

Landslides

Geologic forces that carve the land are often called "erosion." But geologists tend to save that term for the quiet physical and chemical work that breaks down or dissolves solid rock and carries it away piecemeal, in groundwater or glaciers but mostly in streams. For land sculpting on the large scale, what moves sediment in big masses is gravity. Various kinds of landslides do that work, and geologists discuss them under the name **mass wasting**.

Landslide Mechanisms

Mass wasting affects every place on Earth that isn't dead flat. Its most common form is soil **creep**, which moves the material on a slope downhill a centimeter or two per year. You'll notice it where old fences have become tilted in the downhill direction. Construction projects on hillsides must take soil creep into account to avoid disruption as time passes.

Soil creep is the result of shallow, seasonal changes in a slope. The most important of these are expansion and contraction due to temperature, wet and dry seasons, and freezing and thawing.

Three agents—groundwater, earthquakes and changes to the slope—can trigger more deep-seated ground movements called **landslides**. These three mechanisms work by giving gravity extra help:

1. A little groundwater actually makes soil stronger: a thin water layer between soil grains holds them together by the force of its surface tension. But too much water fills up all the pore space, and at that point excess groundwater moving downslope adds to the pore pressure beneath it, which acts to lift up and weaken the slope.
2. Vibrations from earthquakes add directly to gravity and help it overcome the strength of the ground. Indirectly, vibrations (even from vehicles or pile-driving) can unsettle the soil and add to pore water pressures.
3. Operations that steepen slopes at the base (like river erosion or artificial excavations) or load slopes at the top (like sediment deposition or building structures) give gravity direct help. Changes that affect drainage can increase the input of water into a slope. Either way, these natural and human actions can raise the odds of failure.

The word "landslide" isn't precise enough for geologists—they have names for many kinds of landslide. Here are the most common types. See some pictures of them in the [Gallery of Landslides](#).

Rockfalls and Rockslides

Rockfalls are a serious hazard in places like California's Yosemite Valley, where the valley walls are steep and the rock is old. They're just what you would think—masses of bedrock that come loose and crash to the ground below. A few years ago a big rockfall struck the Happy Isles area

of Yosemite, with some unusual effects. For one thing, the falling rock struck the valley floor and pushed aside the air there, which rushed outward at hurricane speed. That air blast knocked down trees over a large area. For another thing, the force of the rockfall was enough to set seismographs jiggling far away.

Rockslides are slightly slower and more organized than rockfalls—masses of broken rock moving together down a slope or a chute, not tumbling down in pieces.

Slumps

Slumps are shaped like the mark you would make if you sat on the side of a dirt pile. Small slumps are common in roadcuts, but they can also be huge. The most common cause of slumps is excess water in the ground, whether from heavy rains or from human activities that affect the drainage. Slumps sound like something slow and quiet, but they can be just as catastrophic as anything else out there. The gigantic Heart Mountain slide in prehistoric Wyoming may have been a slump.

Earth flows, Mudflows and Debris Flows

Slides with "flow" in their names move as a thick, viscous fluid. Earthflows consist of soil and weathered rock, thus they tend to be shallow and gentle. Their toes typically form lobes. With more fluid, they grade into mudflows.

Debris flows range from slow creeping movements to the very largest, nastiest landslides. They consist of mixed-sized stuff from boulders to dust (debris). They can be dry or wet, or even frozen (when they're usually called avalanches), and can flow at great speed and for scary distances. A debris flow killed 20,000 people in Peru in 1970. The outpouring from the 1980 eruption of Mount St. Helens, a fearsome volcanic soufflé that wiped out a large tract of land, was a debris flow. A far bigger debris flow, blanketing the whole northern end of California's Shasta Valley, swept down from Mount Shasta some 300,000 years ago.

Lahars

Lahars are mudflows or debris flows that occur on volcanoes, where large amounts of fine ash or crumbling, rotten rock pile up on steep slopes. Rains, or melted ice from the mountaintop, mix with this stuff and create a lethal muck that can choke a whole river valley. Lahars can be so large that after a century or so, whole cities can be built on their forested tops without anyone realizing that another lahar could arrive to wipe them out. For instance, the suburbs of Seattle lie on a gigantic lahar called the Osceola Mudflow, far from its origin on Mount Rainier.

Mass wasting in all its forms seems to be pure trouble for humanity. But without it, nothing would sculpt our canyons, our hillsides and our mountains. Mass wasting keeps the Earth fresh and beautiful.

PS: As mass wasting is not mentioned in the Bible, creationists are handicapped when they consider the Grand Canyon. All they can come up with from scripture is Noah's flood. Thus we get the tortured logic of creationist books, trying to make the totally different situation in the Middle East apply to Arizona, where mass wasting is the only explanation that fits our understanding of real rocks.