

Student Ideas about Earth’s Changing Surface

Common student idea	Scientific explanation
Landforms	
Trees, flowers, and grass are landforms because they grow out of the land.	Trees and grass are living organisms that need the land to grow. They use the land to anchor themselves and absorb nutrients from the soil. They are “on” the land, and not land itself. Further, grasslands are often confused with landform called plains. Grasslands (also called prairies) are large tracts of land with the dominant vegetation being grasses. Plains are the landform to describe a large area of flat land. Plains are often covered with grass (hence the confusion of the terms), but can also be found with desert or tundra vegetation..
Landforms, like islands, float on the ocean.	The land beneath the ocean is a varied landscape of plains, mountains, canyons, and more. Sometimes the mountains, usually volcanic, rise above the surface of the ocean and form islands that are visible from above the water. Because we cannot see the mountain below the surface of the water, it can appear that islands are piece of land on top of water. These islands can change shape over time as waves and wind begin to break down the rock that is above the surface of the water.
Mountains are built up over time by new layers of rock and soil being stacked on top of one another.	Mountains are formed when tectonic plates collide and push the land up into mountains. The plate collisions along a subduction zone (a continental plate colliding with an oceanic plate) often cause volcanic mountain chains such as the Andes or Cascade Mountains. Other plate collisions (between two continental plates) cause uplift when the land collides and pushes upwards forming mountains. A good example of this is the Himalayas.
Tall mountains are older mountains.	Shape and height alone cannot be used to determine the age of a mountain. Mountain ranges are built by the movement of tectonic plates and torn down by the processes of weathering and erosion. The rate of erosion and weathering depends on factors such as the amount of rainfall an area gets, cycles of freezing and thawing, rock makeup, vegetation, and slope.
Landforms are the same today as they have always been.	Landforms are always changing. Sometimes the change is very slow or gradual and happens over long periods of time. Other times the change happens very quickly. Earth’s surface is continually building up and wearing down through geologic and climatic processes.
Changes on Earth’s Surface	
Students view the world as always having looked as it does now, or that any changes that have occurred must have been sudden and comprehensive.	Earth’s surface is continually changing. The speed with which it changes varies depending on the processes and forces involved. The speed can range from abrupt to very slow, and combinations of both types of actions shape Earth’s surface.

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<p>Students have a difficult time imagining that Earth’s surface will undergo radical changes. Except for a few volcanoes erupting and a few big earthquakes happening, Earth’s surface will not change that much in the future.</p>	<p>Whereas students grasp the immediate impacts of observable events such as volcanoes and earthquakes, scientists pay attention to events and processes acting on Earth’s surface that are not observable over short time periods, such as the effects of erosion and weathering over thousands of years or the result of slow-moving tectonic plates over millions of years. It is these unobservable mechanisms that explain most of the landforms that exist on Earth today and that scientists use to predict changes to Earth’s surface in the future.</p>
<p>Rocks do not change.</p>	<p>Rocks, a component of Earth’s landscape, also change with varying speed. Through the process of weathering, large blocks of rock material are broken apart into smaller pieces, becoming pebbles, sand, and silt. When these rock bits are moved by wind, water, or glaciers and are deposited and buried, compacted, and cemented together, they can become sedimentary rock. When rocks are buried deep under layers of rock, if there is enough heat and pressure to cause a change in their chemical makeup, they can become metamorphic rock. Through tectonic movement, some rock material gets driven down into lower levels of the lithosphere (Earth’s surface layer) and melts into magma, which can eventually cool and harden to form igneous rock.</p>
<p>Rocks break, or shrink, because they get old.</p>	<p>Rocks are broken apart into smaller rocks and, eventually, sand or silt through the processes of physical and chemical weathering.</p>
<p>Water Changing Earth’s Surface</p>	
<p>Water is not strong enough to move rock or form a canyon. Something else, such as an earthquake, cracked the land open and then the river started to flow in the canyon.</p>	<p>Water can change the surface of the Earth in subtle and drastic ways over time. Sometimes change can happen fast, such as during a flood or major rain event. Water can wash away large portions of land or cut new channels into the land. However, water usually changes the land much more slow ways over millions of years. For example, the Grand Canyon was carved by a river over millions of years. Water slowly dissolves rock into smaller fragments and then moves the finer fragments from one place to another over time.</p>
<p>Water dissolved rock and it disappears.</p>	<p>Water does dissolve rock, but it does not “disappear”; rather, the rock is broken into finer pieces that are transported from one place to another. For example, over time rock in a river bed is broken down and the smaller pieces of rock are carried to the river delta or ocean floor.</p>
<p>Water only changes Earth’s surface during a flood.</p>	<p>Erosion happens at differing rates depending upon the material being moved and the force moving the material. Landslides and tsunamis may result in fast changes in Earth’s surface, while other examples of erosion, such as the carving of the Grand Canyon, take place over much longer time periods.</p>

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Rivers flow through valleys (they do not make the valleys).	Rivers change the land that they flow through. When there is a large difference in elevation from one point of the river to another, the water flow is swift and the river cuts a deep channel. When a river passes through a landscape that has less of a slope, the water flows more slowly and the cutting action of the river is slowed or stops altogether. In this case, the river erodes the banks, widening the river and smoothing over the waterfalls.
Most rivers flow “down” from north to south.	Rivers flow “down” from higher elevations to lower elevations without regard to the compass direction of north, south, east or west.