Lesson 2 | Earth's Interior

Name _____ Date _____ Class _____

Launch Lab

LESSON 2: 10 minutes

How can you model Earth's layers?

Earth is made of three main layers: the thin outer crust, the thick mantle, and the central core. You can use different objects to model these layers.

Procedure

1. Read and complete a lab safety form.
2. Place a **hard-cooked egg** on a **paper towel.** Use a **magnifying lens** to closely examine the surface of the egg. Is its shell smooth or rough? Record your observations in your Science Journal.
3. Carefully peel away the shell from the egg. *WARNING: Do not eat the egg.*
4. Use the **plastic knife** to cut the egg in half. Observe the characteristics of the shell, the egg white, and the yolk.
5. Make a drawing of the egg's layers in your Science Journal. Which layers could represent layers of Earth? Label the layers as *crust, mantle,* and *core.*

Think About This

1. What other objects could be used to model Earth's layers?

_____

_____

_____

2. **Key Concept** Explain why a hard-cooked egg is a good model for Earth's layers.

_____

_____

_____

_____

_____

_____

Name _____ Date _____ Class _____

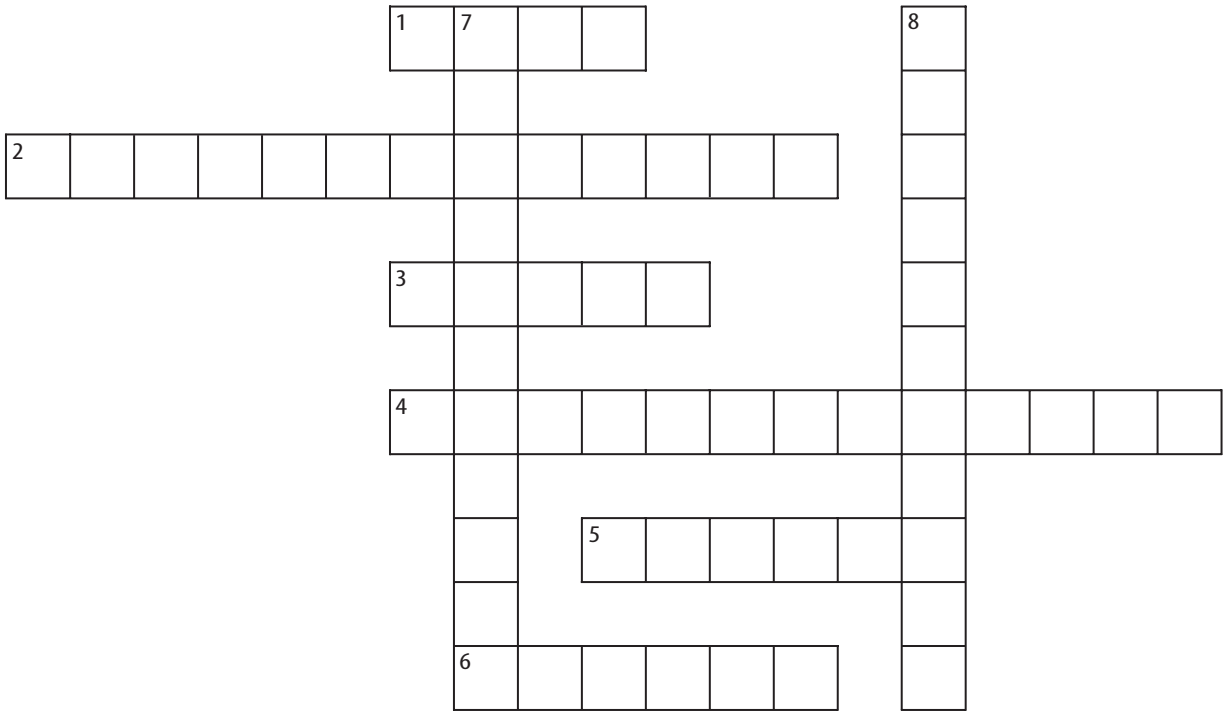
Content Vocabulary

LESSON 2

Earth's Interior

Directions: *Use the clues and the terms listed below to complete the puzzle.*

asthenosphere	**core**	**crust**	**lithosphere**
magnetosphere	**mantle**	**nickel**	**observation**



Clues

Across

1. the dense, metallic center of Earth

2. a plastic, or flowing, layer within Earth's mantle

3. the brittle, rocky outer layer of Earth

4. the outer part of Earth's magnetic field

5. the thick middle layer in the solid part of Earth

6. a specific type of metal

Down

7. an act of noting a fact or an occurrence

8. the rigid layer of Earth that includes the crust and the uppermost mantle

Name _____ Date _____ Class _____

Lesson Outline

LESSON 2

Earth's Interior

A. Clues to Earth's Interior

1. Scientists explore the geosphere by going into deep _____.

2. Scientists learn about the inside of Earth by sending down instruments and bringing up rock samples from _____.

B. Temperature and Pressure Increase with Depth

1. The deeper you go below Earth's surface, the _____ the temperature is.

2. The deeper you go below Earth's surface, the _____ the pressure is.

3. The pressure increases because of the _____ of the overlying rocks.

C. Using Earthquake Waves

1. Scientists learn about Earth's interior by studying waves from _____.

2. These waves move in different ways through different kinds of _____.

D. Earth's Layers

1. The _____ is the brittle, rocky outer layer of Earth.

2. Earth's outermost layer is similar to the shell of an egg: It is the _____ layer.

3. There are two types of crust—continental crust and _____ crust. Continental crust is much _____ than crustal rocks under the oceans.

E. Mantle

1. Below the crust is the _____, the thick middle layer of Earth.

2. The rocks in the mantle are _____ than crustal rocks.

3. Scientists group the mantle into _____ different layers.

a. The topmost layer of the mantle is a rigid layer called the _____.

Lesson Outline continued

b. The rocks in the mantle's second layer are so hot that they melt and become _____, which means that they begin to flow.

c. The layer of melted rock in mantle is the _____.

d. The lowest two layers of the mantle are solid because great _____ in these layers prevents the rock from melting.

e. The upper mantle and lower mantle form the _____ of Earth's layers.

F. Core

1. Earth's _____ is the dense, metallic center of the planet.

2. The central part of Earth is made of _____. When the planet was young, these dense materials melted and were pulled by _____ toward Earth's center.

3. Earth's core has a(n) _____ layer that is liquid and a(n) _____ layer that is solid.

4. The _____ core spins a little faster than the rest of Earth. It is made of _____ crystals.

5. The core causes a(n) _____ to form around Earth.

G. Earth's Magnetic Field

1. The movement of molten iron in Earth's core makes the planet act like a giant bar _____, with one pole near the top of the planet and one pole near the bottom.

2. Over time, Earth's magnetic field has _____ in strength and direction.

H. Magnetosphere

1. Earth's _____ field protects the planet against cosmic rays and charged particles from the Sun.

2. The _____ is the outer part of Earth's magnetic field. It interacts with _____ and _____ particles from the Sun, trapping some particles and pushing away others.

Name _____ Date _____ Class _____

Inquiry **MiniLab** **LESSON 2: 10 minutes**

Which liquid is densest?

Earth's layers were determined by density. The iron in the inner core makes up Earth's densest layer. The silicon and oxygen in Earth's crust are much less dense.

Procedure

1. Read and complete a lab safety form.
2. Pour 50 mL of **corn syrup** into a **100-mL beaker.** Label the beaker.
3. Fill the remaining **three 100-mL beakers** with 50 mL of **glycerin, water,** and **vegetable oil,** respectively. Label them.
4. Stir a few drops of **blue food coloring** into the water using a **spoon.**
5. Rinse the spoon. Then stir a few drops of **red food coloring** into the corn syrup.
6. Pour the corn syrup into a **250-mL beaker.**
7. Use a **funnel** to gently pour the glycerin on top of the corn syrup. Hold the funnel along the side of the beaker.
8. Repeat step 7 using the vegetable oil, then the water.

Data and Observations

Analyze and Conclude

1. **Describe** what happened to the liquids. Why did this occur?

_____

_____

_____

_____

_____

2. **Key Concept** How are the layers of liquid in the beaker similar to Earth's layers?

_____

_____

_____

_____

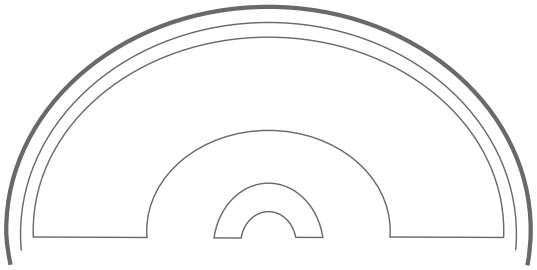
Name _____ Date _____ Class _____

Content Practice A

LESSON 2

Earth's Interior

Directions: *The diagram below represents a cross section of Earth. Draw a line from each layer to the correct part of the diagram.*



1. upper mantle
2. crust
3. inner core
4. asthenosphere
5. uppermost mantle
6. outer core
7. lower mantle

Directions: *Put a check mark on the line before each item that helped scientists learn about the inside of Earth.*

_____ **8.** global warming

_____ **9.** samples from deep wells

_____ **10.** temperatures in deep mines

_____ **11.** heat at the equator

_____ **12.** waves made by earthquakes

_____ **13.** energy in hurricanes

Name _____ Date _____ Class _____

Content Practice B

LESSON 2

Earth's Interior

Directions: *Complete each item on the lines provided.*

1. **Explain** how the parts of a hard-boiled egg, including the shell, correspond roughly to Earth's layers.

_____

_____

2. How did deep mines and wells give clues to the nature of Earth's interior?

_____

_____

3. **Explain** the differences between continental crust and oceanic crust.

_____

_____

_____

_____

4. **Name** the four parts of the mantle from top to bottom.

   a. _____

   b. _____

   c. _____

   d. _____

5. Scientists group Earth's two top layers, which consist of rigid rock, into a layer they call the _____.

6. **Name** and describe the two parts of the core.

   a. _____

   b. _____

Name _____ Date _____ Class _____

School to Home **LESSON 2**

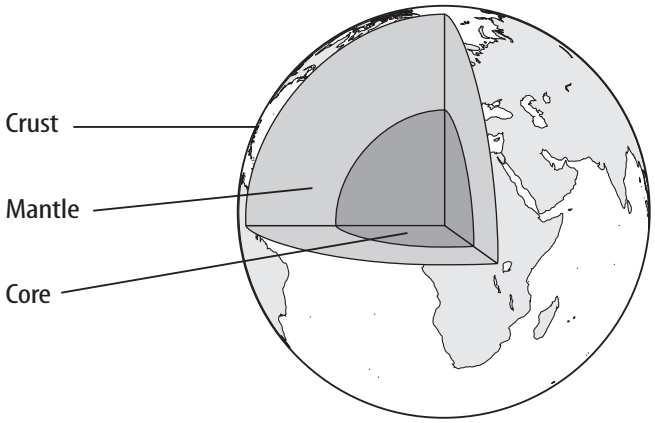
Earth's Interior

Did you know?

Some models are smaller than the objects they represent. For example, a model of Earth is smaller than the planet. Although a model is not the same size as the object, it usually can represent the proportions of the object's component parts accurately. A model that represents the interior layers of Earth can maintain the relative size of each layer as compared to the other layers. Models that maintain the relative size of an object help us understand the object's individual parts without having to see the object.

Directions: *With your learning partner, make a model of Earth.*

1. Use the illustration of Earth's layers below as a guide for making a model of Earth and its interior layers. You can make your model out of any material, such as clay, papier-mâché, plastic foam, colored gelatin, or food.



2. What are the relative sizes of each layer in your model?

_____

_____

_____

3. **Describe** any problems you had when you made your model, and tell how you overcame those problems.

_____

_____

_____

Name _____ Date _____ Class _____

Key Concept Builder

LESSON 2

Earth's Interior

Key Concept What are the interior layers of Earth?

Directions: *Write the layers of Earth in order from the inside to the outside.*

asthenosphere	**inner core**	**lithosphere**
lower mantle	**outer core**	**upper mantle**

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Directions: *Work with a partner. Suppose you could get a sample of material from each of Earth's layers. Which layer did each of these samples come from?*

7. hot liquid iron _____

8. cool solid rock _____

9. hot solid rock _____

10. hot melted rock _____

11. very hot solid iron _____

12. hottest solid rock _____

Name _____ Date _____ Class _____

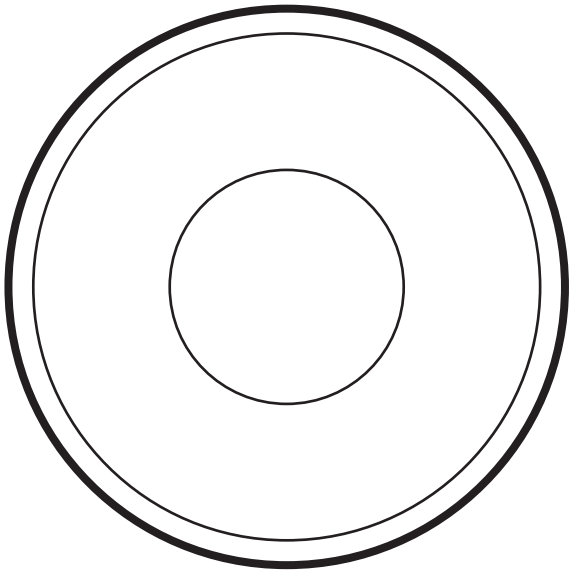
Key Concept Builder **LESSON 2**

Earth's Interior

Key Concept What are the interior layers of Earth?

Directions: *Use the diagram to answer each question.*

The diagram below represents a hard-boiled egg that has been sliced in half. The circle in the middle is the yolk. A hard-boiled egg is considered to be a good model for the structure of Earth's layers.



1. In this model, what do the shell and membrane correspond to in Earth's structure?

_____

2. Which part of the egg is comparable to Earth's core? _____

3. How does the model differ from Earth's core in terms of solidity?

_____

_____

4. How does the composition of Earth's core differ from the composition of the higher layers?

_____

_____

Name _____ Date _____ Class _____

Key Concept Builder

LESSON 2

Earth's Interior

Key Concept What are the interior layers of Earth?

Directions: *Use the knowledge you have gained about Earth's core in Lesson 2 to complete each item on the lines provided. Compare your responses with a partner's responses.*

1. How do the two parts of the core move?

_____

_____

2. What effect do these movements have?

_____

_____

_____

_____

3. In this respect, Earth is much like a giant

_____.

4. How does the magnetic field protect Earth?

_____

_____

_____

_____

5. How does a compass work?

_____

_____

_____

Name _____ Date _____ Class _____

Key Concept Builder **LESSON 2**

Earth's Interior

Key Concept What evidence indicates that Earth has a solid inner core and a liquid outer core?

Directions: *Scientists have learned about the interior of Earth in a number of ways, such as by digging deep wells and studying the waves created by earthquakes. Complete each item on the lines provided.*

1. What is the main characteristic about Earth that has been learned by studying deep wells and deep mines?

_____

_____

2. The deepest well in the world extends less than _____ percent of the way to the center of Earth.

3. What could scientists conclude about deeper parts of Earth from this finding?

_____

_____

4. What have scientists learned about Earth's structure from earthquake waves?

_____

_____

5. How do earthquake waves make these findings possible?

_____

_____

_____

6. Some hot rock in Earth is melted and flows very slowly. Scientists use the term _____ to describe rocks that flow in this way.

7. Deeper in Earth, hotter rock is solid rather than flowing. It is the tremendous _____ at that depth that keeps the rock solid.

Name _____ Date _____ Class _____

Enrichment **LESSON 2**

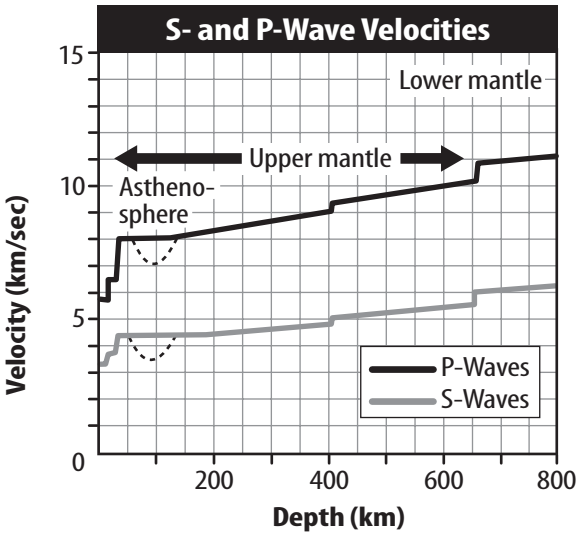
Analyzing Earthquake Waves

Scientists use the indirect method of analyzing earthquake waves to study the interior of Earth. In most sciences, researchers use indirect methods of gathering data; these methods extend our senses in exploring natural phenomena. For example, scientists use telescopes and microscopes to examine phenomena that is larger and smaller, respectively, than can be seen with the unaided eye; they use radar waves to detect the positions of airplanes and ships; and we hear and see voices and images from afar with telephone, radio, and television.

Earthquake Waves

During an earthquake, vibrations of the moving crust make waves that travel through Earth and that can be recorded on instruments called seismographs. Wave data provide information about the unseen interior of Earth.

Experiments in labs have shown that two types of seismic waves—P-waves and S-waves—travel through Earth materials. The velocity of the two kinds of seismic waves depends upon the composition and state of the material through which the waves travel. Researchers have found that some waves cannot travel through liquid and that the velocity of a wave changes when it reaches a boundary between two types of material. This graph shows the velocity of P-waves and S-waves at different depths below Earth's surface.



Applying Critical-Thinking Skills

Directions: *Respond to each statement.*

1. **Compare** the velocities of P-waves and S-waves as shown in the graph.
2. **Relate** the depth underground and the velocities of P-waves and S-waves.
3. **Hypothesize** which layers are in Earth between 2,000 km and 4,000 km.

Name _____ Date _____ Class _____

Challenge **LESSON 2**

Do humans have a compass in their noses?

Researchers have found that humans possess a tiny, shiny crystal of magnetite in the ethmoid bone, which is located between the eyes and just behind the nose. Magnetite is a magnetic material that is also present in homing pigeons, migratory salmon, whales and dolphins, honeybees, and bats. Magnetite helps animals determine orientation and direction by enabling them to sense magnetic fields produced by Earth.

Interview five family members, friends, neighbors, or community members and ask them to write directions for how to get to a popular local destination, such as a park or a restaurant. Have them describe to you how they usually find the best way to get to somewhere new. Record their responses and note any gestures that they made.

Working with a partner or in a small group, combine your results and analyze the methods described by different people in the interview. For example, did they use measured distances, street names, or feelings? Did they consult maps, ask other people, or use trial and error?

Organize the results of your analysis in a chart or graph in the space below.

1. What methods did most people use to get to specific destinations?

_____

_____

2. Could some people easily find places or navigate in places where they had never been before?

_____

Name _____ Date _____ Class _____

Inquiry **Skill Practice** ***Measure*** **LESSON 2: 15 minutes**

How can you find the density of a liquid?

Earth's interior is made of solids and liquids that have different densities. You can measure volume and mass and then calculate the density using the equation: $\textbf{density} = \frac{\textbf{mass}}{\textbf{volume}}$.

Learn It

Scientists **measure** to learn how much they have of a particular type of matter. Recall that matter is anything that has mass and volume. You can measure mass using a triple-balance beam. The unit of mass you will use most often is the gram (g). You can measure liquid volume using a graduated cylinder. Milliliter (mL) is the unit of volume you will use most often.

Materials

50-mL beakers (3)	graduated cylinder	corn syrup
vegetable oil	balance	isopropyl alcohol

Safety

Try It

1. Read and complete a lab safety form.
2. Measure the mass of a 50-mL graduated cylinder. Record the mass.

_____

3. Pour about 15 mL of alcohol into a clean beaker.
4. Slowly pour the alcohol into the graduated cylinder until the alcohol measures 10 mL.
5. Measure and record the mass of the alcohol and the graduated cylinder.

_____

6. Subtract the mass recorded in step 2 from the mass recorded in step 5.

_____

7. Empty and clean the graduated cylinder as instructed by your teacher.
8. Repeat steps 3–7 using the corn syrup and then the vegetable oil.

Skill Practice continued

Apply It

9. **Calculate** and record the density of each liquid using your mass and volume measurements and the equation shown at the top of page 40.

10. Which fluid has the greatest density? Which has the least? Explain your answer.

11. **Key Concept** Based on what you have learned, describe the relative density of Earth's layers.