Common Student Ideas about Earth's Changing Surface

	Common Student Idea(s)	Scientific Explanation
Landforms	Trees, flowers, and grass are landforms because they grow out of the land.	Trees and grass grow on the land, but they aren't landforms. They're living organisms that need the land to live and grow. They anchor themselves to the land and absorb nutrients from the soil. Grasslands (also called *prairies*) are large tracts of land in which grass is the dominant vegetation. Grasslands are often confused with landforms called *plains*. A plain is a large area of flat land. Plains are often covered with grass (hence the confusion with grasslands), but they may also be covered with desert or tundra vegetation.
	Landforms, like islands, float on the ocean.	Landforms don't float on top of the ocean. The land beneath the ocean is comprised of various landforms, including plains, mountains, and canyons. Sometimes, mountains under the ocean, many of which are volcanic, rise above the surface and form islands. Because undersea mountains aren't visible, it can seem as if islands are landforms floating on top of the water, but that isn't the case. Islands change shape over time as waves and wind break down the rock jutting above the ocean surface.
	Mountains are built up over time as layers of rock and soil are stacked on top of each other.	Mountains are formed when interlocking sections of Earth's crust, called *tectonic plates*, collide and push the land upward. Plate collisions along a *subduction zone* (a continental plate colliding with an oceanic plate) often form volcanic mountain chains, such as the Andes or Cascade Mountains. When two continental plates collide, they cause *uplift*, pushing the land upward to form mountains. A good example of this type of mountain building is the Himalayan Mountains.
	Tall mountains are older mountains.	The age of a mountain can't be determined from height (or shape) alone. The movement of tectonic plates and the processes of weathering and erosion are continually building up and tearing down mountain ranges. The rate of erosion and weathering depends on such factors as the amount of rainfall an area gets, cycles of freezing and thawing, rock makeup, vegetation, and the slope the land.
	Landforms are the same today as they've always been.	Landforms are always changing. Sometimes they change gradually over long periods of time, and at other times, changes may take place very quickly. Earth's surface is continually being built up and worn down through geologic and climatic processes.

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Changes to Earth's Surface	The world has always looked the way it does now. OR Any changes to Earth's surface have happened quickly and all at once.	Earth's surface is continually changing. The speed at which it changes varies depending on the processes and forces involved. The speed of change can range from abrupt to very slow, and combinations of both types of actions shape Earth's surface.
	Except for a few volcanoes erupting and a few big earthquakes happening, Earth's surface won't change that much in the future. *[Students have a difficult time imagining that Earth's surface undergoes radical changes.]*	Whereas students grasp the immediate impacts of observable events like volcanic eruptions and earthquakes, scientists pay attention to events and processes acting on Earth's surface that aren't observable over short time periods, such as the effects of erosion and weathering over thousands of years or the results of tectonic-plate movement over millions of years. These unobservable mechanisms explain most of the landforms that exist on Earth today, and scientists use them to predict future changes to Earth's surface.
	Rocks don't change.	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 that become pebbles, sand, and silt. When wind, water, or glaciers move these rock bits and they're deposited, buried, compacted, and cemented together, they can become *sedimentary rock*. When layers of rock are buried deep under other layers of rock, if there's enough heat and pressure to cause a change in their chemical makeup, they can become *metamorphic rock*. Through tectonic movement, some rock material is driven into lower levels of the lithosphere (Earth's surface layer) and melts into magma, which can eventually cool and harden to form *igneous rock*.
	Rocks break, or shrink, because they get old.	Rocks don't break or shrink because of age. The processes of physical and chemical weathering cause them to break apart into smaller rocks over time and eventually break down further into sand or silt.
Water Changing Earth's Surface	Water isn't strong enough to move rock or form a canyon. Something else, like an earthquake, cracks the land open, and then a river starts to flow in a canyon.	Water can change the surface of Earth in subtle and drastic ways over time. Sometimes change can happen quickly or suddenly, such as during a flood or a 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 slowly over long periods of time as water dissolves rock into smaller fragments and then moves these fragments from one place to another. One example is the Grand Canyon, which the Colorado River gradually carved out over millions of years.
	Water dissolves rock, and the rock disappears.	While water does dissolve rock, it doesn't cause rock to disappear. Rather, rock is broken into smaller fragments that are transported from one place to another. For example, as rock in a riverbed is broken down over time, smaller pieces are carried away and deposited in a river delta or on the ocean floor.

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Water Changing Earth's Surface	Water only changes Earth's surface during a flood.	Erosion happens at varying rates depending on the material being moved and the force moving it. Floods, landslides, and tsunamis can change Earth's surface quickly and suddenly, while other types of erosion take place over much longer periods of time, such as the gradual carving action of a river that formed the Grand Canyon.
	Rivers flow through valleys; they don't form valleys.	Rivers change the land they flow through. When elevation varies significantly from one point in a river to another and the slope is steep, swift-flowing water cuts a deep channel in the land. When there is less of a slope, the water flows more slowly, and the cutting action of the river is reduced or eliminated. In this case, the water erodes the banks, widening the river and smoothing over the waterfalls.
	Most rivers flow from north to south.	Rivers flow from higher elevations to lower elevations without regard to compass direction (north, south, east or west).