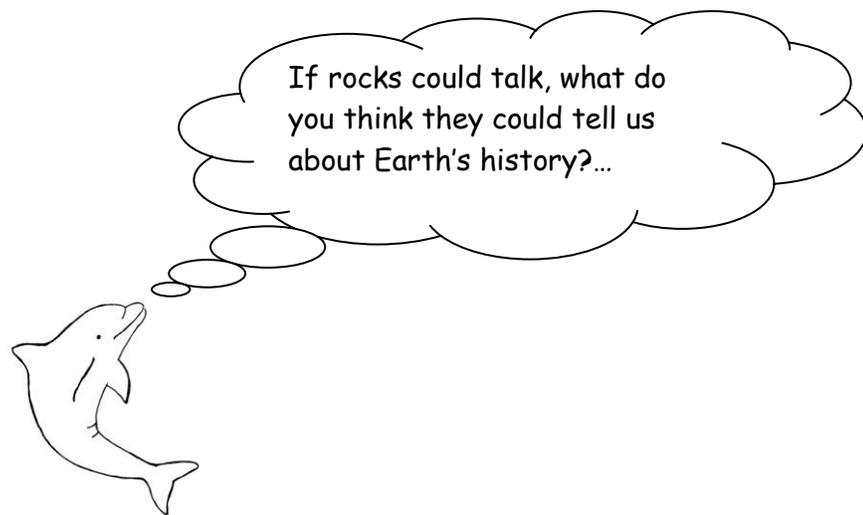


Earth's Rocky Surface

You have learned that Earth's surface is not permanent and is constantly changing. Some changes take place very slowly over millions of years, such as crustal plates moving and creating mountains or valleys. Other changes happen quickly, such as earthquakes and volcanic eruptions. In this lesson, you will learn about another very slow series of changes that take place - the rock cycle.

Introduction



You have probably seen many rocks all around you and never thought about where they came from or how old they are. Some rocks are billions of years old. Other rocks are forming today as a volcano erupts somewhere on the Earth. Because rocks are so old and

form in different ways, they can tell us about the Earth's history. They provide clues about how rivers or mountains formed, what organisms lived when, and what the climate was like on Earth.

Rocks are the building blocks of the Earth and form the continental crust, ocean floor, beaches, and mountains. A **rock** is a solid made up of one or more minerals. A **mineral** is a naturally occurring, nonliving solid with a definite chemical composition and crystal shape. Rocks are classified according to how they were formed. The three classes of rocks are igneous, sedimentary, and metamorphic. Rocks from each class reflect the conditions that existed at the time they were formed.

Rocks also change over time, becoming other types of rocks. This continuous changing of rocks from one kind to another over long periods of time is known as the *rock cycle*. In this activity you will learn about the rock cycle by studying samples of rocks. You will also learn about how rocks form and change by examining and identifying rock samples from each of the three rock classes.

Vocabulary

crystals	igneous	rock
deposition	lava	sediment
erosion	metamorphic	sedimentary
fossil	mineral	weathering

Materials

(per class)

igneous rock samples

sedimentary rock samples

metamorphic rock samples

(per team)

magnifying glass

vinegar

dropper

Procedure

Obtain a set of rocks and read the following description of each class of rock and the processes of the rock cycle. You will make observations of different rocks and classify them as igneous, sedimentary, or metamorphic. Follow the directions as you read about each class of rocks.

Igneous Rocks

Igneous rocks get their name from the Latin word *ignis*, which means fire. Igneous rocks are formed when melted (molten) rock material cools and hardens. When the molten rock erupts from a volcano, it is called **lava**. When lava cools and hardens into rock at the Earth's surface, it cools so fast that **crystals** do not have time to form. This type of igneous rock may look glassy. Sometimes the melted rock does not reach the surface and cools very slowly beneath the surface; in this case, large crystals may form.

Characteristics of Igneous Rocks

- Igneous rocks may contain crystals, which frequently can be seen by the naked eye.
- Some igneous rocks contain no crystals and appear glassy.
- Igneous rocks may be found in many colors and often show different colored crystals.
- Igneous rocks do not show layers of crystals.

The following are igneous rocks in the collection. Read each characteristic and identify each rock. Write the name of the rock in the table. To decide whether you are correct, send one person to the Internet -

<http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Slideshow/Slideindex.html> or ask your teacher.

Basalt (1)
 Granite (2)
 Obsidian (3)
 Pumice (4)

Igneous Rock Characteristics	Identification of Rock Specimen	Were you correct? If not, write the correct rock name.
<p><u>Igneous Rocks forming Beneath the Surface</u> When igneous rocks cool slowly under the Earth's surface, the crystals more time to grow and are larger.</p>		
<p>Which rock probably formed under the Earth's surface? This rock makes up most of the continent crust and has pink, gray, and dark crystals.</p>		

<u>Igneous Rocks forming near the Earth's Surface</u>		
When igneous rocks cool quickly at the Earth's surface, crystals generally do not have time to grow. If crystals do grow, they are very small.		
Which igneous rock is black and glassy?		
Which igneous rock cooled so quickly that gas bubbles were trapped? This rock is very lightweight because of its low density. It is usually light gray.		
Which rock is dark gray or black? This rock makes up the ocean floor.		

Weathering and Erosion and the Formation of Sedimentary Rocks

Over time rocks may be **weathered** (broken apart) by wind, rain, and changes in temperature, resulting in sediments (small particles of rock). **Erosion** is the process by which the sediments are moved from one place to another. Erosion can be caused by running water, waves, gravity, wind, and glaciers.

Sedimentary rocks are made of these particles of older minerals and rocks (**sediments**) that have been carried along and **deposited** by wind and water. This usually happens on the ocean floor or the bottom of rivers, lakes, and swamps. These sediments may include bits of rock in the form of mud, sand, or pebbles. They may be mixed with fragments of shells, bones, or other remains of living things. Over time these sediments are pressed and cemented together to form sedimentary rocks. **Fossils** are often found in sedimentary rocks.

Sedimentary rocks can be classified according to the materials that they are composed of. One type is made of fragments of previously existing rocks. Examples are sandstone and conglomerate rocks. A second type is made of the remains of living organisms. For example, limestone is formed from the remains of many types of sea organisms, such as clams, oysters, and corals. Chalk is a type of limestone composed of

small microscopic shells and calcite. Coal, which is also used as a fossil fuel, forms when plants and animals are buried and compressed in the Earth over millions of years.

Characteristics of Sedimentary Rocks

- Most are composed of sediments or fragments of other rocks.
- Some are composed of plant and animal remains and may contain fossils.
- Sedimentary rocks often have distinct parallel layers or bands.
- Sedimentary rocks often appear dull or earthy.

The sedimentary rocks in this collection are:

- Coal (5)
- Conglomerate (6)
- Limestone (7)
- Sandstone (8)
- Shale (9)

Read each characteristic and identify each rock. Write the name of the rock in the table. To decide whether you are correct, send one person to the Internet - <http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Slideshow/Slideindex.html> or ask your teacher.

Sedimentary Rock Characteristics	Identification of Rock Specimen	Were you correct? If not, write the correct rock name.
Sedimentary Rocks made of Fragments of existing Rocks		
Which rock is made of a combination of pebbles cemented together?		
Which rock formed from small, sand-sized grains?		

Sedimentary Rocks made of Organisms once Living		
In swamps, trees and plants die and settle into the water. This material may be compressed to form layers of carbon. Which one of these rocks was formed from material deposited in a swamp? This rock is black and lightweight. It may be soft and break easily.		
Shells or skeletons of many marine organisms, such as corals, are composed of calcite, a mineral containing calcium. As organisms die, layers of calcite may form. In time, these may be changed into rock. Coral reefs are made of this rock. Which one of these rocks was probably deposited in an ocean? One way to test for calcite is to put a drop of vinegar on the rock. If it fizzes, it has calcite in it.		
This is the most common sedimentary rock, made of fine grains of mud, clay, and other sediments.		

Metamorphic Rocks

When rocks are buried deep in the Earth, great heat and pressure or chemical reactions may cause them to change into new rocks. These rocks are called **metamorphic**. The word *morph* means form, and *meta-* means change. Metamorphic rocks may form from the changing of igneous, sedimentary, or other metamorphic rocks.

<p>Metamorphic Rocks</p> <ul style="list-style-type: none"> • Metamorphic rocks often look like igneous rocks except that they show bands of color. • Metamorphic rocks may show signs of bending and distortion. • Mineral crystals in metamorphic rocks are generally flat.

The metamorphic rocks in this collection are:

- Gneiss (10)
- Marble (11)
- Quartzite (12)
- Slate (13)

Read each characteristic and identify each rock. Write the name of the rock in the table. To decide whether you are correct, send one person to the Internet - <http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Slideshow/Slideindex.html> or ask your teacher.

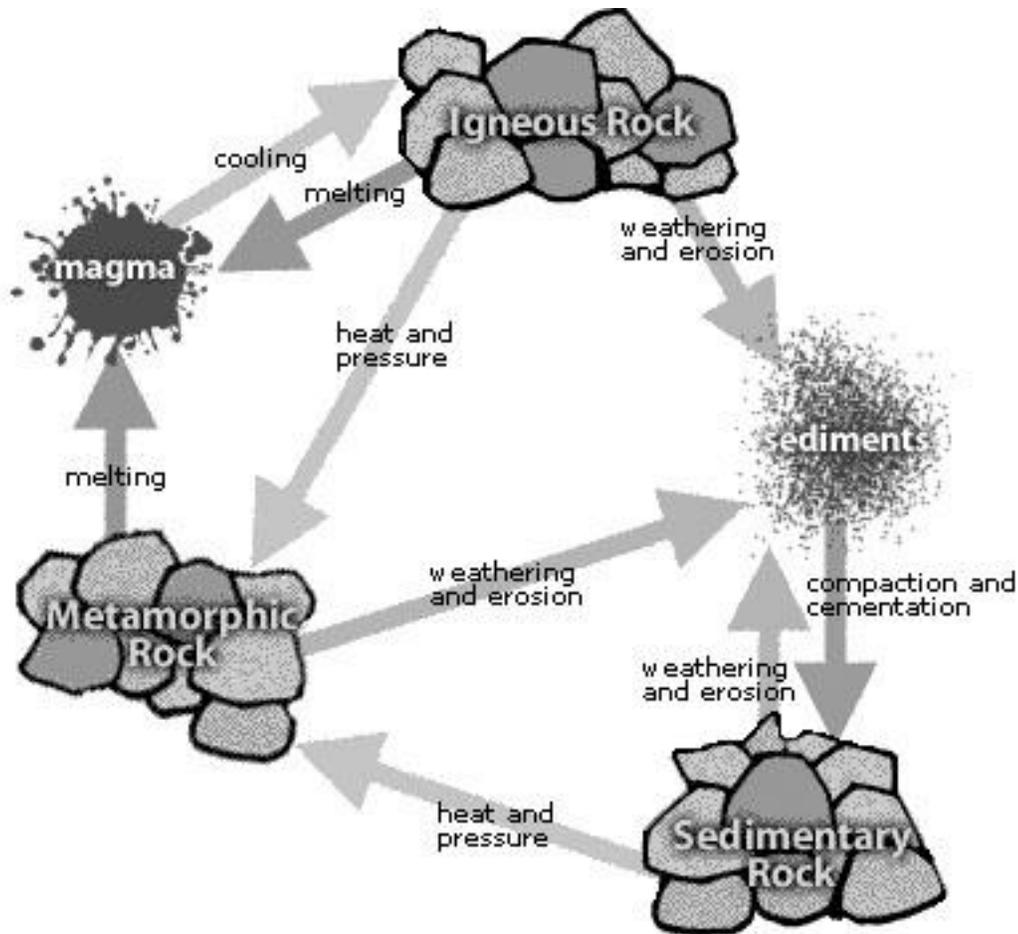
Metamorphic Rock Characteristics	Identification of Rock Specimen	Were you correct? If not, write the correct rock name.
Metamorphic Rocks with Crystals Arranged in Layers		
Which rock formed from shale and shows layers? The rock is dark gray or black and it is often used for walkways.		
Which rock formed from granite and shows bands of dark and light crystals?		
Metamorphic Rocks with Crystals NOT Arranged in Layers		
If a limestone rock (which contains calcite) is changed by heat and pressure, this metamorphic rock will form. (Hint: You can check with the vinegar test).		
If a sandstone rock, containing quartz grains, is changed by heat and pressure, this rock may form. This rock appears glassy because of the quartz crystals.		

Review

Earth's crust is constantly changing. Even rocks change from one kind to another or break apart. A rock is made up of two or more minerals. A mineral is a naturally occurring,

nonliving solid with a definite chemical composition and a crystal structure. Examples of three common minerals are diamond, quartz, and talc.

The rock cycle is a graphic representation of how the three major types of rocks change from one kind to another over long periods of time. The rock cycle is the continuous changing of rocks from type to another over long periods of time.



There are three classes of rocks - igneous, sedimentary, and metamorphic. Each of these classes may melt to form magma, be weathered into sediments, or undergo heat and pressure.

Igneous rocks form when molten material cools and hardens. Examples of igneous rocks are granite, basalt, and pumice. Over time, igneous, sedimentary, and metamorphic rocks may be broken apart. This process is called weathering and the broken pieces of rock are called sediments.

Rivers and streams carry the sediments along until the flow of water slows. This process is called erosion. The sediments are then deposited or dropped in a new location. Sand at a beach is an example. Soil is pieces of weathered rock mixed with material from

living organisms. Over time sediments may be pressed or cemented together to form sedimentary rocks. Sedimentary rocks can also contain shells, bones, leaves, stems, fossils, or other remains of living things. Examples of sedimentary rocks are sandstone, limestone, and coal.

As layers of sedimentary rock are buried under more layers of sediments, they are heated and pressed even closer together. Metamorphic rock forms when the heat and pressure are great enough to change the rock. *Meta* means change and *morph* means form. Marble and slate are examples of metamorphic rocks. Sedimentary and metamorphic rocks may melt and become igneous rocks again.

Island Development

What type of rocks do you think your island would have? To decide, think about whether you decided to locate your island near a plate boundary with volcanoes and earthquakes. Or, if you want to locate your island near a coral reef, what type of rock would most likely be there? What are some possible uses of the type of rock you will have on your island? Record your thoughts and decisions on the journal pages in Lesson 11.

Literacy Connection

Write a story about a rock as it passes through the rock cycle. Use the vocabulary words from the lesson in your story.

Internet Resources

Rocks and Minerals Slide Show

<http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Slideshow/Slideindex.html>

Mineralogical Society of America

<http://www.minsocam.org/MSA/K12/rkcycle/rkcycleindex.html>

Rock Cycle Reunion

<http://www.washington.edu/uwired/outreach/teched/projects/web/rockteam/WebSite/index.htm.htm>

Rocks and Minerals

<http://edtech.kennesaw.edu/web/rocks.html>

Rock Sites

<http://www.thecoo.edu/~apeter/rocksites.htm>