment are called weathering and erosion. Weathering and erosion affect all rocks on the earth's surface.

Compacting and Cementing

Ask the students what happens to a loose pile of garbage when it is put into a compactor (the squeezing of the machine produces a solid cube of compacted garbage). Explain to the students that the same thing happens to sediment formed from the weathering and erosion of rock. Tell the students that over time, sediment accumulates in oceans, lakes, and valleys, eventually building up in layers and weighing down the material underneath. This weight presses the sediment particles together, compacting them. Water passing through the spaces in between the particles helps to cement them together even more. This process of compacting and cementing of sediment forms sedimentary rock and is also called *lithification*.

Activity #3

Now that the students are familiar with the rock cycle tell them that they are going to play a game where they will become rocks and move through the rock cycle.

Explain “Journey through the Rock Cycle” to the students. Tell the students that there are 5 stations set up around the classroom and explain what each station is. Explain that at each station there is a die. To begin the game each student will pick the station where they wish to start from or go to the station that they are assigned and form a line. Once the signal is given for the game to start each student will take a turn rolling the die in order to determine what path they will take. For example, if a student begins at the igneous station they will roll the die at that station. If they are instructed to “melt into magma” this student will then leave the igneous station and move to the magma station. Once at the magma station the student will wait in line until it is their turn to roll the die.

Pass out a copy of the *Journey through the Rock Cycle Student Worksheet* to each student. Tell the students that while they are at each station and while they are moving to different stations they must record what is happening on their journey. After the game is over each student will have a record of what happened.

Make sure that the students clearly understand the activity. Allow them a small amount of time to get to their starting station. Give the signal for the game to start and monitor the students during the duration of the activity. Plan on at least 10 minutes for the duration of the activity if possible.

Wrap-Up/Conclusion

At the conclusion of “Journey through the Rock Cycle” have the students return to their seats. As time allows, have several students share their “adventure”. Briefly review the types of rocks and the rock cycle.

Display the map of the longest caves in the United States that was created by the students at the end of Lesson #2. Ask the students what type of rock the longest caves of the United States are found in? (sedimentary)

Display the map showing the distribution of sedimentary rocks in North America found on the website: <http://www.nationalatlas.gov/articles/geology/types/sedimentary.html>. Explain to the students that sedimentary rocks are the most common rock type on the earth’s surface. Ask the students why they think so many caves are found in sedimentary rock? Explain to the students that they are going to investigate this further in the next lesson.