



# Be a Scientist!

Use clay of different colors to make a scale model of Earth and its layers. Review the distances below the surface of each layer shown in the diagram on page 3. These distances should help you determine how thick to make each layer of clay.

Assemble your layers and then carefully use a plastic knife to cut your model Earth in half to reveal the layers. Adjust your model as needed to make it an accurate scale model.

Use clay to add landforms on the surface of your model (not to scale). Include landforms that could have formed or changed because of movements in Earth's interior layers.



## Beyond the Book

Use the library or the Internet to find out what is inside another planet, such as Mars.

FOCUS Book

# WHAT'S INSIDE PLANET EARTH?



: Science A-Z 



# WHAT'S INSIDE PLANET EARTH?



## FOCUS Question

What is below Earth's surface,  
and how do we know?

Systems and System Models

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Waterfalls

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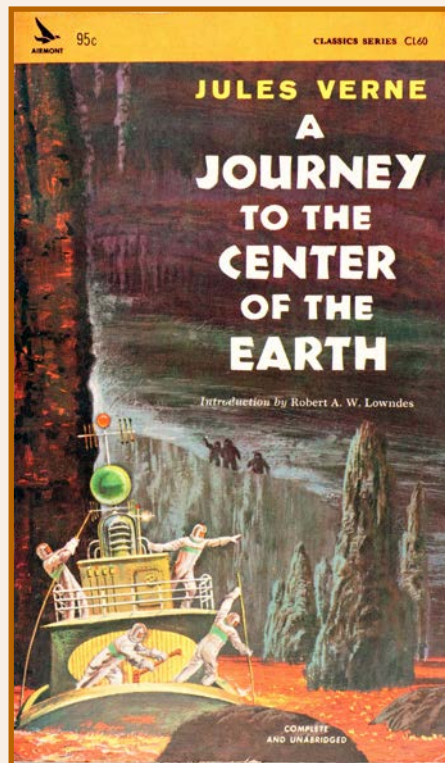
## What's Down There?

What might you experience if you could journey to Earth's center? You may have watched a science fiction movie or read a fiction book about taking such a voyage.

Nobody has actually gone there, however, and it's likely impossible. That's why, until recently, Earth's interior remained a mystery. Scientists could only speculate about what lies deep below Earth's surface.

Earth is composed of three main layers. The *crust* is the outermost and thinnest layer. The middle layer, which lies beneath the crust, is the *mantle*. The *core* is the innermost layer. This layer is divided into a liquid outer core and a solid inner core. But how do we know this? Let's find out how scientists solved the mystery.

Earth's interior was still a mystery when author Jules Verne wrote his famous science fiction story *A Journey to the Center of the Earth* in 1864.



## Read-Think-Write

Write your answers on separate paper. Use details from the text as evidence.

- 1 What are the names of Earth's layers?
- 2 How can scientists use *direct evidence* to study Earth's layers?
- 3 How can scientists use *indirect evidence* to study Earth's layers?
- 4 A strong earthquake happens in California. Instruments on the other side of Earth record both P waves and S waves from the earthquake. Using the diagram on page 4, which of Earth's layers did the waves travel through?
- 5 How are the outer core and inner core different?

### FOCUS Question

What is below Earth's surface, and how do we know? Imagine that you could travel into the future and people have invented a way to travel to Earth's inner core. Write a short story or daily diary entry explaining the conditions and types of rocks you observe along your journey from the surface to the center of Earth.

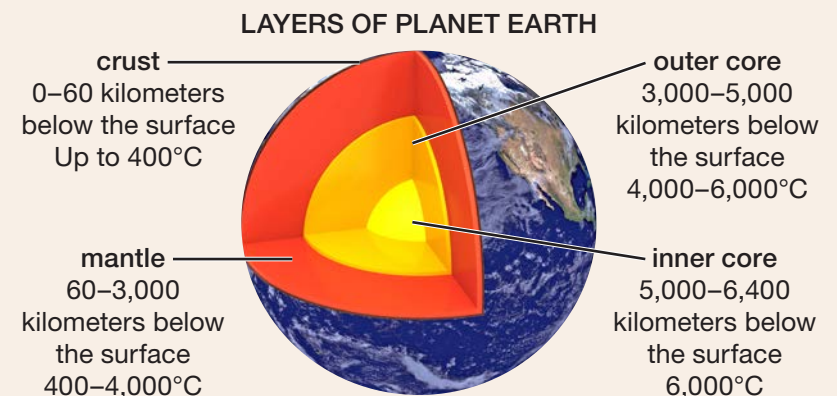


## Interior Sleuths

Solving the mystery of Earth's interior wasn't easy for *geologists*—scientists who study Earth. People can't see through solid rock or dig to Earth's center. The deepest hole ever drilled only reaches about 12 kilometers (7.5 mi.). Instead, geologists use two kinds of information to study Earth's interior. They use *direct evidence* and *indirect evidence*.

Observations you can make yourself are direct evidence. Scientists observe rocks and lava on Earth's surface. They study rocks from mines and holes drilled below the surface.

Indirect evidence is information you use to infer an answer when you can't make observations yourself. It includes recordings of earthquake waves called *seismic* (SIZE-mik) waves. By studying these waves, geologists can infer what lies thousands of kilometers below the surface.



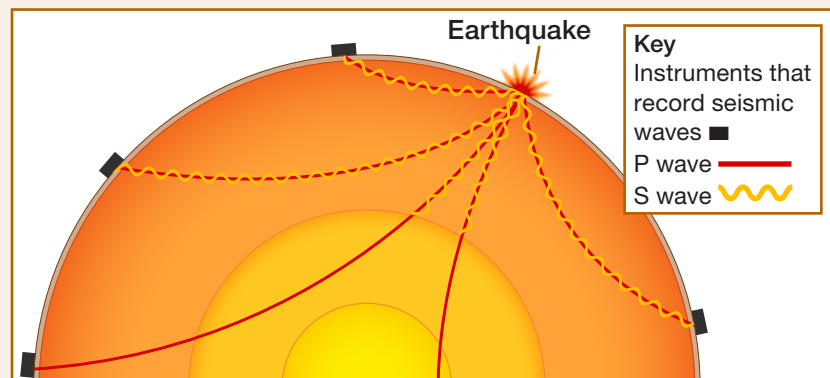
## Seismic Waves

During an earthquake, seismic waves move outward throughout Earth. Instruments around the world record these seismic waves. The waves include *P waves*, which can travel through solids and liquids, and *S waves*, which can travel through solids but not liquids.

When seismic waves move from one material into a different material, their speed and direction change. Either their path bends or the new material blocks them.

If Earth were made up of a single layer of the same material, the seismic waves would pass straight through the planet. Instead, however, seismic waves bend or stop. Using this indirect evidence, scientists inferred that Earth consists of different layers. These layers must be made up of different materials.

INDIRECT EVIDENCE FROM SEISMIC WAVES



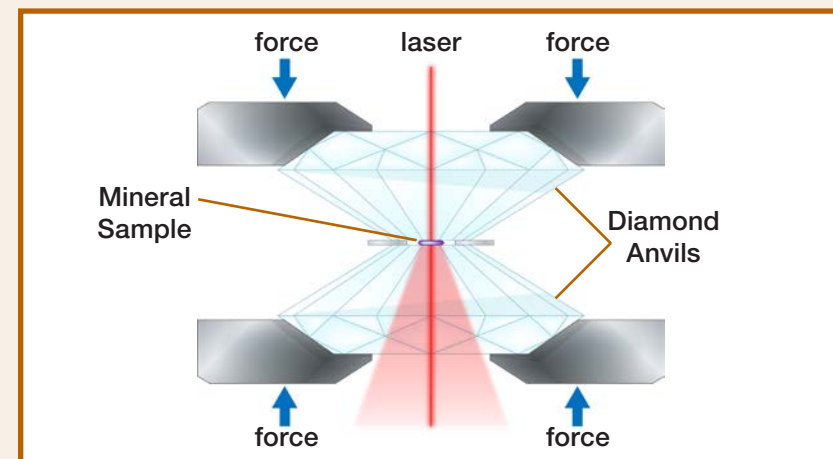
P (primary) and S (secondary) waves pass through the solid crust and mantle. Only P waves can pass through the liquid outer core.

## The Sleuthing Continues

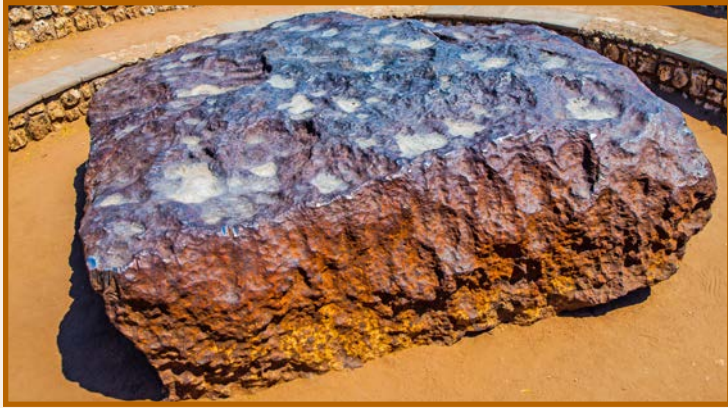
Would it be exciting to journey to Earth's center? You bet! But we aren't likely to ever take that journey to gather direct evidence. Digging deep below the surface is difficult and expensive. It would be impossible to survive the high temperature and pressure of the core.

However, we can keep gathering indirect evidence and add to what we know about Earth's center. Scientists use technology to do just that. One method is to model the high temperature and pressure conditions of the mantle and core with a diamond-anvil cell. In a lab, scientists heat minerals with lasers while squeezing them between two diamonds. This way, they can learn about processes deep inside Earth without actually going there.

SIMULATION OF CONDITIONS INSIDE EARTH







Scientists think the inner core is made up of solid material similar to this iron-rich meteorite.

## The Inner Core

Scientists also use seismic waves to make inferences about the inner core. The S waves are stopped by the liquid outer core. But P waves enter the inner core, and then they change direction and speed. Their path and speed indicate that the inner core is a solid ball made mostly of iron.

The inner core is the hottest, densest layer of all. Yet it's not liquid like the outer core. Why? The extreme pressure of all the other layers pushing in on it keeps the inner core solid, even at extreme temperatures.

The pressure also helps make the inner core hot because squeezing makes materials warmer. Heat moves outward from Earth's core and helps drive currents that move tectonic plates and change landforms on the surface.

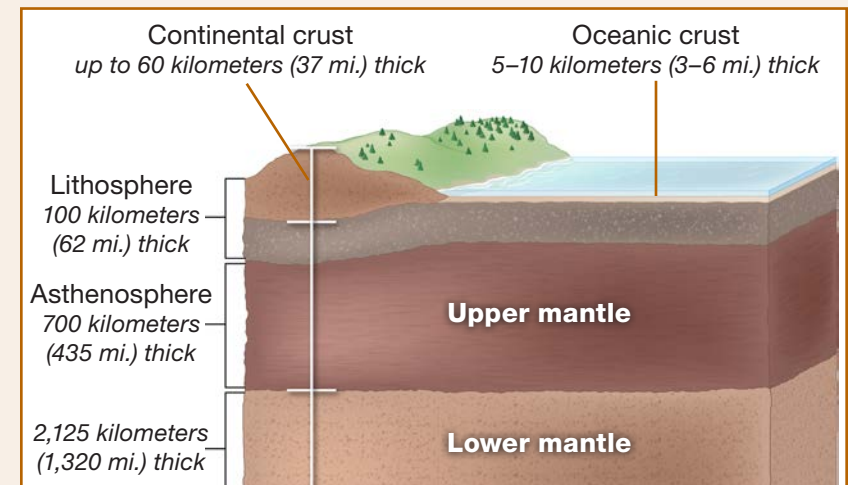
## The Crust

Earth's crust is the layer we call home. It's thousands of degrees cooler than the other layers. Geologists know more about it than the mantle or core because they can collect direct evidence.

The crust is broken into pieces, called *tectonic plates*, which slowly move on Earth's surface. The movement and interaction of these plates create and change landforms. Plate movements create mountains, volcanoes, trenches, and mid-ocean ridges.

The crust varies in thickness and is made up of different rock types. The *continental crust* makes up the continents and consists mostly of a type of rock called *granite*. The *oceanic crust* is under the oceans and consists mostly of *basalt*.

THE CRUST AND MANTLE





granite



basalt

Earth's crust is made up of granite and basalt. The mantle is composed mostly of peridotite.



peridotite

## The Mantle

Both P and S waves pass through the crust and mantle. Scientists infer that this likely means both layers are solid. Seismic waves also travel faster in the mantle, meaning that the mantle is denser than the crust.

To learn more about the mantle (see page 5), scientists study volcanoes. During an eruption, mantle rock is forced up to the surface. This rock reveals that the mantle is made mostly of rock called *peridotite* (puh-RI-duh-tite).

Although the mantle is mostly solid, it moves slowly over time. The tectonic plates in the crust sit on top of the mantle. Heat within the mantle moves by way of *convection currents*. These currents help move the plates and therefore can change landforms on Earth's surface.

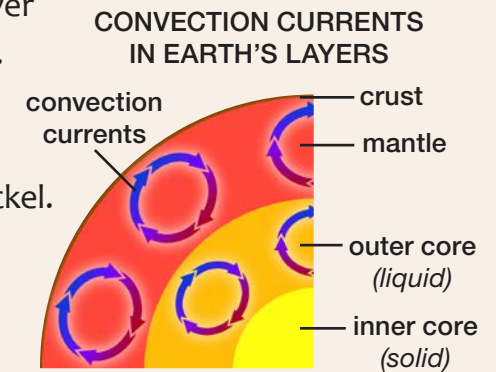
## The Outer Core

Beneath the mantle, scientists record a change in seismic waves at a depth of about 3,000 kilometers (1,864 mi.). The P waves change speed and direction. The S waves stop. Since S waves can't pass through liquids, scientists can infer that a liquid layer exists deep inside Earth.

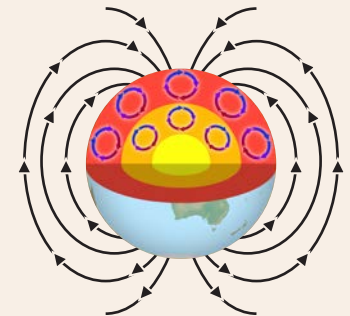
This layer is the outer core. It is mostly made up of melted iron and nickel.

As in the mantle, convection currents move material around within the outer core.

This movement of liquid iron produces an electric current. This current is the source of Earth's magnetic field.



Convection currents in the outer core produce Earth's magnetic field (below).



### Science in Your World

Earth's outer core actually helps keep you safe! The magnetic field it produces helps protect you and all other living things by deflecting the Sun's harmful radiation.