KEY CONCEPT

6.1 Earth has several layers.

BEFORE, you learned

- Minerals and rocks are the building blocks of Earth
- Different types of rocks make up Earth's surface

NOW, you will learn

- About the different properties of Earth's layers
- About the plates that make up Earth's outermost layers

VOCABULARY

inner core p. 186
outer core p. 186
mantle p. 187
crust p. 187
lithosphere p. 187
asthenosphere p. 187
tectonic plate p. 188

EXPLORE Density

Will a denser material sink or float?

PROCEDURE

1. Add equal amounts of water to 2 cups. Add 3 spoonfuls of salt to one of the cups and stir until the salt is dissolved.
2. Add 10 drops of food coloring to the same cup in which you dissolved the salt.
3. Gently pour about a third of the colored salt water into the cup of fresh water. Observe what happens.

MATERIALS

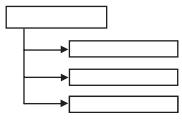
- 2 clear plastic cups
- tap water
- table salt
- plastic spoon
- food coloring

WHAT DO YOU THINK?

- What did you observe when the two types of water were mixed?
- What does this activity tell you about materials of different density?

Earth is made up of materials with different densities.

SUPPORTING MAIN IDEAS
Support the main ideas about Earth's layers with details and examples.



Scientists think that about 4.6 billion years ago, Earth formed as bits of material collided and stuck together. The planet grew larger as more and more material was added. These impacts, along with radioactive decay and Earth's gravity, produced intense heat. The young planet became a glowing ball of melted rock.

In time, denser materials, such as iron and nickel, sank toward the center of Earth. Less dense materials moved toward the surface. Other materials settled between the planet's center and its surface. Slowly, Earth's main layers formed—the core, the mantle, and the crust.

VOCABULARY
Draw a description wheel in your notebook for each term. You might want to include the pronunciation of some terms.

Earth's layers have different properties.

How do scientists know what Earth's deep interior is like? After all, no one has seen it. To explore the interior, scientists study the energy from earthquakes or underground explosions they set off. The energy travels through Earth somewhat like ripples move through a pond. The energy moves slower through less dense materials or liquids and faster through denser materials or solids. In this way, scientists infer what each layer is made of and how thick the layers are, as shown in the diagram below.

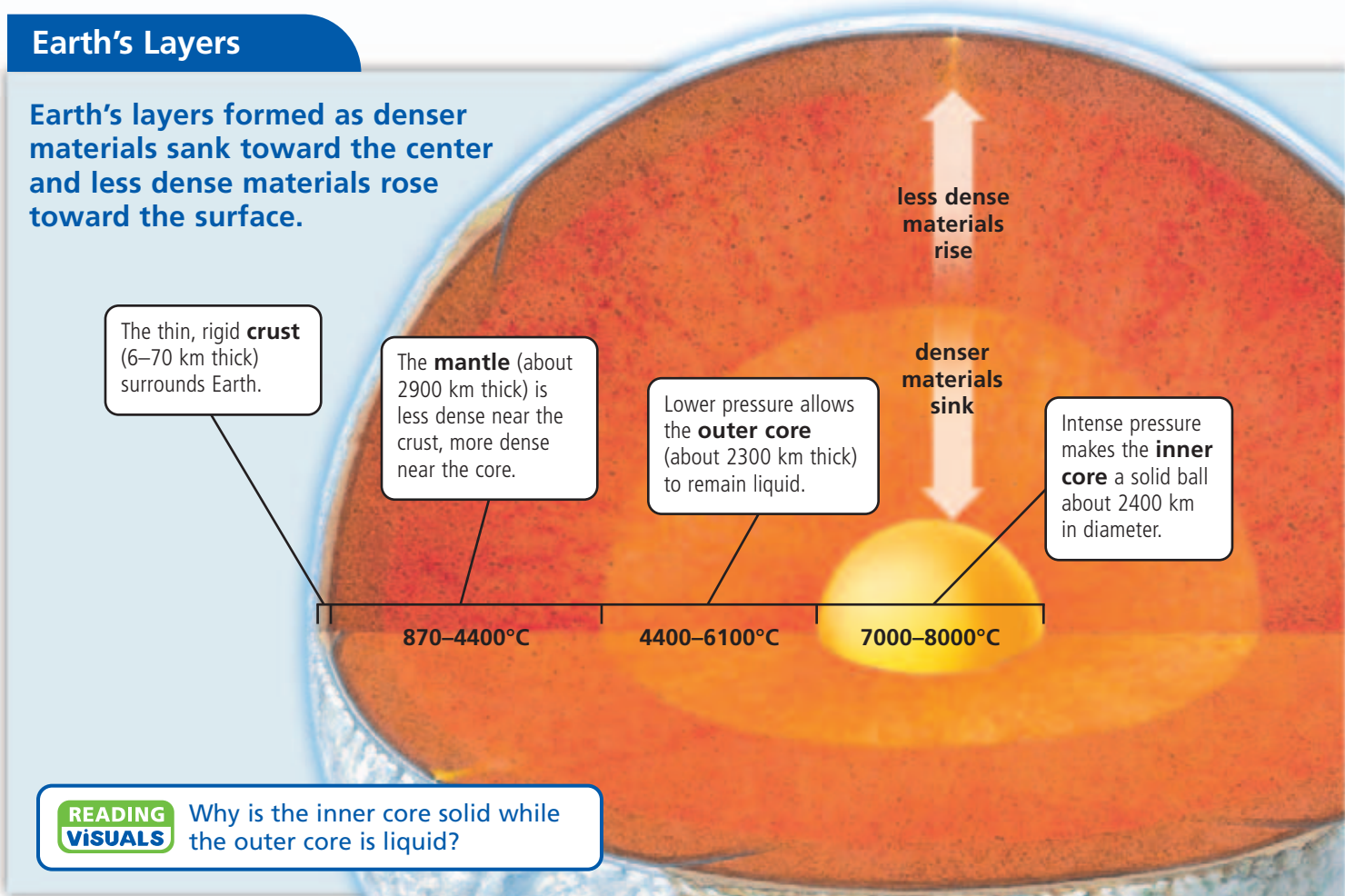
Core, Mantle, Crust

The core is Earth's densest region and is made up of two parts. The **inner core** is a ball of hot, solid metals. There is enormous pressure at the center of Earth. This squeezes the atoms of the metals so closely together that the core remains solid despite the intense heat.

The **outer core** is a layer of liquid metals that surrounds the inner core. The temperature and pressure in the outer core are lower than in the inner core. The lower pressure allows the metals to remain liquid.

Earth's Layers

Earth's layers formed as denser materials sank toward the center and less dense materials rose toward the surface.



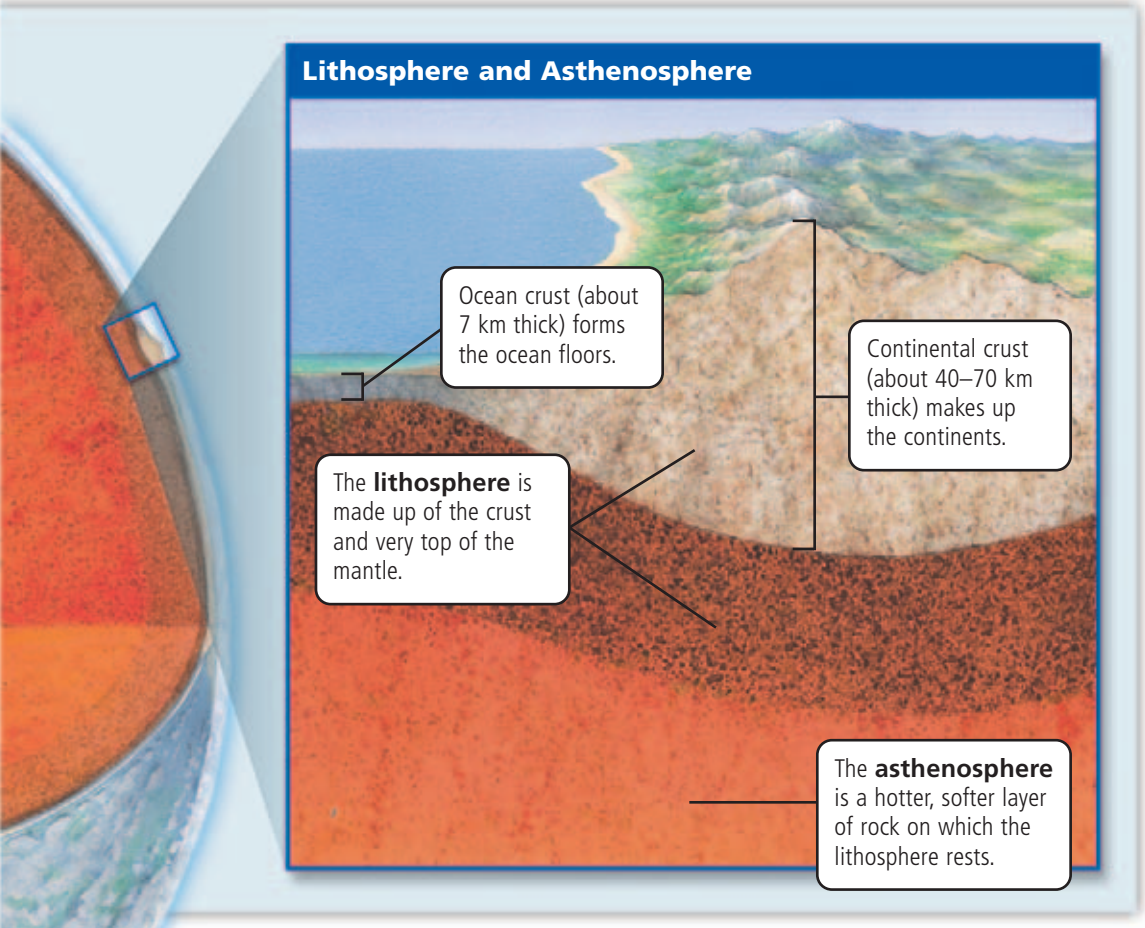
READING VISUALS Why is the inner core solid while the outer core is liquid?

The **mantle** is Earth's thickest layer, measuring nearly 2900 kilometers (1700 mi). It is made of hot rock that is less dense than the metallic core. The very top part of the mantle is cool and rigid. Just below that, the rock is hot and soft enough to move like a thick paste.

The **crust** is a thin layer of cool rock. It surrounds Earth somewhat like a shell surrounds an egg. There are two basic types of crust. Continental crust includes all continents and some major islands. Oceanic crust includes all the ocean floors. As the diagram below shows, Earth's crust is thinnest under the oceans and thickest under continental mountain ranges. The crust is home to all life on Earth.

Lithosphere and Asthenosphere

Earth's crust and the very top of the mantle together form the **lithosphere** (LIHTH-uh-SFEER). The Greek prefix *litho-* means "stone" or "rock." This layer is the most rigid of all the layers. The lithosphere sits on top of the **asthenosphere** (as-THEHN-uh-SFEER), a layer of hotter, softer rock in the upper mantle. The Greek word *asthenés* means "weak." This layer is not actually weak, but it is soft enough to flow slowly like hot tar. You can imagine the lithosphere as solid pieces of pavement resting on hot tar.



INVESTIGATE Earth's Different Layers

How can you model Earth's layers?

SKILL FOCUS
Modeling

MATERIALS
- clear plastic cup
- small colored wooden beads
- gravel
- stirring stick
- tap water

TIME
15 minutes

PROCEDURE

1. Put a layer of wooden beads about 1 centimeter thick at the bottom of a clear plastic cup or small jar.
2. Put a layer of gravel about 2 centimeters thick on top of the wooden beads. Stir the beads and gravel until they are well mixed.
3. Put another layer of gravel about 1 centimeter thick on top of the mix. Do NOT mix this layer of gravel.
4. SLOWLY fill the cup about two-thirds full of water. Be sure not to disturb the layers in the cup.
5. Stir the beads and gravel with the stick. Observe what happens.

WHAT DO YOU THINK?

- What happened to the materials when you stirred them?
- How do you think this model represents the layers of Earth?

CHALLENGE What could you add to the model to represent Earth's solid core?

The lithosphere is made up of many plates.

READING TiP
The word *tectonic* comes from the Greek *tecktōn,* which means "builder." Tectonic plates are constantly building and changing landforms and oceans around Earth.

As scientists studied Earth's surface, they discovered that the lithosphere does not form a continuous shell around Earth. Instead, they found that the lithosphere is broken into many large and small slabs of rock called **tectonic plates** (tehk-TAHN-ihk). Scientists do not know exactly how or when in Earth's history these giant plates formed.

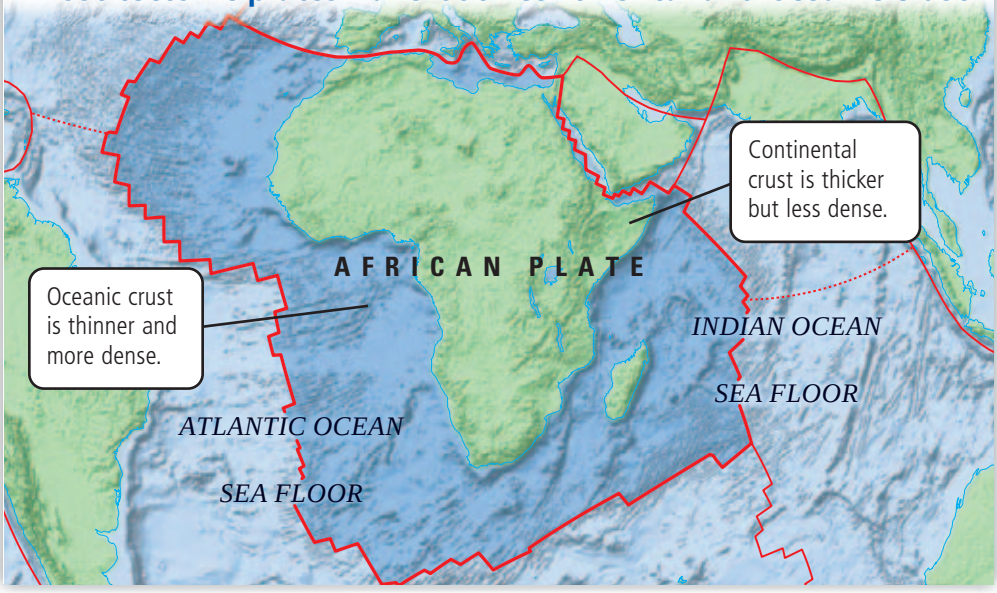
Tectonic plates fit together like a jigsaw puzzle that makes up the surface of Earth. You could compare the lithosphere to the cracked shell of a hard-boiled egg. The shell may be broken into many pieces, but it still forms a "crust" around the egg itself.

Most large tectonic plates include both continental crust and oceanic crust, as shown in the diagram on page 189. Most of the thicker continental crust rises above the ocean. The rest of the plate is thin oceanic crust, or sea floor, and is underwater. The next time you look at the continents on a world map, remember you are seeing only the part of Earth's crust that rises above the ocean.

CHECK YOUR READING Why do you see only the dry land areas of tectonic plates on a typical world map?

African Plate

Most tectonic plates have both continental and oceanic crust.



In the diagram above, notice how much of the African Plate, shaded darker blue, lies underwater. The continent of Africa, which looks large on a world map, is actually about half the size of the entire plate. The plate's oceanic crust forms part of the sea floor of the Atlantic and Indian oceans and of the Mediterranean Sea. The ocean crusts of other plates make up the rest of the sea floors.

Earth's layers and tectonic plates are two of the most important discoveries in geology. They helped solve a mystery that had puzzled people for nearly 400 years. The mystery involved two questions. Have the continents always been where they are today? If not, how did they move to their present positions? In Section 6.2, you will find out how scientists are answering these questions.

6.1 Review

KEY CONCEPTS

1. Briefly describe the inner and outer cores, the mantle, and the crust.
2. In what ways is the lithosphere different from the asthenosphere?
3. Describe the structure of most tectonic plates.

CRITICAL THINKING

4. **Draw Conclusions** Suppose you are looking at a scene that has mountains near an ocean. Where do you think the crust would be the thickest? Why?
5. **Hypothesize** What would Earth look like if most of its crust was above sea level?

CHALLENGE

6. **Predict** You have learned that Earth's lithosphere is made up of many plates. How do you think this fact might help scientists solve the mystery of the moving continents?