AGENTS OF EROSION AND DEPOSITION

Forces of weathering and erosion are constantly reshaping Earth's surface. **Erosion** includes the chemical and physical breakdown of rocks *and* their transport from their point of origin to another location. Blowing wind, running water, flowing ice and gravity are the forces that erode rock and sculpt the landscape.

The Cycle of Erosion and Deposition

The first step of erosion is **weathering**. **Mechanical weathering** refers to physical processes that break down rock, like repeated heating and cooling, **frost wedging**, **abrasion** from rocks hitting each other, glaciers grinding rock and sediment against each other, and waves pounding against rocks at the seashore. **Chemical weathering** refers to the chemical processes that break down rock, such as **acid precipitation**, naturally occurring carbonic acid dissolving limestone, chemical decay of sulfide minerals like pyrite, and even natural acids in root tips that allow plants to cling to and eat through bedrock.

The next step of erosion is **transportation**. Technically erosion refers to the moving of rock from its point of origin to another locality. It takes energy to move rock material. The energy is applied by wind, water, and moving ice (**glaciers**). This energy not only moves the

rock but also wears it down into smaller and smaller particles. When the amount of energy decreases to the point that it cannot move the particles anymore, the rocks are **deposited**. Over time the broken sediments accumulate, often into immense layers. These sediments can be in place for millions of years during which time they can even **lithify**, that is, become stone.

The **cycle of erosion and deposition**, however, doesn't stop once sediments are deposited. After deposition, they can be further weathered and eroded and moved again and then deposited in yet another lo of all the continents gher points of t sited in the ocean

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Water Erosion

Streams and rivers are constantly eroding and shaping the landscape. For example, the Mississippi River erodes and moves 436,000 tons of sediment every single day. All the materials that a river or stream carries is called its **load**. Load includes **dissolved load** which is salts dissolved in the water, **suspended load** which is smaller particles held in suspension by the energy of the moving water, and **bed load** which is larger particles that are bounced along the bottom or bed of the river.

When the moving water from a river empties into a standing body of water, like a lake or the ocean, the sediments fall out of suspension and are deposited. The result is a triangular-shaped deposit known as a **delta**. The sediments fall out of suspension because the river water stops moving and therefore loses its energy. When the energy of the flowing water stops, it can no longer hold the sediments in suspension and the sediments then settle to the ocean or lake floor.

When moving water transports sediments from a mountainous or hilly area into a flat, low-lying plain, the water suddenly slows down and the sediment is deposited in a triangular-shaped formation. In this situation it is called an **alluvial fan** (see image below).

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Mean an deeper and do not have a steep gradient. Such rivers are described as **mature.**

Very broad, relatively shallow rivers that wander back and forth across the landscape are called **meandering rivers**. They flow slowly and therefore are low-energy rivers. They meander because the landscape on which they flow is very flat with very little change in elevation from one end to another. These are considered **old rivers**.

As we have seen, the Earth is a dynamic planet. Given the right geologic forces, a region that has been eroded to the point of being an old river running across a well-eroded landscape can be rapidly uplifted. This uplift causes the meandering river to dramatically carve down into the sediments. This situation is known as a **rejuvenated river**.

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Waves E[illegible]

The [illegible] turns this rock into s[illegible]es produce tw[illegible] **erosional**

Depo[illegible]barrier spits. **Beaches** are large deposits of grains that have been eroded from rock. This process takes thousands and millions of years. Most people are familiar with common tan, sandy beaches. This sand is quartz sand. The type of sand on a beach, however, depends on the source rock of the sand. Granite is the source of the tan beaches of places like Cape Cod and the Jersey Shore. The black sand beaches of Hawaii are derived from the black basaltic lava from which the Hawaiian islands were formed.

When waves crash on a shoreline, they come in at an angle. This creates currents of water that run parallel to the beach. These currents are called **long shore currents** and they are responsible for moving sand down a beach and producing formations like **barrier spits**. Cape Cod, Massachusetts is a dramatic example of a barrier spit. A **spit** is a stretch of land that sticks out from the mainland into the open ocean. It is described as a barrier because it is a barrier that protects th

Eros n cut and sculpted b waves. Hard rock an are called a **he**

Waves can the waves cut completely through the rock a **sea arch** is formed.

In time the smaller remnant o of the water. This isolated, individual rock now separated from the headland is called a **sea stack**.

Lesson Checkpoint: How is a sea arch created?

Wind Causes Erosion

Erosion by wind is a different process than wave erosion. The wind itself does not really cause erosion. The particles that are moved by the wind, like sand on beaches and deserts and ice in arctic environments, actually cause the erosion. Geologists use a number of different terms to describe and define the erosional caused by wind energy.

Wind moves sand particles by bouncing them across the surface. They bounce into each other and then are moved forward in the direction of the blowing wind. This process of moving sand particles is called **saltation**.

The process of wind blowing particles against rocks, thereby grinding them down and, in some cases, polishing them, is called **abrasion**. A rock that has been abraded by wind-blown particles is known as a **ventifact**. A ventifact is pictured here.

When the circumstances are right the wind can blow the sand cover completely away, revealing the hard underlying bedrock. This is a process called **deflation**.

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Different types of dunes are identified based on their shapes.

Barchan dunes are crescent-shaped with their "horns" pointing in the direction of the blowing wind.
Transverse dunes form a wavelike ridge that is transverse to the wind.
U-shaped dunes form a U-shape in which the open end of the U faces the oncoming wind.
Longitudinal dunes (also known as **linear dunes**) are long, straight, dunes that form parallel to the direction of the blowing wind.
Network dunes are complex groups of dunes that are created by wind that blows into a region from a number of different directions.

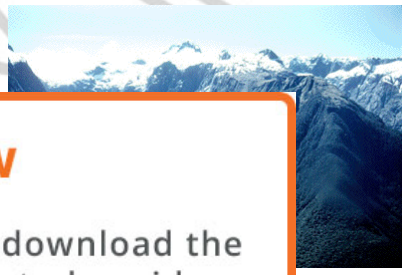
Lesson Checkpoint: Which way do dunes migrate?

Glaciers

There are two different types of glaciers. **Continental glaciers** are massive sheets of ice that literally cover large portions of continents. **Alpine glaciers** (also known as **mountain glaciers**) form in the high altitudes of mountains. In fact, most alpine glaciers form in valleys that were first carved by streams. It is not surprising, then, that glaciers have been described as "rivers of ice."

Glaciers move as ice is added to the glacier. Gravity pulls alpine glaciers downhill. In both types, the ice flows, like a mass of very thick putty or plastic. Continental glaciers create flattened, relatively smooth landscapes. Alpine glaciers create rugged landscapes with dramatically sculptured mountain features.

Both types of glaciers cause erosion due to their sheer weight pushing against rock as they move. They break off large chunks of rock and grind them down. If a glacier has enough time to work on a particular geographic area, it can grind rock down to a powder as fine as flour (collections of windblown glacial "dust" are called



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When three alpine glaciers erode a single mountaintop, a rugged, pointed peak is formed which is called a **horn**. An **arête** is a ridge created by two adjacent glaciers carving their way through two adjacent valleys.

Both types of glaciers create similar depositional features. **Moraines** are ribbons of glacial **till** which are deposited at the sides and the end of glaciers. "Till" is unsorted silt and rock created by glaciers. **Drumlins** are spoon-shaped hills of till that form underneath continental glaciers. The long tail end of the drumlin points in the direction of the glacier's movement. **Kames** and **eskers** are deposits of sorted glacial sediment that are deposited by running water that flows either on top of or through glaciers as they melt.

Lesson Checkpoint:
How do glaciers erode and what features do they form?

Mass Wasting

Large masses of rock material can move suddenly when they become unstable. The force causing the movement is gravity. This is called **mass wasting**. There are two basic types of mass wasting. **Rapid mass wasting** refers to the sudden and highly destructive movement of large masses of soil and strata. **Slow mass wasting** refers to the slow, persistent movement of soil and dirt over long periods of time.

A number of factors are involved in a mass wasting event, including the type of rock and soil involved, the angle at which it rests on the landscape, and the amount of water in the rock and soil. Loose soil that sits on a steep slope that is saturated with water is highly likely to suddenly move. The sudden and motion of large volumes of rock and dirt is called a **landslide**. This is an example of rapid mass wasting.

landslide

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