Weathering, Erosion & Deposition
Why is this important?

Erosion and weathering are major forces that shape the world around us.
Why is this important?

People play a part in the way and amount that our soil erodes around us.
Our World
Weathering, Erosion, Deposition Process

1. Weathering
   - **wears down** rocks and other substances on the Earth’s surface.
   - produces sediment

2. Erosion
   - **moves** sediment from one place to another.

3. Deposition
   - sediment is **laid down** in new locations

- Weathering, erosion, and deposition work together in a cycle that wears down and builds up the Earth’s surface.
Types of Weathering

1. Mechanical weathering
   - breaks the rock down into smaller pieces (*physical change*)

2. Chemical weathering
   - causes a change in the chemical makeup of the rock (*chemical change*).
Examples of Mechanical Weathering

**Abrasion** - The wearing away of a substance by *solid particles* carried by *wind, water, or other forces*
Examples of Mechanical Weathering

**Exfoliation** — The breaking off of curved sheets or slabs parallel to a rock’s surface.
Examples of Mechanical Weathering

Frost Action – The breaking apart of a rock caused by water freezing and expanding within cracks.
Examples of Mechanical Weathering

**Root-pry** – The breaking apart of rocks caused by the growth of plant roots.
Examples of Chemical Weathering

**Oxidation** – Chemical reaction between the iron in rocks and oxygen in the air to form iron oxide, or rust.

\[
\text{Fe(Iron)} + \text{O}_2(\text{oxygen}) = \text{FeO}_2 \text{ (iron oxide)}
\]
Examples of Chemical Weathering

**Acid Rain** – Occurs when carbon dioxide or sulfur oxide dissolve in the rain.

- $\text{CO}_2 + \text{H}_2\text{O} = \text{HCO}_3^-$ (carbonic acid)
- $\text{SO}_3 + \text{H}_2\text{O} = \text{H}_2\text{SO}_4$ (sulfuric acid)
- dissolves rocks such as feldspars and limestone
Examples of Chemical Weathering

**Plant Acids**
- Acids produced by plants slowly dissolve minerals in rocks.
- Important in the formation of soil.

Moss and Lichen
Erosion

- **Erosion** occurs when *weathered* rock and soil is **moved** from one location to another.
- Erosion can be caused by the following:
  - *Gravity*
  - *Running Water*
  - *Glaciers*
  - *Wind*
  - *Ocean Waves*
Deposition

- **Deposition** occurs when sediment is *laid down* in new locations.
- Can be deposited near to where it was originally weathered or it may be hundreds or thousands of miles away!
- Type of deposition and formation will depend on the type of erosion!
Erosion by Gravity
Erosion by Gravity

- Gravity causes **mass wasting**, a process that moves sediment downhill.
- Types of mass wasting:
  - *Landslides*
  - *Mudflows*
  - *Slump*
  - *creep*.
- Mass wasting can be rapid or slow.
- Remember, these different types of mass wasting are eroding the rock because they are moving it downhill.
Examples of Mass Wasting

Mudflows

Landslide
Examples of Mass Wasting

- Slump
- Creep
Deposition by Gravity

- The type of deposition caused by gravity
  - **Talus**
    - the pile of rocks and sediment that is deposited at the base of a slope.
Erosion by Running Water
Running water is the major cause of erosion that has shaped Earth’s surface.

Runoff is rain water that moves over the land.

Streams and rivers can also cause abrasion as the sediments being carried constantly collide with other rocks.
Deposition by Running Water

- Faster moving water can carry a larger amount of sediment. Therefore, fast-moving rivers erode more sediment than small streams.
- When the water slows down, stream or river cannot carry as much sediment and sediment gets deposited.
- As sediment is deposited, it creates new formations such as oxbow lakes, alluvial plains, and deltas.
Formation of an Oxbow Lake

Step 1.

Step 2.

Step 3.
Formation of an Alluvial Fan

• When a stream flows out of a steep, narrow mountain valley, it suddenly becomes wider and shallower.
• The water slows down and sediments are deposited to form an alluvial fan.
Formation of a Delta

• A river ends its journey when it flows into the ocean.
• The water slows down and sediments are deposited and build up a landform called a delta.
Glacial Erosion
Glacial Erosion

- A glacier is any large mass of ice that moves slowly over land.
- Continental glaciers have covered large parts of the US in times known as Ice Ages.
- The glaciers of the last Ice Age began about 2.5 million years ago and only finally retreated around 10,000 years ago.
Glacial Erosion

- As the glacier moves over the land, it picks up rocks in the process and carries them with it. This process is known as **plucking**.
- Many rocks are dragged on the bottom of the glacier and can scar the bedrock as they grind along the bottom. This is a type of **abrasion** and can scratch or “scar” the bedrock below.
Examples of Plucking & Glacial Scarring
Glacial Deposition

- When a glacier melts, it deposits the sediment that was eroded from the land, creating various landforms.
- The mixture of sediments deposited directly on the surface is called till.
- The till deposited at the edges of a glacier forms a ridge called a moraine.
- Retreating glaciers also create small depressions called kettles that form when a chunk of ice is left in glacial till. When the ice melts, the kettle remains.
- Kettles often fill with water, forming kettle lakes.
Glacial Deposition

**U-Shaped Valley**
A flowing glacier scoops out a U-shaped valley.

**Glacial Lake**
Glaciers may leave behind large lakes in long basins.

**Moraine**
A moraine forms where a glacier deposits mounds or ridges of till.

**Drumlin**
A drumlin is a long mound of till that is smoothed in the direction of the glacier’s flow.

**Kettle Lake**
A kettle lake forms when a depression left in till by melting ice fills with water.
Glacial Erosion

This is a boulder-size example of till.

Glacial scarring
Wind Erosion
Wind Erosion

- Wind caused erosion by deflation and abrasion.
- **Deflation** is the process by which wind removes surface materials such as silt and clay.
- Slightly heavier particles such as sand will skip for a short distance but soon falls back to the ground.
- Even heavier pieces of sediment can slowly move over the ground with strong winds.
- **Abrasion** by wind-carried sand can cause weathering. Then, the small pieces of newly weathered sediments get carried away by the wind as well.
Wind Erosion

- Fine particles are carried through air.
- Medium-sized particles skip or bounce.
- Larger particles slide or roll.
“Dancing Stones” of Death Valley!

These large pieces of rock have mysteriously been moving on their own. It was just discovered recently that strong winds have been eroding them across the desert!
Wind Deposition

- The sediment carried by wind can form sand dunes and loess deposits.
- **Sand dunes** usually form when the wind strikes an obstacle and slows down. These dunes are often found in the desert and on beaches.
- Sometimes, very fine clay and silt are deposited in layers far from its original source.
- This fine, wind-deposited sediment is **loess**.
- Loess helps to form fertile soil and are found on many farmlands in Nebraska, Iowa, Missouri and Illinois.
Formation of a Sand Dune

Crescent-shaped dunes form where the wind usually blows in the same direction.

Star-shaped dunes form where the wind direction changes frequently.
Ocean Wave Erosion
Ocean Wave Erosion

- The energy in ocean waves comes from the wind that blows across the water’s surface.
- Waves shape the coast through erosion by transporting sand and other sediment.
- The waves can also cause mechanical weathering (abrasion) as they hit land while carrying sediment. The large waves have a lot of energy and can break apart rocks on impact.
Ocean Wave Deposition

- The waves shape a coast when they deposit sediment, forming coastal features such as beaches and sandbars.
- A **beach** is an area of wave-washed sediment along a coast. The sediment deposited is usually sand but may be formed of small fragments of coral or sea shells.
Ocean Wave Deposition

- A longshore drift will deposit sediment offshore and create a formation known as a spit.
- The **spit** is a beach that projects like a finger out into the water.
- Incoming waves carrying sand may build up long ridges of sand parallel known to the shore, known as **sandbars**.
Ocean Wave Deposition

- **Beach**: Formed as waves pile up sand along the shore.
- **Spit**: Formed as longshore drift deposits sand along the shore.
- **Sandbar**: Formed by wave action.
- **Longshore Drift**: Movement of sediment along the shore.
- **Depositional Features**: The areas where sediment is deposited due to wave action.