

Reflect

All the **landforms** on Earth have changed over time and continue to change. Many of the changes were caused by wind, moving water, or moving ice. Mountains have grown and shrunk. Rivers have cut away land and built new land. Ocean waves and currents have built up beaches and washed them away. Winds have piled up mounds of sand and flattened them. Some of these changes have taken

landforms: features on the surface of Earth such as mountains, hills, dunes, oceans, and rivers

millions of years. Other changes happened in days, hours, or minutes. These changes happened in the past. They are happening now. They will continue to happen in the future.

Think about the landforms where you live. How do you think they have changed over time? How do you think they will change in the future?

What are some forces that can change Earth's surface?

A *force* is a push or pull. You can change the surface of a wooden board by pushing a sheet of sandpaper over it. You can also change its surface by pulling a blade across it. Forces change Earth's landforms. However, the forces that shape Earth do not come from sheets of sandpaper or blades. Instead, they come from substances that move over the land, like wind, water, or ice.

We will examine three of these substances that shape and change Earth: moving air, or wind; moving water, such as rivers, waves, and rainfall; and giant slabs of moving ice called *glaciers*.

What Do You Think?

This picture shows the Grand Canyon, a deep gorge in northern Arizona. How do you think moving wind, water, or ice helped to carve the Grand Canyon?



Look Out!

Not all changes to Earth's landforms take a long time. Some changes happen very quickly. For example, heavy rains can loosen soil and rocks on hillsides, triggering landslides in minutes. The powerful winds of a hurricane can destroy a beach in just hours. Steady winds in a desert can build up or move sand dunes in days. A volcano erupting lava and hot ash can change Earth's surface in an instant. So can an earthquake.

How can you describe and identify landforms like deltas, canyons, and sand dunes?

From space, the mouth of the Mississippi River looks like separate blue fingers cutting through flat land. The land is shaped somewhat like a triangle. The base of the triangle borders the Gulf of Mexico, the body of water into which the river slowly flows. The apex of the triangle, the pointed end, points inland. This triangle of land is called a delta. Many rivers around the world have formed deltas.



These desert sand dunes were built by winds.

Imagine that you operated a truly huge earth mover. If you used it to scoop out a hole in the ground 1,829 meters (6,000 feet) deep, 446 kilometers (277 miles) long, and 29 kilometers (18 miles) wide, you would have made the Grand Canyon. Canyons are found all over the world. All have steep, rocky sides. At the top they are usually very long and wide. At the bottom they are usually very narrow. If you look into the deepest part of a canyon, you will often see a river. The river helped to carve out the canyon as it flowed across the land over thousands of years.

Look Out!

Sand dunes are easy to spot. If you have ever visited an ocean beach, you may have seen them. They usually lie behind the flat part of the beach. They look like small hills of sand. Although sand dunes come in different sizes, their shapes are similar. Which forces do you think helped form these dunes? The side of the dune where the wind hits slopes up gently. The side of the dune away from the wind slopes more steeply. Sand dunes are found in deserts as well as along ocean coasts like those found along barrier islands on the Gulf of Mexico.

If you were to hike into the mountains, you might come across valleys of different shapes. Some valleys would be V-shaped. Others would be U-shaped. You might wonder why the shapes of the valleys are different. The answer has to do with the forces that created each valley. You might notice a swiftly flowing stream in the V-shaped valley. On the other hand, you might notice piles of boulders along the sides and at the bottom of the U-shaped valley. These are clues to your question's answer. V-shaped valleys are carved by flowing water, while glaciers are responsible for carving U-shaped valleys.



Glaciers carve U-shaped valleys between mountains as they move slowly across the land.

Try Now



Examine maps of different parts of the world. Look for rivers that empty into large bodies of standing water such as oceans, seas, and gulfs. Identify the rivers that form deltas. Copy and paste maps or photographs of these rivers onto poster board. Use a marker to show the locations of the deltas. Use different-colored markers to identify the rivers that formed the deltas.

This photograph of a delta shows how the river system deposits sediment as it flows into a larger body of water.

What Do You Think?

How are wind, water, or ice involved in the formation of these landforms?

A delta is formed over many years where a river slows down. Rivers slow down where they empty into large bodies of water like oceans. As the river slows down, particles of dust and dirt the river has been carrying sink to the bottom. This process is called deposition. The particles are called sediments. The sediments build up on the bottom of the river. Over time the sediments may pile high enough to form an area of flat land. The soil in deltas is typically rich with nutrients carried downriver in the sediments.

Canyons are carved over millions of years by two processes. These processes are weathering and erosion. *Weathering* is the breaking up of large rocks into smaller pieces. Weathering is caused by wind, flowing water, or ice. Wind and flowing water rub away rock. Ice breaks down rock when liquid water freezes in a crack in a rock. When liquid water freezes, it expands. The expansion widens the crack. As the crack widens, pieces of rock break off. *Erosion* is the movement of weathered rock from one place to another. To form the Grand Canyon, the fast-flowing water of the Colorado River carried away lots of weathered material over thousands of years. Eventually, nothing was left but a great hole in the ground that continues to erode.

Sand dunes are built by erosion and deposition. Wind sweeps across the sand. As the wind moves, it picks up particles of sand. The faster the wind moves, the more pieces of sand it can pick up and carry. The wind carries the pieces of sand away. That is erosion. When the wind slows down, it drops the sand. That is deposition. The deposited sand piles up. This forms a sand dune.

Many mountain valleys are formed either by flowing water or flowing ice, both of which erode the land under them. Streams and rivers carry away weathered rock. Young streams move very rapidly. They cut a deep groove with steep sides in the land. So the mountain valleys they carve are V-shaped.

On the other hand, glaciers are very heavy. They move very slowly. As they move, they rub against the ground. They pick up and push along small rocks as well as boulders the size of cars. These rocks and boulders get deposited at the sides and end of the glacier. Because a glacier has a rounded bottom, it carves out a rounded, U-shaped valley.

What Do You Think?

Looking to the Future: How do human activities change the land?

People perform activities that can change Earth's landforms. For example, people may cut down trees or even entire forests. The forests are cut down to provide lumber to build such things as houses and furniture. However, while they were growing, the trees protected and stabilized the land. Their roots kept rich soil from washing away during heavy rains. Without the trees, the hills may become barren. They become creased with gullies, or small valleys. Plants have difficulty growing. Animals that made their homes in the forest must move to new homes or die out.





However, people are also finding ways to preserve forestland. One way is to stop cutting down all the old trees in the forest. When people come in to log most of the forest, they can leave some old trees behind. Another way is to quickly plant new trees where the old ones have been cut down. These types of actions can help preserve the land. The forests will grow back, and animals will keep their homes.

What do you know?

Landforms are made by different processes, or natural forces. The table on the next pages shows a number of landforms. In the cell beside each landform, write the primary natural force most likely responsible for forming that landform. Be sure to explain your reasoning for each answer.

Natural Forces	
<ul style="list-style-type: none">• Slowly moving glacier• Slowly flowing river• Weathering	<ul style="list-style-type: none">• Slowly moving air (wind)• Quickly flowing river• Erosion• Deposition

What Do You Think?

Landform	Which Natural Force Formed It? How?
 A photograph of rolling sand dunes in a desert landscape under a clear blue sky. The dunes are a vibrant orange-brown color.	
 A photograph of a lush green valley between steep, forested mountains. A river flows through the center of the valley, and snow-capped peaks are visible in the distance under a blue sky with light clouds.	
 A photograph of a wide, deep canyon with layered rock formations. The scene is captured during sunset or sunrise, with a purple and orange sky.	
 An aerial photograph of a winding river flowing through a wide, flat valley. The river is a dark blue line, and the surrounding land is a mix of green and brown, suggesting a mix of vegetation and soil.	

Landforms Close to Home

To help students learn more about how Earth's land changes over time, take them to an area near your community where the land has changed over a short or long period of time. The area may relate directly to the topics introduced and discussed above—that is, it may contain canyons, deltas, sand dunes, or mountain valleys. However, it may relate simply to an effect of wind, flowing water, or ice on the land.

For example, if you live in a farming area, you might have students investigate how the land is affected by windbreaks, terraced farming, or the like. If you live in a coastal area, you might have students investigate the effects of wind, waves, and tides on the beach or in wetlands habitats. If you live in an urban area, local parks might provide examples of how weathering and erosion have affected the land or how conservation methods have preserved it. An empty lot where construction workers are laying new soil might provide an opportunity to see erosion after a rain shower. Any area affected by wind or water works well for this activity.

Here are some questions to discuss with students:

- How has this area of land changed over time?
- What caused the changes?
- How have these changes affected living things?