

# Rock On

**Average Program Length:** 45 minutes

**Meeting Location:** Visitors Center

**Total material list:**

- Flour
- Used coffee grinds
- Salt
- Sand
- Water
- Fossil stamps
- Rock cycle poster (Park Provided)
- Plate tectonics poster (Park Provided)
- Park map (Park Provided)
- Rock identification kit
- Mineral identification kit

## Activities by Scout Level

### Girl Scout

**Daisies and Brownies-** pick at least 2 of the steps below

**Juniors and Cadettes-** pick at least 3 of the steps below

**Seniors and Ambassadors-**pick at least 4 of the steps below

### Boy Scout

**Lions, Tigers, Wolves, and Bears-** pick at least 2 of the steps below

**Webelos, Scout Rank, and Tenderfoot-** pick at least 3 of the steps below

**Second Class, First Class, Star Scouts, Life Scouts, and Eagle Scouts-**  
pick at least 4 of the steps below

# Background

There are three main different types of rocks in the world--igneous, sedimentary, and metamorphic. **Igneous rocks** form as a result of the cooling of magma. When magma cools and solidifies underground, the resulting igneous rock is plutonic. These types of rocks may be surfaced through weathering processes or the movement of plate tectonics. When magma cools and solidifies during or after being moved to the surface through volcanic processes, the resulting igneous rock is volcanic. Igneous rocks are classified based on the size and composition of their constituent mineral crystals. As a general guide, the longer the igneous rocks take to cool and crystallize, the larger the mineral crystals will become. You can tell igneous rocks at first glance if the minerals of the rock are crystallized and fused together with no surrounding cement. Some well-known types of igneous rocks include granite, rhyolite, andesite, diorite, obsidian, gabbro, and basalt. **Sedimentary rocks** take their compositional elements from other sources that have been weathered to sediment, re-deposited, and re-solidified through compression and cementation. Sedimentary rocks generally have a layered appearance—as sediment is pressed and solidified by the overlying crust; the particles align themselves horizontal to the pressure. There are three types of sedimentary rocks: clastic, chemical, and organic. Types of clastic sedimentary rocks such as conglomerate, sandstone, and shale, are composed of debris from weathered rock materials. Types of chemical sedimentary rocks such as rock salts and gypsums form as standing water evaporates and dissolved minerals are deposited. Types of organic sedimentary rocks such as coal and limestone form out of calcium, plant, and animal deposits that are buried and solidified before they have a chance to disintegrate. You can tell sedimentary rocks at first glance if the constituent elements are “glued” together by a surrounding cement, or if the elements are of varying size, shape, and composition as opposed to simple mineral crystals.

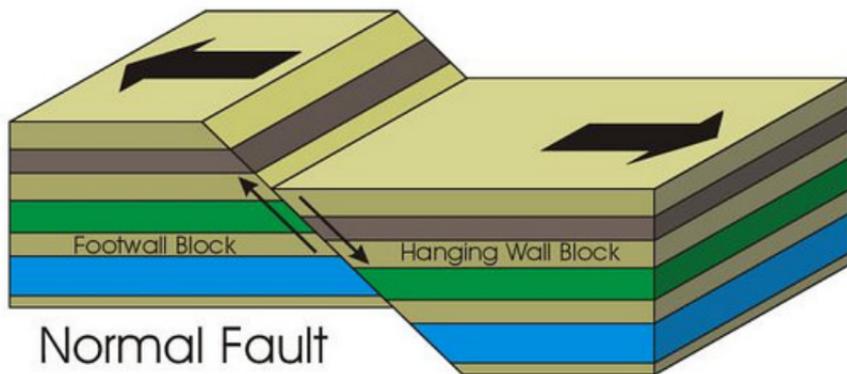
**Metamorphic rocks** are types of existing rocks that have been altered in form as a result of changes in heat and pressure. In mountainous regions, for example, where rock matter is pressed and altered by plate tectonic

activity, metamorphic rocks are very common. If you should stumble upon a metamorphic rock outcrop in the field, outside of any mountain range, chances are good that you're standing at the location of an ancient mountain range that has been weathered away over millions of years. Common types of metamorphic rocks, such as marble, schist, and gneiss, bear the appearance of having been twisted, folded, or swirled as though the rocks had become pliable or altered. Partial meltdown, pressure, and re-crystallization that occur deep within the Earth's crust at regions of plate tectonic activity are responsible for these characteristics.

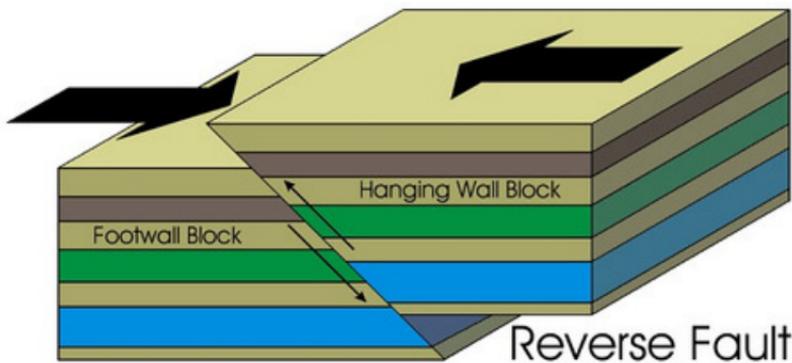
**Fossils** are formed in a number of different ways, but most are formed when a plant or animal dies in a watery environment and is buried in mud and silt. Soft tissues quickly decompose leaving the hard bones or shells behind. Over time sediment builds over the top and sediments are hardened into sedimentary rock. Sedimentary rocks form at temperatures and pressures that do not destroy fossil remnants. As the encased bones decay, minerals seep in replacing the organic material cell by cell in a process called "petrification." Alternatively the bones may completely decay leaving a cast of the organism. The void left behind may then fill with minerals making a stone replica of the organism.

**Plate tectonics** is the theory that Earth's outer shell is divided into several plates that glide over the mantle, the rocky inner layer above the core. The plates act like a hard and rigid shell compared to Earth's mantle. This strong outer layer is called the lithosphere. Faults usually occur where plates meet, as they collide, pull apart, or scrape past each other. All the stress and strain produced by moving plates builds up in the Earth's rocky crust until it simply can't take it any more. All at once, CRACK!, the rock breaks and the two rocky blocks move in opposite directions along a more or less planar fracture surface called a fault. The sudden movement generates an earthquake. We classify faults by how the two rocky blocks on either side of a fault move relative to each other. There are three main types of faults:

- The one you see below is a normal fault. A normal fault drops rock on one side of the fault down relative to the other side. Take a look at the side that shows the fault and arrows indicating movement. See the block farthest to the right that is shaped kind of like a foot? That's the foot wall. Now look at the block on the other side of the fault. See how it's resting or hanging on top of the foot wall block? That's the hanging wall. We have a small normal fault at the Park.

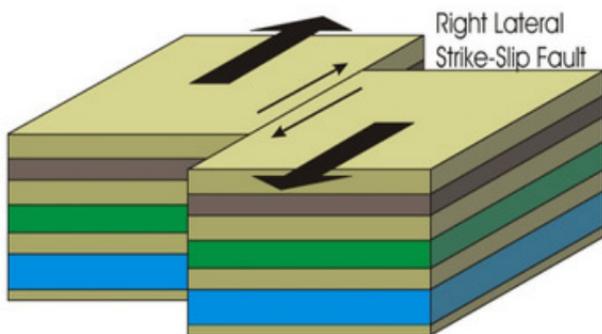


- The one you see below is a reverse fault. Compare this image with the normal fault above. Along a reverse fault one rocky block is pushed up relative to rock on the other side.



The one you see below is a strike-slip fault. Strike-slip faults have a different type of movement than normal and reverse faults. You probably noticed that the blocks that move on either side of a reverse or normal fault slide up or down along a dipping fault surface. The rocky blocks on either side of strike-slip faults, on the other hand, scrape along side-by-side. You can see in the illustration that the movement is horizontal and the rock layers beneath the surface haven't been moved up or down on either side of the fault. The major fault off the coast of San Diego, the San Andreas fault, is a strike-slip fault.

### Strike-Slip Fault



Identifying different types or rocks is often a challenge. Nonetheless, rocks can usually be identified, depending on their composition (what they're made up of). Rocks are composed of a variety of different minerals. You will be able to see the different mineral-types later, in the rock kit. See the tables below on how to identify different rock types.

The guide below will help you identify if a rock is igneous, sedimentary, or metamorphic. There are two types of igneous rocks--intrusive and extrusive. Intrusive rocks formed slowly, under the earth's interior when magma solidified. Extrusive rocks cooled quickly, above the surface of the earth, when lava leaked or exploded out of openings.

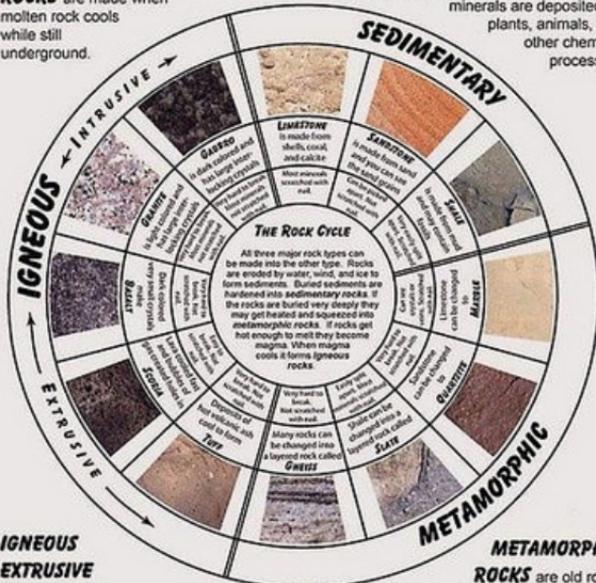
## HOW TO IDENTIFY ROCKS

### IGNEOUS INTRUSIVE

**ROCKS** are made when molten rock cools while still underground.

### SEDIMENTARY ROCKS

are made when pieces of rocks settle from the water or when minerals are deposited by plants, animals, and other chemical processes.



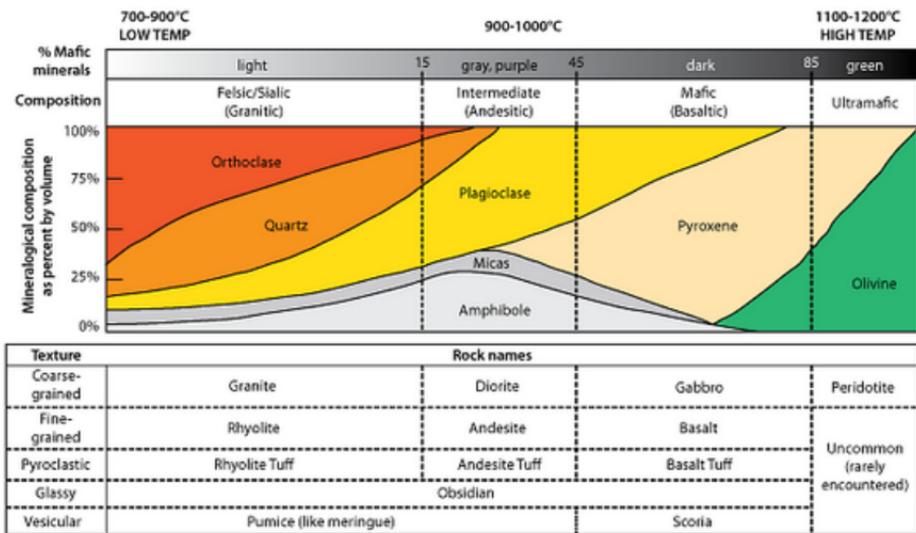
### IGNEOUS EXTRUSIVE

**ROCKS** are made when molten rock flows on the land surface or is thrown into the air and then is cooled into rock.

### METAMORPHIC ROCKS

are old rocks that have been squeezed and heated but not melted. What new rock is made depends on what the original rock was and on the amount of heat and pressure.

You can identify **igneous rocks** depending on how much of each mineral type it has. For example, if the rock is coarse-grained with a lot of quartz, it's probably Granite. If it's fine-grained with a lot of pyroxene, it's probably Basalt.



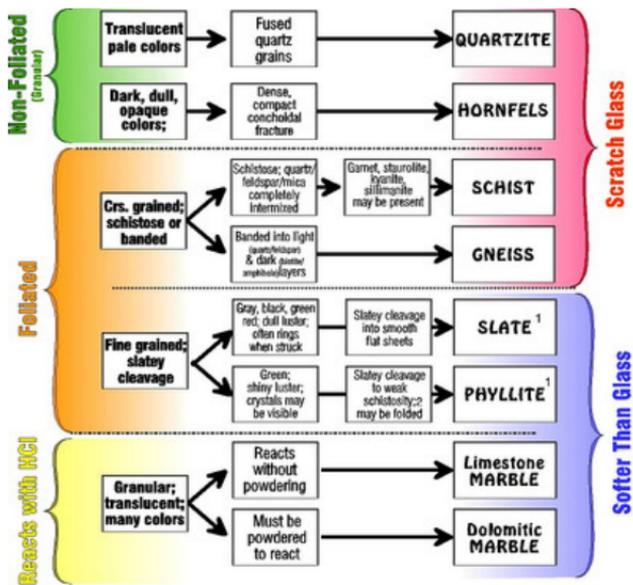
Many **sedimentary rocks** can be determined by their course or fine texture.

## Identification of Sedimentary Rocks

Detrital Sedimentary Rocks				Chemical Sedimentary Rocks		
Clastic Texture Particle Size	Sediment Name	Rock Name	Composition	Texture	Rock Name	
Coarse (over 2 mm)	Gravel (Rounded particles)	Conglomerate	Calcite, CaCO <sub>3</sub>	Nonclastic: Fine to coarse crystalline	Crystalline Limestone	
	Gravel (Angular particles)	Breccia		Travertine		
Medium (1/16 to 2 mm)	Sand  (if abundant feldspar is present the rock is called Arkose)	Sandstone		Clastic: Visible shells and shell fragments loosely cemented	Coquina	B L i o c m h e e m i c o n a t e
	Fine (1/16 to 1/256 mm)	Mud		Siltstone	Clastic: Various size shells and shell fragments cemented with calcite cement	Fossiliferous Limestone
Very fine (less than 1/256 mm)	Mud	Shale	Clastic: Microscopic shells and clay	Chalk		
				Quartz, SiO <sub>2</sub>	Nonclastic: Very fine crystalline	Chert (light colored) Flint (dark colored)
				Gypsum CaSO <sub>4</sub> •2H <sub>2</sub> O	Nonclastic: Fine to coarse crystalline	Rock Gypsum
				Halite, NaCl	Nonclastic: Fine to coarse crystalline	Rock Salt
				Altered plant fragments	Nonclastic: Fine-grained organic matter	Bituminous Coal

**STOP**

**Metamorphic rock** can often be identified by its foliation and mineral composition. Foliated rocks have repetitive layering, or banding.



<sup>1</sup> (Shale), slate, and phyllite complete intergrade with each other. Distinctions may be difficult.

## Matching Badges



Junior-Rocks  
Rock



BSA-Geology

Correlates to Next Generation  
Science Standards for ESS1:  
EARTH'S SYSTEMS:  
PROCESSES THAT SHAPE  
THE EARTH

# Program Activities

1. At home, before you come to the Park, do the interactive “type of rocks” internet activity at [www.learner.org/interactives/rockcycle/types.html](http://www.learner.org/interactives/rockcycle/types.html). Read the first page, and then do the “Rock Collection” online activity, and finally test yourself in the “Identify Rock Types” quiz. The button to the next page is at the bottom, and the whole process should take 10 minutes or so. Don’t worry if you’re confused or get some answers wrong. We’ll help explain at the Park!
2. Make a fossil of your own! Using 1 cup flour, 1 cup used coffee grinds,  $\frac{1}{2}$  cup salt,  $\frac{1}{4}$  cup sand, and  $\frac{3}{4}$  cup water, create a fake rock. Mix all the dry ingredients together, and then add the water. Imprint a fossil-shape into the wet rock, wait for it to dry slightly, and remove the object. You will be left with a imprinted fossil of your own!
3. Where there is a lot of sandstone, there is a lot of erosion. That’s because the ground is made up of loosely packed sediments. Walk around the Park and see if you can spot any areas that are eroding and don’t have many plants. Mark these spots on a map and let our Visitors Center know.
4. Look at the different types of rocks in an rock kit, and learn which ones are igneous, metamorphic, and sedimentary. Look at the different minerals in the mineral kit. Can you see which rocks are composed of which minerals? Then, explore the park and look at the different rock types. Can you figure out what kind of rock (from the rock cycle) is dominant? Take photos of different rocks that you find.
5. Scavenger hunt for a normal fault. Once you find it, report back to our rangers! (Ask rangers for hints, it’s a bit hard to find! \*From the searchlight, you need to look northwest across the canyon to see the offset bed along the Bayside Trail\*). How can you tell it’s a normal fault, and not a reverse or slip fault?
6. The San Andreas fault will eventually cause another continental transform, medium-large magnitude earthquake. Places near convergent plate boundaries will suffer from even larger magnitudes. In 1960, Chile had a catastrophic 9.4 magnitude earthquake. Infrastructure in developing countries often struggles to meet earthquake-safe standards, and buildings on loosely-packed soil suffer tremendously when shaking ground “liquefies” with the tremors. What can you do to ensure people living in these areas are safe and prepared when the time comes? (ie: Create a public service announcement on earthquake preparedness/safety.)