

Inside the Earth

Terms to Learn

crust	mesosphere
mantle	outer core
core	inner core
lithosphere	tectonic plate
asthenosphere	

What You'll Do

- ◆ Identify and describe the layers of the Earth by what they are made of.
- ◆ Identify and describe the layers of the Earth by their physical properties.
- ◆ Define tectonic plate.
- ◆ Explain how scientists know about the structure of Earth's interior.

The Earth is not just a ball of solid rock. It is made of several layers with different physical properties and compositions. As you will discover, scientists think about the Earth's layers in two ways—by their *composition* and by their *physical properties*.

Earth's layers are made of different mixtures of elements. This is what is meant by differences in composition. Many of the Earth's layers also have different physical properties. Physical properties include temperature, density, and ability to flow. Let's first take a look at the composition of the Earth.

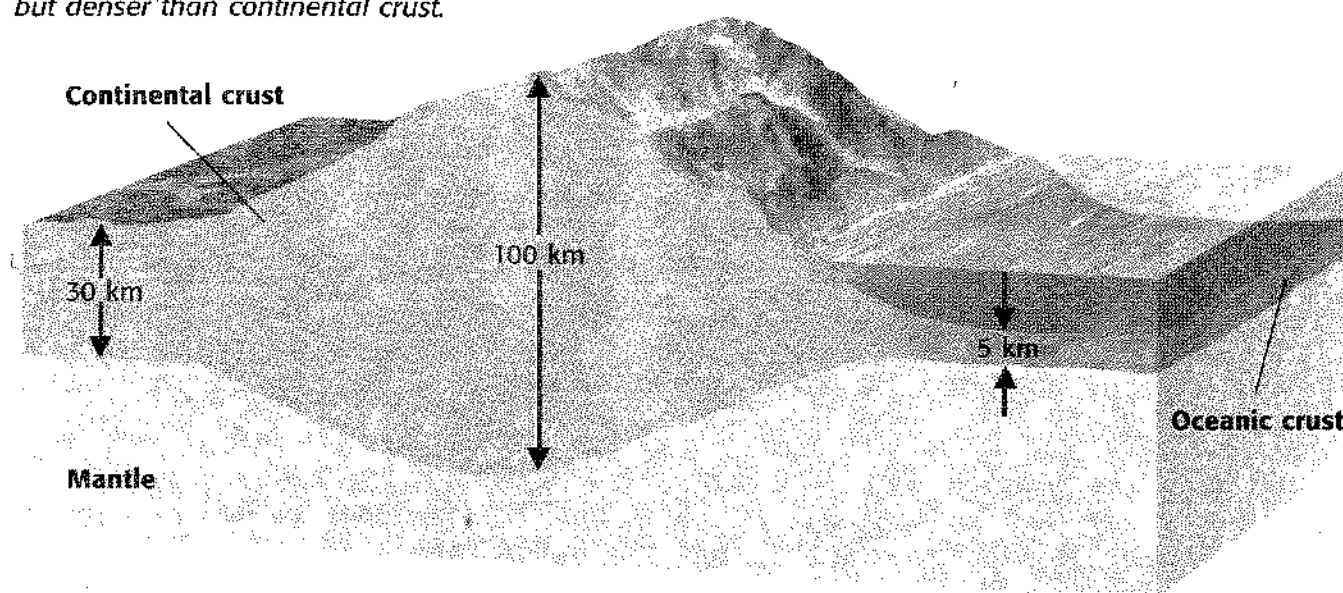
The Composition of the Earth

The Earth is divided into three layers—the *crust*, *mantle*, and *core*—based on what each one is made of. The lightest materials make up the outermost layer, and the densest materials make up the inner layers. This is because lighter materials tend to float up, while heavier materials sink.

The Crust The **crust** is the outermost layer of the Earth. Ranging from 5 to 100 km thick, it is also the thinnest layer of the Earth. And because it is the layer we live on, we know more about this layer than we know about the other two.

There are two types of crust—continental and oceanic. *Continental crust* has a composition similar to granite. It has an average thickness of 30 km. *Oceanic crust* has a composition similar to basalt. It is generally between 5 and 8 km thick. Because basalt is denser than granite, oceanic crust is denser than continental crust.

Figure 1 Oceanic crust is thinner but denser than continental crust.



The Mantle The **mantle** is the layer of the Earth between the crust and the core. Compared with the crust, the mantle is extremely thick and contains most of the Earth's mass.

No one has ever seen what the mantle really looks like. It is just too far down to drill for a sample. Scientists must infer what the composition and other characteristics of the mantle are from observations they make on the Earth's surface. In some places mantle rock has been pushed up to the surface by tectonic forces, allowing scientists to observe the rock directly.

As you can see in Figure 2, another place scientists look is on the ocean floor, where molten rock from the mantle flows out of active volcanoes. These underwater volcanoes are like windows through the crust into the mantle. The "windows" have given us strong clues about the composition of the mantle. Scientists have learned that the mantle's composition is similar to that of the mineral olivine, which has large amounts of iron and magnesium compared with other common minerals.

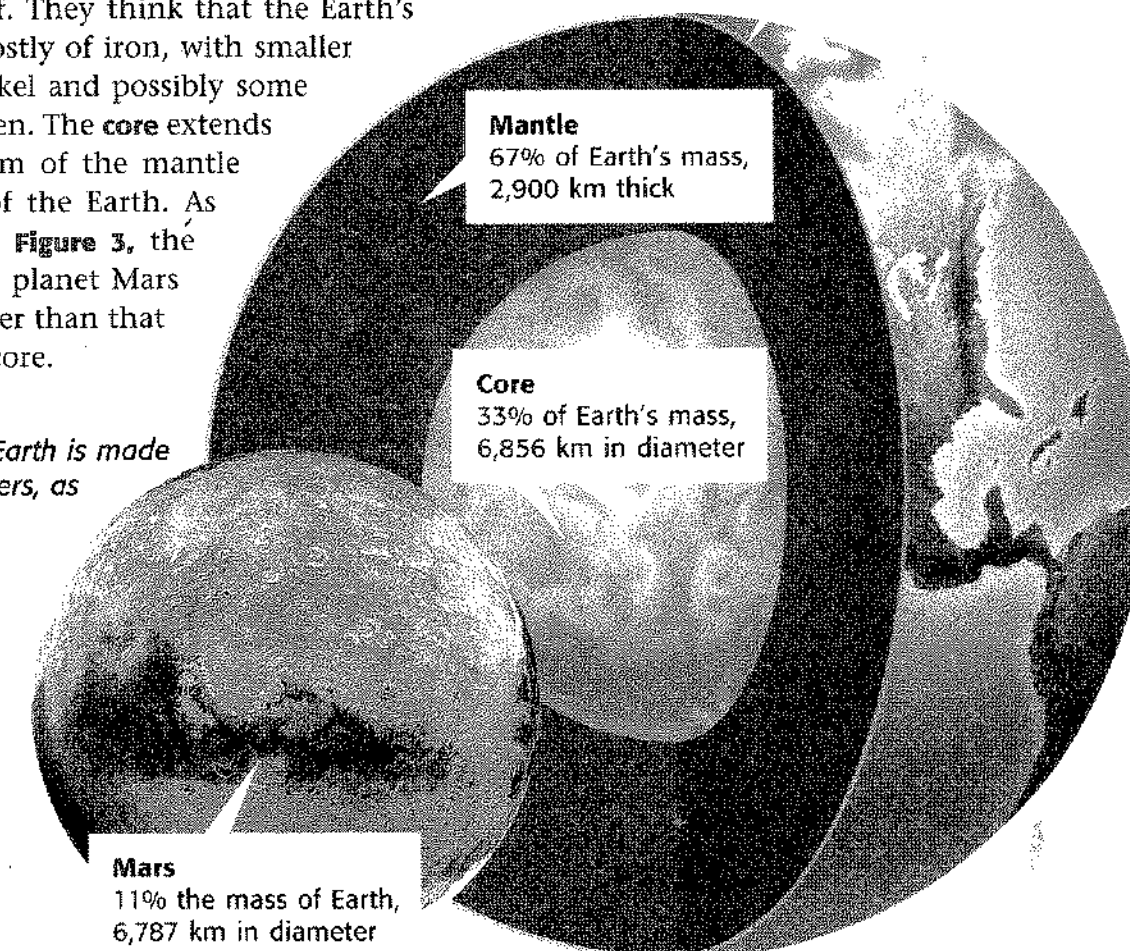
Figure 2 Volcanic vents on the ocean floor, such as this one off the coast of Hawaii, allow magma to escape from the mantle beneath oceanic crust.



Crust
less than 1% of Earth's mass,
5–100 km thick

The Core By studying the different layers that make up the Earth, geologists can get an idea of which elements each is made of. They think that the Earth's *core* is made mostly of iron, with smaller amounts of nickel and possibly some sulfur and oxygen. The **core** extends from the bottom of the mantle to the center of the Earth. As you can see in Figure 3, the diameter of the planet Mars is slightly smaller than that of the Earth's core.

Figure 3 The Earth is made up of three layers, as shown here.



MATHBREAK

Using Models

Imagine that you are building a model of the Earth that is going to have a radius of 1 m. You find out that the average radius of the Earth is 6,378 km and that the thickness of the lithosphere is about 150 km. What percentage of the Earth's radius is the lithosphere? How thick (in centimeters) would you make the lithosphere in your model?

The Structure of the Earth

So far we have talked about the composition of the Earth. Another way to look at how the Earth is made is to examine the physical properties of its layers. The Earth is divided into five main physical layers—the *lithosphere*, *asthenosphere*, *mesosphere*, *outer core*, and *inner core*. As shown below, each layer has its own set of physical properties.

Lithosphere The outermost, rigid layer of the Earth is called the **lithosphere** ("rock sphere"). The lithosphere is made of two parts—the crust and the rigid upper part of the mantle. The lithosphere is divided into pieces called *tectonic plates*.

Asthenosphere The **asthenosphere** ("weak sphere") is a soft layer of the mantle on which pieces of the lithosphere move. It is made of solid rock that, like putty, flows very slowly—at about the same rate your fingernails grow.

Mesosphere Beneath the asthenosphere is the strong, lower part of the mantle called the **mesosphere** ("middle sphere"). The mesosphere extends from the bottom of the asthenosphere down to the Earth's core.

Scientists call the part of the Earth where life is possible the *biosphere*. The biosphere is the layer of the Earth above the crust and below the uppermost part of the atmosphere. It includes the oceans, the land surface, and the lower part of the atmosphere.

