KEY CONCEPT

Ocean water moves in currents.

BEFORE, you learned
- The ocean is explored with sonar and satellite imaging
- The ocean floor is a varied landscape
- The ocean contains dissolved salts and gases

NOW, you will learn
- What causes ocean currents
- How currents distribute heat around the globe
- How currents interact with climate and weather

VOCABULARY
- ocean current p. 84
- downwelling p. 86
- upwelling p. 86
- El Niño p. 88

EXPLORE Currents

How does cold water move?

PROCEDURE
1. Stir together cold water, ice, and 3 drops of food coloring in the paper cup. Tape the cup to one inside corner of the plastic box.
2. Fill the plastic box with enough room-temperature water to submerge the bottom of the cup.
3. Use a toothpick to carefully poke a hole in the bottom of the cup. Observe the movement of water.

WHAT DO YOU THINK?
How do you know the water is moving? What do you think is the reason for this movement?

The oceans have major currents.

Would you ever want to go rafting on the ocean? Thor Heyerdahl of Norway did it in 1947 to demonstrate how early people might have migrated around the world. He floated on a wood raft from South America to Polynesia, without motor or paddles, powered only by an ocean current. An ocean current is a mass of moving water. There are many different currents that move water through the ocean. As they move water, ocean currents distribute heat and nutrients around the globe.
Surface Currents

Strong winds blowing over the ocean are set in motion by the uneven heating of Earth’s surface. These winds cause surface currents to flow. The currents extend only about 100 to 200 meters (300–500 ft) down into the ocean, but they cover large areas. The map below shows the major surface currents.

Earth’s rotation curls surface currents into giant clockwise whirlpools in the Northern Hemisphere. In the Southern Hemisphere, currents curl counterclockwise because of Earth’s rotation. The shapes of continents also affect the paths of surface currents.

Use your finger to trace a few of the surface currents on the map. Surface currents carry warm water away from the equator and cool water away from the poles. In this way, surface currents moderate global temperatures.

CHECK YOUR READING

What causes surface currents?

Global Surface Currents

Surface currents are caused by winds. They move warm water away from the equator and cool water away from the poles.

Which currents could be used for sailing east across the Atlantic Ocean?
Deep Currents

In addition to surface currents, there are also currents flowing deep in the ocean. Deep currents are driven by differences in water density. Dense water sinks in the ocean the same way that dense chocolate syrup sinks in a glass of milk.

Seawater can become more dense because of cooling, an increase in salinity, or both. The densest water is found in the polar regions. For example, as sea ice forms near Antarctica, the salinity of the cold water beneath the ice increases. The highly dense water sinks down the continental slope of Antarctica and then moves slowly across the ocean floor. It may take 1000 years for water from this current to resurface near the equator. Another deep current flows out from the Arctic Ocean.

The movement of water in deep currents involves two processes important to ocean life. **Downwelling** is the movement of water from the surface to greater depths. As the water sinks, it carries oxygen down from the surface. The oxygen allows animals to live in the deep ocean.

**Upwelling** is the movement of water up to the surface. Because this process brings up nutrients from the deep ocean, large numbers of ocean animals live in areas where upwelling occurs.

How Upwelling Affects Ocean Life

Upwelling provides nutrients that support animals and plants in surface waters.

1. Wind moves water away from the shore.
2. Upwelling occurs as deeper water rises to replace the surface water that has moved away.

The water rising to the surface is rich in nutrients. Many fisheries are located in areas of upwelling because ocean animals thrive there.
Ocean Systems

Chapter 3:

Currents interact with climate and weather.

Imagine mixing red and blue paint in a cup by blowing through a straw. You can move some paint around, but you cannot predict exactly what pattern will result. Similarly, the ocean and the atmosphere interact in unpredictable ways. Moving air produces movement in the water while the water changes the air above it.

Remember that windblown surface currents help distribute heat around the globe by moving warm water away from the equator and cool water away from the north and south poles. The Gulf Stream, for example, is a surface current that moves warm water northeastward toward Great Britain and Europe. Because of the warm Gulf Stream waters, the British climate is mild. No polar bears wander the streets of Great Britain, as they might in places in Canada that are just as far north.

What happens where bodies of water meet?

PROCEDURE

1. Divide the box into two compartments, using masking tape and aluminum foil.
2. Pour one solution into one side of the box while a partner pours the other solution into the opposite side. Be sure you and your partner pour at the same time in order to keep the barrier from breaking.
3. Sprinkle pepper on the high-salinity side.
4. Use the pencil to poke two holes in the aluminum foil—one just below the water surface and another near the bottom of the box. Observe for 10 minutes.

WHAT DO YOU THINK?

- What did you observe in the box? Did you expect this?
- What forces drove any movements of water you observed?

CHALLENGE

Compare what you observed with what you have learned about the actual movements of water in the ocean. How could you change the experiment to better model actual ocean currents?

How does the Gulf Stream affect Great Britain?
A change in even one of Earth’s surface currents can result in huge changes in weather patterns. Most years, winds blow westward across the tropical Pacific Ocean. Every three to seven years, however, these winds do not blow as strongly as usual. Without the winds, the movement of currents in the Pacific is disrupted. These changes in air and water movements cause a global weather event called El Niño, which may last for 12 to 18 months.

During El Niño years, weather patterns change around the planet. Some places get more or less rain or snow than usual. Temperatures may be warmer or cooler than in other years. By using satellite readings of ocean temperatures and floating measurement devices to study conditions in the Pacific, scientists can often predict when El Niño will occur and how severe, or strong, it will be.

**COMPARE AND CONTRAST** These two towns are at about the same latitude, or distance from the equator. Ice can be found off the coast of La Scie, Newfoundland. Ice is never found off the coast of Fowey, England, which has mild weather year-round. What might explain this difference? **Hint:** the answer has to do with the Gulf Stream.