7.1 Introduction to Oceans

About 97% of Earth's water is contained in five oceans. The oceans cover most of Earth's surface and are important to life on the planet. However, we can't drink ocean water. It's too salty! In this section you will learn why the oceans are salty. You'll also learn about ocean currents.

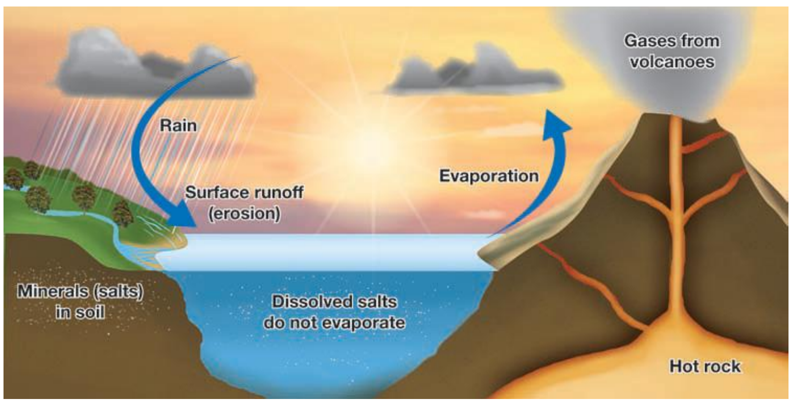
Salt water

Salt in ocean water

Ocean water is about 3.5 percent salt. The word **salinity** is used to describe the saltiness of water. Most of the salt in ocean water is sodium chloride. You use sodium chloride, or table salt, on your food. Sodium chloride is found in nature as the mineral *halite* (Figure 7.1). In some places, special ponds called *salt evaporation ponds* are set up to harvest salt from the ocean (Figure 7.2).

Sources of salt

The salt in the oceans comes from minerals in the ocean floor, from gases released by volcanoes, and from rivers that carry dissolved minerals from land to sea. These dissolved minerals come from chemical weathering of rocks on the continents.



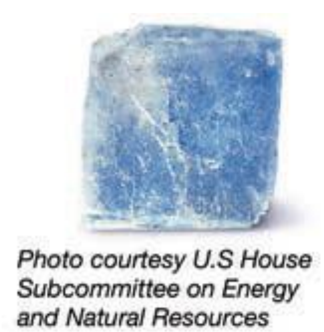


Figure 7.1: *Sodium chloride, or table salt, comes from the mineral halite.*

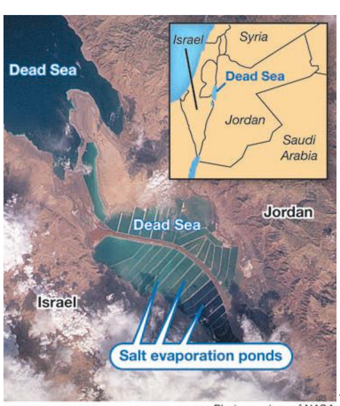


Photo courtesy of NASA **Figure 7.2:** *Salt evaporations ponds in the Dead Sea are used to harvest salt for human consumption.*

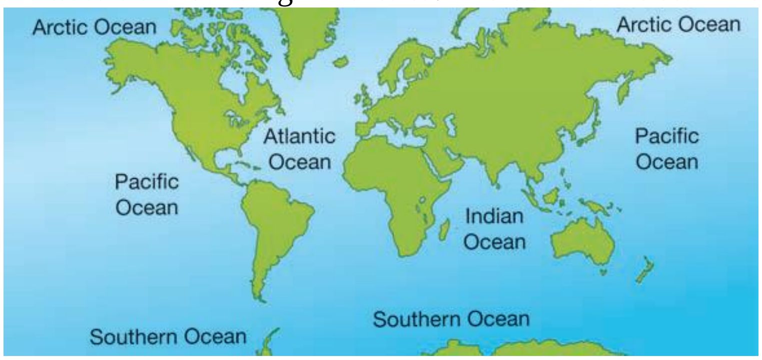
Earth's oceans

Earth from space

Astronauts are amazed when they see our blue planet from space. Earth is mostly bright blue because of its vast oceans.

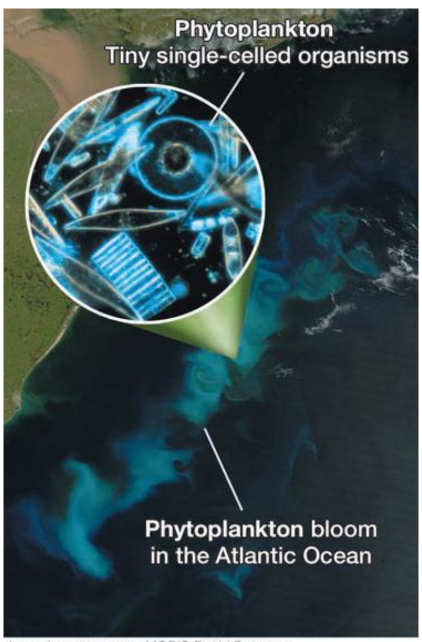
Five oceans

Four of Earth's oceans are easy to identify because of the shape of the surrounding continents. These four oceans are the Atlantic, Pacific, Indian, and Arctic oceans. The fifth ocean, the Southern Ocean, is composed of the waters surrounding Antarctica. The Southern Ocean includes the water south of 60° S latitude.



The importance of Earth's oceans

Oceans are an important source of water for the water cycle. They also help maintain Earth's heat balance. Because water has a high specific heat, the oceans do not heat up or cool down quickly. As a result, our climate does not become too hot or too cold. Also, oceans spread energy and heat from the hot equator to the colder poles through ocean currents and waves. In addition to moving heat, ocean currents help propel ships as they navigate the globe. The oceans are also important because tiny, single-celled ocean organisms called *phytoplankton* that live in the oceans produce most of the oxygen in the atmosphere (Figure 7.3).



Large image courtesy MODIS Rapid Response Project at NASA/GSFC. Inset image courtesy NOAA.

Figure 7.3: *Tiny, single-celled ocean organisms called phytoplankton produce most of the oxygen in the atmosphere.*

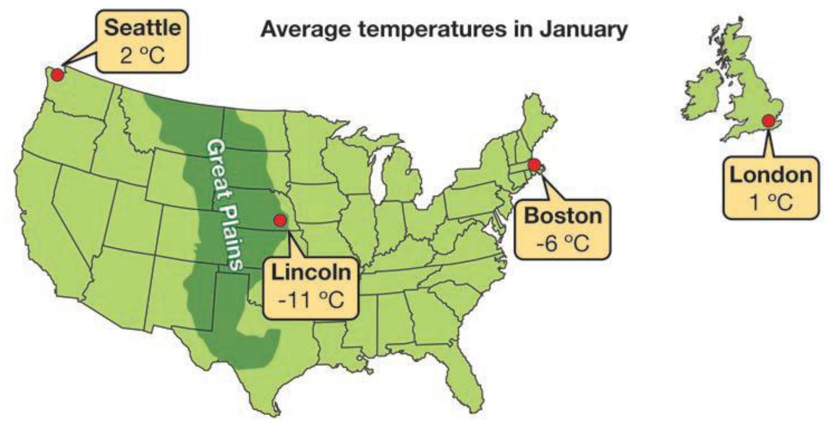
Oceans and Earth's climate

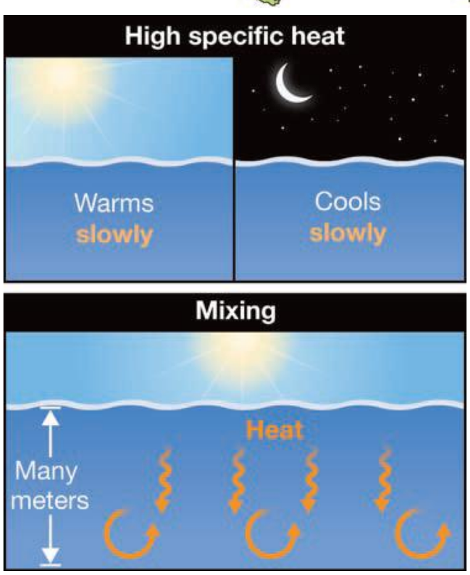
Storing heat in the oceans

Earth's oceans are warmed by the Sun during daylight hours and that heat energy is stored. The oceans are able to store heat energy for two reasons. First, water has a high specific heat, so it takes a long time for it to cool down once it is warm. Second, solar radiation penetrates the water surface and allows the Sun's heat energy to be stored many meters deep (Figure 7.4). Because of this heat storage, the water on Earth prevents the planet from getting too hot or too cold.

Where do you find milder climates?

The climates on the coastline are milder than they are inland. This is because ocean-warmed wind and air masses move over the oceans toward the land. In Europe, the prevailing westerlies blow over the ocean toward the coastline (Figure 7.5). As a result, Europe tends to have mild winters. The northeastern United States has more severe winters because the prevailing westerlies blow away from its coast. But even so, the nearness of water makes the winters milder there than in places like the Great Plains of the United States. This area can be extremely cold because it is far from the ocean.





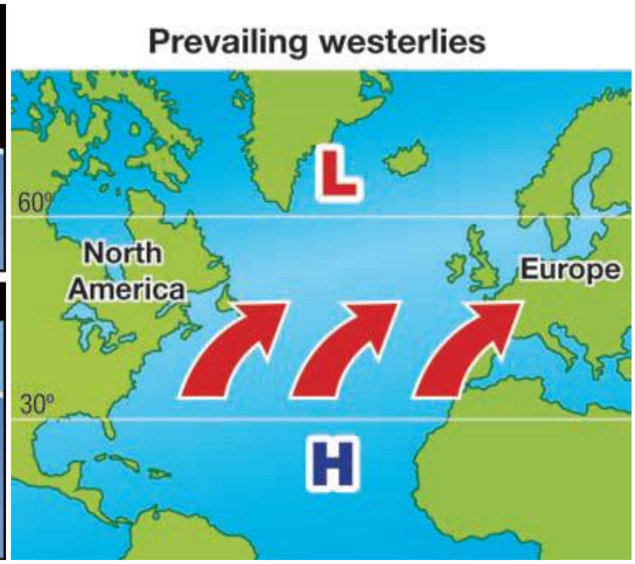


Figure 7.4: *Two reasons why the oceans store heat energy.*

Figure 7.5: *The prevailing winds between 30° and 60° N latitude.*

Surface currents and gyres

Wind drives surface ocean currents

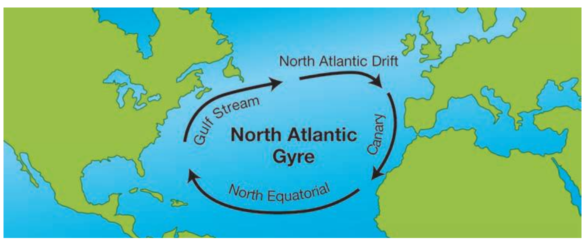
The Sun's unequal heating of Earth and the Coriolis Effect cause permanent global wind patterns (see Chapter 6). As they blow across the ocean, these winds push water in the direction they are moving. This creates **surface ocean currents** that can travel for long distances. Small "pushes" to the surface ocean currents also come from the tides as they move in and out along coastlines.

Surface currents transport heat energy

Surface currents move enormous quantities of water. The Gulf Stream is a surface ocean current that transports 80 million cubic meters of water per second past Cape Hatteras (Figure 7.6). Because the Sun heats this water, the currents also transport heat energy. The heat transported by the Gulf Stream is equivalent to the output of 1 million power stations! Surface ocean currents usually carry heat from regions near the equator toward the poles.

Gyres

The Coriolis effect and the shape of the coastlines cause surface ocean currents to form large rotating systems called **gyres**. Gyres north of the equator—like the North Atlantic gyre—turn in a clockwise direction. The North Atlantic gyre is composed of four surface ocean currents. Gyres south of the equator turn in a counterclockwise direction.



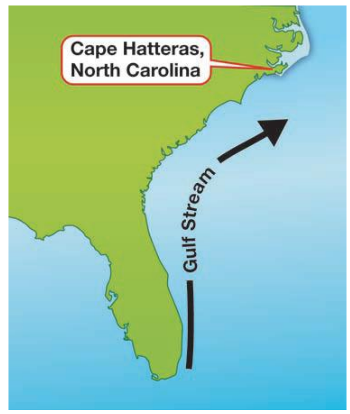


Figure 7.6: *The Gulf Stream is a surface ocean current. The Gulf Stream is part of the North Atlantic gyre.*

Deep ocean currents

What is a deep ocean current?

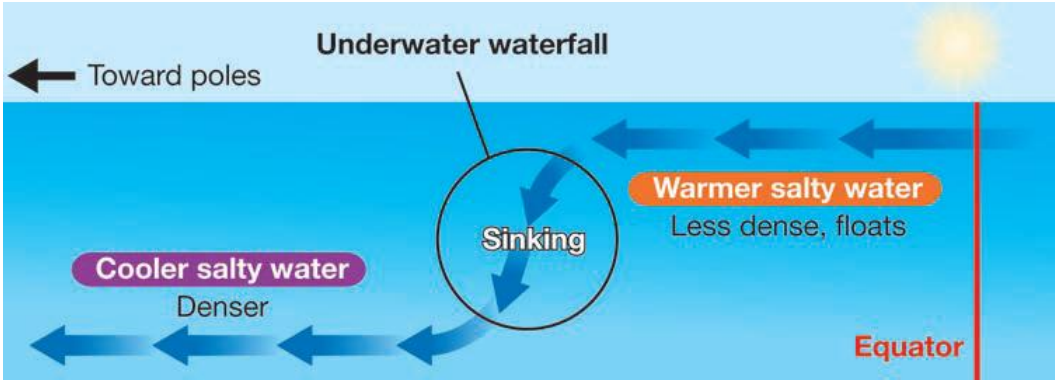
Deep ocean currents move below the surface of the ocean. They are slower than surface ocean currents. Deep ocean currents are driven by density differences. Denser water sinks and less-dense water floats. Since temperature and salinity affect the density of water, the currents are also called *thermohaline currents*. *Thermo* means temperature and *haline* means salt.

Evaporation near the equator

Global wind patterns and heat speed up evaporation of water near the equator. When ocean water evaporates, the water leaves and the salt stays behind. When this happens, surface ocean currents near the equator become saltier.

Temperature and density

A surface ocean current cools as it moves from the equator toward the poles. Because this water is saltier than surrounding water and because it is now cooler, it sinks to the ocean floor as a huge underwater waterfall. What was once a warm *surface ocean current* now flows along the ocean floor as a cold *deep ocean current*. After hundreds to thousands of years, the slow-moving deep ocean current water returns to the surface in a upward moving *upwelling*. Upwelling's return the original surface water and nutrients from the ocean bottom back to the ocean surface.



VOCABULARY

salinity - a term that describes the saltiness of water.

surface ocean currents – wind driven currents that move at the ocean surface, often for long distances.

gyres - large rotating ocean current systems.

deep ocean currents – density and temperature-driven currents that move slowly within the ocean; also called thermohaline currents.

7.1 Section Review

1. What does the term salinity mean?
2. Where does the salt in the oceans come from?
3. Name Earth's five oceans.
4. List two reasons why Earth's oceans help make the planet suitable for life to exist.
5. In which of these places would winter be the most extreme: central Asia or western Canada? Explain your answer. If necessary, look at a globe to answer this question.
6. What keeps surface ocean currents moving?
7. Name the four currents of the North Atlantic Gyre.
8. What characteristics of deep ocean currents affect their motion?
9. At a coastline, freshwater flows into salty water. Which of two these events might be occurring at a coastline? Explain your answer.
10. Challenge: How does the Coriolis effect influence the movement of surface ocean currents in both hemisphere?
11. Challenge: Pick one of these terms and find out its meaning. Write a short paragraph about each term based on your research. Include a diagram with your paragraph to help explain each term.

a. thermocline
b. estuary