


WEATHERING OF ROCKS AND SOIL

Weathering is a collection of natural processes that, over time, break large rock into smaller and smaller pieces. Rocks can be decomposed, that is, broken down, by physical processes (called **mechanical weathering**) and chemical processes (called **chemical weathering**). When a piece of rock of any size moves during weathering, the process is then called **erosion**. When the force of gravity pulling material downhill causes erosion, it is called **mass wasting**.

Mechanical Weathering

Mechanical weathering is the physical decomposition of rocks. There are a number of physical processes that break rock down into smaller and smaller pieces.

1. Mechanical weathering can happen by the **abrasion** of one rock banging against another.
2. When the sun heats rocks during the day, they expand. When they cool, they contract. This expansion and contraction causes the rock to crack and surface weathering occurs.
3. Small pieces of rock can be broken apart by the expansion and contraction cycle.
4. Cracks in rocks can be widened by tree roots. Tree roots take root in this dirt and as the trees grow, the roots grow. Expanding roots actually can have enough force to push rocks apart.



PREVIEW

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Running water rolls rock pieces against each other, breaking the rocks down and polishing their edges.

5. Glaciers break rocks apart and crush rocks against each other as they move from higher to lower elevations.

6. Ocean waves pound against coastal rocks. The force of the waves themselves slowly breaks down the rock formations. The waves also push smaller pieces of rock and other debris against larger rocks, grinding both into smaller pieces.
7. Wind blows small particles against rocks which slowly sands the rocks down, much like sandpaper sands wood.

Lesson Checkpoint: Name two ways that mechanical weathering wears down rock.

Chemical Weathering

Chemical weathering is the decomposition of rocks by chemical reactions. The chemicals can be from natural sources, such as the decomposition of sulfide minerals like pyrite. In modern times, the chemicals can also be the byproduct of pollution created by the burning of fossil fuels. Here is a list of some forms of chemical weathering.

1. Limestone reacts with atmospheric carbon dioxide to form carbonic acid. This acid combines with some minerals in the rock to form soluble compounds that can be washed away. This process is called **carbonate weathering**.
2. Sulfide minerals like pyrite react with oxygen and water to form sulfuric acid. This acidic water can then react with certain rocks to break them down. This is called **pyrite decay** and is a particular problem near the waste piles of old mines.
3. Natural carbonic acid in water eats through limestone to create extensive limestone caves and cave formations such as stalactites and stalagmites.
4. Some lichen and tree roots produce acid in their tips. The acid is used to eat through rock so that the plant can anchor itself to a substrate and also find nutrition. This acid is strong enough to decompose rock.
5. Many minerals are relatively unstable and easily deteriorate in the presence of water and natural chemicals. Feldspar in granite, for example, breaks down into clay.

Lesson Checkpoint:
Describe one type of chemical weathering.

How Does Soil Form?

Soil is a combination of decomposed rock and organic materials. There are different types of soil depending on the climate in which they form. Geologists study soil by studying the **soil profile**. The soil profile is a cross-section of the soil from the surface down to the hard **bedrock** (also called **parent rock**). The soil profile is subdivided into **horizons**. The uppermost is the A horizon and consists primarily of decaying organic material. (Sometimes the A horizon is broken into the O horizon on top of the A horizon below.) This material is called **humus**. The B horizon is also called the **subsoil**. The C horizon contains partially decomposed bedrock or parent rock material. Below the C horizon is unaltered parent rock.



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Soil that is formed over its parent bedrock is called **residual soil**. Soil that has been transported from a different location and then deposited is called **transported soil**.

All soil begins with the underlying parent rock. Mechanical and chemical processes weather this parent rock. As the rock deteriorates, biological material is mixed with the rock pieces. The biological material is usually mostly plant material, but it can also be animal remains as well.

As water percolates down through the soil horizon, it leaches nutrients and minerals from the surface and moves them downward into the lower soil horizons. The C horizon, however, is generally devoid of nutrients.

Lesson Checkpoint:
Which layer of soil has no nutrients?

Types of Soil

The physical characteristics of the soil that forms in any particular region is determined by the region's climate.

1. **Tropical regions** have dense vegetation and high rainfall. The topsoil in tropical regions is very thin because the high rainfall constantly and quickly leaches the topsoil.
2. **Desert climates** have very low rainfall. The little rain that does fall generally evaporates quickly. Soluble minerals that are dissolved in the rainwater are then easily left behind. This is a harsh environment for plants to survive, so there is very little vegetation. Desert soil, therefore, has little to no humus and cannot support much plant life.
3. **Temperate climates** have the most nutrient-rich, productive soils in the world. They have a thick humus layer. They get enough rain to nourish the plant life, but not so much that the soil is leached of its nutrients. The soil horizon, therefore,

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Which type of climate has the most productive soil?

Life in the Soil

Different soils can support different types of life. Soils with rich A horizons (that is, with a lot of humus) are able to support abundant plant life, as well as fungi, bacteria, insects, worms and a variety of small and medium-sized animals. Fungi and bacteria decompose plant material. Worms and insects also break down the decomposing plant material. Animals make their homes in the soil where they live, breed and find protection from predators. Burrowing animals also help create the soil profile by breaking up lower horizons and helping break down hard dirt, soil and rock.

Soil conservation

Soil is essentially a nonrenewable resource. Without careful use, it can be easily and quickly depleted and even destroyed. For example, in the 1920's, farmers in states like Kansas were devastated by a series of events that resulted in the topsoil literally being blown away by the wind in tremendous clouds of dust. Historians call this "The Great Dustbowl." This problem was created by the widespread removal of the grasses that grew on the topsoil (called **cover crops**) which allowed considerable erosion.

The dramatic removal of cover crops, like grasses and wildflowers, will lead to rapid erosion of the topsoil. Since the topsoil holds considerable quantities of water, loss of this natural "sponge" can lead to dramatic flooding. Similarly, water management can become a problem when an area is overdeveloped with homes, businesses, parking lots and roads. When the soil is removed or covered, the water that would have been held by the soil now must run off somewhere.

Soil conservation is also an important consideration for farmers. For example, certain nutrients are lost each year, and the soil becomes less fertile. Consequently, farmers must use fertilizers to keep the soil healthy and productive.



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