Lesson 1

Earth's Layers

ESSENTIAL QUESTION

What are Earth's layers?

By the end of this lesson, you should be able to identify Earth's compositional and physical layers and describe their properties.

If you could dig below this canyon, you would discover that Earth is made up of different layers below its surface.

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Lesson Labs

Quick Labs
- Layers of Earth
- Ordering Earth's Layers

S.T.E.M. Lab
- Models of Earth

Engage Your Brain

1 Predict Check T or F to show whether you think each statement is true or false.

T	F	
☐	☐	The outermost layer of solid Earth is sometimes called the crust.
☐	☐	The crust is the densest layer.
☐	☐	The mantle is the layer between the crust and the core.
☐	☐	Earth's core is divided into five parts.

2 Describe If you were asked to describe this apple, how many layers would you say it has? How would you describe the layers?

Active Reading

3 Synthesize You can often define an unknown word if you know the meaning of its word parts. Use the word parts and sentence below to make an educated guess about the meaning of the word *mesosphere*.

Word part	Meaning
meso-	middle
-sphere	ball

Example sentence
The mesosphere is more than 2,000 km thick.

Mesosphere:

Vocabulary Terms

- crust
- mantle
- convection
- core
- lithosphere
- asthenosphere
- mesosphere

4 Apply As you learn the definition of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

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Peeling the Layers

What is inside Earth?

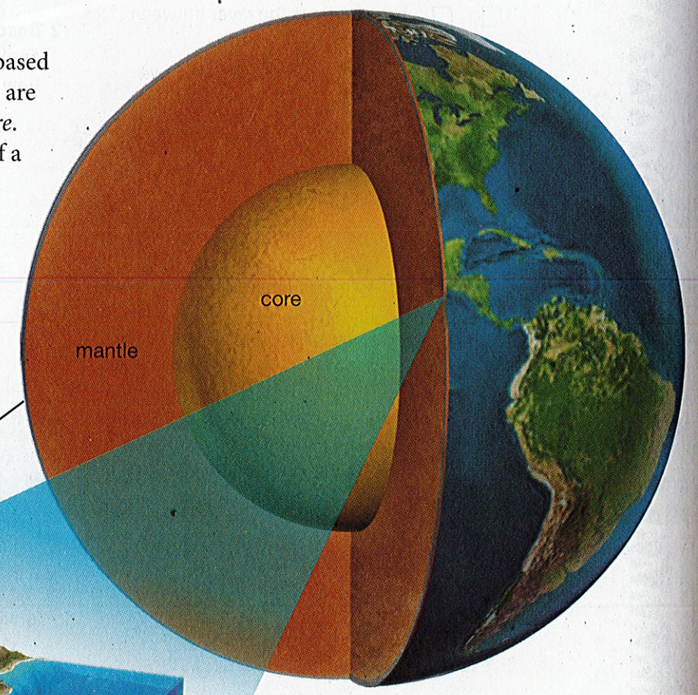
If you tried to dig to the center of Earth, what do you think you would find? Would Earth be solid or hollow? Would it be made of the same material throughout? Actually, Earth is made of several layers. The materials that make up each layer have characteristic properties that vary from layer to layer. Scientists think about Earth's layers in two ways—in terms of their chemical composition and in terms of their physical properties.

Think Outside the Book Inquiry

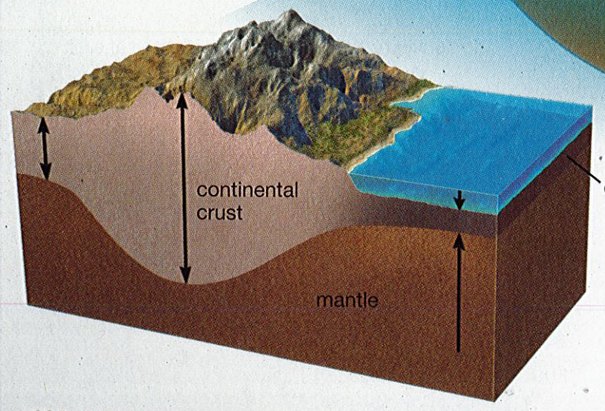
5 Apply With a classmate, discuss why scientists might have two ways for thinking about Earth's layers.

What are Earth's compositional layers?

Earth can be divided into three layers based on chemical composition. These layers are called the *crust*, the *mantle*, and the *core*. Each compositional layer is made up of a different mixture of chemicals.



Earth is divided into three layers based on the chemical composition of each layer.



Continental crust is thicker than oceanic crust.

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Crust

The outermost solid layer of Earth is the **crust.** There are two types of crust—continental and oceanic. Both types are made mainly of the elements oxygen, silicon, and aluminum. However, the denser oceanic crust has almost twice as much iron, calcium, and magnesium. These elements form minerals that are denser than those in the continental crust.

Active Reading

6 Identify List the compositional layers in order of most dense to least dense.

_____

_____

_____

Mantle

The **mantle** is located between the core and the crust. It is a region of hot, slow-flowing, solid rock. When convection takes place in the mantle, cooler rock sinks and warmer rock rises. **Convection** is the movement of matter that results from differences in density caused by variations in temperature. Scientists can learn about the mantle by observing mantle rock that has risen to Earth's surface. The mantle is denser than the crust. It contains more magnesium and less aluminum and silicon than the crust does.

Core

The **core** extends from below the mantle to the center of Earth. Scientists think that the core is made mostly of iron and some nickel. Scientists also think that it contains much less oxygen, silicon, aluminum, and magnesium than the mantle does. The core is the densest layer. It makes up about one-third of Earth's mass.

Active Reading **7 Identify** What element makes up most of Earth's core? _____

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What are Earth's physical layers?

Earth can also be divided into layers based on physical properties. The properties considered include whether the layer is solid or liquid, and how the layer moves or transmits waves. The five physical layers are the *lithosphere, asthenosphere, mesosphere, outer core,* and *inner core.*

Active Reading **8 Label** Write the names of the compositional layers shown below in the spaces provided.

Visualize It!

9 Analyze Which of Earth's compositional layers make up the lithosphere?

_____

Lithosphere

The outermost, rigid layer of Earth is the **lithosphere.** 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** is a layer of weak or soft mantle that is made of rock that flows slowly. Tectonic plates move on top of this layer.

Mesosphere

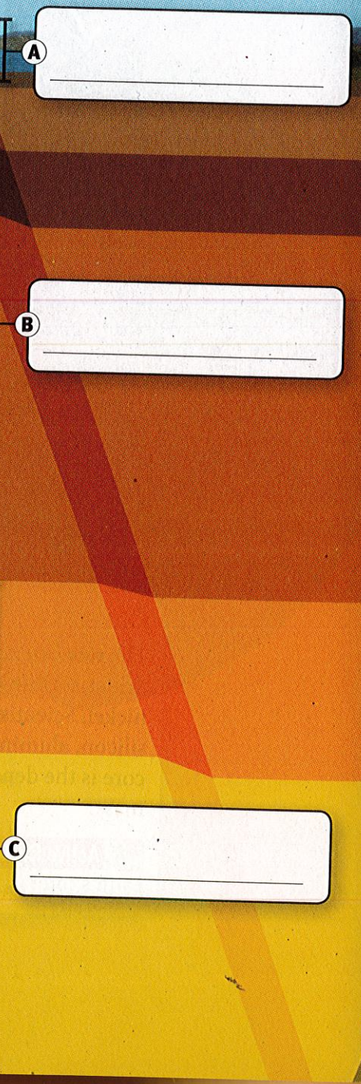
The strong, lower part of the mantle is called the **mesosphere.** Rock in the mesosphere flows more slowly than rock in the asthenosphere does.

Outer Core

The outer core is the liquid layer of Earth's core. It lies beneath the mantle and surrounds the inner core.

Inner Core

The inner core is the solid, dense center of our planet that extends from the bottom of the outer core to the center of Earth, which is about 6,380 km beneath the surface.



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Do the Math Sample Problem

Here's an example of how to find the percentage thickness of the core that is the outer core.

Physical	Compositional
Continental lithosphere (150 km)	Continental crust (30 km)
Asthenosphere (250 km)	Mantle (2,900 km)
Mesosphere (2,550 km)	
Outer core (2,200 km)	Core (3,430 km)
Inner core (1,230 km)	

Identify

A. What do you know?
core = 3,430 km outer core = 2,200 km

B. What do you want to find out?
Percentage of core that is outer core

Plan

C. Write the formula:

Percentage (%) of core that is outer core =

$$\left(\frac{\text{thickness of outer core}}{\text{thickness of core}}\right) \times 100\%$$

D. Substitute into the formula:

$$\% = \frac{(2{,}200)}{(3{,}430)} \times 100\%$$

Solve

E. Calculate and simplify:

$$\% = 0.6414 \times 100\% = 64.14\%$$

Answer: 64.14%

Do the Math You Try It

10 Calculate What percentage thickness of the continental lithosphere is continental crust?

Identify

A. What do you know?

B. What do you want to find out?

Plan

C. Write the formula:

D. Substitute into the formula:

Solve

E. Calculate and simplify:

Answer:

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Visual Summary

To complete this summary, fill in the blanks with the correct word or phrase. Then, use the key below to check your answers. You can use this page to review the main concepts of the lesson.

Earth is divided into three compositional layers.

11 The outermost compositional layer of the Earth is the _____.

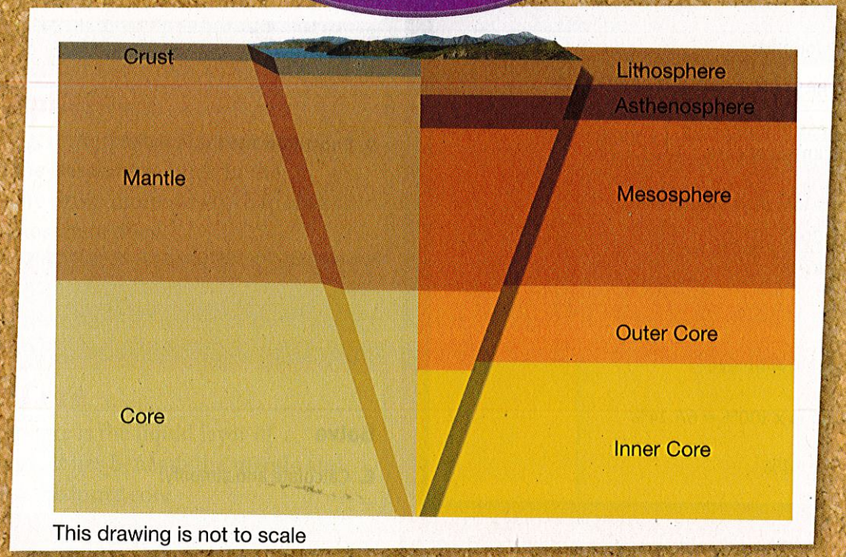
12 The _____ is denser than the crust and contains more magnesium.

Earth is divided into five physical layers.

13 The _____ is divided into pieces called tectonic plates.

14 The _____ core is the liquid layer of Earth's core.

Earth's Layers



Answers: 11 crust; 12 mantle; 13 lithosphere; 14 outer

15 Synthesize Which physical layers correspond to which compositional layers?

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Lesson Review

Vocabulary

Fill in the blank with the term that best completes the following sentence.

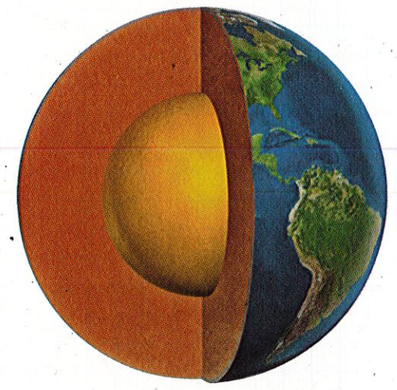
1 The _____ is a region of hot, slow-flowing, solid rock between the core and the crust.

2 The _____ is the densest compositional layer and makes up one-third of Earth's mass.

3 The _____ is the outermost, rigid physical layer of Earth.

Key Concepts

Use this diagram to answer the following questions.



4 **Identify** Which model of Earth's interior does this image show?

5 **Identify** Which of these layers is made mostly of iron and nickel?

6 **Compare** Explain the differences between the inner core and the outer core.

Critical Thinking

7 **Compare** Explain the difference between the lithosphere and the crust.

8 **Hypothesizing** Scientists find dense rock on Earth's surface that is made of magnesium and smaller amounts of aluminum and silicon. What layer of Earth might this rock help scientists study? Explain your answer.

9 **Apply** In a model of Earth's layers that is determined by physical properties, how might the atmosphere be classified? Would it be part of the lithosphere, or a separate layer? Explain your answer.

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