



Weathering and Soil Formation

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Weathering

The **breaking down of rocks** and other materials on the Earth's surface is called weathering. A **slow, continuous process**, it affects all substances exposed to the atmosphere.



Types of Weathering

1. **Mechanical Weathering.**
2. **Chemical Weathering .**
3. **Biological Weathering.**



Mechanical Weathering

When the forces of weathering **break rocks into smaller pieces but do not change the chemical makeup** of the rocks, the process is called mechanical weathering. During mechanical weathering, rocks are broken into different shapes and smaller pieces. At the beginning the edges are jagged, as weathering continues, they become round.



Process of Disintegration in Mechanical Weathering

- **Insolation / Exfoliation**
- **Block Disintegration**
- **Granular Disintegration**
- **Shattering Disintegration**

Insolation / Exfoliation



Block Disintegration



Granular Disintegration



Shattering Disintegration





Causes of Mechanical Weathering

There are several causes of mechanical weathering.

- **Temperature**
- **Freeze-thaw : Frost action/ Ice**
- **Organic activity : Trees and Animals**
- **Gravity : Rock fall and Land slide**
- **Abrasion : Wind**



Temperature

Rocks can be broken apart by changes in temperature. As rocks are heat up in the sun during the day, the outside of the rock expands. The inside of the rocks remain cool and do not expand. When the air temperature drops at night, the outside of the rock cools and contracts. This continuing cycle causes particles to break off. This is called **Exfoliation.**



rock surface heats
up and expands



(a)



rock surface cools
and contracts



(b)

joints form in the outer
part of the rock



(c)

original rock
surface

broken
rocks



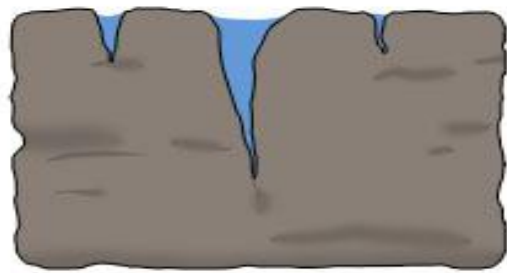
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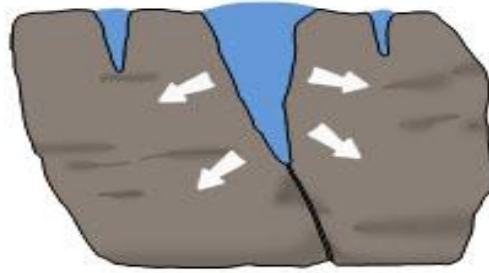
Frost Action

Unlike most liquids, water expands when it freezes. The repeated freezing and melting of water, called frost action, is another cause of mechanical weathering. **When water freezes in cracks in the rocks, it expands, making the crack larger.** In time, this causes the rock to break into pieces.

ONE



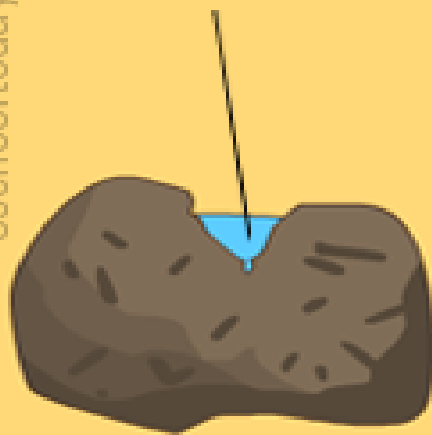
TWO



THREE

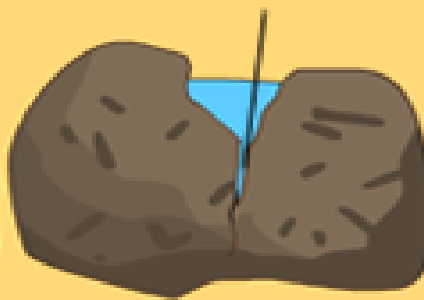


Water collects
in rock crack



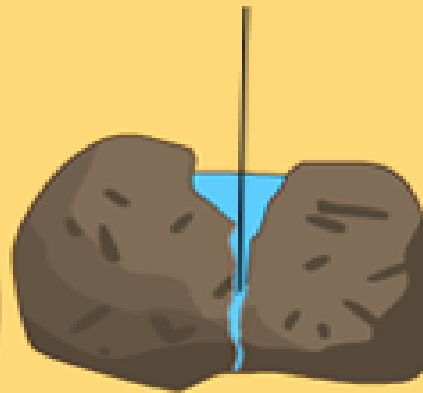
1

Water freezes and
expands, forcing
crack to widen



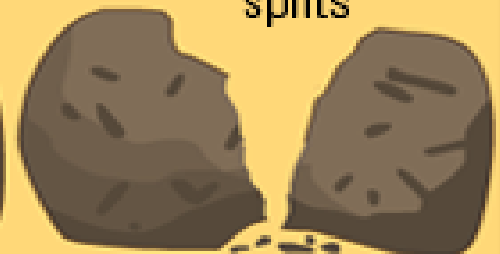
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Ice thaws, contracts
and water gets deeper
into cracks again



3

Repeated expansion
and contraction
causes further
cracks till rock
splits



4



Organic Activity

Plants and animals can cause mechanical weathering. The roots of plants sometimes loosens rock material. **A plant growing in a crack can make the crack larger** as the root spread out. This is known as **root-pry**. It is organic since this activity is caused by living things.



Gravity

Gravity is another agent of mechanical weathering. **Sometimes gravity pulls loosened rocks down mountain cliffs in a landslide.** A landslide is a large movement of loose rocks and soil. As the rocks fall, they collide with one another and break into smaller pieces. Falling rocks usually occur in areas where a road has been cut through, leaving cliffs on both sides.



Abrasion

Wind-blown sand causes mechanical weathering . Abrasion is the wearing away of rocks by **solid particles carried by wind, water or other forces**. In desert regions, the wind easily picks up and moves sand. **The sharp edges of the sand particles scrape off pieces of exposed rocks**. Running water also carries loose rocks which scrape against each other and break.

Wind charged with sand



Polished face



Rock rotation





Chemical Weathering

When the chemical makeup of the rocks is changed it is called chemical weathering.

During chemical weathering, changes occur in the mineral composition of rocks.

Minerals can be added, removed or broken down (decomposed). Many substances react chemically with rocks to break them down.



Causes of Chemical Weathering

There are several causes of chemical weathering.

- **Oxidation**
- **Solution**
- **Hydration**
- **Carbonation**
- **Hydrolysis**



Oxidation

Chemical weathering is also caused by oxidation. **Oxidation is the process in which oxygen chemically combines with another substance.** The result of oxidation is the formation of an entirely different substance. **Iron in rocks combines with oxygen in the air to form iron oxide, or rust.**





Solution

Some mineral present in the rocks are **directly soluble** in the rain water. In this process minerals are **washed out of the soil and rock and are decomposed**. This process is dominant in areas where rocks **salts and Gypsum Formation**.





Hydration

When the pure rainwater enters the pores of rocks, it increases the volume of certain minerals. **Feldspar** is the chief mineral which is affected by this process. The effect of this process is that **rocks become softer and so easily eroded.**





Carbonation

When carbon dioxide dissolves in water, a weak acid called **carbonic acid** is formed. When carbonic acid reacts chemically with other substance, the process of carbonation **occurs.** In nature, carbonic acid is formed when carbon dioxide in the air dissolves in rain. This acid rain falls to the ground and sinks into the soil. **It decomposes feldspar and limestone.**





Soil Formation

- The weathering of rocks on the Earth's surface results in the formation of soil. Soil is formed when rocks are continuously broken down by weathering. As rocks weather, they break into smaller pieces. These pieces are broken down into even smaller pieces to form soil.



Importance of Soil

- The formation of soil is extremely important to most living organisms. Plants depend on soil as source of food. Soil supplies plants with minerals and water needed for growth. Animals depend indirectly on soil since they eat plants and other animals that eat plants.