Teacher Guide: Rock Cycle

Learning Objectives

Students will…

- Trace the path of a piece of rock through the rock cycle.
- Describe how igneous, metamorphic, and sedimentary rocks are formed.
- Explore the possible transformations from one type of rock into another.

Vocabulary

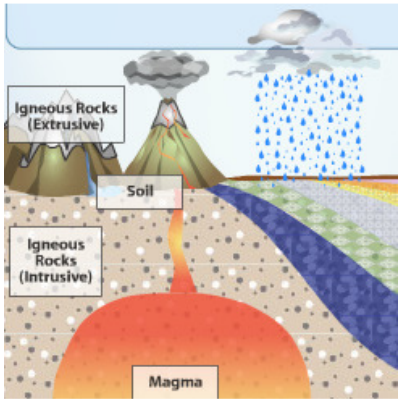
deposition, erosion, extrusive igneous rock, intrusive igneous rock, lava, lithification, magma, metamorphic rock, rock cycle, sediment, sedimentary rock, soil, weathering

Lesson Overview

The world is full of cycles in which materials are formed, transformed, and then broken down again to be reused. These include the carbon cycle, the nitrogen cycle, the water cycle, and the rock cycle.

In the *Rock Cycle* Gizmo™, students follow a piece of rock as it is melted, cooled, weathered, eroded, deposited, heated, and put under pressure.

The Student Exploration sheet contains one activity. In this activity, students explore different phases of the rock cycle.



Suggested Lesson Sequence

1. **Pre-Gizmo activity: Rock transformations** (10 – 20 minutes)
   If you have access to rock samples, bring them in. If not, bring in pictures of rocks or project pictures from your computer.

   First, show students a sample of granite and a sample of conglomerate (ideally one that contains pebbles of granite). Ask your students how the granite could be transformed into the conglomerate.

   Next, show students a sample of granite and a sample of gneiss. Gneiss, pronounced "nice," is a metamorphic rock that looks like a stripy version of granite. Ask students how the granite could have been transformed into gneiss. (If you want, you can also tell them the old adage: "Never take a gneiss rock for granite.")

2. **Prior to using the Gizmo** (10 – 15 minutes)
   Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations. Demonstrate how to take a screenshot and paste the image into a blank document.

3. **Gizmo activities** (15 – 20 minutes per activity)
   Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

4. **Discussion questions** (15 – 30 minutes)
   As students are working or just after they are done, discuss the following questions:
   - How can a rock be transformed from magma into sedimentary rock?
   - How can a rock be transformed from metamorphic rock into soil?
   - What are some of the different ways that rock can be broken down into soil?
   - What are some of the different ways that sediments can be transported?
   - How is the rock cycle similar to other kinds of cycles in nature, such as the carbon cycle or the water cycle? How is it different?

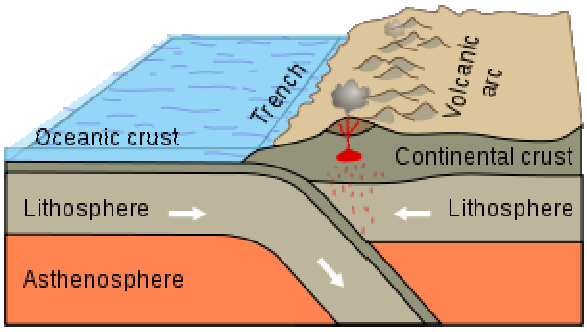
5. **Follow-up activities** (variable)
   There are several ways to follow up the *Rock Cycle* Gizmo.
   - Model the steps of the rock cycle using crayons or sugar cubes. Both wax and sugar can be broken into pieces, squeezed back together under heat and pressure, melted into a liquid, and cooled back into a solid. Details of each activity are given in the **Selected Web Resources** below.
   - Divide the class into groups, and have each group focus on a particular phase in the rock cycle: magma, intrusive igneous rocks, extrusive igneous rocks, soil, sediments, etc. Each group can create a poster with pictures and a short description of their assigned rock type. The posters can then be arranged on a large wall, with arrows drawn to represent the possible transitions between the different phases.
   - The “engine” that powers the rock cycle is plate tectonics. Without moving plates, no uplift would occur, and all continents would eventually be eroded into the sea. Explore the *Plate Tectonics* Gizmo, and identify where different steps of the rock cycle occur. See the **Selected Web Resources** below for a link to the Gizmo.

Scientific Background

Rocks are classified into three main groups. *Igneous rocks* are rocks that crystallize as molten rock (magma or lava), cools, and hardens. *Sedimentary rocks* are formed from cemented rock fragments, chemical precipitates, and organic remains. *Metamorphic rocks* are formed when other rocks are altered by heat and pressure.

The rock cycle describes how rocks can be transformed from one type into another. For example, a sedimentary rock such as limestone can be transformed into the metamorphic rock marble if it is buried deep in Earth’s crust and subjected to high temperature and pressure. If an igneous rock such as granite is uplifted and exposed on Earth’s surface, the action of plants, rain, ice, and snow will break it up into sediments. The sediments will be smoothed and rounded as they are carried to the ocean, and eventually they may be deposited on a beach. Over time, the beach sand may be buried under other layers of sediment and cemented into sandstone.

Convection currents in Earth's mantle provide the energy to keep the rock cycle moving. These convection currents cause the motion of tectonic plates. New crust is created in mid-ocean ridges and old crust is destroyed in subduction zones. Mountains are created along convergent and collisional plate boundaries. In these regions, rocks created deep below Earth's surface are uplifted and exposed to the weathering forces of rain, sunlight, wind, ice, and plants. Over millions of years, these forces act to break down rocks into smaller particles, forming sediments and soil. The sediments are transported by rivers and streams to the ocean, where they are deposited in layers on the continental shelf. Over time, these layers are buried and harden into sedimentary rock.



Convergent plate boundary

Environmental connection: Cycles in nature

Natural cycles play a major role by recycling the materials that are essential to life on Earth. These include the rock, water, carbon, nitrogen, and oxygen cycles. Understanding these processes is crucial for maintaining a healthy environment for living things.

Consider the carbon cycle. Carbon is found in organic materials, in the oceans and atmosphere, and in carbonate rocks such as limestone and coal. Carbon dioxide is added to the atmosphere by volcanic eruptions, by respiration, and by the burning of organic materials. Carbon dioxide is removed from the atmosphere by plants and by organisms such as coral that use carbon to build their skeletons. In the past 200 years, the amount of carbon dioxide in the atmosphere has greatly increased due to the clearing of forests and the burning of fossil fuels such as coal, gas, and oil. The excess carbon dioxide in the atmosphere is changing the world climate and may lead to a wide range of environmental crises if emissions are not reduced.

The rock cycle is interrelated with the carbon cycle. Carbon is stored in sedimentary rocks such as limestone and coal. In a convergent plate boundary, these rocks are melted into magma, and the trapped carbon is then released into the atmosphere in volcanic eruptions. To fully understand the impacts of human activity on the carbon cycle, scientists must account for all the ways that carbon moves into and out of the atmosphere.

Selected Web Resources

Crayon rock cycle activity: http://www.exo.net/~emuller/activities/Crayon-Rock-Cycle.pdf
Rock cycle with sugar cubes: http://www.science-class.net/Lessons/Geology/Rocks_Minerals/sugar_rock_cycle.pdf
Crystallization activity: http://www.geosociety.org/educate/LessonPlans/FastCrystallization.pdf
How rocks are formed: http://www.fi.edu/fellows/payton/rocks/create/index.html
Rock cycle animation: http://www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02.cfm

Related Gizmos:
Rock Classification: http://www.explorelearning.com/gizmo/id?437
Plate Tectonics: http://www.explorelearning.com/gizmo/id?446