

CHAPTER 14 The Movement of Ocean Water

SECTION 1 **Currents**

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What factors affect ocean currents?
- Why are ocean currents important?

National Science Education Standards
ES 1j

What Are Surface Currents?

Imagine that you are stranded on an island. You write a note and put it into a bottle. You throw the bottle into the ocean to communicate with the outside world. Can you predict where the bottle will end up? If you understand ocean currents, you can! The oceans contain many streamlike movements of water called **ocean currents**. There are two main kinds of ocean currents: surface currents and deep currents.

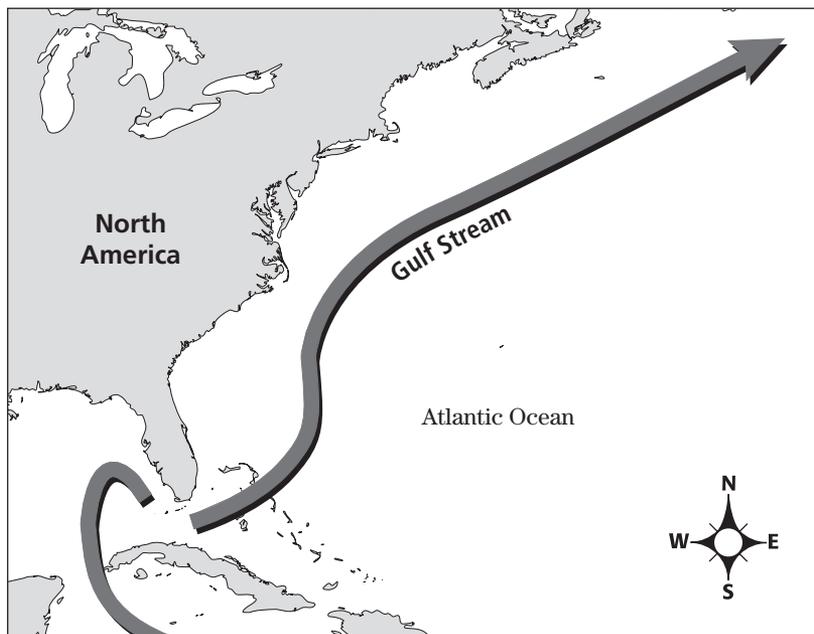
Surface currents are horizontal, streamlike movements of water that are found at or near the surface of the ocean. Surface currents can be up to several hundred meters deep. They can be as long as several thousand kilometers. Three factors affect surface currents: global winds, the Coriolis effect, and continental deflections. ✓

STUDY TIP

Summarize As you read, make a diagram showing the types of ocean currents and the factors that affect them.

READING CHECK

1. Define Write your own definition for *surface current*.



The Gulf Stream is one of the largest surface currents in the world. Every year, it transports at least 25 times as much water as all of the rivers on Earth combined!

TAKE A LOOK

2. Read a Map In what direction does the Gulf Stream flow?

SECTION 1 Currents *continued*

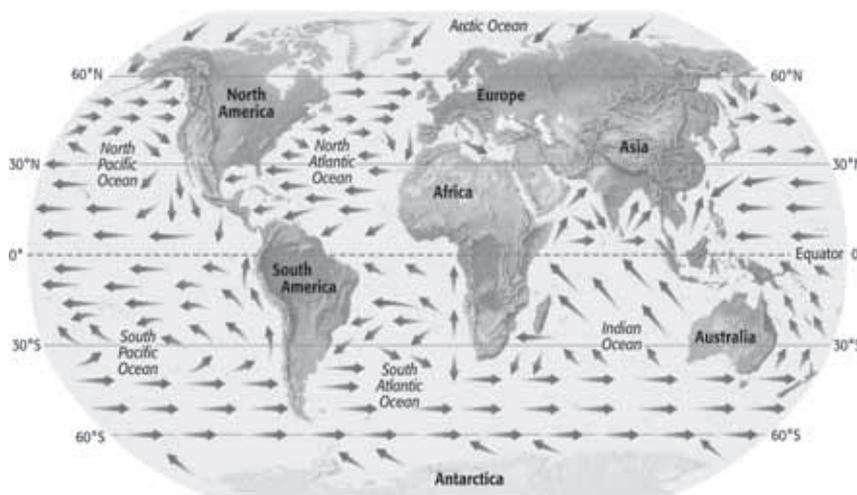
GLOBAL WINDS

Have you ever blown across a bowl of hot soup? You may have noticed that your breath pushes the soup across the surface of the bowl. In much the same way, winds that blow across the surface of Earth's oceans push water across Earth's surface. This process causes surface currents in the ocean. ✓

READING CHECK

3. Explain How do winds cause surface currents?

Many winds blow across Earth's surface, but they do not all blow in the same direction. Near the equator, the winds blow mostly east to west. Between 30° and 60° latitude, the winds blow mostly west to east.



Winds are important in producing surface currents. The winds near Earth's surface do not all blow in the same direction.

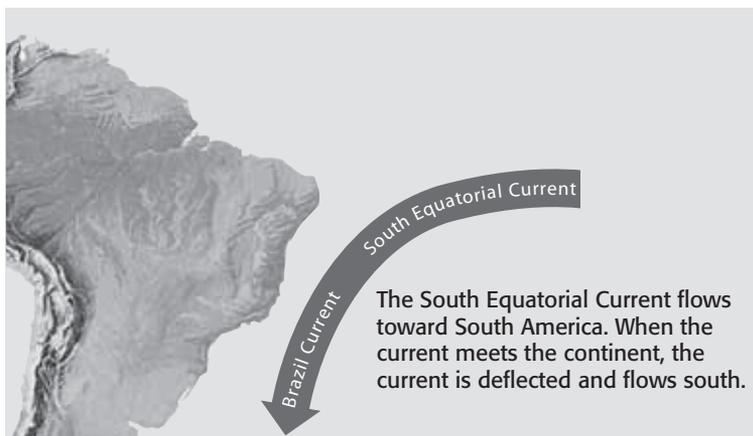
CONTINENTAL DEFLECTIONS

If Earth's surface were covered only with water, surface currents would travel across the oceans in a uniform pattern. However, continents cover about one-third of Earth's surface. When surface currents meet continents, the currents *deflect*, or change direction. The figure below shows this process.

TAKE A LOOK

4. Predict Consequences

What would probably happen to the South Equatorial Current if South America were not there?

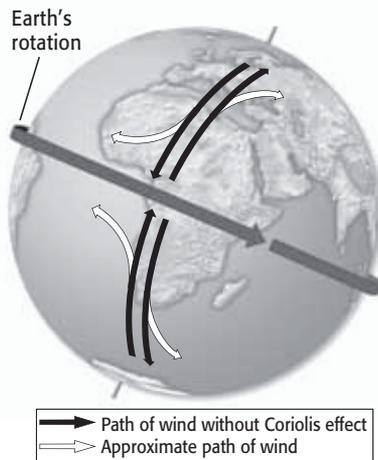


SECTION 1 Currents *continued*

THE CORIOLIS EFFECT

Earth’s rotation also affects the paths of surface currents. If Earth did not rotate, surface currents would flow in straight lines. However, because Earth does rotate, the currents travel along curved paths. This deflection of moving objects from a straight path because of Earth’s rotation is called the **Coriolis effect**. ✓

As Earth rotates, places near the equator travel faster than places closer to the poles. This difference in speed causes the Coriolis effect. Wind or water moving from the poles to the equator is deflected to the west. Wind or water moving from the equator to the poles is deflected east. The figure below shows examples of these paths.



The Coriolis effect causes wind and water to move along curved paths.

The Coriolis effect is most noticeable for things that travel very fast or travel over long distances. Over short distances or with slow-moving objects, the rotation of the Earth does not make much of a difference.

HOW SURFACE CURRENTS DISTRIBUTE HEAT

Surface currents help to move heat from one part of Earth’s surface to another. Water near the equator absorbs heat energy from the sun. Then, warm-water currents carry the heat from the equator to other parts of the ocean. The heat from the warm-water currents moves into colder water or into the atmosphere. The figure on the next page shows Earth’s main surface currents.

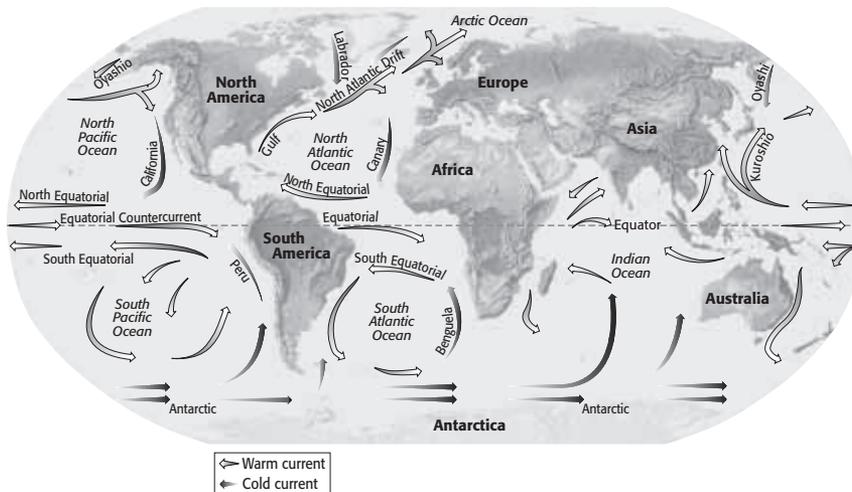
READING CHECK

5. Describe How does Earth’s rotation affect the paths of surface currents?

TAKE A LOOK

6. Apply Concepts A surface current starts at the equator near the west coast of Africa and begins moving north. In which direction will the current end up moving?

SECTION 1 Currents *continued*



TAKE A LOOK

7. Identify Which surface current carries warm water along the equator toward the west coast of South America?

This map shows Earth's major surface currents. Surface currents help to distribute heat across Earth's surface.

What Are Deep Currents?

Not all ocean currents are found at the surface. Movements of ocean water far below the surface are called **deep currents**. Unlike surface currents, deep currents are not controlled by wind. Deep current movements are controlled by water density. ✓

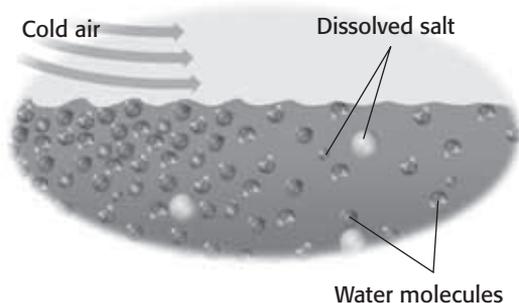
READING CHECK

8. Compare How are deep currents different from surface currents? Give two ways.

Density is the amount of matter in a given space or volume. The density of ocean water is affected by temperature and salinity. *Salinity* is a measure of the amount of salts or solids dissolved in a liquid. Cold water is denser than warm water. Water with a high salinity is denser than water with a low salinity.

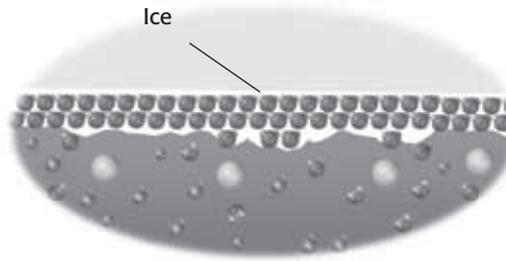
Deep currents form when the density of ocean water increases and it sinks toward the bottom of the ocean. There are three main ways that the density of ocean water can increase. The figure below shows one way. The figures on the next page show two other ways.

Decreasing Temperature
Near the poles, heat moves from ocean water into the colder air. The water becomes colder. The particles in the water slow down and move closer together. The volume of the water decreases, which makes the water denser.

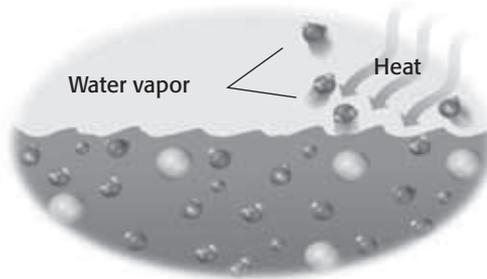


SECTION 1 Currents *continued*

Increasing Salinity Through Freezing When ocean water freezes, the salt in the ocean water does not become part of the ice. The salt remains in the water that has not frozen. This process increases the salinity of the water, and the water becomes denser.



Increasing Salinity Through Evaporation When ocean water evaporates, the salt in the water remains in the liquid. This process increases the salinity of the water, and the water becomes denser.

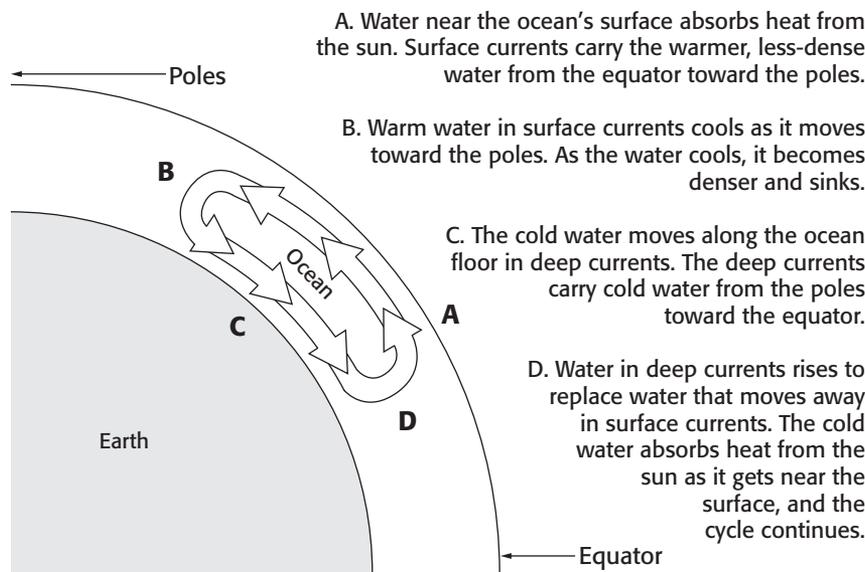


TAKE A LOOK

9. Explain How does freezing cause ocean water to become denser?

There are several main deep currents in the ocean. The deepest and densest water in the ocean is the *Antarctic Bottom Water*, which forms near Antarctica. *North Atlantic Deep Water* is less dense and forms in the North Atlantic Ocean. Water that is less dense stays above denser water. Therefore, North Atlantic Deep Water stays on top of Antarctic Bottom Water when the two meet.

Deep currents and surface currents are closely linked. The warm water in surface currents sinks as it cools and becomes the cold water in deep currents. The figure below shows how this happens.



Critical Thinking

10. Infer Why do most deep currents form near the poles?

Section 1 Review

SECTION VOCABULARY

Coriolis effect the curving of the path of a moving object from an otherwise straight path due to the Earth's rotation

deep current a streamlike movement of ocean water far below the surface

ocean current a movement of ocean water that follows a regular pattern

surface current a horizontal movement of ocean water that is caused by wind and that occurs at or near the ocean's surface

1. **Identify** What causes surface currents?

2. **Identify** What causes deep currents?

3. **Describe** What three factors control the path of a surface current?

4. **List** Give three ways that the density of ocean water can increase.

5. **Explain** What causes the Coriolis effect?

6. **Apply Concepts** Which type of water is more dense: cold, salty water or warm, less salty water? Explain your answer.

6. **Predict Consequences** If there were no continents on Earth, what paths would the ocean's surface currents take? Explain your answer.

