Genre Explanatory Text

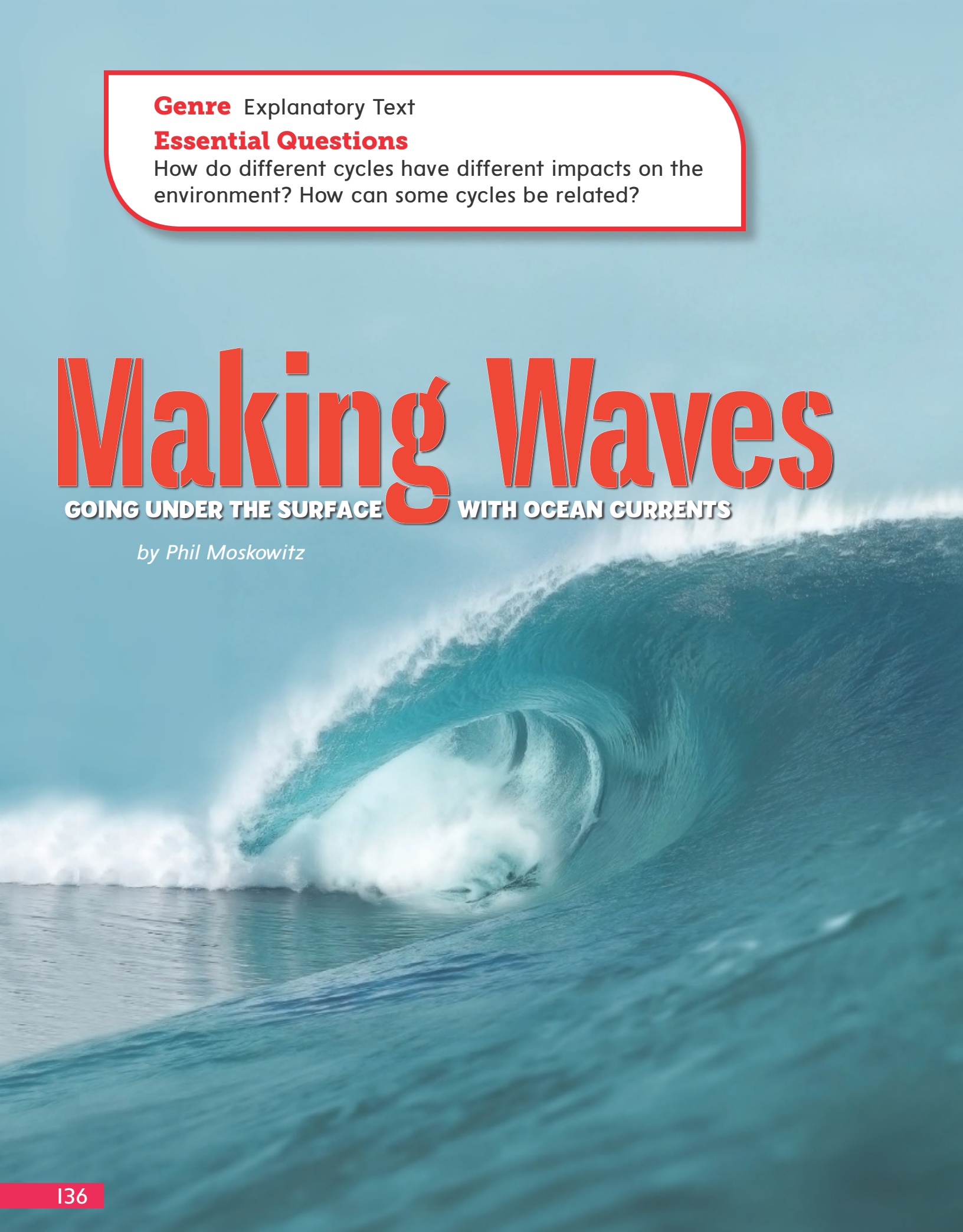
Essential Questions

How do different cycles have different impacts on the environment? How can some cycles be related?

Making Waves

GOING UNDER THE SURFACE WITH OCEAN CURRENTS

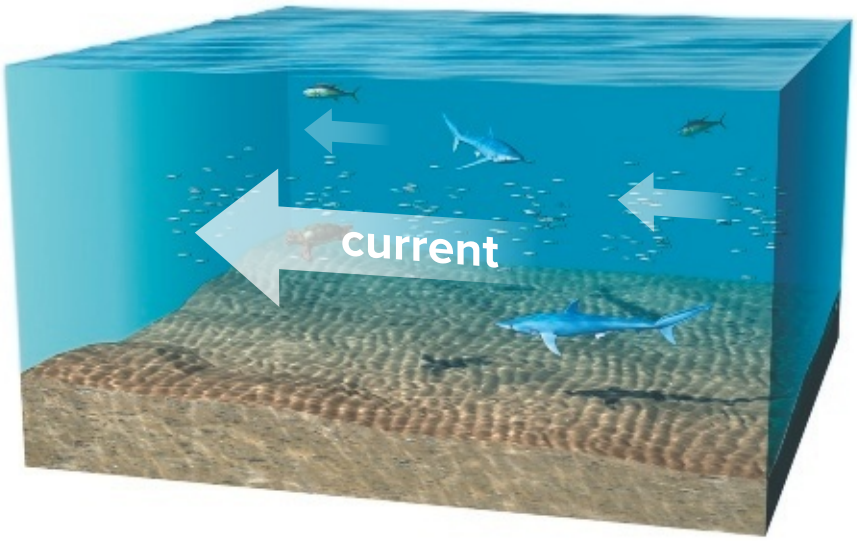
by Phil Moskowitz



Water covers more than seventy percent of our planet's surface. Although the surface is sprinkled with thousands of lakes and seas, most of Earth's water can be found in the five oceans. Inside these oceans, water is constantly moving warmer water to cold regions and cooler water to warm regions. Currents provide nutrients that allow for a rich sea life of plants and animals that live in the oceans.

WHAT ARE OCEAN CURRENTS?

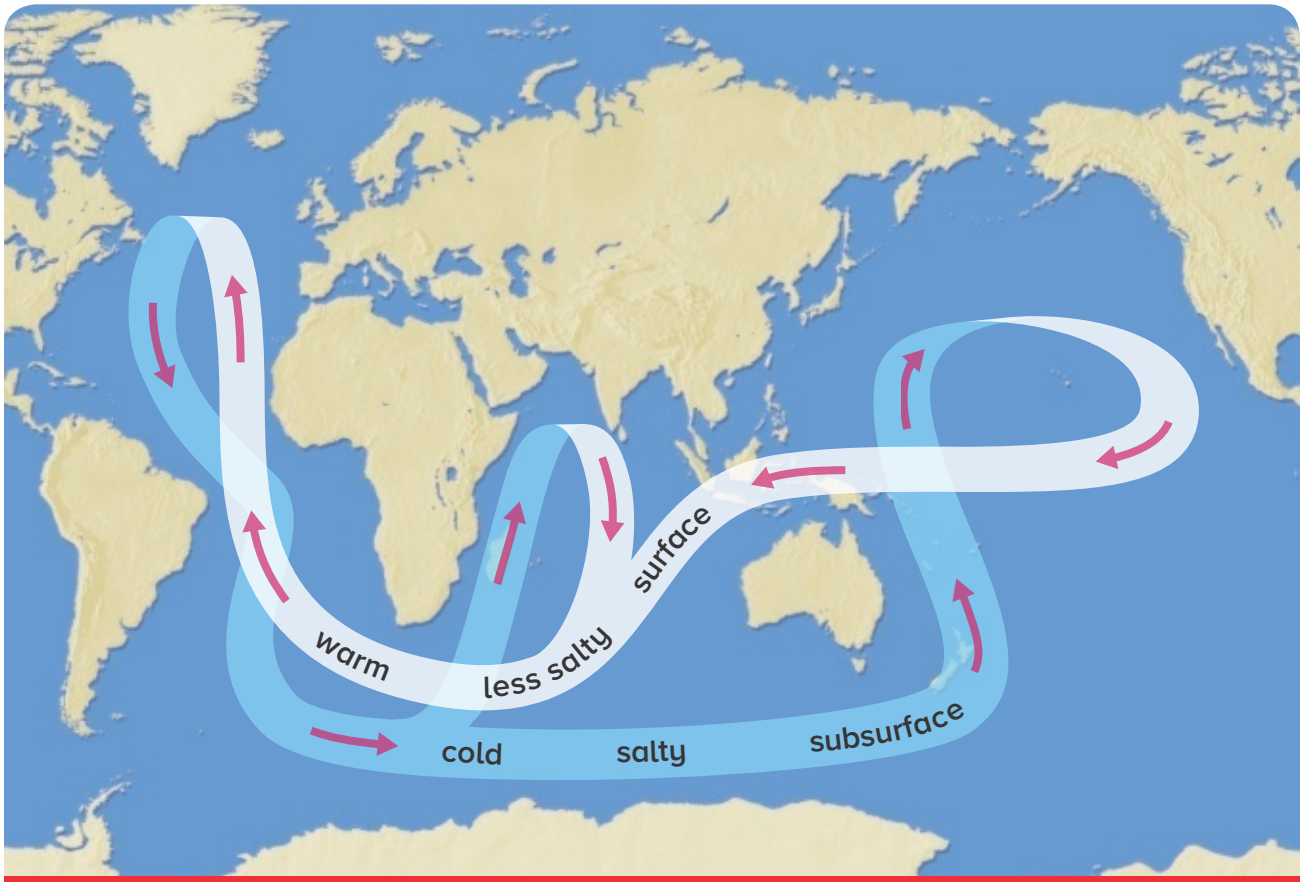
Ocean water is always on the move. Waves can lap quietly against a sandy beach or pound against a rocky shore. Even when the surface of the ocean seems motionless, flowing masses of water are moving just underneath. Known as *currents,* these masses are continually moving. They flow like rivers within the larger bodies of the oceans and mix together water from all around the world. As they move, they carry with them food, animals, and different temperatures that are integral to oceanic ecosystems around the planet.



How strong are currents? When scientists explore the ocean in a submersible, they must consider the strength of the currents in the area. Otherwise, the currents might carry the submersible away!

Currents take different forms depending on how deep they flow in the water. For example, wind forms surface currents. When the sun warms the ground, the air above the ground heats and rises into the atmosphere. Wind forms when cooler air rushes in to fill the empty space left by the rising warm air. When wind blows over the surface of the ocean, it pushes against the water and creates currents. The surface temperature of the water determines whether the currents are cold or warm.

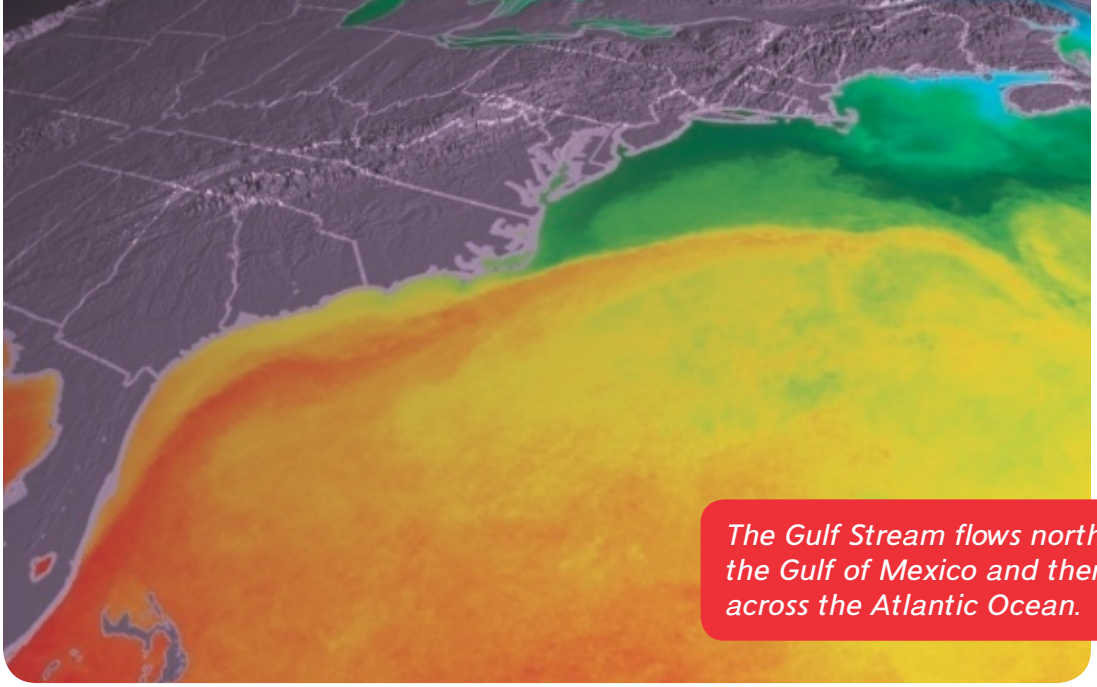
Earth's rotation also influences currents. Earth rotates on its axis once every twenty-four hours. As it spins, the rotation bends the wind and makes it veer off course. If Earth did not spin, the winds coming from the North and South Poles would blow straight across the equator. Instead, the winds bend to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. These bending winds affect the shape of ocean currents.



THE GREAT OCEAN CONVEYOR BELT

Changes in the temperature and salinity of the water cause currents deep underwater. Salinity is the amount of salt in the water. Colder and saltier water sinks and moves warmer and less salty water, creating a *density current*. Near the equator, water becomes saltier because it evaporates, but the salt does not. As this salty, sun-warmed current flows toward the North and South Poles, it begins to cool and sink. It can even sink to the bottom of the sea floor! As the current circles back to the equator, it grows warmer and rises and moves the colder water, thus maintaining the current. Scientists call this cycle the "Great Ocean Conveyor Belt" because it sends ocean water all around the globe.

Tides are another way that water moves around the globe. Although sometimes confused with currents, they are a distinct phenomenon. Tides are caused by the gravitational pull of the sun and moon on Earth's seawater. These alternating forces cause Earth's water levels to rise and fall. Although they are not classified as currents, tides are also responsible for moving water in the ocean. Certain species of fish rely on the movement of the tides. Some turtles also wait until high tide to lay their eggs.



The Gulf Stream flows north from the Gulf of Mexico and then east across the Atlantic Ocean.

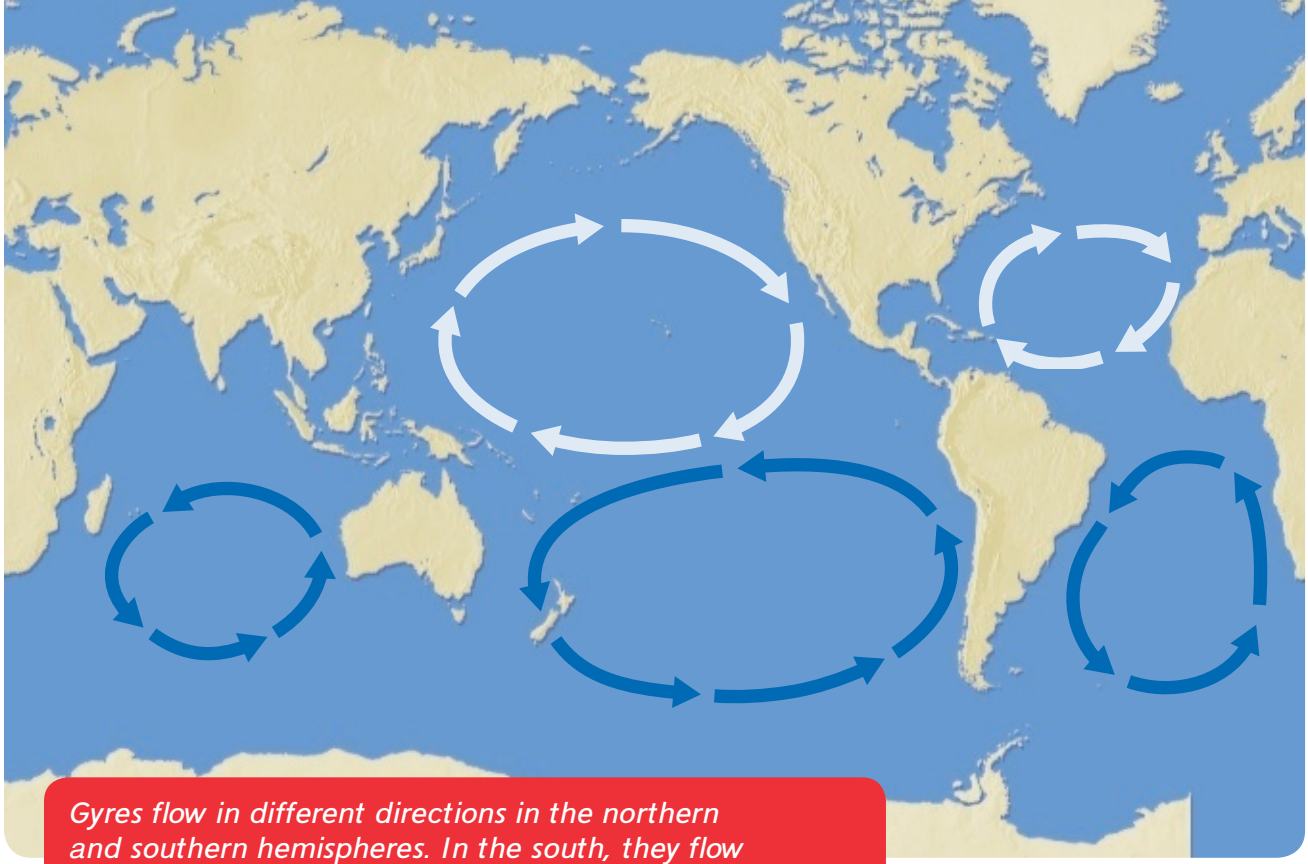
One of the world's largest currents is the Gulf Stream. The Gulf Stream begins in the warm waters near the equator and travels up the east coast of the United States. Then the Gulf Stream turns northeast and brings warm water and warm weather toward northern Europe. The heat from the tropical waters keeps northern Europe warmer than other northern areas.

Ocean currents usually follow a pattern like air currents high in the atmosphere. However, natural events can affect ocean currents on the surface and deep in the ocean. For example, hurricanes or major storms can disturb large masses of water near the surface and create or disrupt currents. Meanwhile, earthquakes and mud slides deep underwater can cause tsunamis, or large sea waves. Tsunamis can move large amounts of ocean water and disrupt currents as well.

GYRES

A *gyre* is a giant rotating pattern of currents in the ocean. Imagine stirring a pot of chicken soup or watching water go down a drain. Notice how the liquid on the outside rotates faster than the water in the center? A gyre acts similarly. The currents on the outside of the gyre move more quickly than the currents on the inside.

In the northern hemisphere, the currents in a gyre rotate in a clockwise direction. In the southern hemisphere, they rotate counterclockwise. These gyres carry cold water into the tropical areas and warm water into the colder climates in a constant motion. In areas where the warm water pushes down the cold water, the gyre kicks up minerals from the sea floor that are important to plankton. Many fish and other animals feed on plankton to survive.

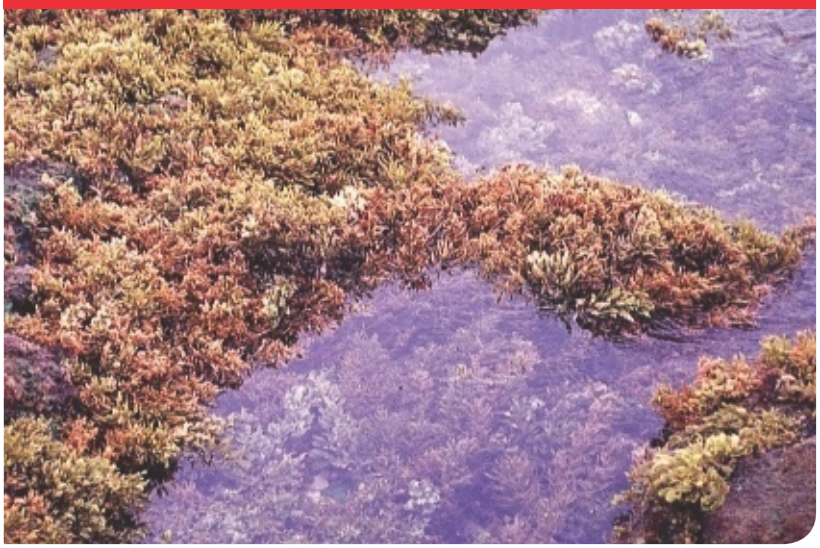


Gyres flow in different directions in the northern and southern hemispheres. In the south, they flow counterclockwise. In the north, they flow clockwise.

Continents and islands form a type of border that fences in a gyre. One example is the South Pacific Gyre. The South Pacific Gyre is hundreds of miles wide because the continents are spread far apart. On the other hand, the northern Indian Ocean Gyre is much smaller because the continents are located closer to one other.

Some gyres are teeming with animal life. One example is the Sargasso Sea, an area of warm water in the North Atlantic Gyre where the currents swirl clockwise north of the equator. The currents pull seaweed into the still waters at the center of the gyre. The result is an ecosystem not found anywhere else on Earth. Eels, crabs, and fish make their homes among the floating beds of seaweed. Baby loggerhead turtles swim to the Sargasso Sea and hide from predators in the floating garden. The turtles feed on small animals until they are large enough to swim in the open sea.

SARGASSO SEA



GARBAGE PATCHES: THE GYRES OF TRASH

Sadly, the swirling currents collect more than floating seaweed. The currents also gather trash. This trash has been carried down rivers into the ocean or dumped overboard from passing ships. This garbage can include plastics such as bottles, bags, or food wrappers. Sewage and other hazardous waste is sometimes dropped from cruise ships. The currents push the floating garbage thousands of miles across the ocean. There the garbage forms into giant stinking rafts of litter and debris. One such raft is known as the "Great Pacific Garbage Patch." It is more than fifteen hundred miles across.

Garbage in the ocean can have a harmful effect on sea life. Some animals die when they swallow bits of plastic thinking it is food. Animals also become trapped in discarded fishing nets and drown. According to one study, more than a hundred different animal species, like sea turtles and sea birds, become entangled in the garbage.

One of the biggest elements in ocean garbage is plastics. Unlike wood or metal, plastic does not break down fully. Instead, plastic breaks apart into smaller pieces that resemble food for fish, such as algae and plankton. Animals can choke or die because their bodies cannot digest the plastic. Additionally, predators can absorb the harmful chemicals in plastic. For instance, if a shark eats a fish that has eaten plastic, the harmful chemicals are then absorbed into the shark's body, which can be fatal.

THE GREAT PACIFIC GARBAGE PATCH

It can take hundreds of years for plastic waste to decompose in an ocean environment.

A whirlpool near Niagara Falls

WATCH OUT FOR THE WHIRLPOOLS!

When two currents come together in a narrow area, such as between two islands, the currents can speed up. The result is a spinning pool of water called a *whirlpool.* Whirlpools can be dangerous, especially to swimmers or sailors in small boats. One of the most famous and deadly whirlpools is located off the northeast coast of Norway. Twice a day, water speeds through a narrow gap between two islands at twenty-five miles per hour.

An *eddy* is similar to a whirlpool. However, an eddy is a circular current of water that runs in the opposite direction of a larger current. Like whirlpools, the water in eddies moves with great velocity. Nevertheless, eddies can still have a positive impact on an ecosystem. The churning motion of eddies causes important nutrients found in deeper water to rise to the surface. These nutrients help sustain plant and animal life.

CURRENTS AND AQUATIC LIFE

Although much of the world's sea life lives near the surface of the water, it may still depend on food that is far beneath it. In a process called *upwelling,* currents can flow upward to the surface and bring important nutrients needed to sustain life. For example, strong currents around Antarctica pump nutrients up to algae and plankton. Swarms of krill then eat the plankton. Whales, seals, and seabirds also migrate great distances to eat the krill.

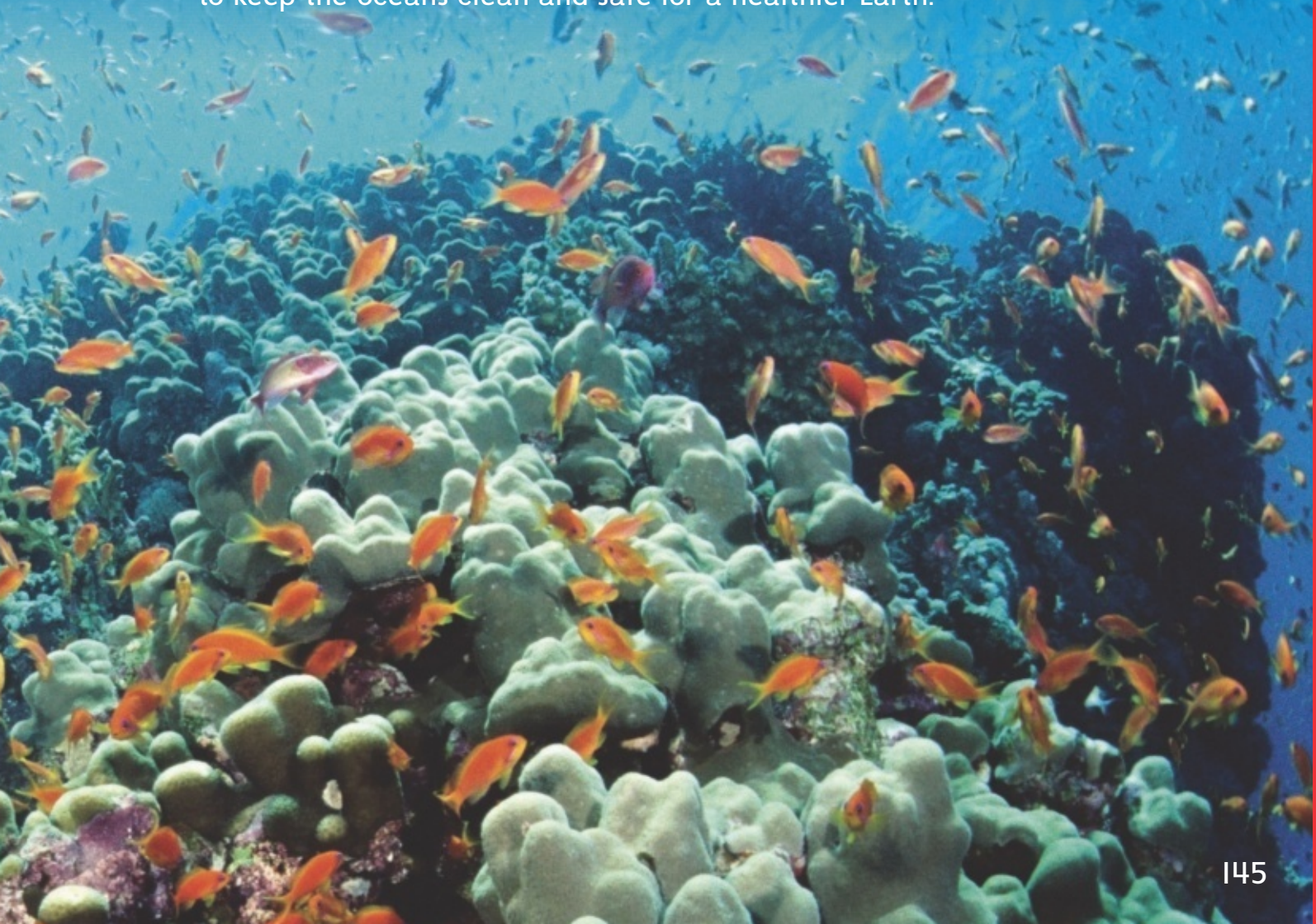
Some upwelling currents can be found near seamounts, or extinct volcanoes found underwater. Seamounts are covered with nutrient-rich sediment. A deep sea current slams into the base of a seamount, and then races up the seamount's side toward the surface, collecting nutrients along the way. The upwelling current then deposits the nutrients at the surface. These areas are called upwelling zones and they are full of sea life.

An upwelling moves nutrients to the top of a seamount.

Conversely, currents that flow downward are vital for life that thrives on the *bottom* of the sea. Downward currents bring oxygen-rich water from the surface into the deep sea in a process called *downwelling.* The surface water cleans the area of harmful bacteria that would be destructive to sea life.

The prevention of upwelling or downwelling in a certain region can have a harmful effect on sea life. For example, sometimes the winds across the Pacific Ocean are not as strong near South America. These weaker winds allow water near the surface to cover up an upwelling that brings vital nutrients up from the sea bed. Without the nutrients, plankton does not grow. Fish that eat the plankton then travel elsewhere to feed. The lack of fish can be disastrous for the birds and people that rely on the fish for food.

Ocean currents have enormous influences on the planet. They carry important nutrients to sea life floating near the surface or crawling along the sea floor. Currents also help regulate the temperature of the planet by moving warm and cool water around the world's oceans. Unfortunately, ocean currents can also collect trash and other pollution that is harmful to sea life. It is important to keep the oceans clean and safe for a healthier Earth.



Respond

Comprehension

You will answer the comprehension questions on these pages as a class.

Text Connections

1. How do currents form?
2. Explain why the world's different oceans could also be seen as only one body of water.
3. Describe the consequences of plastic waste that is left in the ocean.
4. How are whirlpools and gyres similar? How are they different?
5. Describe the importance of weather cycles, based on information in "Making Waves" and "Monsoons."
6. Based on the information from "Making Waves," predict several possible effects of ocean currents collecting trash and pollution.

Did You Know?

The tallest tsunami ever witnessed occurred in 1958 in Lituya Bay, Alaska. When it hit the shore, the wave uprooted trees over 1,700 feet above sea level!

Look Closer

Keys to Comprehension

1. If the Great Ocean Conveyor Belt were to stop circulating water, make inferences about the possible impact on the environment. Quote evidence from the text to support your answer.
2. Summarize the main idea of the section on the Great Pacific Garbage Patch. Quote details from the text to support your answer.
3. Explain how sea life benefits from ocean currents. Use evidence from the text to support your answer.

Writer's Craft

4. Describe what is meant by *upwelling* and *downwelling.* Support your description with details from the text.
5. Compare and contrast the information about the topic of the ocean in "Making Waves" and "Monsoons."

Concept Development

6. The author states: "It is important to keep the oceans clean and safe for a healthier Earth." Describe the evidence the author gives to support this claim.

Write

If you could spend a day at a warm ocean beach, how would you most like to enjoy the water? Write a description of your perfect day enjoying the ocean. Include plenty of sensory details.

Read this Science Connection. You will answer the questions as a class.

Text Feature

A **bulleted list** organizes a list of items that do not belong in a particular order. Some bulleted lists also contain sub-bullets.

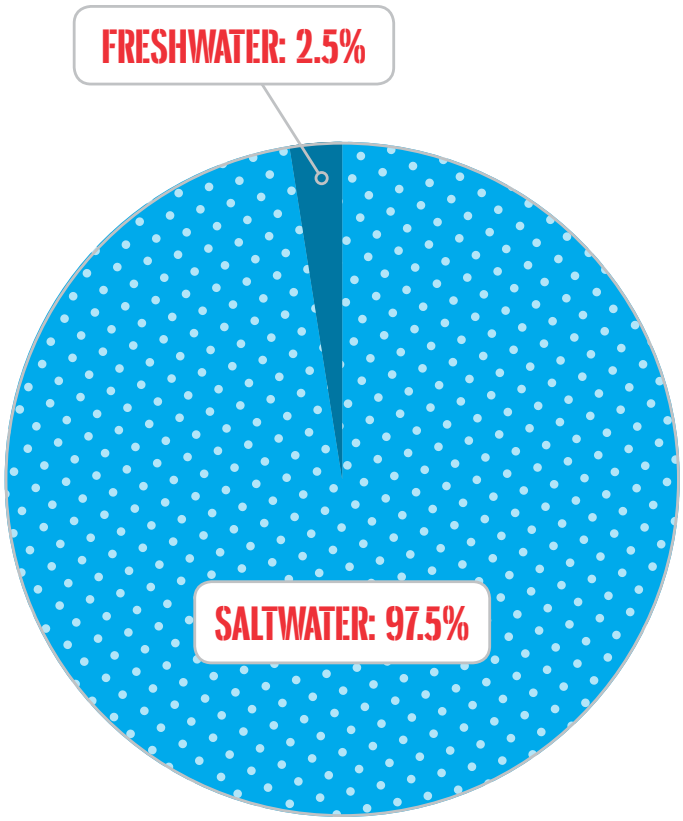
How Is Earth's Water Distributed?

Water is an integral part of life and, thankfully, it covers a huge percentage of the planet Earth. Knowing this might make you wonder why people so often talk about conserving water. Water is constantly moving through the water cycle on Earth, condensing and falling as precipitation. Most of the Earth's surface is covered by water and there are thousands of lakes in the United States alone. Isn't there plenty of water?

Unfortunately, only a tiny portion of Earth's water is freshwater, or drinkable water. Of the amount that is freshwater, much of it is not available for drinking. Here are the percentages that make up all of Earth's water:

- **Oceans** and other saltwater sources contain about 97.5% of all of Earth's water.
- **Freshwater** makes up the remaining 2.5%. Of this total amount of freshwater:
  - Almost 69% is locked inside **glaciers.**
  - A little over 30% is hidden below Earth's surface as **groundwater.**
  - A little over 1% is on Earth's surface in the form of **lakes, rivers,** and **ice,** as well as evaporated water in **clouds.**

When you consider the above numbers, it suddenly makes much more sense to conserve freshwater as much as possible. All the lake and river water in the world would only form a sphere about the size of the state of Georgia, and humans are using more and more of it every year. In less than ten years, our world could be facing an epic water crisis. To sustain future generations, we must carefully manage the freshwater we have so that future generations will have the water they need.



A pie chart comparing the amounts of saltwater and freshwater on Earth

1. Why do people need to conserve freshwater even though water covers so much of Earth?
2. Where is most of the freshwater on Earth?
3. Using the data from the Science Connection, create a pie chart showing the distribution of freshwater on Earth.

Go Digital

Some countries in dry regions are working on ways to desalinate water, or turn salt water into freshwater. Find out more about desalination and its challenges.