These workers are drilling a hole that will be more than two kilometers deep. Later they will lower instruments into the hole to record data at that depth.

Scientists have drilled holes to a depth of about 12 kilometers to collect data on the uppermost portion of Earth's interior.

The waves from earthquakes travel through Earth, and scientists are able to interpret these waves to learn about the structure and composition of Earth's interior.

The Science of Geology

- **What is the science of geology?**
- **Geology is the study of planet Earth, including its composition and structure.**

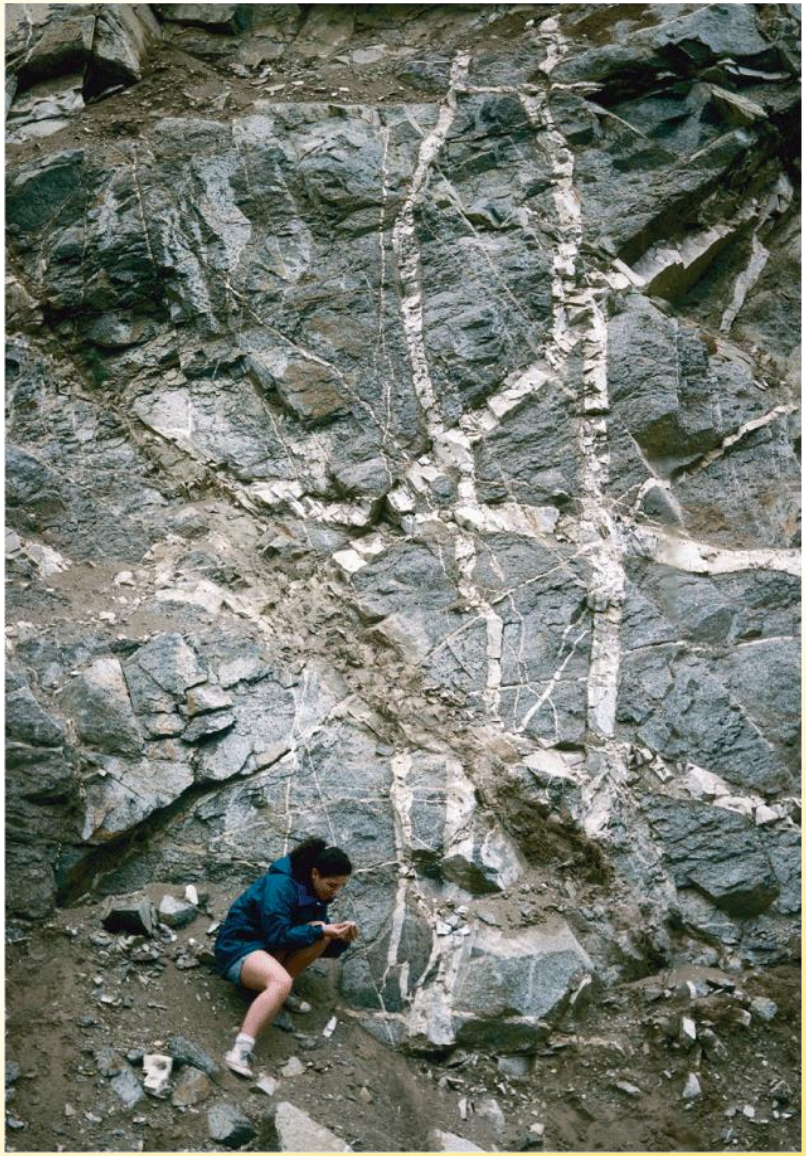
The Science of Geology

Geologists are scientists who study Earth and the processes that shape Earth over time. Geologists study two types of forces that change Earth's surface.

- Constructive forces shape the surface by building up mountains and other land areas.
- Destructive forces slowly wear away mountains and, eventually, every other feature on Earth's surface.

The Science of Geology

This geologist is examining the rocks that make up the side of a canyon.



The Science of Geology

James Hutton developed the principle of uniformitarianism. **Uniformitarianism** is the idea that geologic processes that operate today also operated in the past.

- Ancient rocks can be understood by observing present-day geologic processes.
- Features such as mountains and canyons result from geologic processes that work very slowly over long periods of time.

A Cross Section of Earth

What are the characteristics of Earth's principal layers?

Earth can be divided into three main layers—the crust, mantle, and core—based on the materials that make up each layer.

A Cross Section of Earth

Earth's surface and interior can be compared to a hard-boiled egg.

- Beneath an egg's hard outer shell is a layer of egg white that surrounds the yolk at the center.
- This layering is largely due to differences in density.
- Earth has a similar layered structure.

A Cross Section of Earth

Physical conditions in Earth's interior vary from layer to layer.

- Temperature and pressure in Earth's interior increase with depth.
- As the temperature and pressure increase, the properties of the materials inside Earth also change.

A Cross Section of Earth

A hard-boiled egg is a model for Earth's layered structure.

A Cross Section of Earth

The Crust

The rocky outer layer of Earth is the **crust.**

Like an eggshell, Earth's crust is thin.

Much of the crust is made up of **silicates,** rocks made of compounds of silicon and oxygen, which often contain metals such as aluminum, iron, or calcium.

A Cross Section of Earth

There are two different types of crust. Continental crust, the rock that makes up the continents, consists mainly of less-dense rocks such as granite.

- Continental crust averages about 40 kilometers in thickness, although it ranges in thickness from about 8 to 75 kilometers.
- It is thickest under mountain chains such as the Himalayas.

A Cross Section of Earth

Oceanic crust is the rock that makes up the ocean floor.

- Oceanic crust is composed mostly of dense rocks like basalt.
- Oceanic crust is about 7 kilometers thick on average, and so is much thinner than continental crust.

A Cross Section of Earth

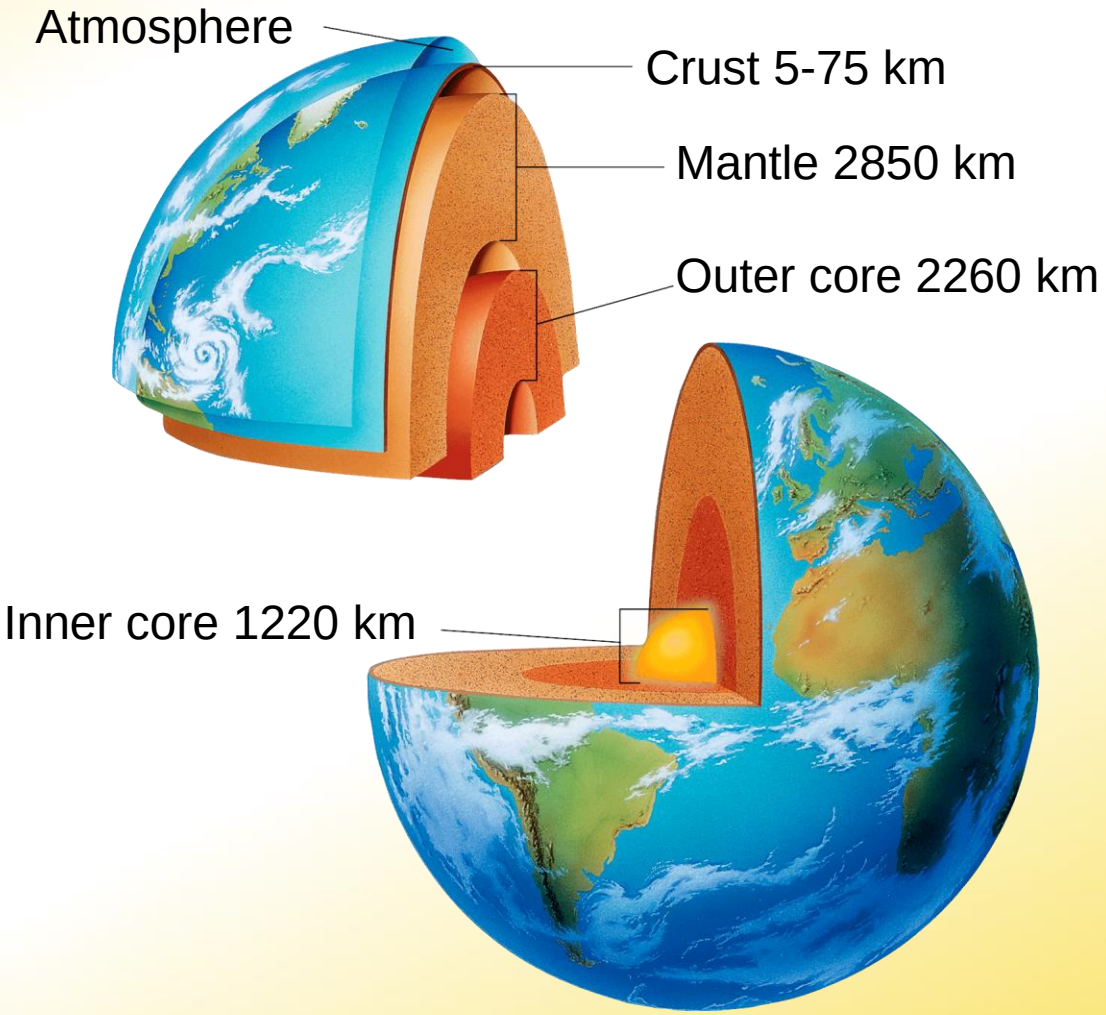
The Mantle

Beneath the crust is the **mantle,** a thick layer of hot but solid rock.

- The mantle extends about 2850 kilometers, from beneath the crust to the top of the core.
- Pressure and temperature increase with depth in the mantle.
- The mantle is composed mainly of silicates. It is rich in iron and magnesium, and so is denser throughout than the crust.

A Cross Section of Earth

Earth's rocky crust is its thinnest layer. Most of the interior is occupied by the hot, solid mantle, the molten metal outer core, and the solid metal inner core.



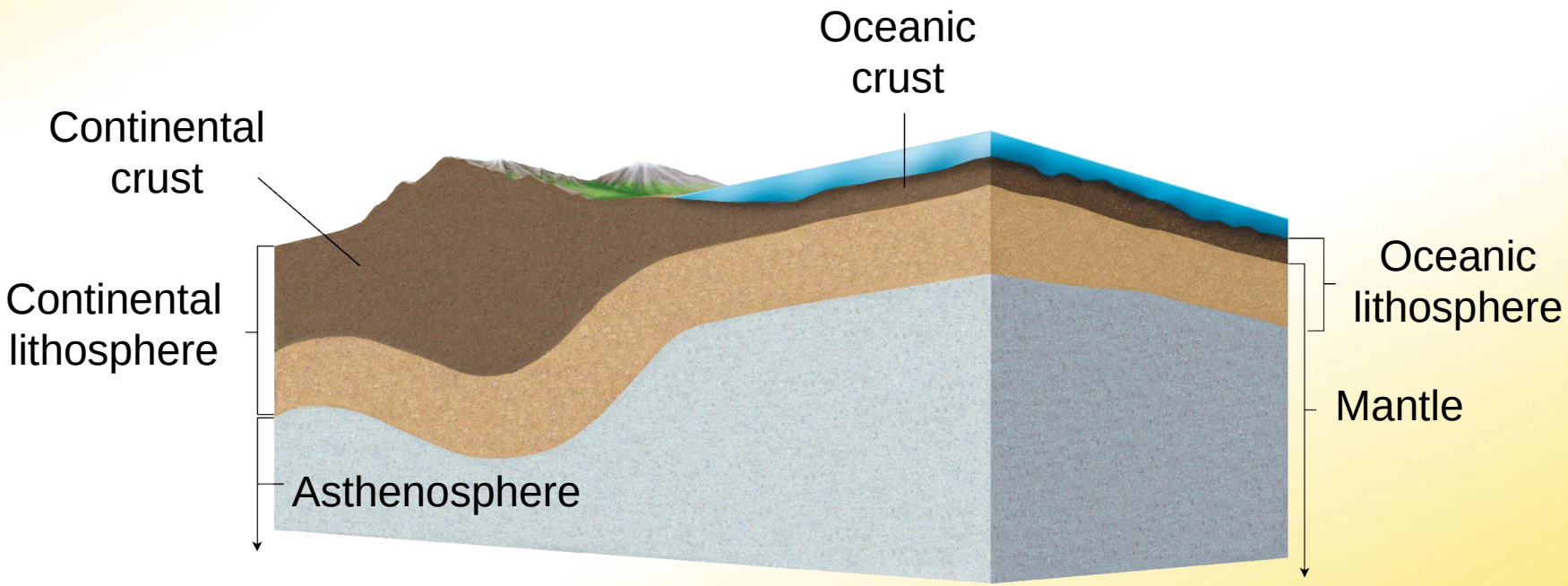
A Cross Section of Earth

Geologists divide the mantle into three layers.

- The **lithosphere** is a layer of relatively cool, rigid rock that includes the uppermost part of the mantle and the crust.
- The **asthenosphere** is a layer of softer, weaker rock that can flow slowly.
- The stronger lower part of the mantle is called the **mesosphere.** The stiffer rock of the mesosphere extends all to the upper surface of Earth's core.

A Cross Section of Earth

The structure of Earth's upper layers is complex. Notice that the continental crust is thicker beneath mountain ranges.



A Cross Section of Earth

The Core

Beneath the mantle is the **core,** a large sphere of metal that occupies Earth's center.

- Scientists think that the core is composed mostly of iron, with lesser amounts of nickel and some lighter elements.
- Within the core, pressure increases greatly with depth.
- At Earth's center, the pressure is estimated to be 3.6 million times the pressure at Earth's surface!

A Cross Section of Earth

The core is divided into two parts—the outer core and the inner core.

- In the outer core, high temperatures keep the metal liquid. As Earth rotates, the flowing iron of the outer core produces an electric current and creates Earth's magnetic field.
- In the inner core, the pressure is very high. As a result, the inner core is solid, even though the temperature at the center of Earth is estimated to be about 5500°C.

Assessment Questions

1. What is geology?
   a. the study of the solar system
   b. the study of minerals
   c. the study of water
   d. the study of planet Earth

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1. What is geology?
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   ANS: D

Assessment Questions

2. The thick layer of hot, dense rock beneath Earth's surface is the
   a. crust.
   b. mantle.
   c. lithosphere.
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Assessment Questions

2. The thick layer of hot, dense rock beneath Earth's surface is the
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   ANS: B