Convection Currents 46

1 40- to 50-minute session

ACTIVITY OVERVIEW

Students explore the mechanism behind plate motion as they investigate convection currents.

KEY CONCEPTS AND PROCESS SKILLS

(with correlation to NSE 5–8 Content Standards)

1. The earth is made of up different layers (crust, mantle, outer core, inner core). Each of these layers has distinct properties. (EARTH SCI: 1)
2. The continents are part of large lithospheric plates that have moved over geological time and continue to move at a rate of centimeters per year. One theory is that convection currents within the earth's mantle drive this plate motion. (EARTHSCI: 1, 2)

KEY VOCABULARY

convection current

magma

mantle

MATERIALS AND ADVANCE PREPARATION

For the class

* supply of warm water

* supply of cold water

For each group of four students

2 9-oz. plastic cups (or other large containers)

1 plastic syringe

1 plastic cup with circular depression

1 small vial with 2-holed cap

1 bottle of red food coloring

* paper towels and/or a sponge

**Not supplied in kit*

Make sure you have plenty of both warm and cold water available. This investigation will work if students use the 9-oz plastic cups provided, but works better if they use larger containers, such as 500-mL beakers.

The vial snaps into the base of the plastic cup with the circular depression. In some cases, it is a very tight fit and the vial must be forcefully pushed into place. You may want to check your materials and snap the two pieces together prior to conducting this activity with the class.

SAFETY

This activity requires the use of warm water. However, extremely hot (e.g. boiling) water is not required; warm tap water will work fine, though it helps to use water that is warm enough so that it doesn't cool down too rapidly. Allow very hot water to cool slightly before allowing students to use it. Review classroom expectations for safety during this activity.

TEACHING SUMMARY

Getting Started

1. Students read the introductory text in the Student Book.

Doing the Activity

2. Students investigate convection currents.

Follow-Up

3. Discuss how differences in temperature cause convenction currents.

TEACHING SUGGESTIONS

GETTING STARTED

1. Students read the introductory text in the Student Book.

Have students read the introduction and Challenge. Explain that **convection** is the circulation of a fluid due to differences in temperature. Students will investigate the formation of a convection current by mixing warm and cold water in two different trials. They will observe which trial results in the formation of a convection current.

DOING THE ACTIVITY

2. Students investigate convection currents.

Demonstrate how to use the equipment, particularly the small vial that fits into the plastic cup. Make clear to students that the 2-holed cap must face up when the vial is snapped into place.

Help students as needed. You may need to provide assistance in recording observations. Students may find it helpful to construct a quick sketch of the movement of the colored water.

Have students complete the investigation. After adding cold water to the warm water in the vial in Trial 1, the warmer, less dense red water should flow out of the holes in the vial and rise above the top of the colder water in the cup. When warm water is added to cold water in the vial in Trial 2, nothing should happen, since the colder, denser water is already below the hot water. If the cup is accidentally moved during Trial 2, it is possible that some of the cooler, red water will flow out of the vial. If this happens, it should appear to settle at the bottom of the cup.

FOLLOW-UP

3. Discuss how differences in temperature cause convenction currents.

Analysis Questions 1 and 2 are intended to help guide students' understanding of convection currents. Ask students to share their responses, and discuss how the differences in water temperature resulted in the formation of a convection current.

Explain that convection currents require a source of heat. Remind students that the temperature of the earth's layers increases with depth. You may want to have students turn to Table 1, "Layers of the Earth," at the end of the Reading in Activity 38, "Beneath the Earth's Surface," to compare the relative temperatures. Since the core is much hotter than the mantle, it would continue to heat magma in the mantle as it began to cool and sink. Scientists hypothesize that the source of the earth's heat is either the radioactive decay of naturally-occurring radioactive elements within the earth's core, or residual heat from the formation of the earth, 4.6 billion years ago.

SUGGESTED ANSWERS TO QUESTIONS

1.  *a. Did both trials result in the movement of water? Why or why not? Discuss your ideas with your group.*

   Only Trial 1, in which the warm water was placed in the vial, resulted in the movement of water (the warm water rose upward and outward). There was no movement of water in Trial 2. This is because warm water rises and cold water sinks. In Trial 2, the warm water was already on top and the cold water was already at the bottom.

   b. What do you think is necessary for a convection current to form?

   It is necessary for warm water to be at the bottom (heated from below) and the cooler water to be sitting above it. It is the rising of warm water and its resulting displacement of the cool water that results in the formation of a convection current.

2.  *Compare the results of your two trials. When warm and cold water are mixed, what happens to*

   a. *the warm water?*

      It rises to the top.

   b. *the cold water?*

      It sinks to the bottom.

3.  *Imagine that hotter magma is lying beneath an area of cooler magma deep in the mantle. What do you predict will happen? Be as specific as you can and explain your reasoning.*

   The hotter magma would rise and the cooler magma would sink. This would results in a current. In this activity, water was used to model magma, so I think what happens to water will happen to magma.

4. *What do scientists believe cause plates to move?*

   Convection currents within the earth's mantle caused by differences in temperature of magma within the mantle.