CALIFORNIA Standards Preview

Standard Set 5. Earth Sciences

5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:

5.a. *Students know* some changes in the earth are due to slow processes, such as erosion, and some are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

5.b. *Students know* natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

5.c. *Students know* moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weather, transport, and deposition).

Genre	Comprehension Skill	Text Features	Science Content
Nonfiction	Sequence	• Captions • Labels • Diagrams • Glossary	Earth's Surface

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California Science

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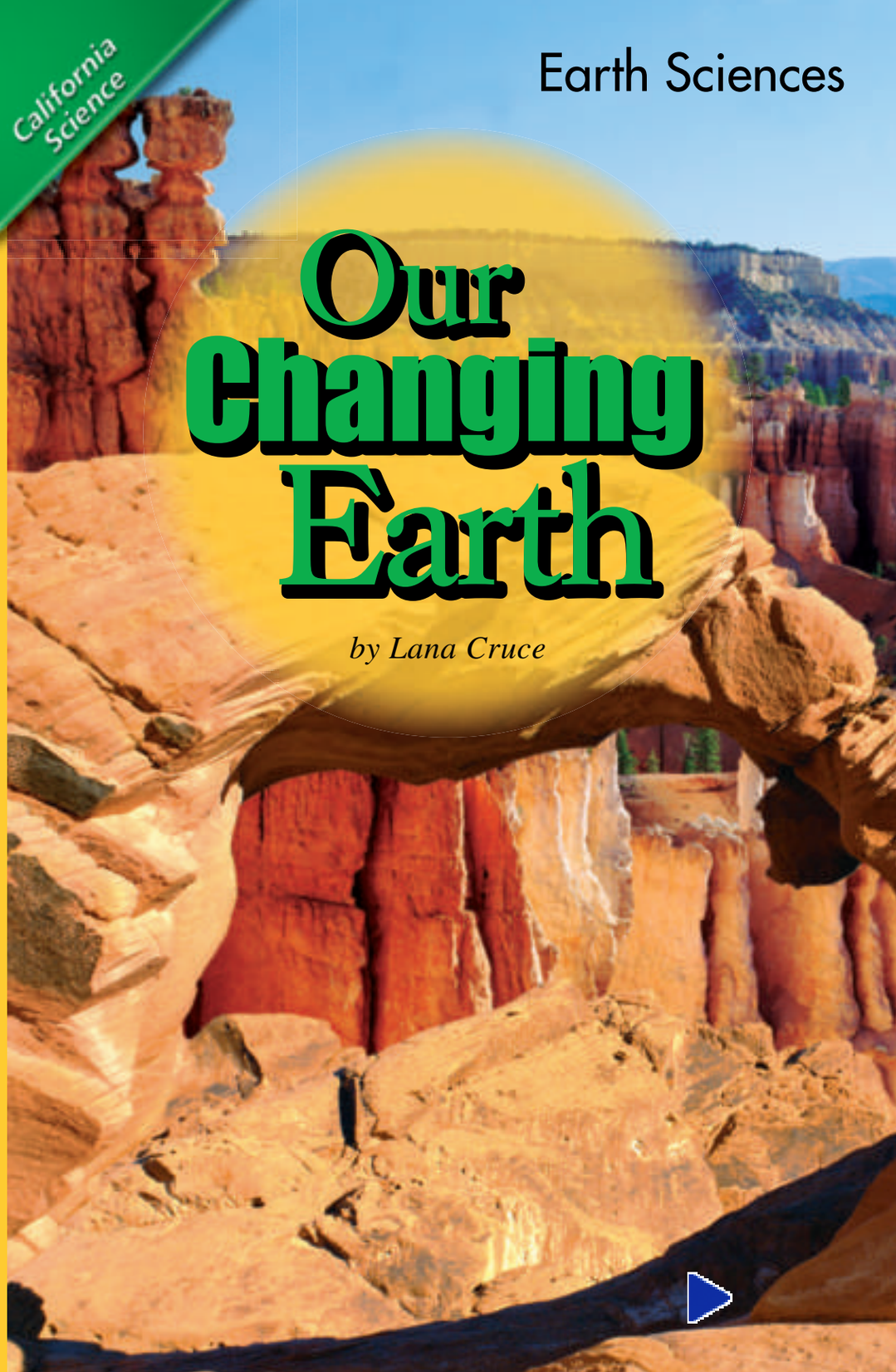
Earth Sciences

Our Changing Earth

by Lana Cruce



Vocabulary

deposition
earthquake
erosion
fault
landform
landslide
soil
transport
volcano
weathering

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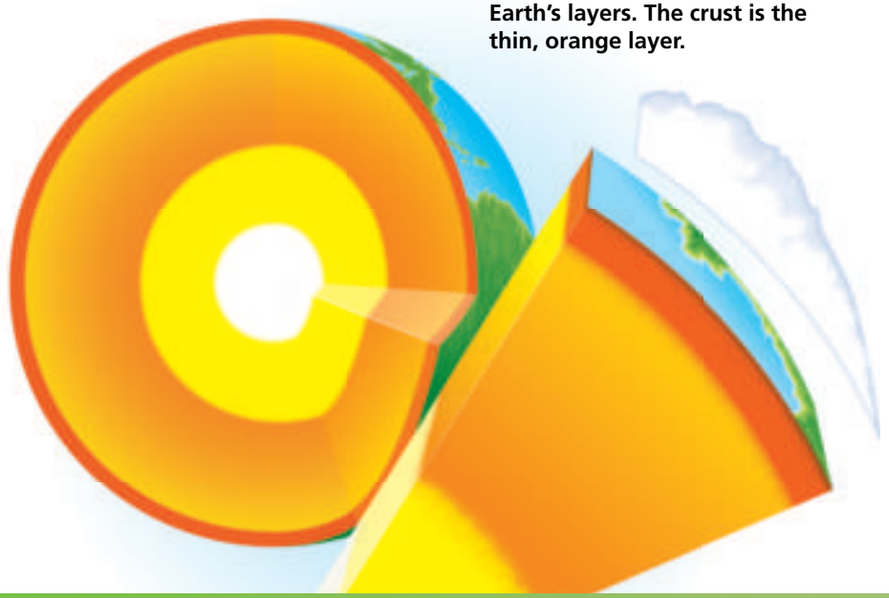
Scott Foresman

Earth's Surface

Earth's outer surface is covered by a layer of rock called the crust. This layer covers all of Earth–even the ocean floor. Ocean crust is made up mostly of basalt. The crust under the continents is mostly granite.

The crust takes on many different shapes and sizes. Sometimes it forms rolling hills. Many other natural features, or **landforms,** cover Earth's surface. Mountains, cliffs, coves, and caves are all landforms.

Some landforms are formed quickly. Others take a long time to form. A stream may take many years to form a gully. But an earthquake can create a crack in the Earth in seconds. What do you think happens to the soil carried away by a flood? What about dust that gets blown into the air by wind?



This cutaway diagram shows Earth's layers. The crust is the thin, orange layer.

Chemical Weathering

Landforms are always changing. They change when their rocks are broken. **Weathering** is the process that breaks rocks in Earth's crust into smaller pieces. It is caused by water, ice, temperature changes, chemicals, and living things.

Chemical weathering happens when chemicals cause rocks to change into different materials. The new materials can then break down into smaller pieces. This happens when oxygen, carbon dioxide, and water mix with other things. For example, when iron combines with oxygen in the air, it forms rust. You may have seen soil that is colored red. Such soils can form when iron is chemically weathered.

Water and heat speed chemical weathering. Rainy places have more chemical weathering than dry places. Warm places have more chemical weathering than cold places.

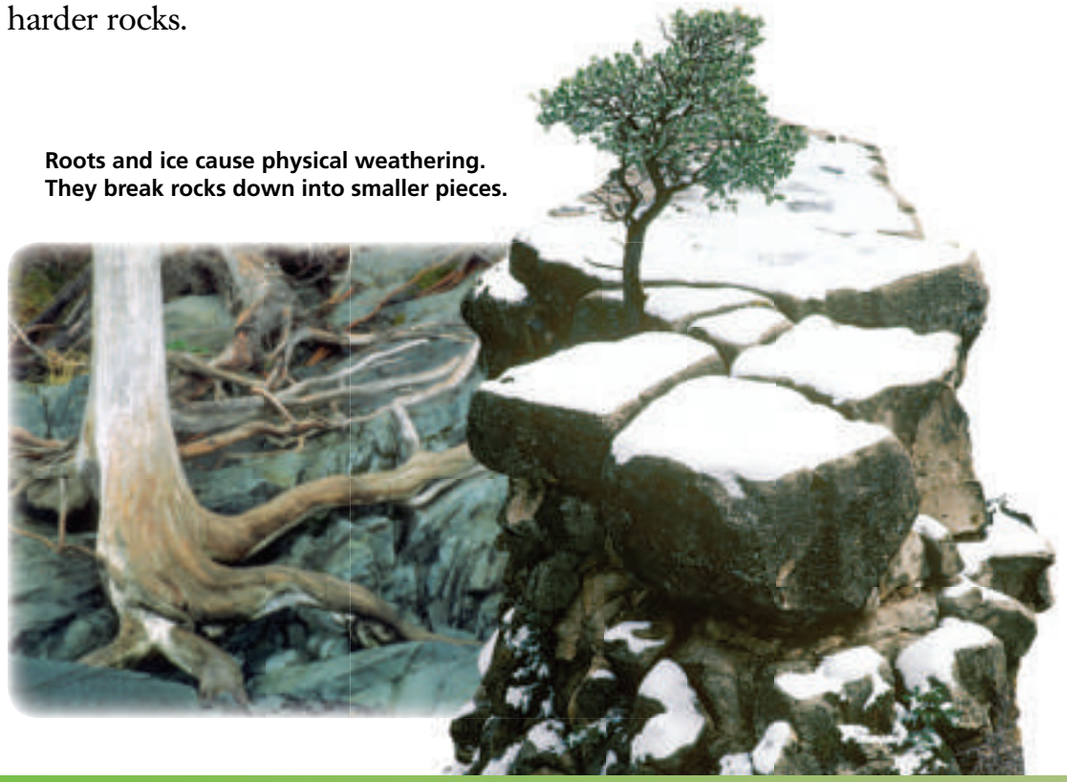
Chemical weathering turned the smokestacks (below) and the steering wheel (right) red.

Physical Weathering

Physical weathering, like chemical weathering, breaks rocks down into smaller pieces. But unlike chemical weathering, physical weathering does not change the rocks into new materials. The rocks just change size. Plants, ice, and water all cause physical weathering. Rock weathers faster when different forces that cause physical weathering are working at the same time.

You might have seen a tree root forming cracks in the sidewalk by pushing it up. Plants can also grow in tiny cracks in rocks. The rocks are split apart as the plant's roots grow and expand. Roots can break apart softer rocks faster than harder rocks.

Roots and ice cause physical weathering. They break rocks down into smaller pieces.



Have you ever been someplace cold and noticed lots of cracks in the roads? Water expands when it freezes. When it freezes in cracks in the road, the ice pushes against the sides of the cracks. This makes the cracks deeper and wider.

The same thing happens with rocks. Each time water freezes and thaws inside of a rock, the cracks in it get a little bit bigger. After a while, the rock will break apart.

Glaciers are another form of ice that can cause physical weathering. Glaciers are large sheets of ice. They move very slowly over land. As a glacier moves, it pulls rocks with it. The rocks scrape across the ground. This creates valleys and ridges. It also breaks the rocks into smaller pieces.

Glaciers scrape across the ground as they move. They form new landforms and break down rocks.

Weathering Caused by Water

Water played a major role in carving out the Grand Canyon. It is an important cause of physical weathering. The water flowing in rivers and streams changes landforms. The rocks and sediments carried by the moving water scrape against the rocky riverbed. This slowly wears away the rock. In time, the water carves out valleys and canyons.

Moving water also shapes landforms along coasts. Waves hit the rocky coast over and over. This slowly but steadily carves away the rocks. Waves also drag sand away from some beaches. They add sand to other beaches.

Water physically weathered the Grand Canyon. It carved out the incredible landforms that you see.

Physical Weathering and Soil

Physical weathering breaks rocks into tiny pieces over time. These small pieces are what make up soil. **Soil** is the thin layer of loose, weathered material that covers most of the land surface of Earth.

Sand, silt, and clay make up most soil. Humus, or decaying plant and animal matter, is also a part of soil. Water and air fill in the tiny spaces between the bits of sand, silt, clay, and humus. Soil in different places has different amounts of sand, silt, clay, and humus. Different types of plants grow well or poorly depending on the amount of sand, silt, clay, and humus in the soil.

Other Weathering

When one type of rock is harder than the other, the wind will physically weather the softer rock first. The harder rock that stays in larger pieces forms buttes, mesas, and other landforms.

Smaller pieces of weathered rock can be moved by wind. The wind can pick up tiny pieces of sand, soil, or dust. These pieces scrape against rocks as they are being blown by the wind. This breaks off other bits of rock. Then the new bits are blown away.

Wind weathers the softer rock in this area. Buttes and mesas form from the harder rock.

Weathering can also happen in open places. Topsoil is the top layer of soil. It is the best soil for growing crops, but it can be weathered in a number of ways. Wind can carry away topsoil that has been made dry by a lack of rain. It can also carry away topsoil that has been broken up by the harvesting of crops. And water that has flooded steep hillsides can also carry away topsoil. As easily as topsoil can be weathered, it takes a long time to replace.

Waves and flowing water break larger rocks down into smaller rocks. Pieces of rock, soil, and sand are taken away by the water. They rub against each other and other rock, making them smaller and smaller. Eventually, the water and the wind may put these pieces down somewhere else.

These ocean waves weather larger rocks. They carry smaller rocks from place to place.

Erosion and Transport Of Weathered Material

Where do small pieces of rock go after they have been weathered? Sometimes they stay in the same place. But other times they are picked up and moved to other places. **Erosion** is the movement of weathered materials. Erosion is caused by water, wind, gravity, glaciers, and living things.

Water often carries, or **transports,** weathered materials from one place to another. As rainwater flows into rivers, it takes small bits of rock with it. The rivers carry rock downstream. Some of the rock may settle if the rivers flow slower. Rivers can carry bits of rock and soil all the way to the ocean. This can make a new landform. Moving water is an important force in transporting weathered materials.

Erosion formed the cut in this rock. Water transports weathered materials from the rock.

Materials can also be transported by wind and gravity. Dry sand and soil can be blown to new places by wind. Gravity moves rocks and soil downhill. The steeper the slope is, the quicker the rocks and soil will move.

Living things also move soil. A mole tunneling through the ground pushes soil around. Insects mix soil as they move through it. When plant roots grow through the soil, they push it away. The spaces the larger roots leave behind can get filled up by air and water.

These insects transport soil as they move through it.

Transporting and Depositing Materials

As you know, wind and water can transport pieces of rock and soil from one place to another. This wears down some parts of Earth's surface and builds up other parts. **Deposition** is the laying down of pieces of rock and soil. Deposition can happen very slowly or very quickly.

When moving water slows down, the largest pieces of rock settle to the bottom first. Smaller pieces, such as sand, sink next. Finally, the smallest bits of silt and clay sink. When sediments settle out at a river mouth, a delta forms.

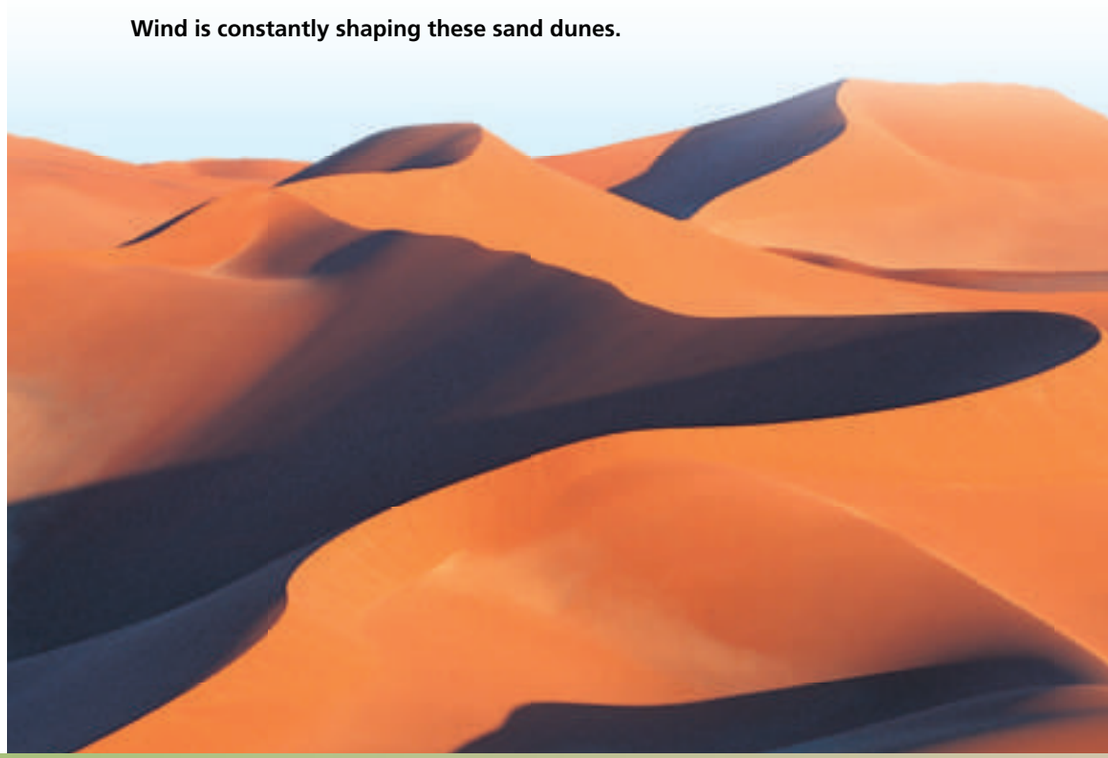
Ocean currents can also bring sand from place to place. This can sometimes make islands of sand near coastlines. But even the islands can be moved from place to place by erosion!

Deposition created this long, sandy island. Erosion and transport may reshape the island.

Small particles can be eroded, transported, and deposited by wind as well. Wind can deposit silt and clay. This forms a layer on top of the soil. Wind in the desert and other places can form sand dunes. These are large, loose piles of sand. Wind is always shaping and reshaping dunes. This is because there are few plants or other objects to block the sand from blowing.

Glaciers also transport and deposit rocks. Glaciers pick up rocks as they move. They can even pick up huge boulders. When glaciers melt, the rocks and soil they dragged along are deposited. Places that glaciers moved through have ridges of broken rocks and soil. Even small glaciers can break apart and transport large pieces of rock.

Wind is constantly shaping these sand dunes.



Landforms Changing Rapidly

Some of the changes to Earth's surface happen quickly. These changes can happen in seconds. Earthquakes, landslides, and volcanoes all cause such rapid changes.

Objects get pulled from higher places to lower places by gravity. Loose, weathered material at the top of a hill or slope is especially likely to be pulled down by gravity. Sometimes rock and soil move slowly downhill. They might only move a little at a time. But sometimes rock and soil can move very quickly. This can happen if strong rains loosen soil on a very steep slope. The rock and soil then tumble quickly downhill and form piles at the bottom.

Gravity pulled weathered material down this steep hillside.

Landslides

The rapid downhill movement of a large amount of rock and soil is a **landslide.** You know that freezing and thawing can loosen rock. Sometimes rock that is loosened in winter slides down a slope in spring.

Landslides can cause a lot of damage. They can even carry large objects with them, such as buildings, cars, and trees. Things in the path of a landslide can be buried in mud. Landslides can destroy homes, roads, and bridges. Large landslides can cover a wide area.

A landslide caused this road to collapse.

Volcanic Eruptions

Volcanoes are landforms that can change Earth's surface rapidly. They are created when molten rock, called magma, forms from melting rock at 80 to 160 kilometers below Earth's surface. The magma has gases in it that make it rise toward the surface. A volcano forms where the magma reaches the surface. This happens at a weak place in Earth's crust.

A volcano erupts when magma reaches the surface. After magma flows out of a volcano, it is called lava. Lava is still very hot. It can have temperatures of 1100°C or higher.

Differences in temperature and the kind of magma cause different kinds of eruptions. In some volcanoes, the built-up pressure causes the gases in the magma to explode. Burning hot rocks, gases, and ash spew out of the volcano's openings, or vents. Other eruptions are less violent. Sometimes, magma oozes slowly out of a volcano.

The explosion of Mount St. Helens in 1980 sent hot rocks, gases, and ash into the air.

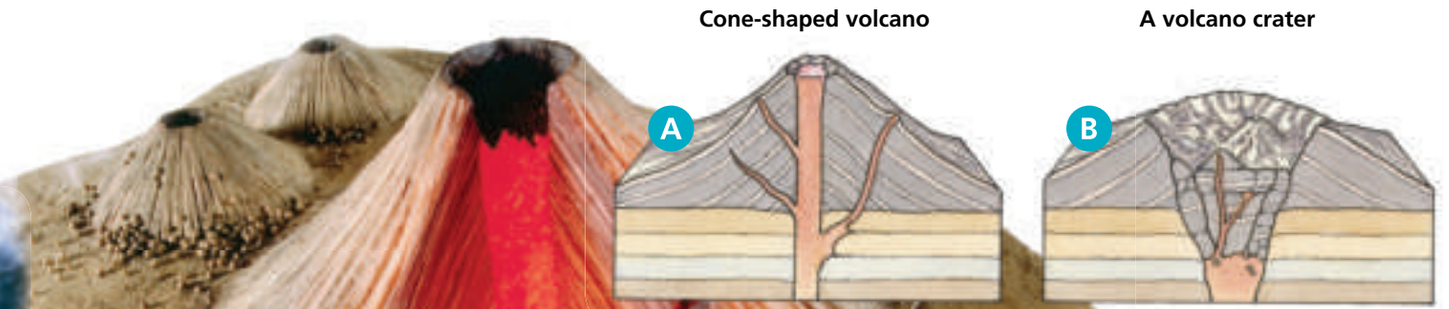
Types of Volcanoes

Most volcanoes are cone-shaped. Sometimes, a crater, or bowl-shaped area, forms around the main vent. Volcanoes can quickly change the land around them when they erupt. Lava and ash spread over a large area. This reshapes both the volcano and the land around it.

Some volcanoes are active. They erupt a lot or show signs of erupting. Hawaii's Mauna Loa is an active volcano.

A volcano is dormant if it has not erupted for a long time. Mount Shasta in California is a dormant volcano.

An extinct volcano is one scientists think will never erupt again. Tanzania's Mount Kilimanjaro is extinct.



Earthquakes' Causes and Effects

Earth's crust lies on top of another layer called the upper mantle. These two layers are split into huge pieces called plates. The plates are always moving. Most volcanoes form along or near the places where these plates meet. Earthquakes mostly happen where plates meet.

A **fault** is a break or crack in rocks where Earth's crust can move. Rocks along a fault can sometimes get stuck, even as the plates continuing moving. The plates put pressure on the rocks. This can cause the rocks to break. If this happens, the plates can move suddenly. The sudden movement that causes Earth's crust to shake is an **earthquake.**

Earthquakes cause vibrations that travel through Earth as waves. The waves move back and forth and up and down within Earth's crust. They can crack Earth's surface.

How much an earthquake changes landforms depends on how close to the surface it hits. It also depends on how long the crust shakes or moves. Earthquakes cause more damage in places with many buildings than earthquakes in places far away from any town.

Most earthquakes are very small. Other earthquakes are powerful and can cause a lot of damage. A very strong earthquake happened on the border between India and Pakistan on October 8, 2005. It destroyed many buildings and caused many deaths.

Earthquakes can cause landslides on the ocean floor or on land. Landslides that happen under the ocean can make huge waves. These waves can cause floods. As you know, landslides can destroy buildings and bury large areas of land.

This map shows three of the faults that are close to San Francisco. Earthquakes happen along these faults.

An earthquake damaged this road.

Glossary

deposition the laying down of pieces of rock and soil

earthquake a sudden movement that causes Earth's crust to shake

erosion the movement of weathered materials

fault a break or crack where Earth's crust can move

landform natural feature of Earth

landslide the rapid downhill movement of a large amount of rock and soil

soil the thin layer of loose, weathered material that covers most of the land surface of Earth

transport to carry from one place to another

volcano place on Earth's crust where magma reaches the surface

weathering the process that breaks down rocks in Earth's crust into smaller pieces

What did you learn?

1. What are some things that can change landforms?
2. List three causes of physical weathering.
3. What causes a landslide to happen?
4. **Writing in Science** Write a one-page essay about how rapid changes in landforms can affect people. Make sure to write an introduction and a conclusion, and give supporting details from the book.
5. **Sequence** Describe the sequence of events that cause a volcano to form. Also list the ways that magma can erupt.