

## Section 4

# Erosion and Deposition by Mass Movement

**Key Concept** Gravity causes material to move downslope in a process called *mass movement*.

### What You Will Learn

- The angle of repose determines whether mass movement will happen.
- Gravity causes rock falls, landslides, mudflows, and creep.

### Why It Matters

Mass movements destroy property and homes. They can destroy wildlife habitats by carrying away plants and animals or by burying a habitat.

---

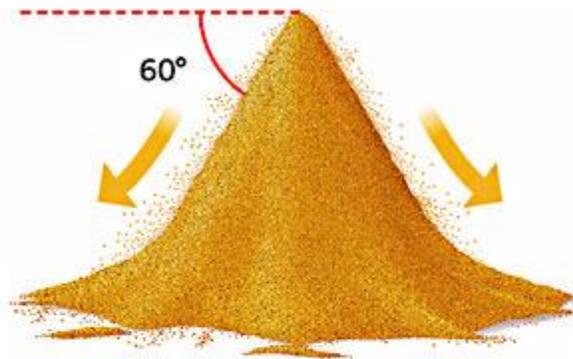
Although you can't see it, the force of gravity is an agent of erosion and deposition. Gravity not only influences water and ice movement but also causes rocks and soil to move downslope. **Mass movement** is the movement of any material, such as rock, soil, or snow, downslope. Mass movement, whether rapid or slow, plays a major role in shaping Earth's surface.

### Angle of Repose

In a dry sand pile, sand in the pile moves downhill until the slope of the pile becomes stable, or unchanging. The *angle of repose* is the steepest angle, or slope, at which loose material no longer moves downslope. The angle of repose is demonstrated in **Figure 1**. The angle of repose varies with the type of surface material. Characteristics, such as size, weight, shape, and moisture level, of the material on the surface determine the angle of repose. If the slope of surface material is greater than the angle of repose, mass movement occurs.

#### Figure 1 Angle of Repose

Sand moves downhill because the slope of the sand pile is steeper than the pile's angle of repose.



The slope of the sand pile has reached the angle of repose, so the sand pile is stable.



## Rapid Mass Movement

The most destructive mass movements happen suddenly and rapidly. Rapid mass movement can be very dangerous and can destroy everything in its path.

### Rock Falls

While traveling along a mountain road, you may have noticed signs along the road that warn of falling rocks. A [rock fall](#) happens when loose rocks fall down a steep slope. Steep slopes sometimes form when a road is built through mountainous areas. Loosened and exposed rocks above the road tend to fall as a result of gravity. The rocks in a rock fall can range in size from small fragments to large boulders.

### Landslides

Another kind of rapid mass movement is a landslide. A [landslide](#) is the sudden and rapid movement of a large amount of material

downslope. Landslides can carry away plants and animals or bury their habitats. A *slump*, shown in **Figure 2**, is the most common kind of landslide. Slumping occurs when a block of material moves downslope over a curved surface. Heavy rains, deforestation, construction on unstable slopes, and earthquakes increase the chance that a landslide will happen.



**Figure 2** This landslide occurred in La Conchita, California, in the spring of 1995.

**Standards Check** How can a landslide affect wildlife habitats?

□

---



### Mudflows

A rapid movement of a large mass of mud is a [mudflow](#). Mudflows happen when a large amount of water mixes with soil and rock. The water causes the slippery mass of mud to flow rapidly downslope. Mudflows commonly happen in mountainous regions when a long dry season is followed by heavy rains. Deforestation and the removal of ground cover often result in devastating mudflows. As shown in **Figure 3**, a mudflow can carry trees, houses, cars, and other objects that lie in its path.

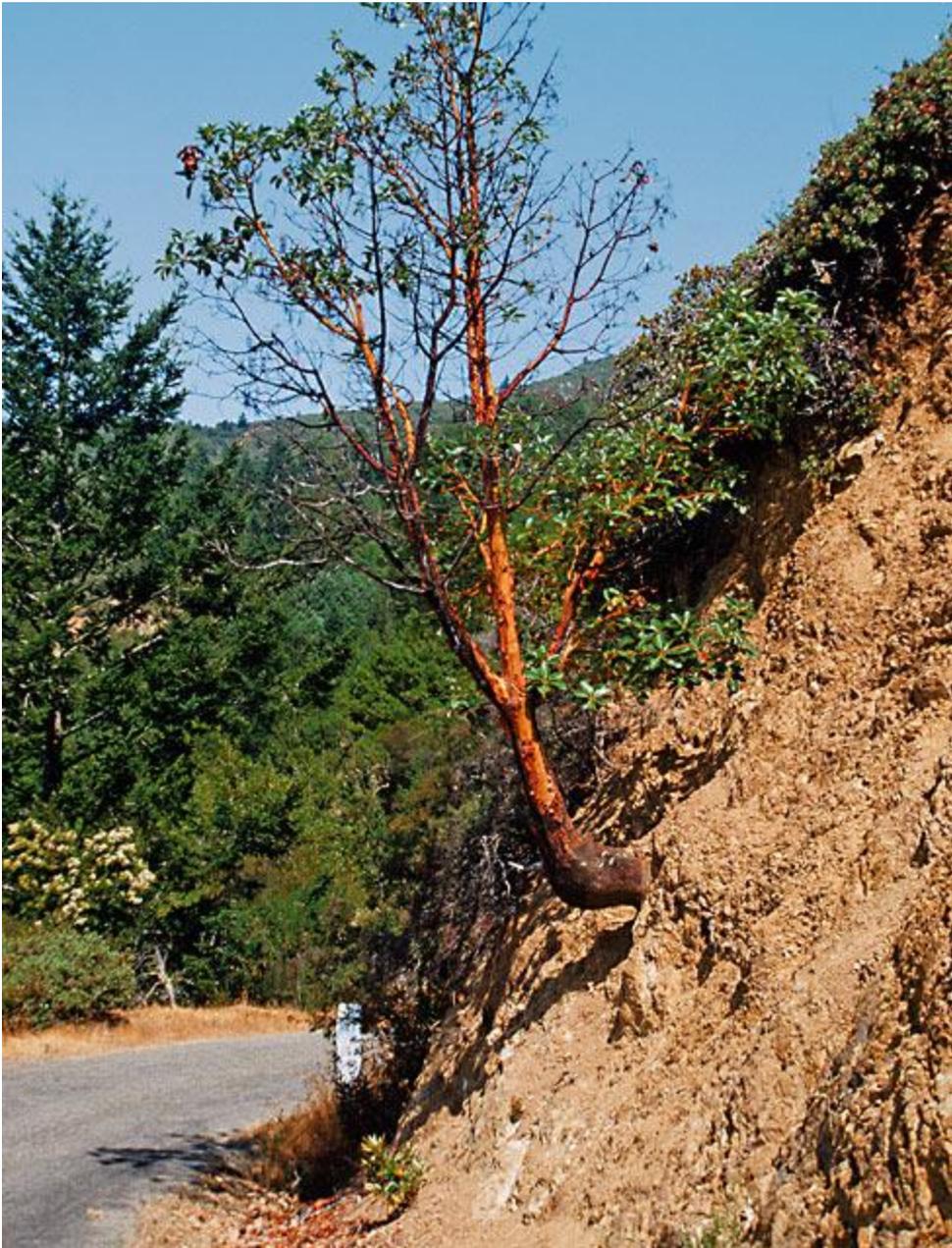


**Figure 3** This photo shows one of the many mudflows that have occurred in California during rainy winters.

### Creep

Even though most slopes appear to be stable, they are actually undergoing slow mass movement. In fact, the ground beneath the tree in **Figure 4** moved so slowly that the tree trunk curved as the tree grew. The extremely slow movement of material downslope is called [creep](#). Many factors contribute to creep. Water loosens soil and allows the soil to move freely. In addition, plant roots act as wedges that force rocks and soil particles apart. Burrowing animals, such as gophers and groundhogs, also loosen rock and soil particles. In fact, all rock and soil

on slopes travel slowly downhill.



**Figure 4** The shape of this tree trunk indicates that creep has occurred along the slope.



## Mass Movement and Land Use

Mass movement is one factor that must be considered when officials decide how to use land. These officials must determine whether an area is safe for certain uses. If they choose poorly, lives may be lost and property may be damaged when humans get in the way of these powerful natural processes.

Construction in areas that are at risk of natural disasters can be hard to avoid. Land-use decisions should be made after considering many factors, including scientific evidence, to predict mass movement's local impacts. When officials know the likelihood of mass movement, they can take steps to reduce predicted effects.

The effects of major mass movement events are usually unfavorable in the short term. But sometimes, the long-term effects can be beneficial. For example, a landslide may allow fresh minerals to be exposed at the surface. These minerals may then be mined or may break down to form soil.

**Standards Check** Why must city planners determine the risk of mass movement when deciding how to use land?



## Section Summary

- Gravity causes rocks and soil to move downslope.
- If the slope on which material rests is greater than the angle of repose, mass movement will occur.
- Four types of mass movement are rock falls, landslides, mudflows, and creep.
- Landslides may destroy buildings and change wildlife habitats.



# Chapter Summary

## The Big Idea

Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment.

---

## Section 1 Shoreline Erosion and Deposition

**Key Concept** Beaches and shorelines are shaped largely by the action of ocean waves.

- Energy from waves crashing against rocks affects shorelines.
- Shoreline features are created by wave erosion.
- Waves deposit sediment at the shore to form beaches.



Waves erode and deposit sediment along shorelines.

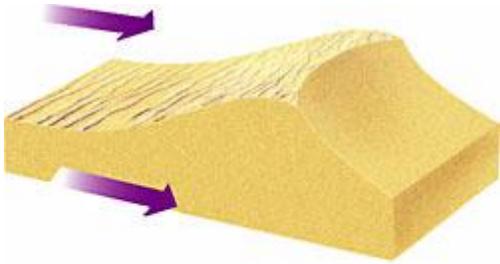
---

## Section 2 Wind Erosion and Deposition

**Key Concept** Wind can cause erosion and can move and deposit sediment.

- Wind erosion happens through saltation, deflation, and abrasion.
- Wind can erode and deposit differing amounts

and sizes of material, depending on the wind speed.



Wind deposits sediment to form dunes.

---

### Section 3

## Erosion and Deposition by Ice

**Key Concept** Glaciers shape Earth's surface by moving rock and sediment.

- As glaciers move, they form a variety of landforms by removing rock and soil
- Glaciers deposit rock material when they melt or retreat.



Alpine glaciers shape the landscape in mountain areas.

---

### Section 4

## Erosion and Deposition by Mass

## Movement

**Key Concept** Gravity causes material to move downslope in a process called *mass movement*.

- The angle of repose determines whether mass movement will happen.
- Gravity causes rock falls, landslides, mudflows, and creep.



Landslides are rapid mass movements.