

4.2

KEY CONCEPT

Ocean water moves in currents.

Sunshine State STANDARDS

SC.D.1.3.3: The student knows how conditions that exist in one system influence the conditions that exist in other systems.

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. 124

downwelling p. 126

upwelling p. 126

El Niño p. 128

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.

MATERIALS

- cold water
- ice cubes
- food coloring
- paper cup
- masking tape
- clear plastic box
- toothpick
- room-temperature 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.



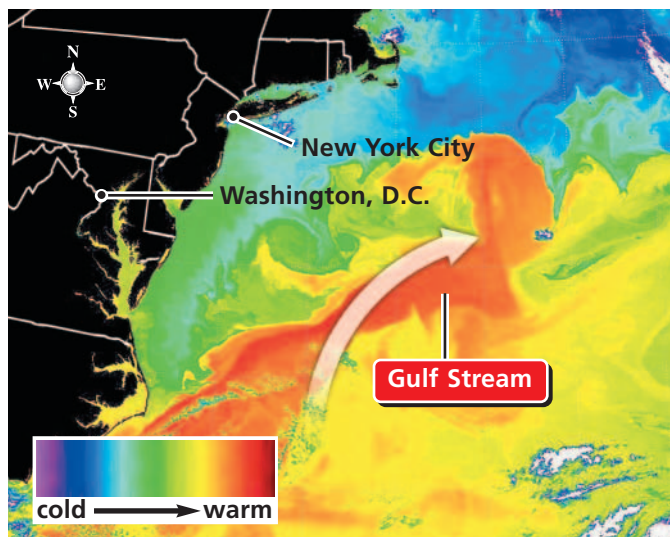
Learn more about the different types of ocean currents.

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.



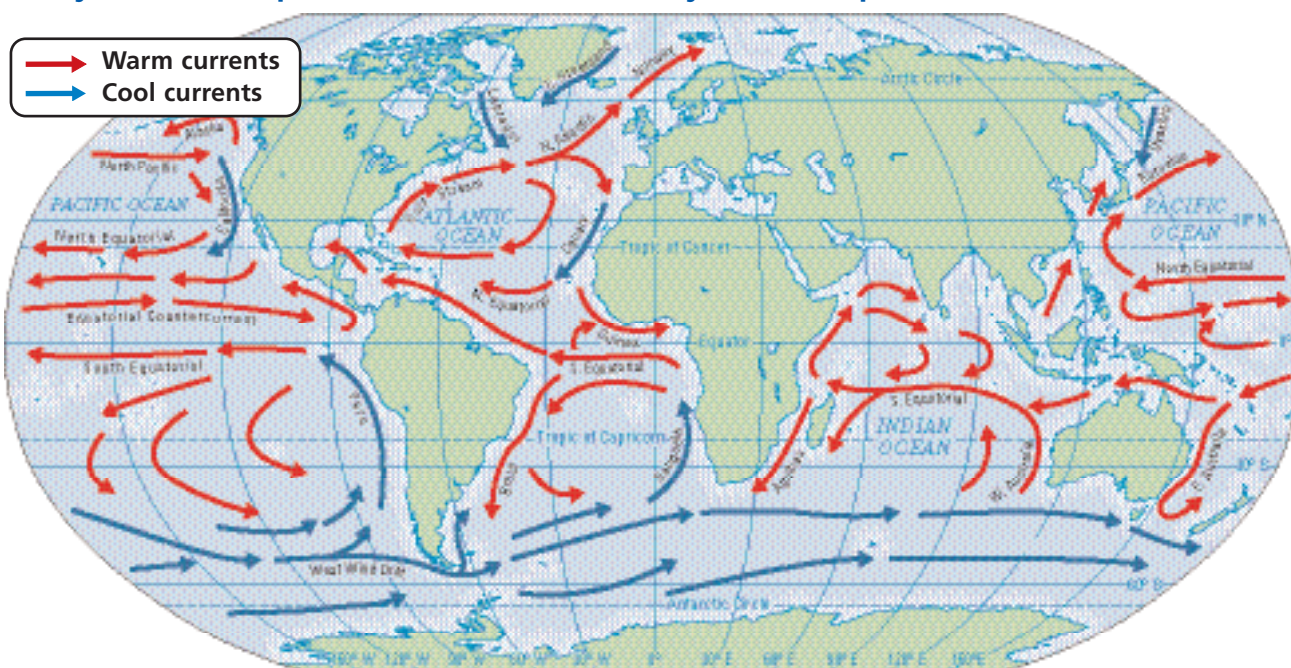
This satellite image shows the Gulf Stream, a surface current that flows along the eastern coast of the United States. The colors indicate the temperature of the water.

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.



READING VISUALS

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

Deep Currents

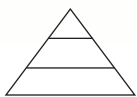
In addition to surface currents, there are also currents flowing deep in the ocean. Deep currents are driven by differences in water density. Dense water sinks in the ocean the same way that dense chocolate syrup sinks in a glass of milk.

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.

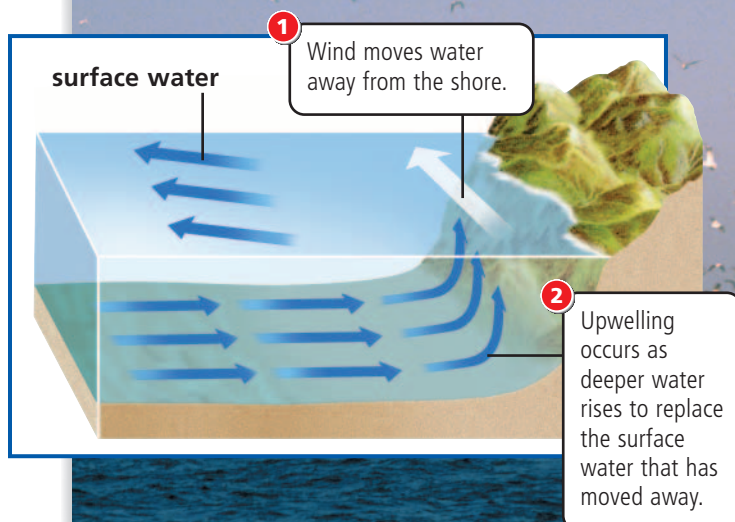
VOCABULARY

Add word triangles for *downwelling* and *upwelling* to your notebook.

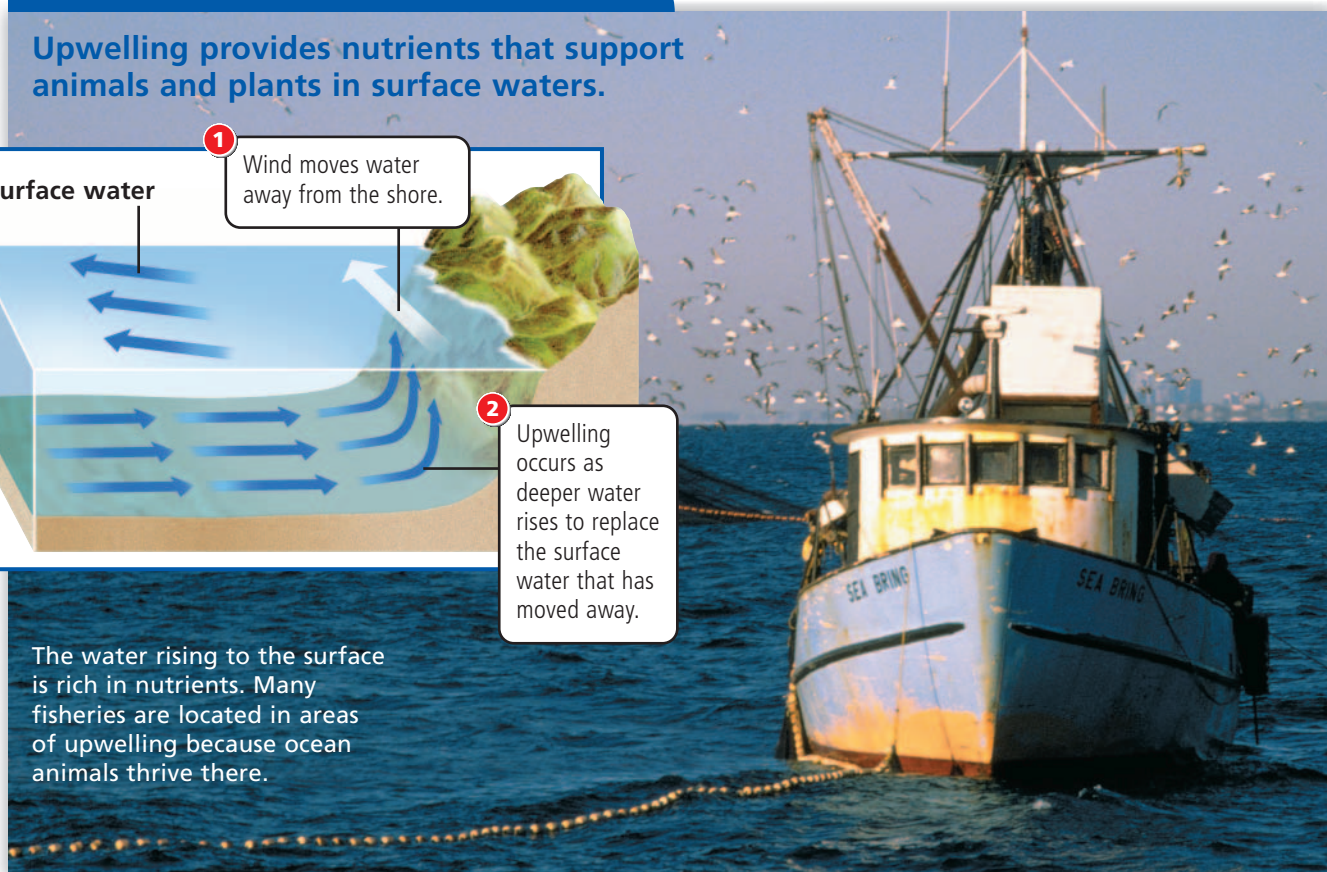


How Upwelling Affects Ocean Life

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



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



INVESTIGATE Currents

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?

SKILL FOCUS

Observing

MATERIALS

- clear plastic box
- aluminum foil
- masking tape
- high-salinity water
- low-salinity water
- pepper
- sharp pencil

TIME
30 minutes



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.

FLORIDA Content Review

Recall what you learned about climate in grade 6. Notice here how the temperature of ocean currents affects the climate of an area.

CHECK YOUR READING

How does the Gulf Stream affect Great Britain?



La Scie, Newfoundland



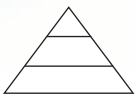
Fowey, England


**READING
VISUALS**

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.

VOCABULARY

Remember to make a word triangle for *El Niño*.



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.

4.2 Review

KEY CONCEPTS

1. What are two causes of currents in the ocean?
2. How do currents distribute heat around the globe?
3. How are climate and weather related to currents? Give two examples.

CRITICAL THINKING

4. **Infer** Describe at least two ways in which upwelled water might differ from the water around it.
5. **Infer** What factor do you think might cause a surface current to change direction?

CHALLENGE

6. **Predict** What would happen if all ocean currents suddenly came to a halt? Describe some effects this change would have.