# Unit

Earth History: Rocks

# Title

1. Crayon Rock Cycle

# Summary

What’s the big deal about rocks? They don’t move, aren’t flashy, and seem pretty useless to the untrained eye. However, geologists are rock detectives, discovering clues to the ancient past. If you know how to read them, rocks can tell an observant scientist about what a place looked like millions and even billions of years ago. This activity introduces the 3 main types of rocks and the processes that form them. Wax crayons are eroded into sediment, compacted into sedimentary rock, partially melted and pressed into metamorphic rock, and finally melted and cooled into igneous rock. This understanding is the basis of the rock cycle. In the Going Further section, there is a recipe for making your own sandstone, siltstone and conglomerate using sediments and a sodium silicate solution.

# Objectives

* Can describe the 3 major types of rock (sedimentary, metamorphic, and igneous) and discuss the relationships between them c
* Can diagram the rock cycle
* Given one of the three major types of rock, can describe the geologic processes that formed it

# Vocabulary

Sedimentary rock

Erosion

Sediment

Cement

Lithifaction

Metamorphic rock

Igneous rock

Magma

Rock cycle

# Time

45-50 minutes

# Grouping

Individual

# Materials

Each student needs:

* Copy of the Rock Cycle Template
* 1 wax crayon (any brand will do.)
* 1 plastic knife
* Wax paper
* Aluminum cup cake tin
* Hot plate and pan with water
* Tongs, potholder

# Setting

Classroom

# Teacher Background

The rock cycle is perhaps the most basic, fundamental principle of geology. All rocks are related to each other and may be transformed from one kind to another. In its simplest form, the rock cycle describes the relationships between the 3 major types of rock:

1. Igneous Rocks - Formed from the cooling of molten rock (magma).
2. Sedimentary Rocks - Formed from layers of sediment as the pressure of overlying layers compact the sediment into rock. Sometimes, a cementing agent, dissolved minerals such as silica or carbonates, helps bind the sediment particles together.
3. Metamorphic Rocks - Formed from other rocks that are exposed to intense heat and pressure and thus change their physical and/or chemical form.

Molten rock or magma solidifies either rapidly at the Earth’s surface or slowly under the Earth’s surface into igneous rock (this is the whole crayon we start with). As these rocks are exposed to erosion and weathering, they are broken down into sediment (a pile of crayon shavings). The grains of sediment may be transported long distances by water, wind or gravity, and eventually deposited in layers. As more and more sediment layers build up on top of each other, the sediments are compacted and sometimes cemented together into sedimentary rock (squishing the crayon shavings together) in a process called lithifaction. With heat and pressure (partial melting in hot water), the rock will undergo a physical and/or chemical change into metamorphic rock. If the rock is melted completely and cooled, you once again have igneous rock.

The rock cycle is attributed to [James Hutton](http://en.wikipedia.org/wiki/James_Hutton) (1726-1797), the “father of geology” who meticulously explored and documented the landscape of the British Isles. Hutton proposed the principle of uniformitarianism, the idea that the processes that shape the world today also operated in the past. His idea brought about the revolutionary notion that given how long it takes for geologic processes to occur today, the Earth must be very very old for all the existing landforms to have been created, not merely the 6000 years allowed by tracing Biblical genealogy. One of his most famous quotes states that with respect to the Earth there is “no vestige of a beginning, and no prospect of an end”.

With greater scientific sophistication and the plate tectonics revolution, many geologists now believe that the basic rock cycle described in this lesson is too simple. The basic rock cycle is cyclical, with no apparent direction or trend. Instead, if plate tectonics is taken into account, there may indeed be a trend towards greater and greater diversity of rock types over time. For more information, see the Tectonic Rock Cycle at http://csmres.jmu.edu/geollab/fichter/Wilson/PTRC.html

# Student Prerequisites

It helps the discussion of sedimentary rocks if students are familiar with soil separation and identifying different sediments (gravel, sand, silt, clay) by size.

# Getting Ready

1. Give each student a piece of wax paper to work on
2. Give each student an aluminum cup cake tin for later
3. Set out remaining materials – crayons, knives, hot plate and pan with water
4. Copy Rock Cycle Template handout

# Lesson Plan

1. Pass out the handout, crayons, wax paper, and knife.
2. Tell students that they have been given a sample of a rock. Looking at the 3 descriptions on the board, which one is this sample most similar to? It doesn’t have grains, layers or streaks. Thus it is an igneous crayon rock! On their handout, in the box at the top of the circle, have students write “igneous rock”.
3. The first step is to create sediment. Have students unwrap their crayons then create a pile of crayon shavings on their piece of wax paper by scraping it with the knife. They may trade crayons among themselves to acquire a mixture of colors. Give them around 5-10 minutes to build up a decent sized pile.
4. On the diagram, the arrow from “igneous rock” can be labeled “erosion”. The next box can be labeled “sediment”.
5. Now fold over the wax to wrap up the sediment pile. Press down on the pile as hard as you can. Gently unwrap it. The sedimentary crayon rock will be fragile but should hold together in a packed layer.
6. Discuss the similarities between the sedimentary crayon rock and the real sedimentary rocks the students observed earlier.
7. On the diagram, the arrow from “sediment” can be labeled “lithifaction – compacting and cementing sediments together”. The next box can be labeled “sedimentary rock”. Discuss this process as it occurs in the real world with layers being squeezed under other layers.
8. Now get a helper to pass out the aluminum tins. Have students put sedimentary rocks in Al tin and wait for further instructions.
9. Teacher will call students up 5 at a time to heat their rocks just so the bottom is melted. Pull tins out of water and set on pot holder. Within a few seconds they are ready to hand back to students. After they are completely cool, students may take them out and hold them. They will need to reuse the Al tin.
10. Discuss the similarities between the metamorphic crayon rock and the real metamorphic rocks the students observed earlier.
11. On the diagram, the arrow from “sedimentary rock” can be labeled “metamorphism – heat and pressure transforms the rock”. The next box can be labeled “metamorphic rock”. Discuss this process as it occurs in the real world with rocks being subjected to intense heat and pressure beneath the surface of the Earth.
12. Each student should put their metamorphic crayon rock back in the tin boat.
13. At this point, students will repeat the process of having their rocks melted 5 at a time. This time, allow the wax to melt until a smooth pool of liquid wax forms and the colors blend together uniformly. Allow to cool completely before students remove from tin.
14. Discuss the similarities between the igneous crayon rock and the real igneous rocks the students observed earlier.
15. On the diagram, the final arrow from “metamorphic rock” can be labeled “melting into magma then cooling”. Discuss this process as it occurs in the real world with rocks being melted deep within the Earth then extruded again as volcanoes or bubbles of magma that do not reach the surface.
16. Ask the students if they think this igneous rock could be turned into sedimentary rock? How? Could it be turned directly into metamorphic rock? How? Could a metamorphic rock be turned directly into sedimentary rock? How?
17. Add additional arrows across the middle of the rock cycle to illustrate that any type of rock can turn into any other type of rock. For example, metamorphic rock can be eroded into sediment then compacted and cemented into sedimentary rock.
18. Clean up! Students can keep their crayon rocks.

# Assessment

1. 9th grade teacher Marcie Krech, has a list of great extension activities related to the rock cycle (<http://www.scienceteachingideas.com/rocks.htm>). They include a vocabulary cut & paste, a lab, a whole class puzzle, a game and a comic strip activity. In fact, Marcie has put her whole Earth Science curriculum online for others to learn from. Thank you!
2. Give students rocks to classify as sedimentary, igneous, or metamorphic.

# Going Further

1. Make sedimentary rocks! Any sediment (powdered clay, silt, playground sand, or a sand and gravel mixture) can be turned into a sedimentary rock with the addition of a dilute sodium silicate solution. See the Sources section for where to purchase sodium silicate. The recipe:
	* 15 ml dilute sodium silicate, dilute full strength sodium silicate with water in a 1 to 1 ratio (a 20 ml syringe is a great measuring tool and dispenser for this viscous solution)
	* 6 tablespoons of sediment (playground sand works great although kids like to mix and match sediments for their own special rock type)

Mix the sediment and sodium silicate in a clear plastic 9 oz cup with a disposable stirrer like a popsicle stick. Be careful not to get sodium silicate on your hands or in your eyes. Smooth out the surface of the mixture with the stirrer. Set aside for 2 days. Once the mixture is completely dry, it can be popped out of the cup and examined up close. If you plan on doing the Layers Upon Layers lesson, consider adding layers of a different sedimentary rock on top of the first before removing the rock from the cups. You are, in effect, creating a permanent version of the depositional cups formed in the Layers Upon Layers lesson.

1. Try the History of Rock lesson where students research a rock and discover the story of its formation.
2. The National Parks Service has a great collection of teacher lesson plans related to rocks and the rock cycle called Geodetectives ([http://www.nps.gov/brca/Geodetect/Rocks%20&%20Minerals/RM%20unitpage.htm](http://www.nps.gov/brca/Geodetect/Rocks%20%26%20Minerals/RM%20unitpage.htm)). There are individual activities for each of the 3 main rock types, a candy rock cycle activity, and a brilliant idea for comparing rocks to identify which rocks are best used for what purposes – building a house, tools, jewelry, etc.

# Sources

The best write up for the crayon rock cycle activity is available from Eric Muller of the Exploratorium’s Teacher Institute. Go to The Crayon Rock Cycle at <http://www.exo.net/~emuller/activities/> Eric has developed many other fantastic activities, particularly for Earth Science.

For additional information about the rock cycle, go to:

* Rocksandminerals.com (<http://www.rocksandminerals.com/rockcycle.htm>)
* The Department of Geology at James Madison University (<http://csmres.jmu.edu/geollab/fichter/Wilson/PTRC.html>)
* Wikipedia (http://en.wikipedia.org/wiki/Rock\_cycle)

Sodium silicate solution (also called water glass) can be purchased from most science supply companies such as Flinn Scientific (<http://www.flinnsci.com>) and Science Kit & Boreal Labs (http://sciencekit.com/). 500 ml costs $5-6. Sometimes it can be found at marine supply stores in quart sized containers for sealing the outside of boats.