

Earth's Elements and Temperatures

Overview:

During this lesson students learn about Earth's composition and temperature. Students also learn that temperatures affect the state of Earth's layers.

Objectives:

The student will learn:

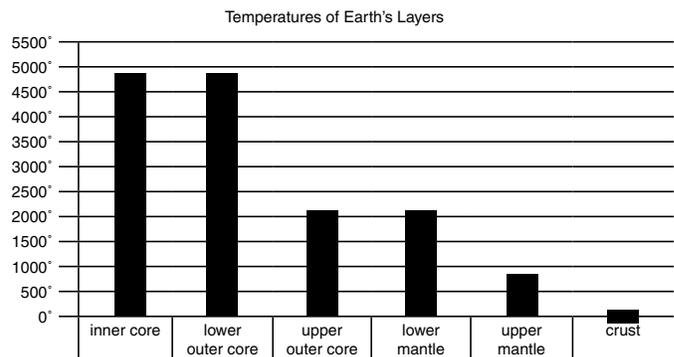
- to identify the temperature range within each of Earth's layers;
- to identify the composition or elements within each of Earth's layers; and
- how temperatures affect Earth's layers.

Materials:

- Bunsen burner or hot plate
- Wax
- Tongs
- 400 ml beaker filled with 100 ml of water
- 250 ml beaker
- Safety goggles
- Student Information Sheet: "Earth's Elements and Temperatures"
- Student Worksheet: "Earth's Elements and Temperatures"

Answers to Student Worksheet:

1. Crust: Varies
Mantle: 870-2200 °C
Outer Core: 2200-5000 °C
Inner Core: 5000 °C
2. Crust: oxygen, silicon, aluminum, calcium, iron, sodium, potassium, magnesium (any 3)
Mantle: silicon, oxygen, iron, magnesium (any 3)
Outer Core: iron, nickel
Inner Core: iron, nickel
3. see table at right
4. hotter



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Activity Procedure:

1. Explain that temperatures in Earth's layers generally increase from Earth's crust to Earth's core.
2. To demonstrate how this temperature increase affects the state of Earth's layers, perform the following demonstration in front of the class (or, if enough hot plates are available, ask students to form groups and perform the procedure themselves).
 - a) Break apart the wax and put it into the small beaker. Explain that the wax is in a solid state, similar to the state of Earth's crust.
 - b) Put the large beaker of water on the bunsen burner or hot plate and use the tongs to place the small beaker of wax inside the larger beaker to create a double boiler. Heat it on the lowest setting. When the wax first starts to melt, explain that this state is similar to the state of Earth's mantle. Earth's mantle is considered to be mostly solid, but it has the quality of plasticity, which means that Earth's mantle is somewhat gooey and changeable. It can flow like a thick liquid.
 - c) Turn up the setting on the bunsen burner or hot plate. Wait until the wax melts into a runny liquid. Explain that Earth's outer core is so hot that it is molten, which means that it acts like a hot liquid.
 - d) Explain that temperatures are even greater in Earth's inner core, however Earth's inner core is solid. Turn off the bunsen burner or hot plate. Earth's inner core is composed of the same material as Earth's outer core. Ask students to brainstorm reasons Earth's inner core is solid and not liquid. After the brainstorming session, explain that scientists believe Earth's inner core, which is at the very center of Earth, is under tremendous pressure. This pressure is so intense that it pushes the elements in Earth's core together into a solid ball.
3. Distribute the Student Worksheet: "Earth's Elements and Temperatures" and the Student Information Sheet: "Earth's Elements and Temperatures." Ask students to fill in the information required on the Worksheet.

Note: Crustal temperatures vary. Ask students to estimate the temperatures on Earth's surface in order to complete the bar graph on the Student Worksheet: "Earth's Elements and Temperatures."
Hint: Earth's surface temperature is similar to air temperature.

Earth's Elements and Temperatures

CRUST

Earth's crust is composed of igneous, sedimentary, and metamorphic rock and is classified as oceanic or continental. The elements in the crust are less dense than those found in Earth's other layers.

Temperature: Varies across the crust

Composition: Mostly made up of the elements oxygen, silicon, aluminum, calcium, iron, sodium, potassium, and magnesium

MANTLE

The mantle contains solid rock. High temperatures and pressure can cause some of this solid rock to flow like an extremely thick liquid and change shape. Rock that can behave like an elastic solid has the property of plasticity, which means it can be molded like wax.

Temperature: Ranges from 870 °C at the upper mantle to 2200 °C at the lower mantle

Composition: The elements silicon, oxygen, iron, and magnesium

OUTER CORE

Earth's outer core contains mostly iron and nickel. Temperatures in the outer core are so hot that elements within this layer melt into molten rock. The molten rock in the outer core behaves like a hot liquid.

Temperature: Ranges from 2200 °C at the upper part of the outer core to 5000 °C at the lower part of the outer core.

Composition: The elements iron and nickel

INNER CORE

Earth's solid inner core contains iron and nickel, which are two elements that usually melt at the 5000 °C temperatures reached in the inner core. However, the inner core is solid. Being at the very center of Earth, the inner core is under tremendous pressure. The pressure is so great that it compresses iron and nickel into a solid ball.

Temperature: Reaches 5000 °C

Composition: The elements iron and nickel

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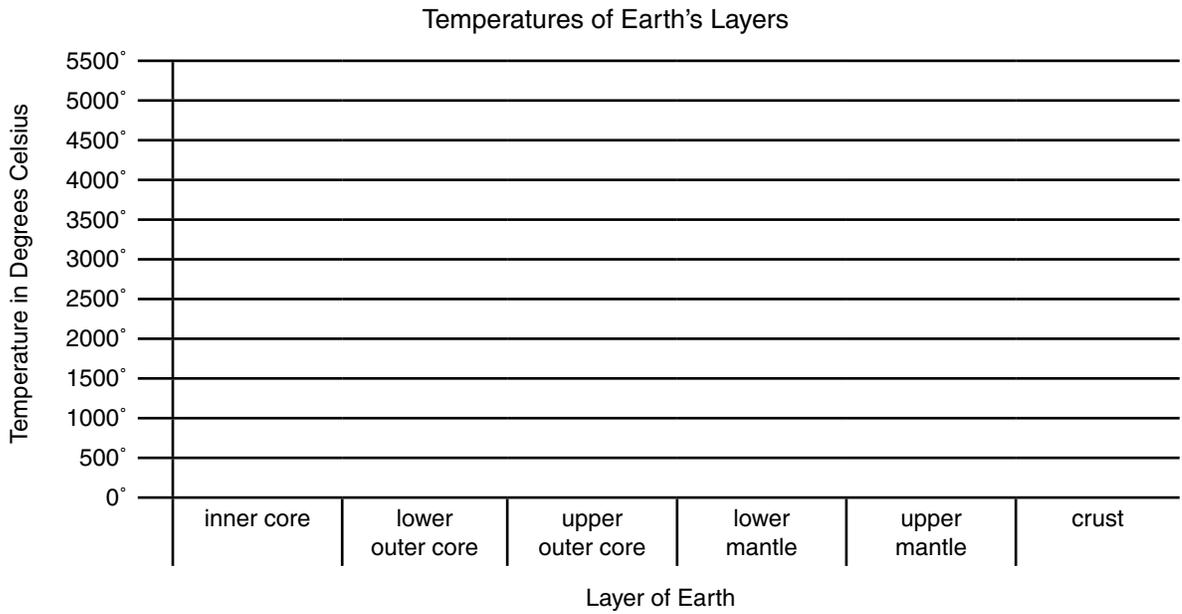
Directions: For each of Earth's layers:

1. Fill in the temperature or temperature range.
2. Write in the most abundant elements that exist in that layer.

a) Crust	Elements: Temperature Range:	0 km
b) Mantle	Elements: Temperature Range:	32 km
c) Outer Core	Elements: Temperature Range:	2900 km
d) Inner Core	Elements: Temperature Range:	5150 km 6500 km

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3. Complete the bar graph below with the temperatures of each of Earth's layers.



4. Circle the correct answer:

Layers near the center of Earth are (*hotter / cooler*) than layers closer to Earth's surface.