

TEACHER BACKGROUND KNOWLEDGE

Surface Processes: Weathering and Erosion

Core Concepts

- Precipitation (caused by the water cycle) and wind cause rocks to be broken into smaller pieces in the process called **weathering**. The rock is then transported away through **erosion**. Together, these two processes are responsible for taking material from higher places, and depositing it in lower places.
 - Weathering
 - Erosion
 - Soil

The rock that is formed on the Earth's surface through volcanoes and mid-ocean ridges, or uplifted from deep underground at subduction zones, does not stay unchanged. We think of features such as mountains, hills, rivers, and shorelines as constant structures, but they are not. Over time, two processes work together to break down all of these structures, and to transport the material that once made them away. These two processes are weathering and erosion. Both of these processes are powered by the Sun.

The sun's energy powers the meteorological system in the Earth's atmosphere that results in wind, rain, ice, and moving water, all of which work together to break up and move rock.

Weathering

Weathering is the process of breaking rock up into smaller pieces. Any rock that you find, from a large granite mountain, a pebble, or a grain of sand at the beach, was once part of an even bigger rock. Rocks are constantly being broken down into progressively smaller pieces by one or more of the different types of weathering. There are two main categories of weathering on the Earth's surface, *mechanical* and *chemical*.

Mechanical weathering happens anytime rocks or other matter rub against or break apart other rocks. When rocks of any size fall down mountains or other slopes, they crash into other rocks, wearing them both down. Moving water, whether from rivers, streams, runoff, or waves crashing in on a lake or ocean, wears down rock that it comes in contact with. Water that is trapped in cracks of rocks, and freezes, will expand and break the rock apart. Plants are also capable of mechanical weathering, growing into cracks in rocks, and wedging them apart with the plant's continuing growth.

Chemical weathering happens when rocks are affected by contact with chemicals. When a substance, such as oxygen from our atmosphere or rainwater which has a small amount of acid in it, comes in contact with some minerals, it can dissolve or change the minerals. Depending on what a rock is made of, some or all of the minerals in a rock can be dissolved away.

Rocks containing minerals based on calcium carbonate, such as limestone or marble, are affected by acids. All rainwater is naturally acidic (pollution has made the acidity level rise in the past several hundred years) and will slowly dissolve calcium-based rocks, and carry the dissolved material away. Along with causing natural rock formations to change, this process is wearing away many buildings, statues, and other man-made structures carved from marble.

Weathering, like most geologic processes, usually happens slowly. However, there are instances such as earthquakes, tidal waves, hurricanes, flash floods, etc... that can cause a large amount of weathering to happen very quickly. Weathering results in many different sized rock particles, from large boulders, to pebbles and grains of sand, to microscopic particles that were chemically dissolved away. It is important to consider these

different sized particles when thinking about processes that follow weathering, including erosion and rock-building.

Erosion

Erosion is the transportation of material that has been weathered from rock. Erosion can happen to any sized rock, but the rock's size will affect how it is eroded. In general, erosion takes rock from high places, and with the help of gravity, **deposits** the rock in low places. Rock that is being eroded away, and is eventually deposited in a final location, is referred to as **sediment**. In the rest of this passage, sediment will be used to refer to anything in the process of eroding or deposition.

There are four main agents of erosion: water, wind, ice and gravity.

- **Water** carries sediment with it as it flows from high places to low places. Water flows in many different ways and locations, depending on how steep of a slope it is running down, and how much water is moving together. These two factors help determine how much, and what sized particles of sediment the running water is able to carry. Slowly moving small streams may only be able to transport small particles of sand and clay, while large, quickly moving rivers can transport pebbles and

larger particles. Water can also transport sediment due to the motion of waves at a shoreline.

- **Ice** moves sediment by trapping different sized particles (from dissolved sediment up to large boulders) in slowly moving sheets called **glaciers**. Glaciers move slowly, and when they melt they deposit all of the sediment enclosed inside of them. Glaciers are capable of carving out large valleys due to their humongous mass and power.
- **Wind** picks up smaller sediment in gusts, and then deposits them when the wind slows down or stops. We see the most wind erosion in deserts, where there is little water to hold sediment down to the ground.
- **Gravity** is a part of all three of the previously mentioned agents, but it can work on it's own as well. Landslides and mudflows are instances where gravity can pull small or large amounts of material down from a high place to a low place. The risk of one of these events becomes stronger as a slope gets steeper and as water is absorbed in the ground to act as a lubricant.

In the end, sediment is deposited in horizontal layers in the lowest possible place that one of the above agents can take it. As layers are deposited, they are covered up by more and more layers of sediment, often of different types of material. As these layers are buried deeper, it is possible for them to be transformed into rock.

Soil

Soil is a mixture of two materials, sediment that has been deposited on the ground and organic material left behind by living things. The sediment can vary in size, from small rocks down to dissolved material. The organic material will include dead and decaying plants and animals, as well as organic waste products. Living things, such as bacteria, fungi, and worms, help break down the organic material, and mix it with the non-organic sediment. This process can take a long time, hundreds of years or more depending on the amount of organic material available.