MS Earth's Oceans

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CHAPTER 1 MS Earth's Oceans

CHAPTER OUTLINE

1.1 Introduction to the Oceans
1.2 Ocean Movements
1.3 The Ocean Floor
1.4 Ocean Life
1.5 References

There's no doubting the power of the ocean when you look at this photo. The surfer is riding a huge wave to shore. Not all ocean waves are this big. But all the world's oceans have waves. Waves are just one way that ocean water moves. Other ways include tides and currents. Ocean water doesn't move like a stream. It doesn't flow downhill. So why does the water move? What causes waves and other ocean motions? In this chapter, you'll find out.

1.1 Introduction to the Oceans

Lesson Objectives

- Describe how the oceans formed.
- State how the oceans influence Earth.
- Describe the makeup of ocean water.
- Identify ocean zones.

Vocabulary

- aphotic zone
- benthic zone
- intertidal zone
- neritic zone
- oceanic zone
- photic zone

Introduction

Much of Earth's surface is covered with oceans. That's why Earth is called the "water planet." Without all that water, Earth would be a very different place. The oceans affect Earth's atmosphere and influence its climate. An incredible diversity of living things inhabit the ocean as well. You might think that oceans have always covered Earth's surface, but you would be wrong!

How the Oceans Formed

When Earth formed 4.6 billion years ago, it would not have been called the "water planet." There were no oceans then. In fact, there was no liquid water at all. Early Earth was too hot for liquid water to exist. Earth's early years were spent as molten rock and metal.

Water on Early Earth

Over time, Earth cooled. The surface hardened to become solid rock. Volcanic eruptions, like the one in **Figure** 1.1, brought lava and gases to the surface. One of the gases was water vapor. More water vapor came from asteroids and comets that crashed into Earth. As Earth cooled still more, the water vapor condensed to make Earth's first liquid water. At last, the oceans could start to form.

FIGURE 1.1
Volcanoes were one source of water vapor on ancient Earth. What were other sources?

Ancient Oceans

Earth's crust consists of many tectonic plates that move over time. Due to plate tectonics, the continents changed their shapes and positions during Earth history. As the continents changed, so did the oceans. About 250 million years ago, there was one huge land mass known as Pangaea. There was also one huge ocean called Panthalassa. You can see it in **Figure** 1.2.

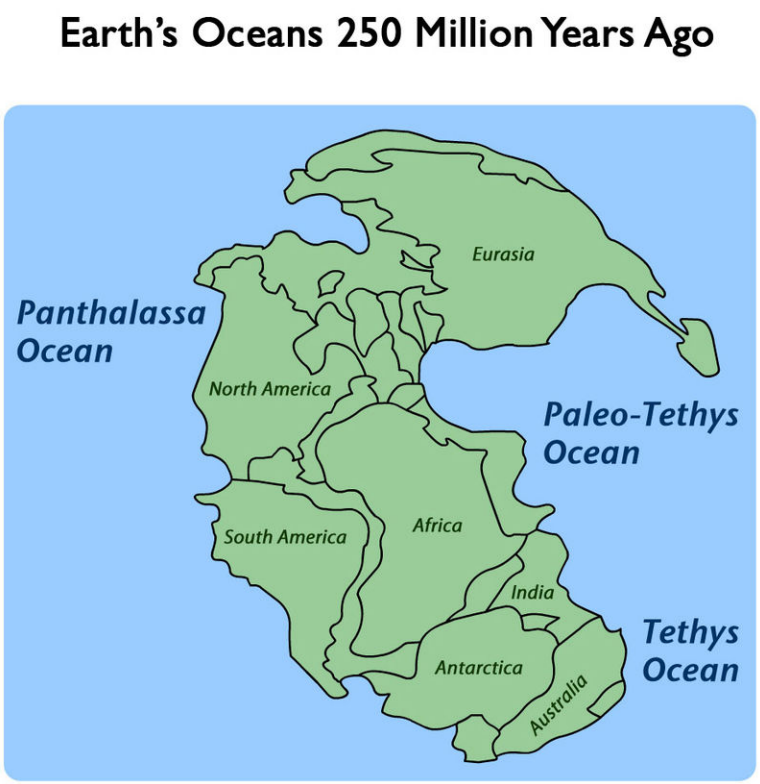


FIGURE 1.2
At the time shown, there was one vast ocean and two smaller ones. How many oceans are there today?

By 180 million years ago, Pangaea began to break up. The continents started to drift apart. They slowly moved

to where they are today. The movement of the continents caused Panthalassa to break into smaller oceans. These oceans are now known as the Pacific, Atlantic, Indian, and Arctic Oceans. The waters of all the oceans are connected. That's why some people refer to the oceans together as the "World Ocean."

The Oceans' Influence

Oceans cover more than 70 percent of Earth's surface and hold 97 percent of its surface water. It's no surprise that the oceans have a big influence on the planet. The oceans affect the atmosphere, climate, and living things.

Oceans and the Atmosphere

Oceans are the major source of water vapor in the atmosphere. Sunlight heats water near the sea surface, as shown in **Figure** 1.3. As the water warms, some of it evaporates. The water vapor rises into the air, where it may form clouds and precipitation. Precipitation provides the freshwater needed by plants and other living things.

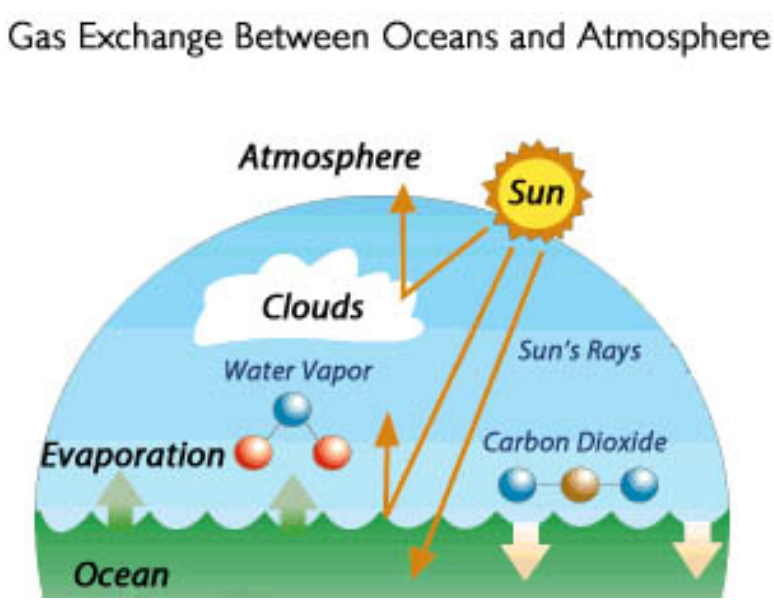


FIGURE 1.3
The oceans and atmosphere exchange gases. Why does water vapor enter the atmosphere from the water?

Ocean water also absorbs gases from the atmosphere. The most important are oxygen and carbon dioxide. Oxygen is needed by living things in the oceans. Much of the carbon dioxide sinks to the bottom of the seas. Carbon dioxide is a major cause of global warming. By absorbing carbon dioxide, the oceans help control global warming.

Oceans and Climate

Coastal areas have a milder climate than inland areas. They are warmer in the winter and cooler in the summer. That's because land near an ocean is influenced by the temperature of the oceans. The temperature of ocean water is moderate and stable. Why? There are two major reasons:

1. Water is much slower to warm up and cool down than land. As a result, oceans never get as hot or as cold as land.
2. Water flows through all the world's oceans. Warm water from the equator mixes with cold water from the poles. The mixing of warm and cold water makes the water temperature moderate.

Even inland temperatures are milder because of oceans. Without oceans, there would be much bigger temperature swings all over Earth. Temperatures might plunge hundreds of degrees below freezing in the winter. In the summer, lakes and seas might boil! Life as we know it could not exist on Earth without the oceans.

Oceans and Living Things

The oceans provide a home to many living things. In fact, a greater number of organisms lives in the oceans than on land. Coral reefs, like the one in **Figure** 1.4, have more diversity of life forms than almost anywhere else on Earth.

FIGURE 1.4
Coral reefs teem with life.

Makeup of Ocean Water

You know that ocean water is salty. But do you know why? How salty is it?

Why Is Ocean Water Salty?

Ocean water is salty because water dissolves minerals out of rocks. This happens whenever water flows over or through rocks. Much of this water and its minerals end up in the oceans. Minerals dissolved in water form salts. When the water evaporates, it leaves the salts behind. As a result, ocean water is much saltier than other water on Earth.

How Salty Is Ocean Water?

Have you ever gone swimming in the ocean? If you have, then you probably tasted the salts in the water. By mass, salts make up about 3.5 percent of ocean water. **Figure** 1.5 shows the most common minerals in ocean water. The main components are sodium and chloride. Together they form the salt known as sodium chloride. You may know the compound as table salt or the mineral halite.

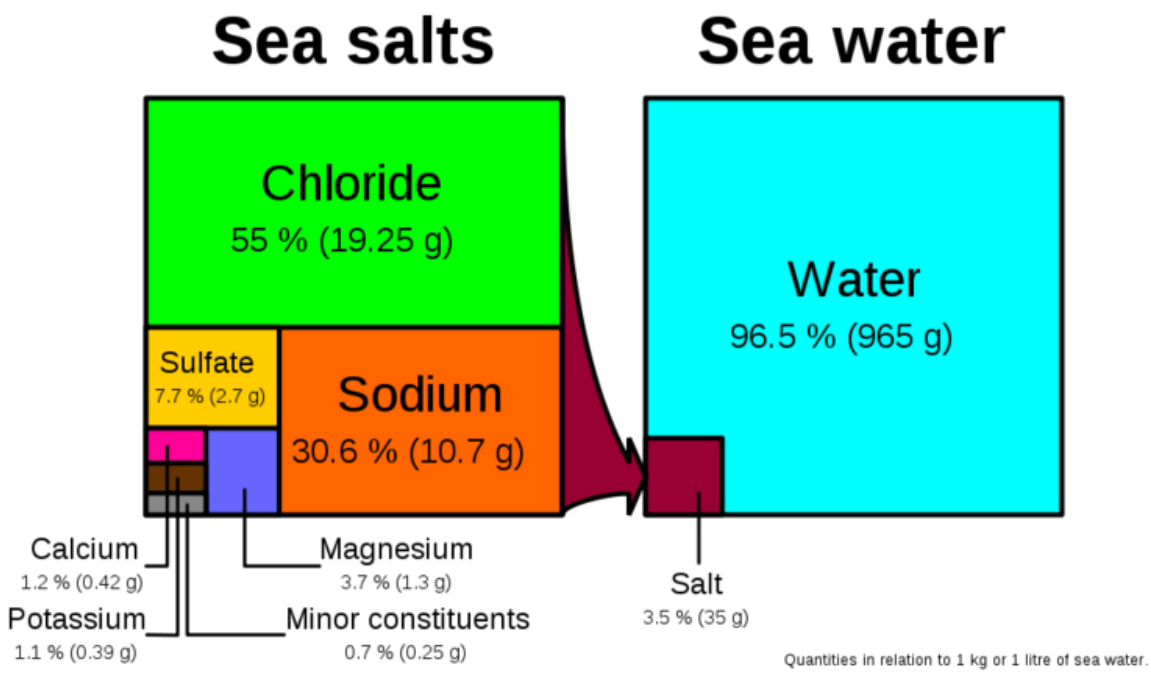


FIGURE 1.5

What percentage of the salts in ocean water is sodium chloride?

The amount of salts in ocean water varies from place to place. For example, near the mouth of a river, ocean water may be less salty. That's because river water contains less salt than ocean water. Where the ocean is warm, the water may be more salty. Can you explain why? (Hint: More water evaporates when the water is warm.)

Ocean Zones

In addition to the amount of salts, other conditions in ocean water vary from place to place. One is the amount of nutrients in the water. Another is the amount of sunlight that reaches the water. These conditions depend mainly on two factors: distance from shore and depth of water. Oceans are divided into zones based on these two factors. The ocean floor makes up another zone. **Figure** 1.6 shows all the ocean zones.

Zones Based on Distance from Shore

There are three main ocean zones based on distance from shore. They are the **intertidal zone**, **neritic zone**, and **oceanic zone**. Distance from shore influences how many nutrients are in the water. Why? Most nutrients are washed into ocean water from land. Therefore, water closer to shore tends to have more nutrients. Living things need nutrients. So distance from shore also influences how many organisms live in the water.

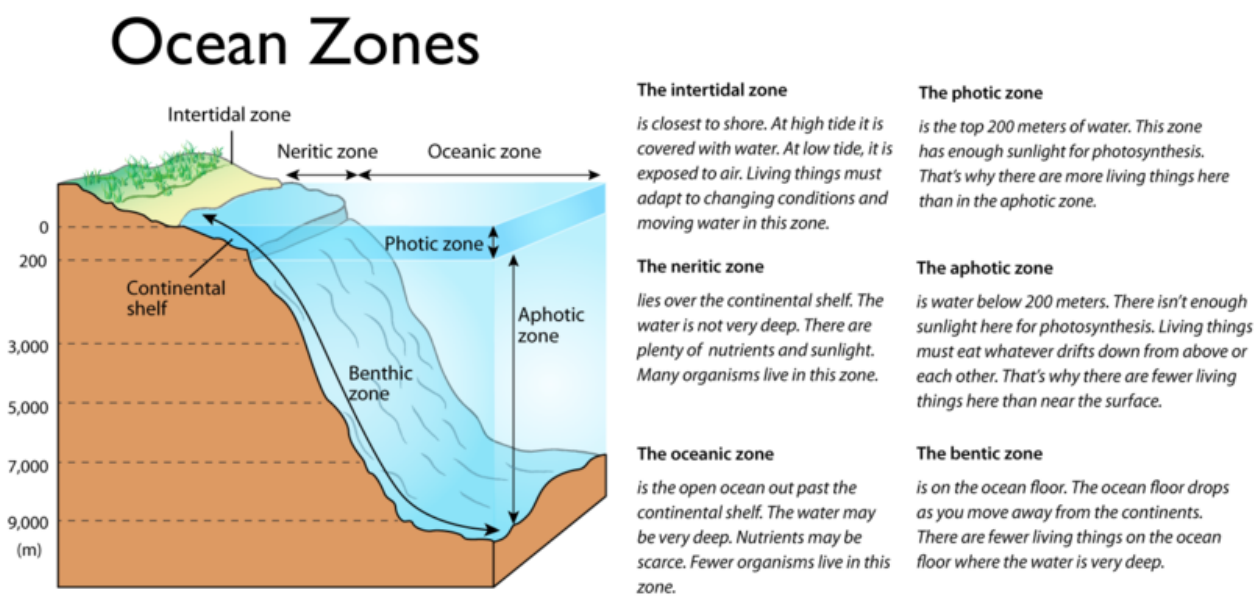


FIGURE 1.6

Distance from shore and depth of water define ocean zones. Which zone is on the ocean floor?

Zones Based on Depth of Water

Two main zones based on depth of water are the photic zone and aphotic zone. The **photic zone** is the top 200 meters of water. The **aphotic zone** is water deeper than 200 meters. The deeper you go, the darker the water gets. That's because sunlight cannot penetrate very far under water. Sunlight is needed for photosynthesis. So the depth of water determines whether photosynthesis is possible. There is enough sunlight for photosynthesis only in the photic zone. Water also gets colder as you go deeper. The weight of the water pressing down from above increases as well. At great depths, life becomes very difficult. The pressure is so great that only specially adapted creatures can live there.

Lesson Summary

- Early Earth was too hot for liquid water to exist. Eventually Earth cooled. Water vapor from volcanoes and objects in space condensed. Oceans finally formed. The oceans changed size and shape as continents drifted.
- Oceans have a big influence on Earth. They exchange gases with the atmosphere. They prevent very hot and very cold temperatures. They are home to many living things.
- Dissolved mineral salts wash into the ocean. As ocean water evaporates, it leaves the salts behind. This makes the water saltier. Ocean water is about 3.5 percent salts. The main salt is sodium chloride.
- The ocean is divided into many zones. Some are based on distance from shore. Some are based on depth of water. The ocean floor is another zone.

Lesson Review Questions

Recall

1. State why there was no liquid water on ancient Earth.
2. Describe how the oceans influence Earth's atmosphere.
3. What is the makeup of ocean water?
4. Describe how ocean water changes as you go deeper in the water.
5. What is the benthic zone?
6. Define the intertidal zone.

Apply Concepts

7. Look at the map (**Figure** 1.7) of Washington State. Washington is on the Pacific coast. Find Raymond and Pullman on the map. Apply lesson concepts to predict how their temperatures compare. Explain your predictions.

FIGURE 1.7
Map of Washington State.

8. Describe the causes of high and low tides on Earth.

Think Critically

9. Compare and contrast the photic and aphotic zones.

10. Imagine that you are going down to the bottom of the ocean in a tiny submarine. What might you see as you go down? Where will it be light? Where will you see the most life forms?

11. Relate ocean zones to nutrients and sunlight in ocean water.

Points to Consider

Most nutrients enter ocean water from the land. However, they may be carried far from shore by currents.

- Many large ocean currents have names. Can you name any ocean currents?
- Currents are like rivers flowing through the ocean. Rivers always flow downhill because of gravity. What do you think causes ocean currents to flow?

1.2 Ocean Movements

Lesson Objectives

- Describe how waves move through water.
- Explain what causes tides.
- Give an overview of surface currents.
- Identify the cause of deep currents.
- Describe upwelling.

Vocabulary

- convection current
- Coriolis effect
- deep current
- density
- neap tide
- spring tide
- surface current
- tide
- upwelling
- wave

Introduction

If you've ever visited an ocean shore, then you know that ocean water is always moving. Waves ripple through the water, as shown in **Figure** 1.8. The water slowly rises and falls because of tides. You may see signs warning of currents that flow close to shore. What causes all these ocean motions? Different types of motions have different causes.

Waves

Most ocean waves are caused by winds. A **wave** is the transfer of energy through matter. A wave that travels across miles of ocean is traveling energy, not water. Ocean waves transfer energy from wind through water. The energy of a wave may travel for thousands of miles. The water itself moves very little. **Figure** 1.9 shows how water molecules move when a wave goes by.

FIGURE 1.8
Waves cause the rippled surface of the ocean.

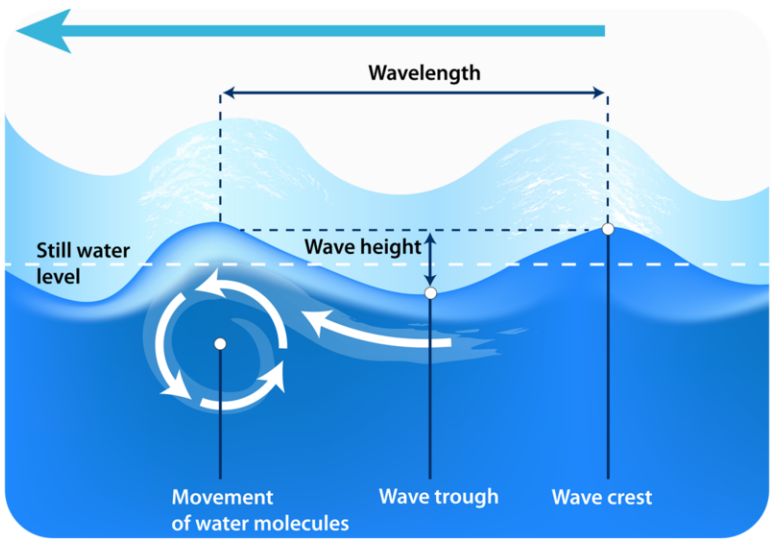


FIGURE 1.9
A wave travels through the water. How would you describe the movement of water molecules as a wave passes through?

The Size of Waves

Figure 1.9 also shows how the size of waves is measured. The highest point of a wave is the crest. The lowest point is the trough. The vertical distance between a crest and a trough is the height of the wave. Wave height is also called amplitude. The horizontal distance between two crests is the wavelength. Both amplitude and wavelength are measures of wave size. The size of an ocean wave depends on how fast, over how great a distance, and how long the wind blows. The greater each of these factors is, the bigger a wave will be. Some of the biggest waves occur with hurricanes. A hurricane is a storm that forms over the ocean. Its winds may blow more than 150 miles per hour! The winds also travel over long distances and may last for many days.

Breaking Waves

Figure 1.10 shows what happens to waves near shore. As waves move into shallow water, they start to touch the bottom. The base of the waves drag and slow. Soon the waves slow down and pile up. They get steeper and unstable as the top moves faster than the base. When they reach the shore, the waves topple over and break.

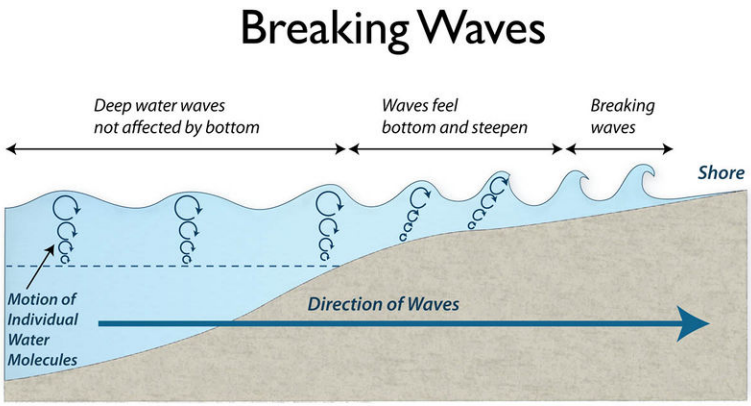


FIGURE 1.10
Waves break when they reach the shore.

Tsunamis

Not all waves are caused by winds. A shock to the ocean can also send waves through water. A tsunami is a wave or set of waves that is usually caused by an earthquake. As we have seen in recent years, the waves can be enormous and extremely destructive. Usually tsunami waves travel through the ocean unnoticed. But when they reach the shore they become enormous. Tsunami waves can flood entire regions. They destroy property and cause many deaths. **Figure** 1.11 shows the damage caused by a tsunami in the Indian Ocean in 2004.

FIGURE 1.11
A 2004 tsunami caused damage like this all along the coast of the Indian Ocean. Many lives were lost.

Tides

Tides are daily changes in the level of ocean water. They occur all around the globe. High tides occur when the water reaches its highest level in a day. Low tides occur when the water reaches its lowest level in a day. Tides keep cycling from high to low and back again. In most places the water level rises and falls twice a day. So there are two high tides and two low tides approximately every 24 hours. In **Figure** 1.12, you can see the difference between high and low tides. This is called the tidal range.

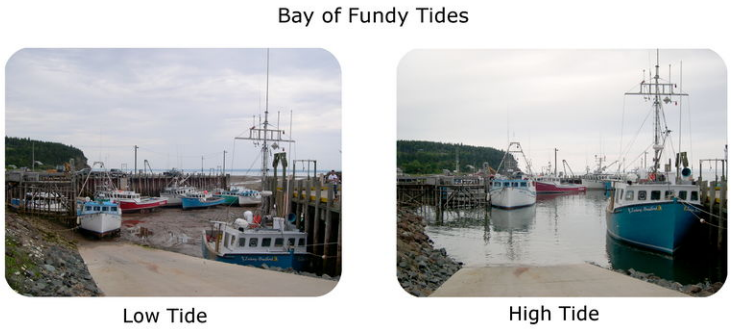


FIGURE 1.12
Where is the intertidal zone in this picture?

Why Tides Occur

Figure 1.13 shows why tides occur. The main cause of tides is the pull of the moon's gravity on Earth. The pull is greatest on whatever is closest to the moon. Although the gravity pulls the land, only the water can move. As a result:

- Water on the side of Earth facing the moon is pulled hardest by the moon's gravity. This causes a bulge of water on that side of Earth. That bulge is a high tide.
- Earth itself is pulled harder by the moon's gravity than is the ocean on the side of Earth opposite the moon. As a result, there is bulge of water on the opposite side of Earth. This creates another high tide.
- With water bulging on two sides of Earth, there's less water left in between. This creates low tides on the other two sides of the planet.

Spring Tides and Neap Tides

The sun's gravity also pulls on Earth and its oceans. Even though the sun is much larger than the moon, the pull of the sun's gravity is much less because the sun is much farther away. The sun's gravity strengthens or weakens the moon's influence on tides. **Figure** 1.14 shows the position of the moon relative to the sun at different times during the month. The positions of the moon and sun relative to each other determines how the sun affects tides. This creates spring tides or neap tides.

- **Spring tides** occur during the new moon and full moon. The sun and moon are in a straight line either on the same side of Earth or on opposite sides. Their gravitational pull combines to cause very high and very low tides. Spring tides have the greatest tidal range.
- **Neap tides** occur during the first and third quarters of the moon. The moon and sun are at right angles to each other. Their gravity pulls on the oceans in different directions so the highs and lows are not as great. Neap tides have the smallest tidal range.

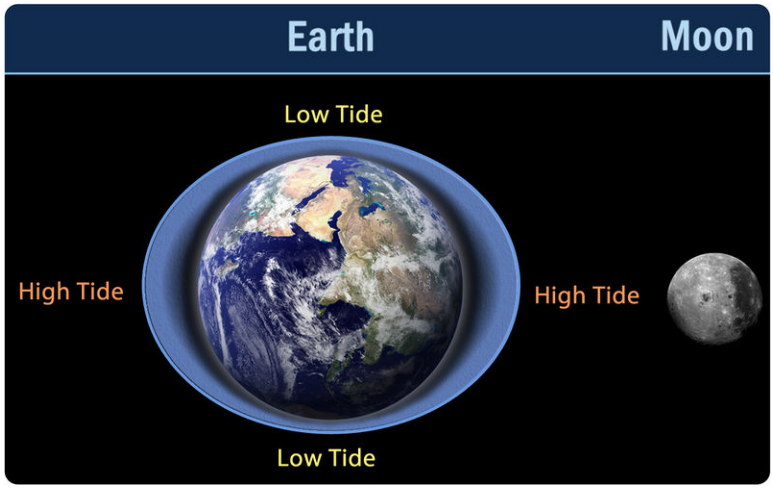


FIGURE 1.13
High and low tides are due mainly to the pull of the moon's gravity.

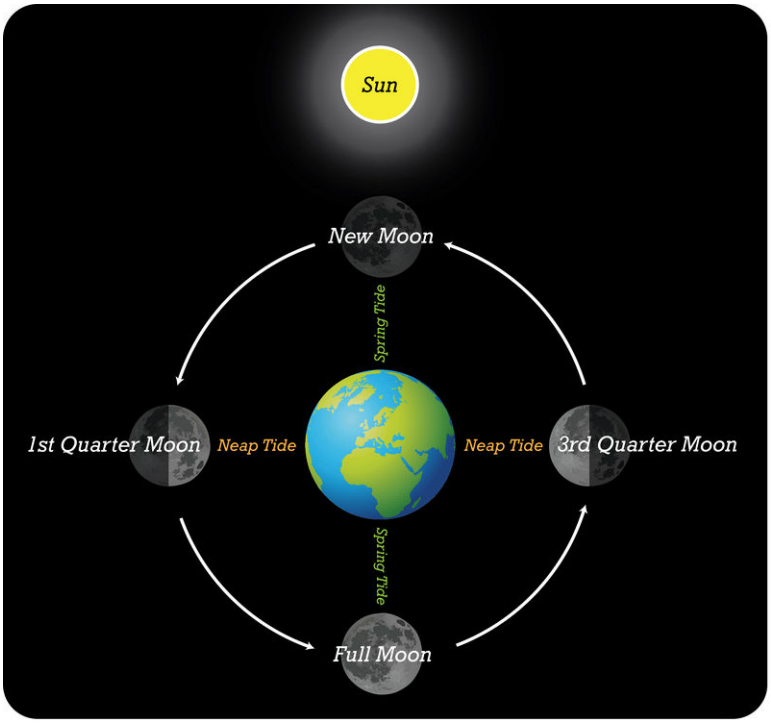


FIGURE 1.14
The sun and moon both affect Earth's tides.

This animation shows the effect of the Moon and Sun on the tides: http://www.onr.navy.mil/focus/ocean/motion/tides1.htm.

Surface Currents

Another way ocean water moves is in currents. A current is a stream of moving water that flows through the ocean. **Surface currents** are caused mainly by winds, but not the winds that blow and change each day. Surface currents are caused by the major wind belts that blow in the same direction all the time.

The major surface currents are shown in **Figure** 1.15. They flow in a clockwise direction in the Northern Hemisphere. In the Southern Hemisphere, they flow in the opposite direction.

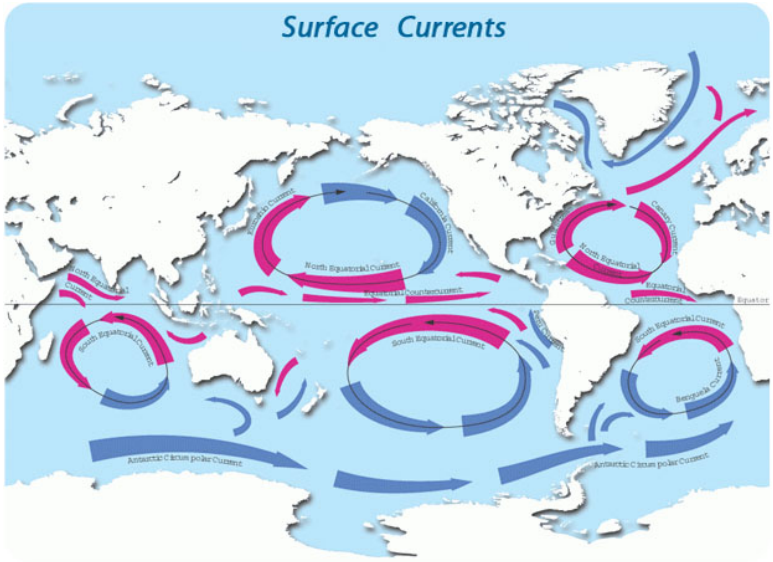


FIGURE 1.15
Earth's surface currents flow in the patterns shown here.

Coriolis Effect

Winds and surface currents tend to move from the hot equator north or south toward the much cooler poles. That's because of differences in the temperature of air masses over Earth's surface. But Earth is spinning on its axis underneath the wind and water as they move. The Earth rotates from west to east. As a result, winds and currents actually end up moving toward the northeast or southeast. This effect of Earth's rotation on the direction of winds and currents is called the **Coriolis effect**.

Surface Currents and Climate

Large ocean currents can have a big impact on the climate of nearby coasts. The Gulf Stream, for example, carries warm water from near the equator up the eastern coast of North America. Look at the map in **Figure** 1.16. It shows how the Gulf Stream warms both the water and land along the coast.

Deep Currents

Currents also flow deep below the surface of the ocean. **Deep currents** are caused by differences in density at the top and bottom. **Density** is defined as the amount of mass per unit of volume. More dense water takes up less space than less dense water. It has the same mass but less volume. Water that is more dense sinks. Less dense water rises. What can make water more dense?

Water becomes more dense when it is colder and when it has more salt. In the North Atlantic Ocean, cold winds chill the water at the surface. Sea ice grows in this cold water, but ice is created from fresh water. The salt is left behind in the seawater. This cold, salty water is very dense, so it sinks to the bottom of the North Atlantic. Downwelling can take place in other places where surface water becomes very dense (see **Figure** 1.17).

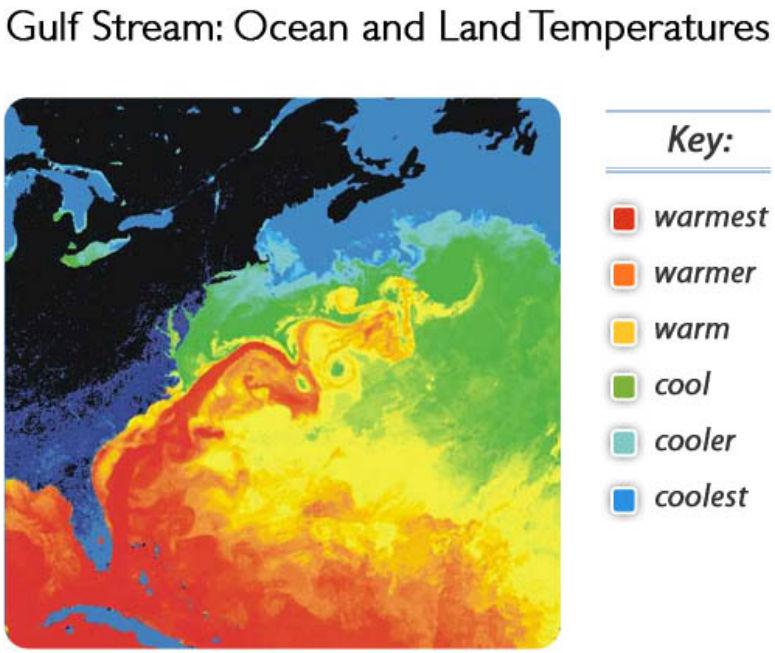


FIGURE 1.16
In this satellite photo, different colors indicate the temperatures of water and land. The warm Gulf Stream can be seen snaking up eastern North America.

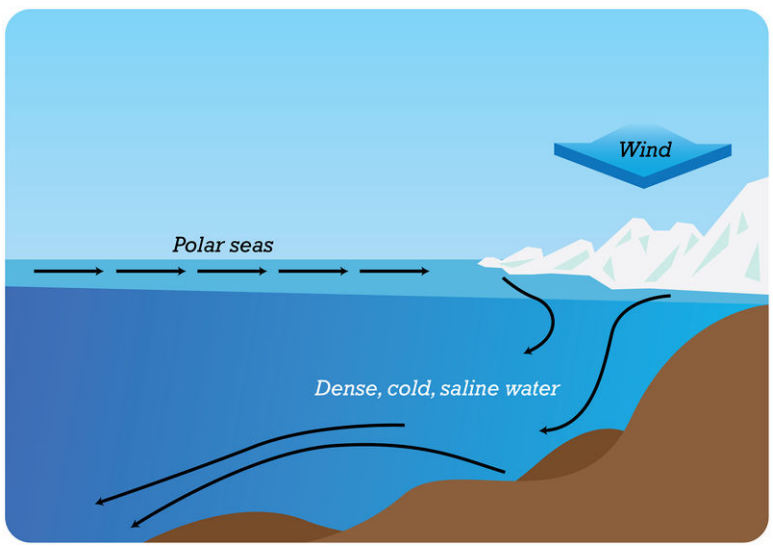


FIGURE 1.17
Deep currents flow because of differences in density of ocean water.

When water sinks it pushes deep water along at the bottom of the ocean. This water circulates through all of the ocean basins in deep currents.

Upwelling

Sometimes deep ocean water rises to the surface. This is called **upwelling**. **Figure** 1.18 shows why it happens. Strong winds blow surface water away from shore. This allows deeper water to flow to the surface and take its place.

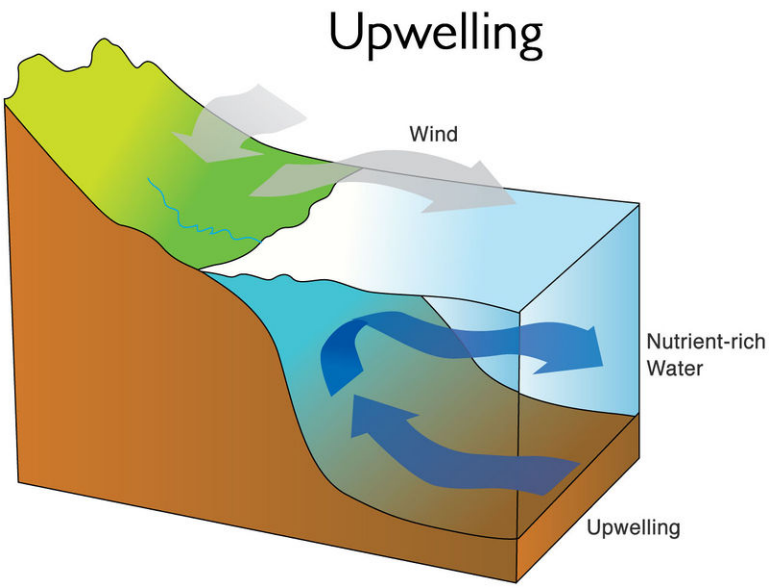


FIGURE 1.18
An upwelling occurs when deep ocean water rises to the surface.

When water comes up from the deep, it brings a lot of nutrients with it. Why is deep water so full of nutrients? Over time, dead organisms and other organic matter settle to the bottom water and collect. The nutrient-rich water that comes to the surface by upwelling supports many living things.

Lesson Summary

- Most ocean waves are caused by winds. The size of a wave depends on how fast, how far, and how long the wind blows. Tsunamis are waves caused by earthquakes.
- Tides are daily changes in the level of ocean water. They are caused mainly by the pull of the moon's gravity on Earth and its oceans. The sun's gravity also influences tides.
- Surface currents are like streams flowing through the surface of the ocean. They are caused mainly by winds. Earth's rotation influences their direction. This is called the Coriolis effect. Surface currents may affect the climate of nearby coasts.
- Deep currents are convection currents that occur far below the surface. They are caused by differences in the density of ocean water.
- Upwelling occurs when deep ocean water rises to the surface. The water brings nutrients with it. These nutrients support many organisms.

Lesson Review Questions

Recall

1. Identify two causes of ocean waves.
2. What factors determine how big a wave is?
3. What is the Coriolis effect?

4. Define density. How is the density of water related to its temperature?

5. Describe upwelling. State why it occurs.

Apply Concepts

6. The crest of an ocean wave is 3 meters above the still water level. The trough is 3 meters below the still water level. The horizontal distance between the crest and trough is 8 meters. Draw a diagram of this wave. Label the crest, trough, and distances. Then calculate the wave's amplitude and wavelength.

7. Assume that a spring tide occurs on September 1. Predict when the next neap tide will occur. When will the next spring tide occur? Explain your answers.

Think Critically

8. Explain why waves break on the shore.

9. If the tidal cycle was actually 12 hours then high tides would occur at the same time every day. In reality, high tides occur about every 12 hours and 25 minutes. Can you think of why this would be the case?

10. Are deep currents the same as surface currents except that they are near the ocean bottom?

Points to Consider

Upwelling brings nutrients to the surface from the ocean floor. Nutrients are important resources for ocean life. However, they aren't the only resources on the ocean floor.

- What other resources do you think might be found on the ocean floor?
- It's hard to get resources from the ocean floor. Can you explain why?

1.3 The Ocean Floor

Lesson Objectives

- Describe how scientists study the ocean floor.
- Identify major features of the ocean floor.
- List resources found on the ocean floor.

Vocabulary

- abyssal plain
- continental shelf
- continental slope
- mid-ocean ridge
- oceanic trench
- seamount
- sonar

Introduction

Vast, unknown spaces still exist for humans to explore. Of course, outer space is still mostly unknown. But some of the most interesting and hardest to reach places are much closer to home. They are on the ocean floor. Only a tiny fraction of the ocean floor has ever been studied. Why? Humans can't travel deep below the water's surface without special vehicles. The pressure of the water is too great. Total darkness and extreme cold make it even more difficult. That's why people have worked for decades to invent technology for studying the ocean floor.

Studying the Ocean Floor

Scientists study the ocean floor in various ways. Scientists — or their devices — may actually travel to the ocean floor. Or they may study the ocean floor from the surface. One way is with a tool called **sonar**.

Using Sonar

Did you ever shout and hear an echo? If you did, that's because the sound waves bounced off a hard surface and back to you. The same principle explains how sonar works. A ship on the surface sends sound waves down to the ocean floor. The sound waves bounce off the ocean floor and return to the surface, like an echo. **Figure** 1.19 show how this happens.

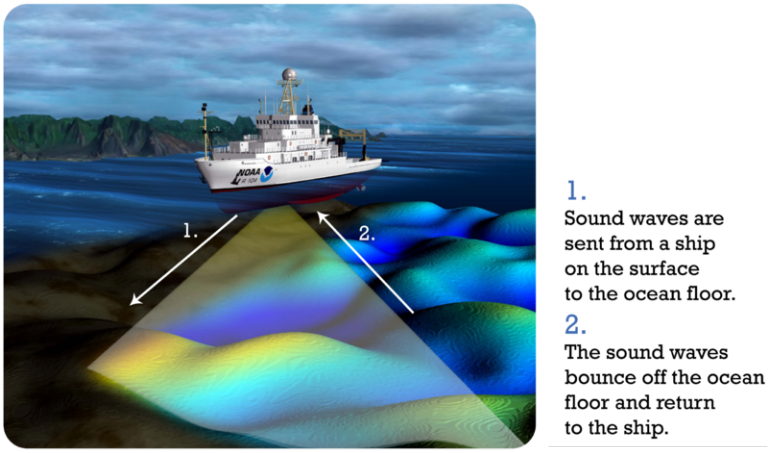


FIGURE 1.19

Sound waves travel through ocean water, but they bounce off the ocean floor. They move through ocean water at a known speed. Can you use these facts to explain how sonar works?

Sonar can be used to measure how deep the ocean is. A device records the time it takes sound waves to travel from the surface to the ocean floor and back again. Sound waves travel through water at a known speed. Once scientists know the travel time of the wave, they can calculate the distance to the ocean floor. They can then combine all of these distances to make a map of the ocean floor. **Figure** 1.20 shows an example of this type of map.

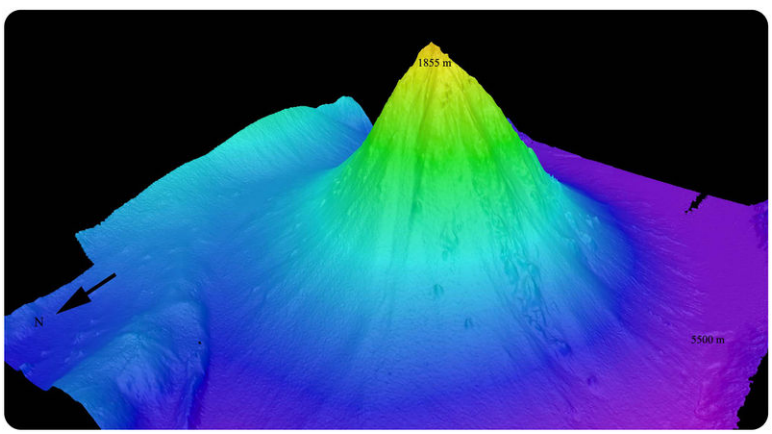


FIGURE 1.20

A map of a 10,000 foot-high undersea volcano in Indonesia made by multibeam solar.

Traveling to the Ocean Floor

Only a specially designed vehicle can venture beneath the sea surface. But only very special vehicles can reach the ocean floor. Three are described here and pictured in **Figure** 1.21:

- In 1960, scientists used the submersible Trieste to travel into the Mariana Trench. They succeeded, but the trip was very risky. Making humans safe at such depths costs a lot of money. People have not traveled to this depth again. The robotic vehicle Nereus went slightly deeper into the trench in 2009.
- The vehicle named Alvin was developed soon after Trieste. The submersible has made over 4,000 dives deep into the ocean. People can stay underwater for up to 9 hours. Alvin has been essential for developing a scientific understanding the world's oceans.

- Today, remote-control vehicles go to the deepest ocean floor. They don't have any people on board. However, they carry devices that record many measurements. They also collect sediments and take photos.

FIGURE 1.21
Vehicles for Underwater Exploration. These special vehicles have been used to study the ocean floor.

Features on the Ocean Floor

Scientists have learned a lot about the ocean floor. For example, they know that Earth's tallest mountains and deepest canyons are on the ocean floor. The major features on the ocean floor are described below. They are also shown in **Figure** 1.22.

- The **continental shelf** is the ocean floor nearest the edges of continents. It has a a gentle slope. The water over the continental shelf is shallow.
- The **continental slope** lies between the continental shelf and the abyssal plain. It has a steep slope with a sharp drop to the deep ocean floor.
- The **abyssal plain** forms much of the floor under the open ocean. It lies from 3 to 6 kilometers (1.9 to 3.7 miles) below the surface. Much of it is flat.
- An **oceanic trench** is a deep canyon on the ocean floor. Trenches occur where one tectonic plate subducts under another. The deepest trench is the Mariana Trench in the Pacific Ocean. It plunges more than 11 kilometers (almost 7 miles) below sea level.
- A **seamount** is a volcanic mountain on the ocean floor. Seamounts that rise above the water surface are known as islands. There are many seamounts dotting the seafloor.
- The **mid-ocean ridge** is a mountain range that runs through all the world's oceans. It is almost 64,000 kilometers (40,000 miles) long! It forms where tectonic plates pull apart. Magma erupts through the ocean floor to make new seafloor. The magma hardens to create the ridge.

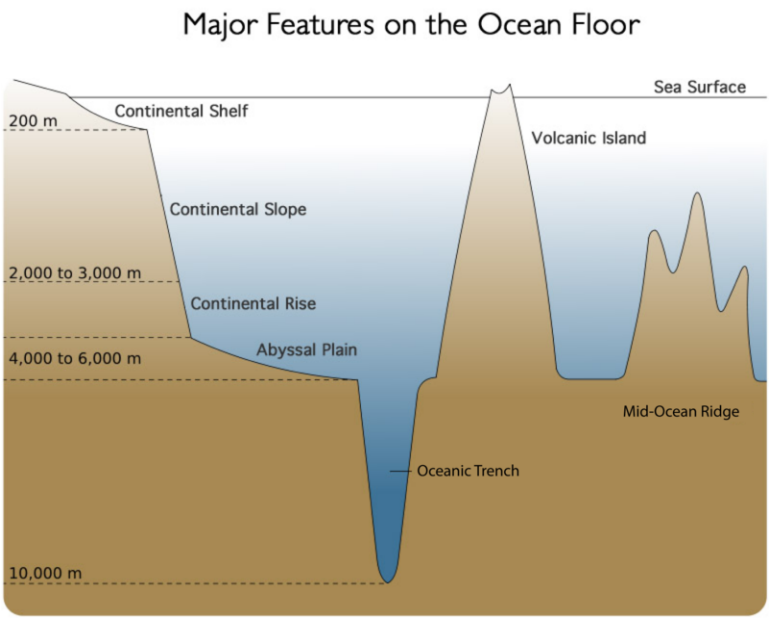


FIGURE 1.22
The features of the ocean floor. This diagram has a lot of vertical exaggeration.

Resources from the Ocean Floor

The ocean floor is rich in resources. The resources include both living and nonliving things.

Living Resources

The ocean floor is home to many species of living things. Some from shallow water are used by people for food. Clams and some fish are among the many foods we get from the ocean floor. Some living things on the ocean floor are sources of human medicines. For example, certain bacteria on the ocean floor produce chemicals that fight cancer.

Nonliving Resources

Oil and natural gas lie below some regions of the seafloor. Large drills on floating oil rigs must be used to reach them. This is risky for workers on the rigs. It is also risky for the ocean and its living things. An oil rig explosion caused a massive oil leak in the Gulf of Mexico in 2010. Oil poured into the water for several months. The oil caused great harm to habitats and living things, both in the water and on the coast. The oil spill also hurt the economy of Gulf Coast states. The effects of the oil spill are still being tallied. There are many minerals on the ocean floor. Some settle down from the water above. Some are released in hot water through vents, or cracks, in the seafloor. The minerals in hot water settle out and form metallic chimneys, as in **Figure** 1.23. These metals could be mined, but they are very deep in the sea and very far from land. This means that mining them would be too expensive and not worth the effort.

Some types of minerals form balls called nodules. Nodules may be tiny or as big as basketballs. They contain manganese, iron, copper, and other useful minerals. As many as 500 billion tons of nodules lie on the ocean floor! However, mining them would be very costly and could be harmful to the ocean environment.

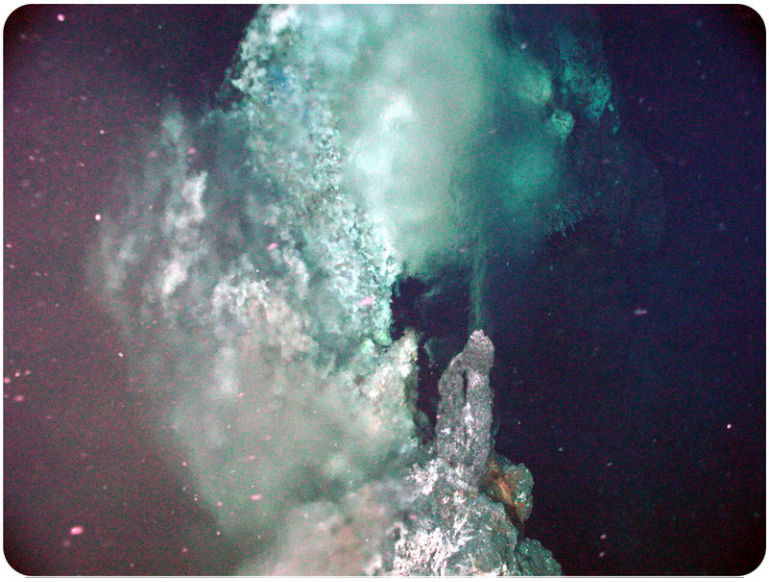


FIGURE 1.23

Metals from the ocean crust are brought by hot water onto the seafloor to create chimneys, as shown in this photo.

Lesson Summary

- Studying the ocean floor is difficult because the environment is so hostile. The seafloor can be studied indirectly with tools such as sonar. It can be studied directly using special vehicles. Some vehicles carry scientists and their devices to the ocean floor. Other vehicles are operated remotely.
- Features of the ocean floor include the continental shelf and slope, abyssal plain, trenches, seamounts, and the mid-ocean ridge.
- The ocean floor is rich in resources. Living things on the ocean floor are used for food or medicines. Nonliving resources include oil, gas, and minerals.

Lesson Review Questions

Recall

1. Why is it difficult to study the deep ocean floor?
2. What is sonar? How can it be used to study the seafloor?
3. What are the continental slope and continental shelf?
4. Gives examples of living resources from the ocean floor.
5. Identify nonliving resources on or below the ocean floor.

Apply Concepts

6. Create a diagram to show how sonar is used to find the distance from the surface to the ocean floor.

Think Critically

7. Relate features of the ocean floor to plate tectonics.

Points to Consider

Many organisms live on the ocean floor. Others live elsewhere in the ocean.

- Where else do organisms live in the ocean?
- How might organisms that live on the ocean floor differ from those that live in other parts of the ocean?

1.4 Ocean Life

Lesson Objectives

- Identify three major groups of marine life.
- Describe marine food chains.

Vocabulary

- benthos
- marine organism
- nekton
- phytoplankton
- plankton
- zooplankton

Introduction

Living things in the oceans are called **marine organisms**. They range from tiny bacteria to the largest known animal, the blue whale. All are adapted for life in salt water. Most are adapted for extreme pressures.

Living Things in the Ocean

When you think of life in the ocean, do you think of fish? Actually, fish are not the most common life forms in the ocean. Plankton are the most common. Plankton make up one of three major groups of marine life. The other two groups are nekton and benthos. **Figure** 1.24 shows the three groups.

Plankton

Plankton are living things that float in the water. Most plankton are too small to see with the unaided eye. Some examples are shown in **Figure** 1.25. Plankton are unable to move on their own. Ocean motions carry them along.

There are two main types of plankton:

1. **Phytoplankton** are "plant-like" plankton. They make food by photosynthesis. They live in the photic zone. Most are algae.
2. **Zooplankton** are "animal-like" plankton. They feed on phytoplankton. They include tiny animals and fish larvae.

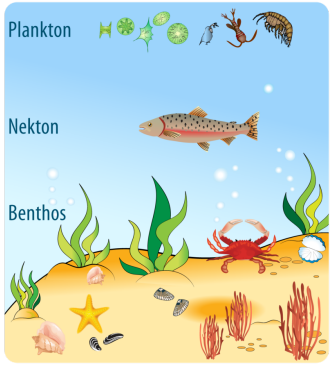
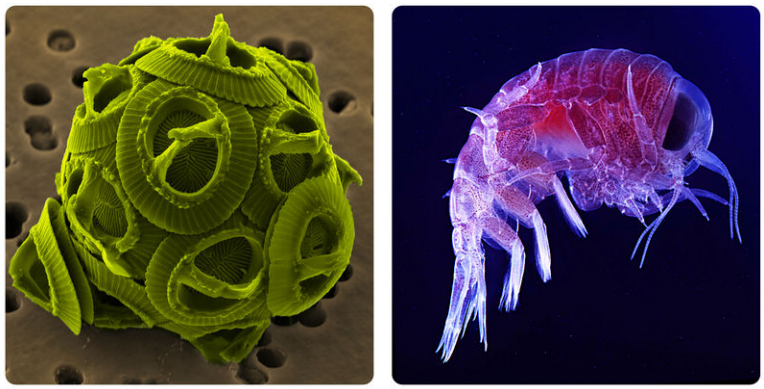


FIGURE 1.24
Living things in the oceans are placed in these three groups.

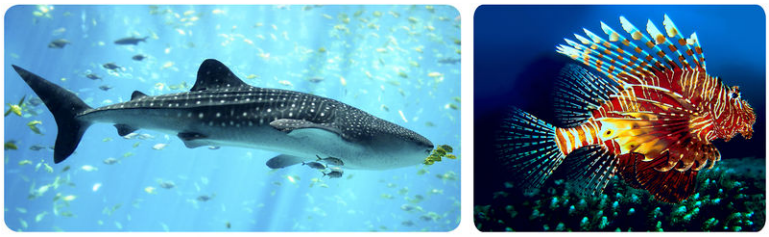


Phytoplankton: *Single-Celled Alga* ***Zooplankton:*** *Tiny Animal*

FIGURE 1.25
The plankton shown here have been magnified. Otherwise, they would be too small for you to see.

Nekton

Nekton are living things that swim through the water. They may live at any depth, in the photic or aphotic zone. Most nekton are fish, although some are mammals. Fish have fins and streamlined bodies to help them swim. Fish also have gills to take oxygen from the water. **Figure** 1.26 shows examples of nekton.



Whale Shark *Lionfish*

FIGURE 1.26
Nekton swim through ocean water.

Benthos

Benthos are living things on the ocean floor. Many benthic organisms attach themselves to rocks and stay in one place. This protects them from crashing waves and other water movements. Some benthic organisms burrow into

sediments for food or protection. Benthic animals may crawl over the ocean floor. Examples of benthos include clams and worms. **Figure** 1.27 shows two other examples.

FIGURE 1.27
These animals live on the ocean floor.

Some benthos live near vents on the deep ocean floor. Tubeworms are an example (see **Figure** 1.28). Scalding hot water pours out of the vents. The hot water contains chemicals that some specialized bacteria can use to make food. Tubeworms let the bacteria live inside them. The bacteria get protection and the tubeworms get some of the food.

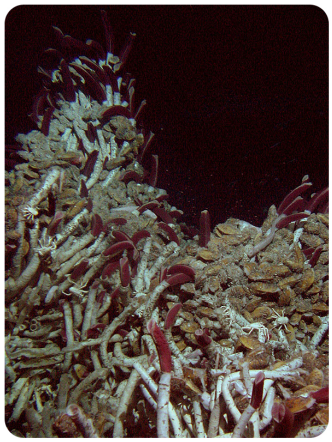


FIGURE 1.28
Tubeworms live near hot water vents on the deep ocean floor.

Marine Food Chains

Figure 1.29 shows a marine food chain. Phytoplankton form the base of the food chain. Phytoplankton are the most important primary producers in the ocean. They use sunlight and nutrients to make food by photosynthesis. Small zooplankton consume phytoplankton. Larger organisms eat the small zooplankton. Larger predators eat these consumers. In an unusual relationship, some enormous whales depend on plankton for their food. They filter tremendous amounts of these tiny creatures out of the water.

The bacteria that make food from chemicals are also primary producers. These organisms do not do photosynthesis since there is no light at the vents. They do something called chemosynthesis. They break down chemicals to make food.

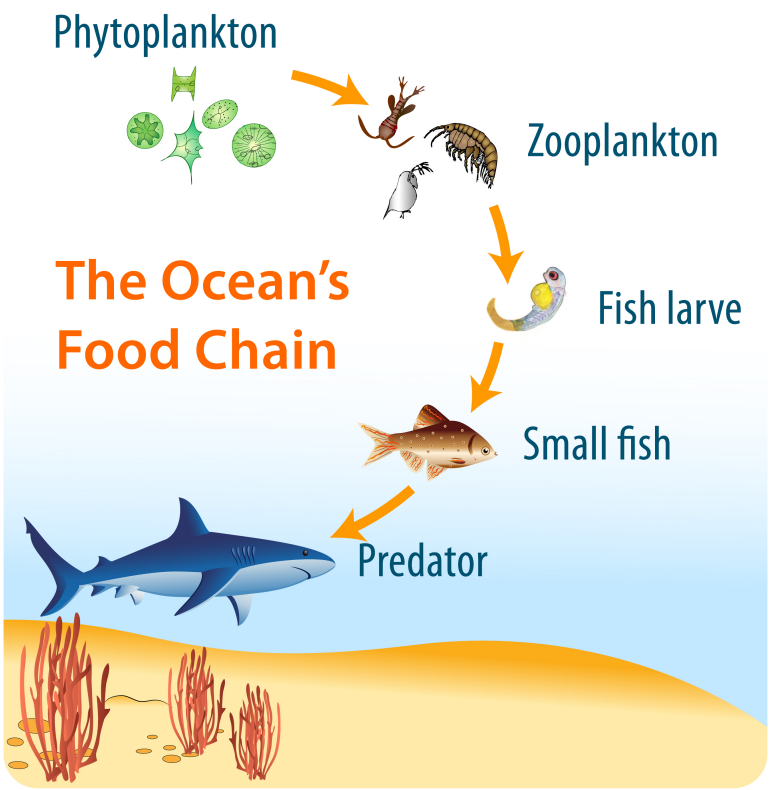


FIGURE 1.29
Many marine food chains look like this example.

When marine organisms die, decomposers break them down. This returns their nutrients to the water. The nutrients can be used again to make food. Decomposers in the oceans include bacteria and worms. Many live on the ocean floor. Do you know why?

Lesson Summary

- Three main groups of ocean life are plankton, nekton, and benthos. Plankton float in the water. Nekton swim through the water. Benthos live on the ocean floor.
- Phytoplankton are the primary producers in the ocean. They form the base of most marine food chains.

Lesson Review Questions

Recall

1. Define marine organism.
2. What are phytoplankton and zooplankton?
3. Why do phytoplankton live in the photic zone?
4. Define nekton.
5. Where do benthos live?

Apply Concepts

6. Create a marine food chain that includes the following living things: jellyfish, worm, shark, algae.

Think Critically

7. Compare and contrast plankton, nekton, and benthos.
8. Explain the importance of phytoplankton to other forms of ocean life.

Points to Consider

This chapter describes how the oceans influence Earth's atmosphere.

- What else do you know about the atmosphere? For example, what gases does it contain?
- The ocean is divided into zones. Do you think the atmosphere is divided into zones as well?

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1.5 References

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