

Weathering



Essential Standard 2.1

Explain how processes and forces affect the lithosphere.

Learning Objective 2.1.3

Explain how natural actions such as weathering, erosion (wind, water, and gravity), and soil formation affect Earth's surface.

I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can distinguish between physical, chemical, and biological weathering.
- I can explain examples of different types of weathering.
- I can identify various factors that can increase the rate of weathering

Weathering

Weathering is the process by which rocks are broken down into smaller pieces.



Weathering can be physical, chemical, or biological in nature and the specific type of weathering that a rock undergoes depends mainly on its environment.

Physical Weathering

During physical weathering, rocks are broken down into smaller pieces, but their chemical composition stays the same.



Physical weathering can occur through several different means such as: temperature changes, frost wedging, water, wind, waves, and gravity.

Temperature Changes

High temperatures can cause rocks to expand, whereas low temperatures can cause rocks to contract.



Continuous expansion and contraction causes pressure on the outer layers of the rock.

As a result, cracks develop and eventually, the outer layers of the rock just wear off.

This is also known as exfoliation.

Temperature Changes

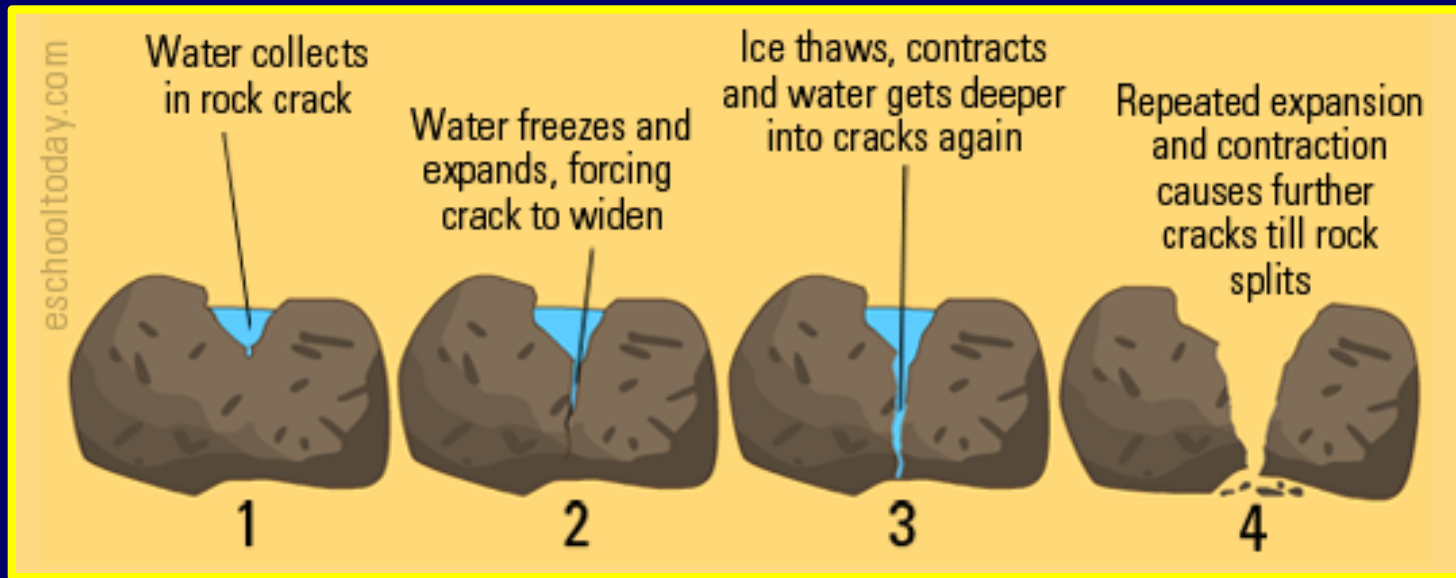
Potholes are a result of exfoliation.



Expansion joints in sidewalks and roads allow the cement to expand and contract without cracking.

Frost Wedging

Frost wedging is a result of water collecting inside of the cracks in a rock.



The expansion of the water, as it freezes, forces the crack to widen until they eventually break apart.

Flowing Water and Waves

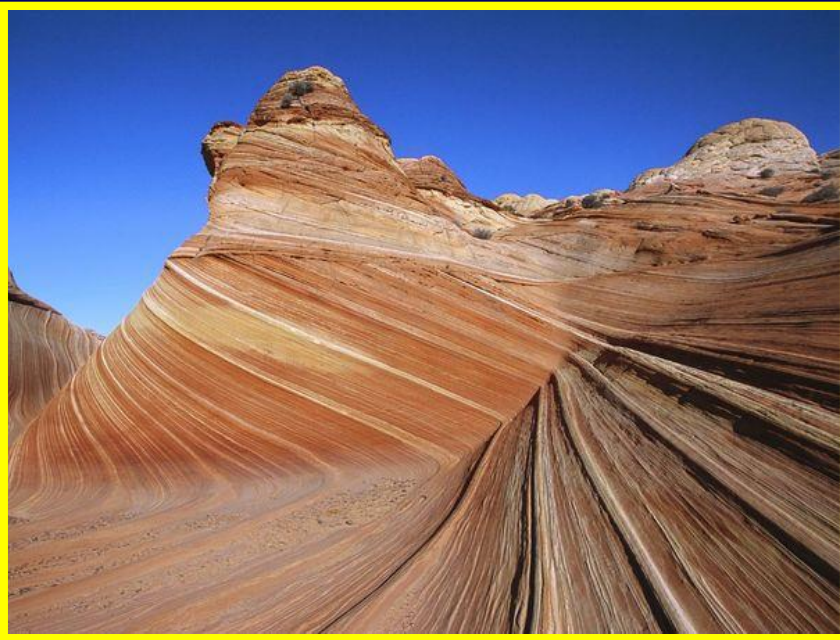
The current from steadily flowing water, over time, wear down and break apart the underlying rocks.



The constant pounding of waves on rocks can also wear down and break rocks apart.

Wind

When wind picks up sand, the sand particles rub against the surface of rocks, eventually wearing them down.



Gravity

Gravity can also weather rocks, but is usually combined with other weathering agents.

When rocks are weathered by water, wind, or waves and they begin to break apart, then gravity helps break the rocks into even smaller pieces as they fall and are smashed apart.



Chemical Weathering

Chemical weathering occurs when rocks and minerals undergo changes in their composition, resulting in a new substance being formed, as the rocks are broken down.



Agents of chemical weathering include: oxygen, water, carbon dioxide, and acids.

Oxygen, Water, and Iron

When water and oxygen mix with the iron in rocks, it creates a new substance called rust.



Rust is a lot softer material than iron and is worn away a lot easier.

Water - Dissolving

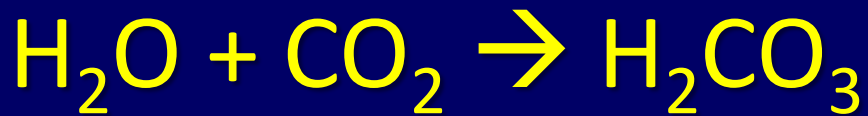
Water is able to dissolve many kinds of minerals faster than other minerals within the rocks.



The more easily dissolved minerals get washed away, leaving the harder to dissolve minerals behind.

Carbonic Acid

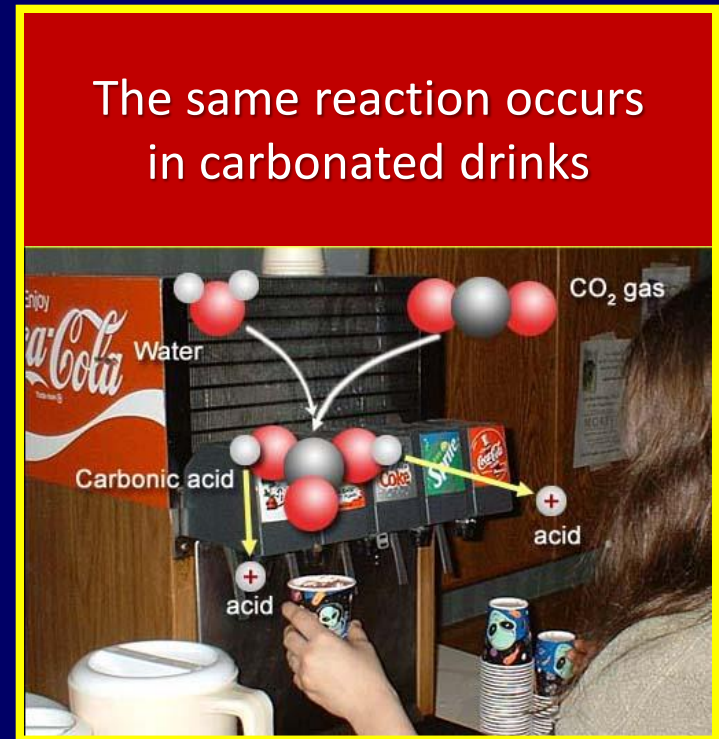
Carbon Dioxide also contributes to the chemical weathering process when it combines with water to form carbonic acid.



H_2O = Water

CO_2 = Carbon Dioxide

H_2CO_3 = Carbonic Acid



Carbonic Acid

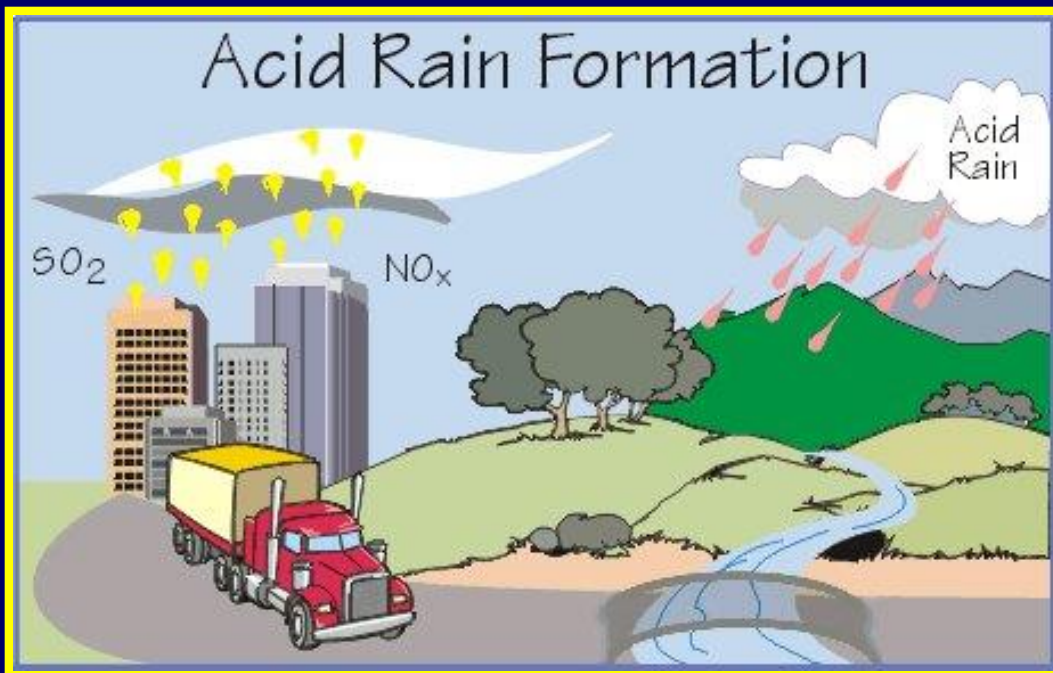
Carbon dioxide enters groundwater when organisms in the soil perform cellular respiration.

Carbonic acid in groundwater breaks down limestone to create underground caverns.



Acid Precipitation

Acid precipitation is formed when oxygen and water in the air mixes with exhaust from burning fossil fuels, especially coal, to create sulfuric acid and nitric acid.



Coal Burning Plant

Acid Precipitation

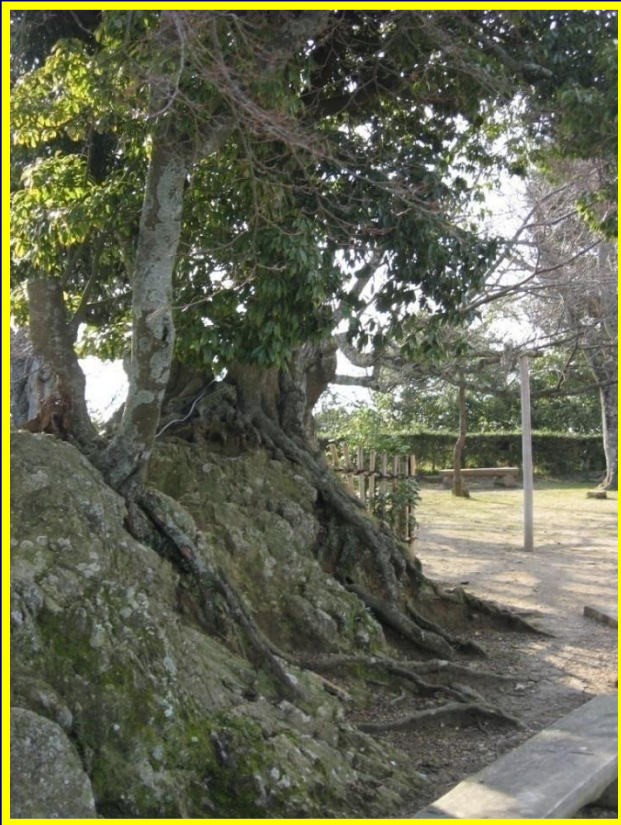
Acid precipitation dissolves limestone and marble, eventually wearing the rock away.



A lot of ancient marble statues have been worn away due to acid precipitation.

Biological Weathering

Biological Weathering occurs when living organisms break down rock.



Roots of trees and shrubs aid in weathering as their roots grow into the cracks of rocks, causing the rocks to break apart.

Biological Weathering

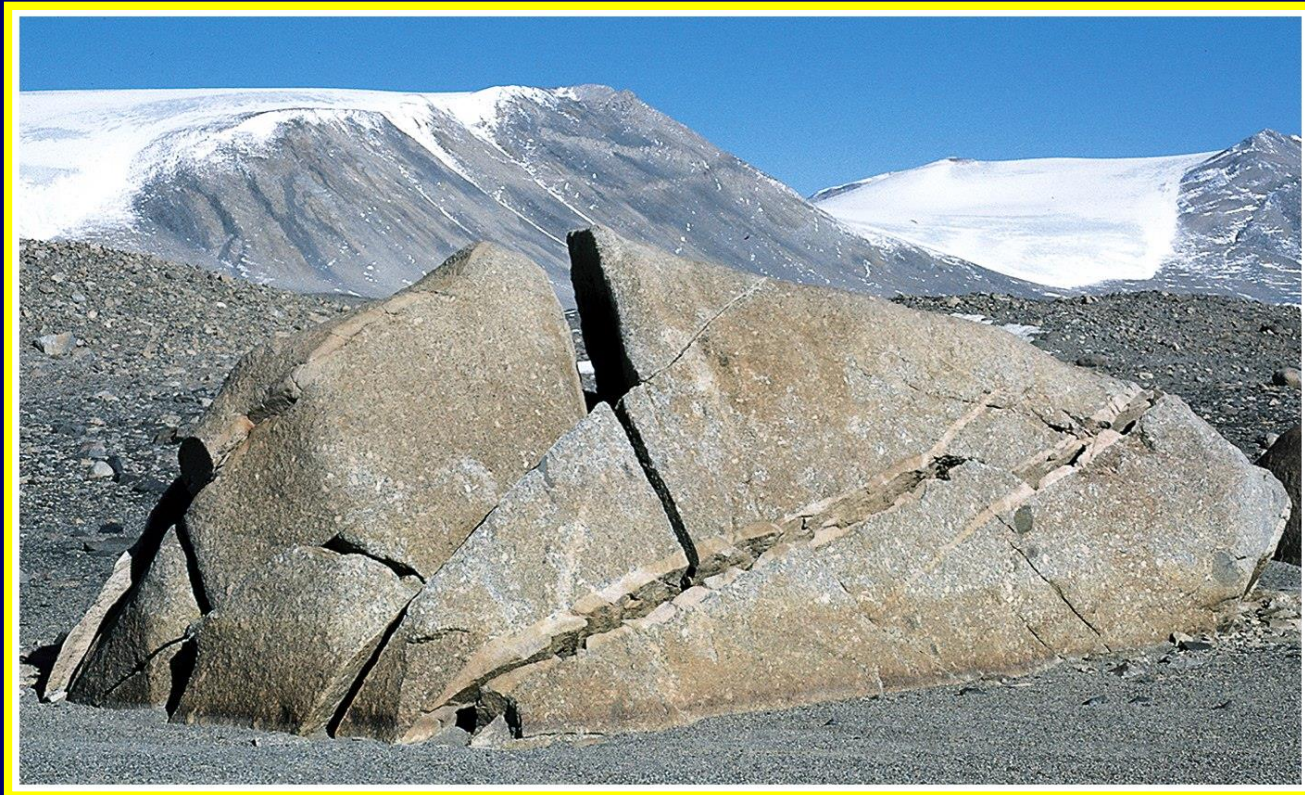
Lichen is a combination of an algae and a fungus that can grow on bare rock and as it grows, the fungus releases chemicals that break down the rock.



Lichen is actually one of the first things to grow on volcanic islands and is essential for the formation of soil on those islands.

Cold Climates

Physical weathering dominates in very cold climates where water undergoes repeated freezing and thawing allowing frost wedging to take place.



Tropical Climates

Chemical weathering occurs faster in climates that have warm temperatures, abundant rainfalls, and lush vegetation.



Chemical weathering dominates in tropical rainforests as heavy rain combines with the carbon to produce high levels of carbonic acid that dissolves the rocks very quickly.

Type of Rock

The composition of the rocks and minerals also play a role in the rate of weathering.



Sedimentary rocks, which are very soft, are more easily weathered than igneous and metamorphic rocks.

Topography

Topography is another factor that affects the rate of weathering.



White Cliffs of Dover, England.

Materials on sloped land tend to move as a result of gravity.

This exposes more of the rock surface to weathering effects.

The End

