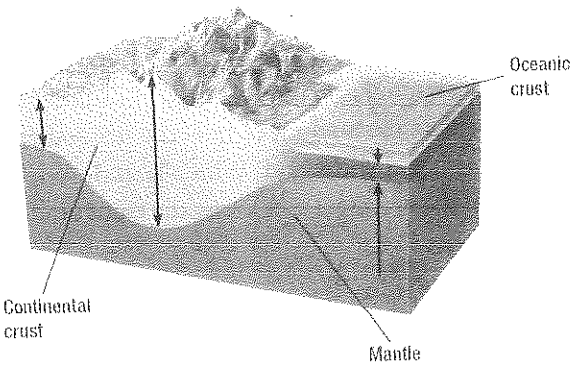
Name _____ Date _____

SC.7.E.6.1 Describe the layers of the solid Earth, including the lithosphere, the hot convecting mantle, and the dense metallic liquid and solid cores. **SC.7.E.6.5** Explore the scientific theory of plate tectonics by describing how the movement of Earth's crustal plates causes both slow and rapid changes in Earth's surface, including volcanic eruptions, earthquakes, and mountain building. **SC.7.E.6.7** Recognize that heat flow and movement of material within Earth causes earthquakes and creates mountains and ocean basins.

Earth's Layers

Inside the Earth

If you were able to cut Earth in half, you would notice that Earth is made up of several layers. Each layer of Earth has its own properties and composition. When studying the chemical composition of Earth's layers, scientists have identified three main layers—the crust, mantle, and core. The crust is the outer layer of Earth and the layer where living things live and grow. There are two types of crust: continental and oceanic. Continental crust makes up the continents, while oceanic crust makes up the oceans.



Earth's Layers

The mantle is located between the crust and core. It is made of hot, slow-moving, solid rock. Convection causes cooler, denser rock to sink and warmer, less dense rock to rise. When warmer rock rises and is closer to Earth's crust, scientists are able to study the rock and learn more about Earth's mantle.

The core is located beneath the mantle and the center of Earth, and is likely made of the metals iron and nickel. The core is very hot and very dense. It makes up about one-third of Earth's mass.

The Earth has five main layers. They are the lithosphere, asthenosphere, mesosphere, outer core, and inner core. The outer layer of Earth is called the **lithosphere**. It is made up of the crust and the rigid, upper part of the mantle. This layer is divided into moving tectonic plates. The **asthenosphere** is a layer that contains softer parts of the mantle and is made up of rock that moves slowly. The **mesosphere** is the lower part of the mantle. Like in the asthenosphere, rock in this layer flows slowly. The rock in the mesosphere flows even more slowly than the rock in the asthenosphere. The outer core is a liquid layer located beneath the mantle. This layer surrounds the inner core, which is the solid center of Earth.

Plate Tectonics and Earth's Layers

The theory of plate tectonics describes large-scale movements of Earth's lithosphere. Plate tectonics explains how and why features in Earth's crust form and continents move. The lithosphere, or the solid outer layer of Earth, is divided into tectonic plates that move in different directions and different speeds. Each plate fits together with the plates surrounding it. The plates all vary in size, shape, and thickness. The Andes Mountains, for instance, formed where the South American plate and Nazca plate meet.

Name _____ Date _____

Plate Boundaries

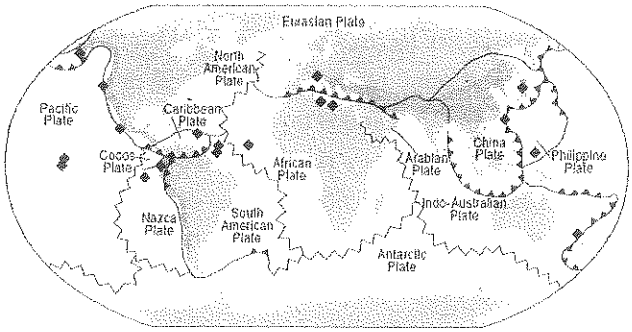


Plate Boundaries

A **plate boundary** is where two tectonic plates meet. The most dramatic changes in Earth's crust occur along plate boundaries. Plate boundaries may be on the ocean floor, around the edges of continents, or even within continents. There are three types of plate boundaries: divergent boundaries, convergent boundaries, and transform boundaries. Each type of plate boundary is associated with characteristic landforms.

Convergent boundaries form where two plates collide. Three types of collisions can happen at convergent boundaries. When two tectonic plates of continental lithosphere collide, they buckle and thicken, which pushes some of the continental crust upward. When a plate of oceanic lithosphere collides with a plate of continental lithosphere, the denser oceanic lithosphere sinks into the asthenosphere. Boundaries where one plate sinks beneath another plate are called subduction zones. When two tectonic plates of oceanic lithosphere collide, one of the plates subducts, or sinks, under the other plate.

At a **divergent boundary**, two plates move away from each other. This separation allows the asthenosphere to rise toward the surface and partially melt. This melting creates magma, which erupts as lava. The lava cools and hardens to form new rock on the ocean floor.

A boundary at which two plates move past each other horizontally is called a **transform boundary**. However, the plate edges do not slide along smoothly. Instead, they scrape against each other in a series of sudden slippages of crustal rock that are felt as earthquakes. Unlike other types of boundaries, transform boundaries generally do not produce magma. The San Andreas Fault in California is a major transform boundary between the North American plate and the Pacific plate. Transform motion also occurs at divergent boundaries. Short segments of mid-ocean ridges are connected by transform faults called fracture zones.

Why Plates Move

Scientists have proposed three mechanisms to explain how tectonic plates move over Earth's surface. Mantle convection drags plates along as mantle material moves beneath tectonic plates. Ridge push moves plates away from mid-ocean ridges as rock cools and becomes denser. Slab pull tugs plates along as the dense edge of a plate sinks beneath Earth's surface.

As atoms in Earth's core and mantle undergo radioactive decay, energy is released as heat. Some parts of the mantle become hotter than other parts. The hot parts rise as the sinking of cooler, denser material pushes the heated material up. This kind of movement of material due to differences in density is called **convection**. It was thought that as the mantle convects, or moves, it would drag the overlying tectonic plates along with it. However, many scientists have criticized this hypothesis because it does not explain the huge amount of force that would be needed to move plates.

Newly formed rock at a mid-ocean ridge is warm and less dense than older, adjacent rock. Because of its lower density, the new rock rests at a higher elevation than the older rock. The older rock slopes downward away from the ridge. As the newer, warmer rock cools, it also becomes denser. These cooling and increasingly dense rocks respond to gravity by moving down the slope of the asthenosphere, away from the ridge. This force, called **ridge push**, pushes the rest of the plate away from the mid-ocean ridge.

At subduction zones, a denser tectonic plate sinks, or subducts, beneath another, less dense plate. The leading edge of the subducting plate is colder and denser than the mantle. As it sinks, the leading edge of the plate pulls the rest of the plate with it. This process is called **slab pull**. In general, subducting plates move faster than other plates do. This evidence leads many scientists to think that slab pull may be the most important mechanism driving tectonic plate motion.

Mountains and Volcanoes

The movement of energy as heat and material in Earth's interior contribute to tectonic plate motions that result in mountain building. Mountains can form through folding, volcanism, and faulting.

Folded mountains form when rock layers are squeezed together and pushed upward. They usually form at convergent boundaries, where plates collide. For example, the Appalachian Mountains formed from folding and faulting when the North American plate collided with the Eurasian and African plates millions of years ago.

Fault-block mountains form when tension makes the lithosphere break into many normal faults. Along the faults, pieces of the lithosphere drop down compared with other pieces. The pieces left standing form fault-block mountains.

Volcanic mountains form when melted rock erupts onto Earth's surface. Many major volcanic mountains are located at convergent boundaries. Volcanic mountains can form on land or on the ocean floor. Volcanoes on the ocean floor can grow so tall that they rise above the surface of the ocean, forming islands. Most of Earth's active volcanoes are concentrated around the edge of the Pacific Ocean. This area is known as the Ring of Fire.

Volcanic eruptions also occur when an oceanic plate sinks under a continental plate. The eruptions build up mountain ranges on the continental plate, near the plate boundary. If two continental plates converge, neither plate sinks, but instead they push against each other, causing Earth's surface to push up and form mountain ranges.

Earthquakes

Earthquakes are another kind of rapid change that occurs on Earth's surface. When two plates are moving apart, Earth's outer layer is stretched and tension breaks the crust, forming large cracks called faults. This motion breaks and bends rock. Rock can become stuck as the plates scrape along. When the rocks that are stuck break free, energy is released. This makes Earth's surface shake. It causes an earthquake to occur.

Earthquakes can occur at all plate boundaries. Fault-block mountains and valleys form as plate motion causes rock to move up or down on either side of a fault. Volcanism also occurs at these boundaries as rock melts below the thinning surface. This can form volcanic mountains.

Name _____ Date _____

Benchmark Review
SC.7.E.6.1, SC.7.E.6.5, SC.7.E.6.7

Student-Response Activity

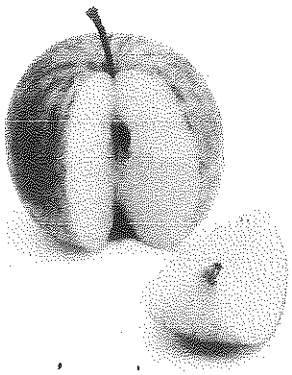
1. Describe each of Earth's layers.

crust _____

mantle _____

core _____

2. How can this apple be compared to Earth's layers?



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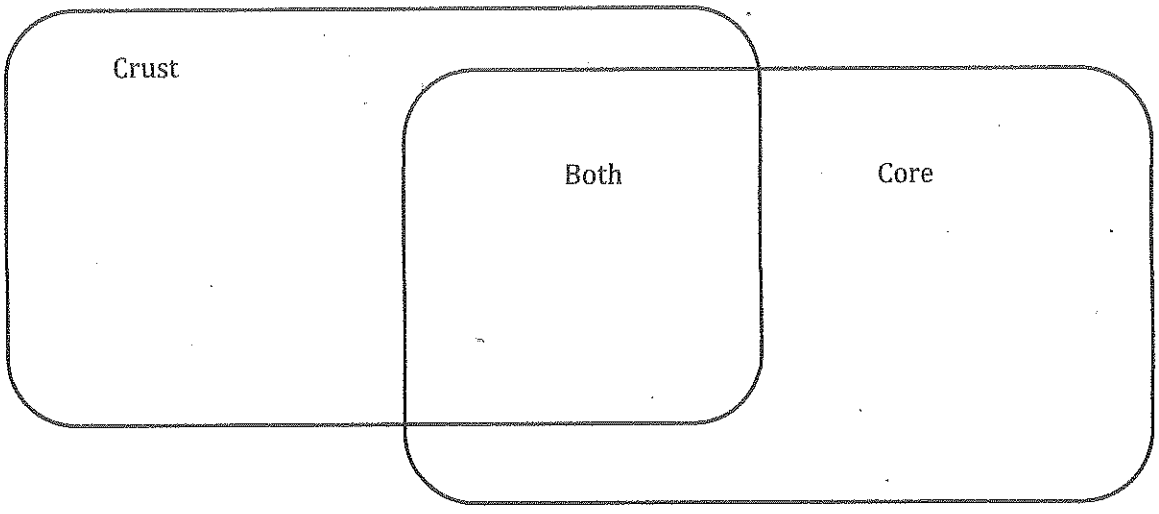
3. Fill in the Venn diagram to compare and contrast Earth's crust and core.



4. How are Earth's mantle and core different from each other?

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_____

_____

Name _____ Date _____

Benchmark Assessment SC.7.E.6.1, SC.7.E.6.5, SC.7.E.6.7

Fill in the letter of the best choice.

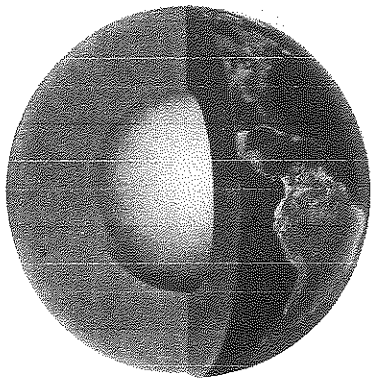
1. Which is the outermost, rigid physical layer of Earth?
   - (A) asthenosphere
   - (B) inner core
   - (C) lithosphere
   - (D) outer core

2. Which describes how scientists learn more about Earth's mantle?
   - (F) by studying earthquakes
   - (G) by studying rock that has risen due to convection
   - (H) by taking pictures from outside the Earth
   - (I) by using radioactive dating

3. What are tectonic plate boundaries?
   - (A) areas where Earth's core experiences a high amount of stress
   - (B) areas where Earth's core experiences a low amount of stress
   - (C) areas where Earth's crust experiences a high amount of stress
   - (D) areas where Earth's mantle experiences a high amount of stress

4. Which describes the innermost layer of Earth?
   - (F) It is likely made up of the metals nickel and iron.
   - (G) It is made up of fast moving rock.
   - (H) It is made up of slow moving rock.
   - (I) It likely has a very high concentration of oxygen.

5. Use this diagram to answer this question.



Which model of Earth's interior does this image show?
   - (A) the model of Earth's layers based on chemical composition
   - (B) the model of Earth's layers based on physical properties
   - (C) the model of Earth's layers based on size
   - (D) the model of Earth's layers based on temperature