



Name

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SECTION LIFE IN THE EARTH SYSTEM  
**15.1 Study Guide**

**KEY CONCEPT**

The biosphere is one of Earth's four interconnected systems.

**VOCABULARY**

biosphere	hydrosphere	geosphere
biota	atmosphere	

**MAIN IDEA:** The biosphere is the portion of Earth that is inhabited by life.

Write a description of each Earth system in the table below.

Earth System	Description
1. biosphere	
2. hydrosphere	
3. atmosphere	
4. geosphere	

5. What is the connection between the biota and the biosphere?

---



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6. Use an example to explain how the four Earth systems are connected.

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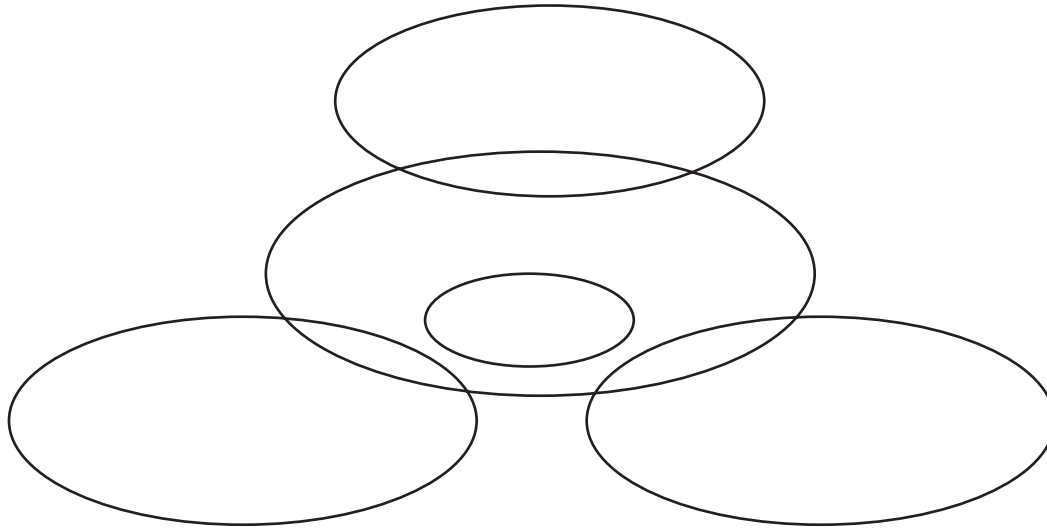
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CHAPTER 15  
The Biosphere

## STUDY GUIDE, CONTINUED

7. Fill in the following diagram with the correct term (biosphere, biota, hydrosphere, atmosphere, geosphere).



**MAIN IDEA:** Biotic and abiotic factors interact in the biosphere.

8. In your own words, describe the Gaia hypothesis.

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### Vocabulary Check

Choose the word from the box below that best matches up with each Earth system.

air	water	earth	life
-----	-------	-------	------

9. Atmosphere \_\_\_\_\_
10. Biosphere \_\_\_\_\_
11. Geosphere \_\_\_\_\_
12. Hydrosphere \_\_\_\_\_



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**SECTION**  
**15.1**

LIFE IN THE EARTH SYSTEM

**Power Notes**

Earth System	Description

Scientists who contributed to the Gaia hypothesis:

- \_\_\_\_\_
- \_\_\_\_\_

Gaia hypothesis summary:

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SECTION LIFE IN THE EARTH SYSTEM  
**15.1 Reinforcement**

**KEY CONCEPT** The biosphere is one of Earth’s four interconnected systems.

The **biosphere** is the part of Earth where life exists. Within the biosphere is a collection of living things called the **biota**. The biosphere is connected to three other Earth systems:

- the **hydrosphere**, which includes all of Earth’s water, ice, and water vapor
- the **atmosphere**, which includes the air blanketing the surface of Earth
- the **geosphere**, which includes all of the features of Earth’s surface and everything below the surface of Earth

Biotic and abiotic factors interact in the biosphere. A change in one Earth system can affect the others. James Lovelock proposed the Gaia hypothesis to explain how biotic and abiotic factors interact in the biosphere. In this hypothesis, the Earth is considered to be a living organism in which the atmosphere, geosphere, and hydrosphere are cooperating systems that yield a biosphere capable of supporting life. The Gaia hypothesis recognizes the complex connections and feedback loops between the biotic and abiotic components of Earth.

1. List the four Earth systems.

---

---

2. What is the connection between the biota and the biosphere?

---

---

---

3. What is the Gaia hypothesis?

---

---

---



SECTION 15.2 | CLIMATE Study Guide

KEY CONCEPT

Climate is a key abiotic factor that affects the biosphere.

VOCABULARY

climate microclimate

MAIN IDEA: Climate is the prevailing weather of a region.

- 1. What is the difference between an area's weather and climate?

Two horizontal lines for writing the answer to question 1.

- 2. What are four key factors that shape an area's climate?

One horizontal line for writing the answer to question 2.

MAIN IDEA: Earth has three climate zones.

- 3. Name the main reason why the surface of Earth is heated unevenly by the Sun.

One horizontal line for writing the answer to question 3.

- 4. What characteristic of Earth results in different seasons over a period of a year?

Two horizontal lines for writing the answer to question 4.

Complete the following chart with the location and characteristics of each climate zone.

Table with 3 columns: Zone, Location, Characteristics. Rows include 5. polar zone, 6. tropical zone, and 7. temperate zone.

## STUDY GUIDE, CONTINUED

8. What effect does the heating of Earth have on air and water movement?

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---

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9. Why do areas closer to bodies of water have different climates than do inland areas?

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10. How does the presence of mountains affect an area's climate?

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---

---

---

11. What is a rain shadow?

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---

**Vocabulary Check**

12. What is the difference between a climate and a microclimate?

---

---

13. List four characteristics of the climate where you live. Include information on temperature and precipitation.

---

---



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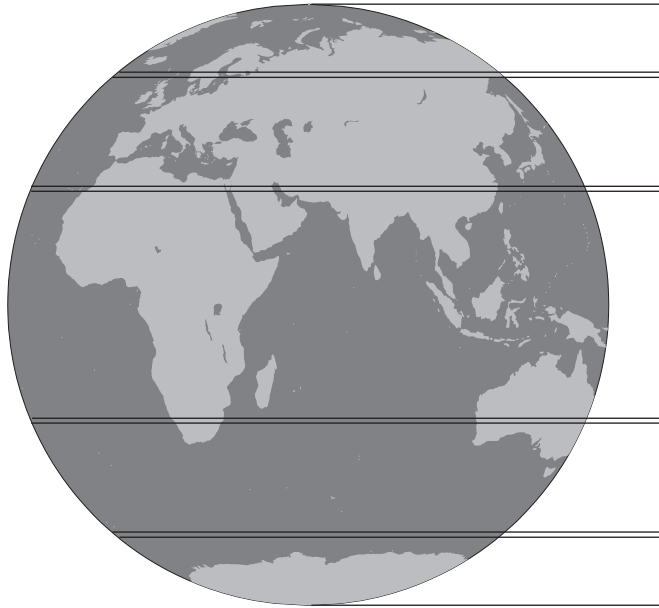
**SECTION**  
**15.2**

CLIMATE  
**Power Notes**

Climate is:

Microclimate is:

**Climate Zones**



\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Factors that influence climate:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

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SECTION  
**15.2**

CLIMATE  
**Reinforcement**

**KEY CONCEPT** Climate is a key abiotic factor that affects the biosphere.

While weather changes on a daily, and sometimes hourly, basis, **climate** is defined as the long-term pattern of weather conditions in a region. An area's climate includes factors such as average temperature, average precipitation, and relative humidity. A **microclimate** is the climate of a small specific place within a larger area.

Due to Earth's curved shape, the planet is heated unevenly by the Sun, creating three main climate zones. These zones are determined by the angle in which sunlight hits Earth. The three zones are

- the polar climate zone, located in for northern and far southern reaches of the planet, where the temperature is often below freezing
- the tropical climate zone, located at the equator, which is characterized by warm, moist conditions
- the temperate climate zone, located in the wide area that lies between the polar and tropical climate zones, which is characterized by distinct seasons of equal length

Sunlight also warms water and air, helping to shape the different climate zones. Movement of air leads to the movement of water, which, along with other factors, produces ocean currents. Landmasses also shape climates. A rain shadow is produced on the downwind side of a mountain, causing an eastern slope to be much drier than the western slope of a mountain.

1. How is an area's climate different from its weather?

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2. What factor contributes to the creation of three climate zones on Earth?

---

---

3. What are the three main climate zones?

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SECTION **15.3** | BIOMES **Study Guide**

**KEY CONCEPT**

**Biomes are land-based, global communities of organisms.**

**VOCABULARY**

canopy	coniferous
grassland	taiga
desert	tundra
deciduous	chaparral

**MAIN IDEA:** Earth has six major biomes.

Fill in the chart with details about the six major biomes found on Earth.

Biome	Description
1. tropical rain forest	
2. grassland	
3. desert	
4. temperate	
5. taiga	
6. tundra	

7. What is the difference between tropical and temperate grasslands?

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8. What are the four different types of deserts?

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CHAPTER 15  
The Biosphere

## STUDY GUIDE, CONTINUED

9. How does precipitation differ in a temperate deciduous forest and a temperate rain forest?

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10. Why do few plants grow in the tundra?

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11. Describe the main characteristics of chaparral.

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**MAIN IDEA:** Polar ice caps and mountains are not considered biomes.

12. Why aren't polar ice caps and mountains considered biomes?

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13. Where are the polar ice caps located?

---

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14. What is a mountain life zone?

---

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### Vocabulary Check

15. I lose my leaves in the autumn. I am a \_\_\_\_\_.

16. I retain my needles all year long. I am a \_\_\_\_\_.

17. I am the uppermost branches of a tree. I am called the \_\_\_\_\_.



Name

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SECTION  
**15.3**

BIOMES  
**Power Notes**

Tropical	Description
	• •
Grassland	• •
	• •
Desert	• •
	• •
Temperate	• •
	• •
Taiga	• •
	• •
Tundra	• •

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SECTION  
**15.3**

BIOMES  
**Reinforcement**

**KEY CONCEPT** Biomes are land-based, global communities of organisms.

A biome is a major community of organisms, usually characterized by the climate conditions and plant communities that live there. Earth has six major biomes. These broad biome types can be subdivided into even more specific zones. Climate conditions of the Earth's biomes include

- Tropical rain forest—warm temperatures and abundant rainfall occur all year long
- Tropical **grassland**—warm temperature throughout the year, with specific rainy and dry seasons
- Temperate grassland—dry and warm during the summer, most precipitation falls as snow during the winter
- **Desert**—very dry climate all year long
- Temperate **deciduous** forest—hot temperatures in the summer and cold temperatures in the winter; precipitation occurs evenly across the year
- Temperate rain forest—one long wet season and a relatively dry summer
- **Taiga**—long, cold winters and short, warm and humid summers
- **Tundra**—subzero temperatures during the long winter, and little precipitation falls across the year

**Chaparral** is a minor biome that is characterized by hot, dry summers and cool, moist winters. Most plants found in this biome are small-leaved evergreen shrubs.

Polar caps and mountains are not considered biomes. Polar caps, which are found at the poles at the top and bottom of Earth are ice-covered areas that have no soil and no specific plant community. Mountains are not considered biomes because climate conditions change on a mountain as elevation increases.

1. What is a biome?

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---

2. List eight biomes that occur on Earth.

---

---

---

3. Why aren't ice caps or mountains considered biomes?

---

---



Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

**SECTION**  
**15.4** | MARINE ECOSYSTEMS  
**Study Guide**

**KEY CONCEPT**

Marine ecosystems are global.

**VOCABULARY**

intertidal zone	abyssal zone	phytoplankton
neritic zone	plankton	coral reef
bathyal zone	zooplankton	kelp forest

**MAIN IDEA:** The ocean can be divided into zones.

Complete the following table with information about ocean zones.

Zone	Depth	Description
1. intertidal		
2. neritic		
3. bathyal		
4. abyssal		

5. What zone has the most biomass? What type of organism makes up most of this biomass?

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6. Why are phytoplankton critical to life on Earth?

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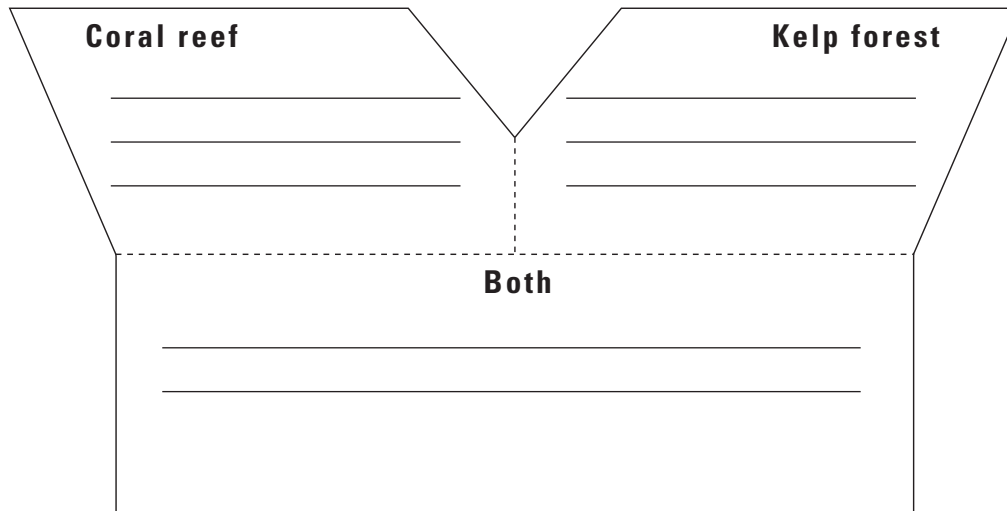
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**CHAPTER 15**  
The Biosphere

## STUDY GUIDE, CONTINUED

**MAIN IDEA:** Coastal waters contain unique habitats.

7. Complete the following Y-diagram to outline the similarities and differences between a coral reef and a kelp forest.



8. What is a coral reef made from?

\_\_\_\_\_

\_\_\_\_\_

9. Why are coral reefs considered delicate?

\_\_\_\_\_

\_\_\_\_\_

**Vocabulary Check**

10. I am a photosynthetic plankton. What am I? \_\_\_\_\_
11. I am an animal plankton. What am I? \_\_\_\_\_



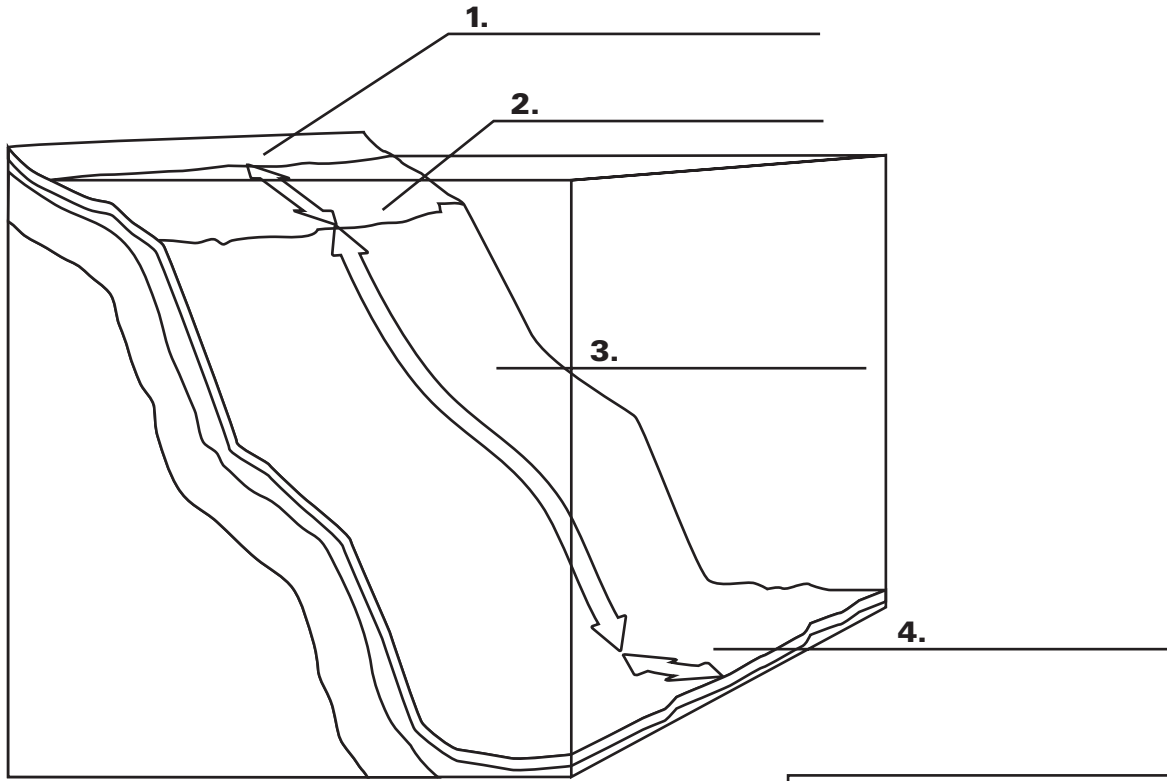
Name \_\_\_\_\_

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**SECTION**  
**15.4**

**MARINE ECOSYSTEMS**  
**Power Notes**



**Description of Ocean Zones**

**1.**

**2.**

**3.**

**4.**

Two unique coastal habitats:

- \_\_\_\_\_
- \_\_\_\_\_

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Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

SECTION  
**15.4**

MARINE ECOSYSTEMS  
**Reinforcement**

**KEY CONCEPT** Marine ecosystems are global.

The ocean can be divided into four major zones:

- The **intertidal zone** is the strip of land between the high and low tide lines.
- The **neritic zone** extends from the intertidal zone to the edge of the continental shelf; most of the ocean’s biomass is found in the neritic zone.
- The **bathyal zone** extends from the edge of the neritic zone to the base of the continental shelf.
- The **abyssal zone** lies below 2000 meters and is in complete darkness.

Most of the biomass in an ocean is found in the neritic zone. Much of this biomass is made up of different types of **plankton**, which are free-floating organisms that live in the water. **Phytoplankton** are photosynthetic plankton, while **zooplankton** are animal plankton. Marine phytoplankton are critical to life on Earth because they carry out the bulk of photosynthesis on Earth, providing most of Earth’s oxygen.

Shallow coastal waters contain unique habitats. **Coral reefs** are found within the tropical climate zone, where water temperatures remain warm year-round. Coral reefs are areas of high biodiversity. **Kelp forests** are found in cold, nutrient-rich waters. These underwater forests are made up of communities of kelp, a type of seaweed.

1. What are the four major ocean zones?

\_\_\_\_\_

2. Which oceanic zone contains the most biomass?

\_\_\_\_\_

3. In terms of their source of energy, what is the difference between phytoplankton and zooplankton?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4. Why wouldn’t you find a kelp forest near a coral reef?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_





Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

**SECTION**  
**15.5**

ESTUARIES AND FRESHWATER ECOSYSTEMS

**Study Guide**

**KEY CONCEPT**

Freshwater ecosystems include estuaries as well as flowing and standing water.

**VOCABULARY**

estuary	littoral zone	benthic zone
watershed	limnetic zone	

**MAIN IDEA:** Estuaries are dynamic environments where rivers flow into the ocean.

1. What is an estuary?

\_\_\_\_\_  
\_\_\_\_\_

2. What is the distinctive feature of an estuary?

\_\_\_\_\_  
\_\_\_\_\_

3. Describe why estuaries are considered to be highly productive ecosystems.

\_\_\_\_\_  
\_\_\_\_\_

4. Why are estuaries sometimes called the “nurseries of the sea”?

\_\_\_\_\_  
\_\_\_\_\_

5. What adaptations are necessary for organisms that live in an estuary?

\_\_\_\_\_  
\_\_\_\_\_

6. What impact does the removal of an estuary have on surrounding areas?

\_\_\_\_\_  
\_\_\_\_\_

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**CHAPTER 15**  
The Biosphere

## STUDY GUIDE, CONTINUED

**MAIN IDEA:** Freshwater ecosystems include moving and standing water.

7. What are the characteristics of a wetland?

---



---

8. What is an important function of wetlands with regard to the water supply?

---



---

**MAIN IDEA:** Ponds and lakes share common features.

9. Complete the following chart with details about the different zones found in a pond or lake.

Zone	Location	Description
littoral zone		
limnetic zone		
benthic zone		

**Vocabulary Check**

10. What is a watershed?

---

11. The term *estuary* comes from the Latin word *aestus*, which means “tide.” How does this meaning relate to the definition of estuary?

---



---



Name

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**SECTION**  
**15.5**

ESTUARIES AND FRESHWATER ECOSYSTEMS

**Power Notes**

Definition	Description
Other Facts	Threats

**Estuary**

**Lake Zones**

Zone	Description

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SECTION 15.5 ESTUARIES AND FRESHWATER ECOSYSTEMS  
**Reinforcement**

**KEY CONCEPT** Freshwater ecosystems include estuaries as well as flowing and standing water.

An **estuary** is a partially enclosed body of water formed where a river flows into an ocean. The distinctive feature of an estuary is the mixture of fresh water from a river with salt water from the ocean. Because of the high amount of nutrients brought into an estuary from the river and the ocean, estuaries are extremely productive ecosystems. Estuaries also provide a sanctuary for animals to reproduce and re-fuel. Estuary ecosystems also act as a buffer between the ocean and coastal lands and help to prevent flooding that results from storms such as hurricanes.

Rivers and streams are flowing bodies of water that serve as pathways through a number of different ecosystems. A **watershed** is a region of land that drains into a river, river system, or other body of water. Wetlands are freshwater ecosystems characterized by the presence of standing water, or water that flows very slowly.

Like oceans, freshwater lakes and ponds can also be divided into separate zones:

- The **littoral zone** is located between the high and low water marks along the shoreline, and its warm and well-lit waters are the home to a number of plants and animals.
- The **limnetic zone** refers to the open water located farther out from shore, and is characterized by an abundance of plankton communities, which support fish populations.
- The **benthic zone** is the lake or pond bottom, where less sunlight reaches, and is inhabited by decomposers such as bacteria.

1. What is an estuary?

---

---

2. What is the distinctive feature of an estuary?

---

3. What is a wetland?

---

---

4. What are the three zones that make up a lake or pond?

---



CHAPTER  
**15**

CONSTRUCTING COMBINATION GRAPHS: CLIMATOGRAM

**Data Analysis Practice**

Climatograms show average climate data for a specific location or biome collected over a period of time.

**Climate Data for Sydney, Australia, 1858–2004**

Month	Temperature (°C)	Precipitation (mm)
January	22.2	103.3
February	22.2	117.4
March	21.1	131.2
April	18.6	127.2
May	15.4	123.3
June	13.1	128.1
July	12.1	98.1
August	13.3	81.5
September	15.5	68.7
October	17.8	76.9
November	19.6	83.1
December	21.3	78.1

Source: Australian Government Bureau of Meteorology

- Construct** Use the information from the table to construct your own climatogram in the space below.

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**2. Identify** During which three months did the least amount of precipitation fall?

---

**3. Conclude** What pattern exists in the data?

---

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---

In recent years, the controversial issues of global warming and climate change have been widely covered by the mass media. Thousands of newspaper, magazine, and journal articles have been written. Local and national news stations have broadcast numerous segments and specials addressing the issue. Hundreds of Web sites are dedicated to providing information regarding global warming and climate change. Mainstream movies such as “The Day After Tomorrow” and novels such as Michael Crichton’s *State of Fear* have focused on these issues. When you consider all of the different sources of information on these issues, how do you know what to think?

### **GLOBAL WARMING AND CLIMATE CHANGE**

Global warming is an increase in the average temperature of the Earth’s atmosphere, which can result in climatic change. Climate change refers to any significant change in the measures of climate (temperature, precipitation, or wind) over an extended period of time (decades or longer). Data collected by NOAA and NASA show that the average temperature of the Earth’s surface has increased 1.2 to 1.4 degrees (F) since 1900. In addition, changes in precipitation patterns, snow and ice cover, and sea levels indicate that climate change is taking place.

According to the EPA, climate change can be caused by natural factors such as changes in the Sun’s intensity or the Earth’s orbit, or volcanic eruptions; natural processes within the climate system such as changes in ocean currents and circulation; and human activities that change the composition of the Earth’s atmosphere and land surface. The debate about global warming and climate change centers on these factors. Some people think that climate change is caused by natural processes and is cyclical. Others think that human activities (for example, burning fossil fuels) have increased the levels of greenhouse gases such as carbon dioxide, causing atmospheric temperatures to increase. The Intergovernmental Panel on Climate Change (IPCC), formed in 1988 by the United Nations Environment Programme and the World Meteorological Organization, has stated that “There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.”

### **MIXED MESSAGES**

Journalists working for the mainstream media aim to be fair, balanced, and unbiased in their reporting. This generally means that when an article is written regarding an issue, the most common position relating to the issue is identified and then alternative positions are discussed if they exist and are considered credible. A recent study has found that the U.S. media coverage of global warming using “balanced” reporting can lead to an informational bias. By presenting competing points of view on a scientific issue, both views appear to have equal scientific support and value when one may in fact be supported much less. This type of reporting allows skeptics to challenge and downplay scientific data and understanding, making it difficult for the public to accurately analyze the information.

In this study, published in the July 2004 issue of the journal *Global Environmental Change*, 636 randomly selected news articles relating to human contributions to global warming were examined. All of the selected articles had been published in either the *New York Times*, *Washington Post*, *Los Angeles Times*, or *Wall Street Journal* between the years 1988 and 2002. The study found that 53% of the examined articles gave approximately equal attention to the opposing views that global warming is the result of natural fluctuations and

that humans are merely a contributing factor. It was also determined that 35% presented both sides of the issue, but focused on human contributions. Six percent of the articles focused explicitly on the predominant scientific view that humans are contributing to global warming, while another 6% focused on whether human-caused global warming even exists. In general, the study found that the news coverage deviated considerably from the IPCC's consensus regarding human involvement in global warming.

Answer the following questions on a separate piece of paper.

1. Read the following statement and then explain how it may present an informational bias.

The ability to study climatic patterns has been critical to the debate over the phenomenon called “global warming.” Some scientist believe—and some ice core studies seem to indicate—that humanity’s production of carbon dioxide is leading to a potentially dangerous overheating of the planet. But skeptics contend there is no evidence the warming exceeds the climate’s natural variation.

*Los Angeles Times*, December 2, 2002.

2. There is substantial scientific data and a consensus within the scientific community that human activities are changing the composition of the Earth’s atmosphere and contributing to global warming. From your perspective, explain how informational bias regarding global warming and climate change may affect the general public’s understanding of these issues and influence their behavior.
3. In your opinion, do you think that both sides of a scientific issue should be reported on with equal weight when consensus has formed to support just one position? Should journalists always present two or more sides to a story if there only appears to be one? Explain.



**Pre-AP Activity**

You have learned in Chapter 15 that the tundra biome is a vast barren region located in the far northern latitudes. It comprises one of Earth's harshest habitats: a region of low biotic diversity, meager precipitation, and below-freezing winters that last up to 10 months a year. But while tundra harbors a relatively low diversity of living things, it is rich in organic matter, much of which is locked inside the upper layers of the frozen earth.

**TUNDRA CHARACTERISTICS AND ECOLOGY**

The ground of the tundra region is a mix of soil, rocks, and ice that, depending on its water content, may resemble frozen mud or cold, dry earth. The uppermost layer of ground is called the active layer. It ranges in thickness from several inches to five feet or more, depending on factors such as local climate and vegetation. In many areas, the active layer may contain or be covered with thick accumulations of peat—partially decayed plant matter rich in carbon. The active layer contains a large proportion of ice. During the short Arctic summer, sections of this may thaw, producing small lakes and bogs that refreeze when temperatures drop with the onset of winter. Below the active layer lies permafrost—ground that remains frozen year round. Permafrost generally resembles chunks of rock and soil cemented together with ice. It extends down at least 300 meters (1000 feet), but may be deeper in some areas.

Tundra winters last 10 months and are extremely harsh—temperatures average around  $-34^{\circ}\text{C}$  but may drop below  $-50^{\circ}\text{C}$ . Winds can reach speeds of 160 km per hour (100 miles per hour). Days are extremely short; the Sun is completely below the horizon for roughly 10 weeks, keeping the region in total and frozen darkness. Summers last between one and two months; but though the season is short, its days are long, with close to 24 hours of sunlight each day. Summer temperatures average around  $3$ – $12^{\circ}\text{C}$ . Precipitation is scarce, however; total annual precipitation, including winter snowfall, averages 15–25 cm.

The long periods of sunlight in the summer allow for almost continuous photosynthesis. Lichens are abundant. Along with tundra moss, they are important producers. Some tundra communities contain sedges, grasses, and small shrubs. Reindeer, musk oxen, snowshoe hares, lemmings, lynx, and snowy owls are adapted for life here, as are polar bears in coastal areas. Many birds migrate to the tundra in summer and leave in winter. Most decomposition is carried out by bacteria and fungi.

**METHANE**

Methane ( $\text{CH}_4$ ) is a carbon-based gas produced by both natural and human-related processes. It is an end product of digestion and decomposition. Natural sources of methane include wetlands, oceans, swamps, soils, and permafrost. These sources collectively account for only 40 percent of global methane emissions; human-related activities are responsible for the other 60 percent. Fossil fuel production, rice cultivation, waste management, and livestock are among the most critical sources.

Like carbon dioxide, methane is a greenhouse gas—in the atmosphere, it prevents infrared radiation emitted from Earth's surface from escaping the atmosphere. Without this effect, Earth would be too cold to live on. However, the steady increase in greenhouse gas concentration over the past two centuries has produced global warming, an unprecedented rise in global air and surface temperatures. This, in turn, can cause climate change.

Methane is far less abundant in the atmosphere compared to carbon dioxide, but it packs a greater punch: a methane molecule is more than 20 times more powerful than carbon dioxide in its ability to trap heat. Analysis of ice cores drawn from glaciers shows that methane is more abundant in Earth's atmosphere today than at any point in the last 400,000 years.

### **TUNDRA METHANE AND GLOBAL WARMING**

The vast Arctic tundra harbors a significant store of carbon compounds. Over the past tens of thousands of years, these compounds were locked inside the permafrost and ice covering the area. The extensive peat bogs are a ready source of carbon; furthermore, when these freeze in winter, bog gases are trapped inside bubbles. Over the past several decades, increased global temperatures have affected the natural thaw/freeze cycles of the tundra. Historically, the increased sunlight and warmer temperatures of summer would cause relatively small lakes and bogs to form as the active layer ice melted; the rapid onset of winter temperatures would cause these to refreeze. However, the thaw-freeze cycle is increasingly skewed: each spring a larger number of lakes and bogs form or increase in size, and each winter, the high levels of gas prevent these areas from refreezing completely. This shift in the natural cycle has produced a serious problem: the more lakes form, the greater the quantity of methane released when the lakes melt.

A study undertaken by a team of Russian and American scientists revealed that lakes in Siberia that thaw every summer are releasing five times more methane than had been estimated. In one study, scientists reported that methane was literally bubbling in the active layer at such a rapid rate that it prevented the surface from refreezing in winter. More than one million square kilometers of tundra have started thawing for the first time in roughly 11,000 years. If the present circumstances continue, methane emissions will rise exponentially, increasing the concentration of atmospheric greenhouse gases, which in turn will raise global temperatures. The increased thaw area in the Arctic poses a further danger: thawing lakes are darker than the surrounding tundra, so their darker color attracts and absorbs more heat, thereby increasing the thaw rate and subsequent emission of methane.

### **FEEDBACK LOOPS**

A feedback loop is a pathway of two or more steps in which the effects of one factor feeds back into the pathway, increasing or decreasing the effects of other factors. In a positive feedback loop such as the one shown below, the effect of one factor increases the next factor, which increases the next factor, and so on.

The linked pathway is modeled as a loop because at some point, a link will feed back to the initial factor. The cycle becomes continuous, with no true beginning or end. In some circumstances, positive feedback loops can be forced to end if one or more links can be broken. However, if the effect of one or more stages passes a tipping point, the cycle will “run away”—that is, there will be no possibility of stopping it from continuing on.

### **DRAW A FEEDBACK LOOP**

1. On a separate sheet of paper, model the relationship between tundra methane emissions and climate change by drawing a detailed positive feedback loop. Your loop should feature the factors described in this activity's introductory text.



Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

**CHAPTER 15**

**THE BIOSPHERE  
Vocabulary Practice**

- biosphere                      grassland                      neritic zone                      estuary
- biota                            desert                            bathyal zone                      watershed
- hydrosphere                    deciduous                      abyssal zone                      littoral zone
- atmosphere                    coniferous                      plankton                          limnetic zone
- geosphere                      taiga                              zooplankton                      benthic zone
- climate                          tundra                            phytoplankton
- microclimate                    chaparral                        coral reef
- canopy                            intertidal zone                    kelp forest

**A. Word Origins** Circle the Greek and Latin word parts in each vocabulary term. Then use the Greek and Latin meanings to construct a very basic definition of the vocabulary word.

abyss- = bottomless	bio- = life	klima- = climate
atmos- = vapor	decidere = to fall off	limne = lake
bathy- = deep	geo- = earth	litor- = shore
benthos = bottom	hydro- = water	micros = small

WORD	DEFINITION
1. atmosphere	
2. hydrosphere	
3. geosphere	
4. biosphere	
5. benthic zone	
6. limnetic zone	
7. littoral zone	
8. bathyal zone	
9. abyssal zone	
10. deciduous	
11. microclimate	

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**CHAPTER 15**  
The Biosphere

## VOCABULARY PRACTICE, CONTINUED

**B. Who Am I?** Choose among these terms to answer the riddles below:

atmosphere	desert	kelp forest
canopy	deciduous	hydrosphere
chaparral	estuary	taiga
coniferous	geosphere	tundra
coral reef	grassland	watershed

1. I am a type of tree that drops its leaves during autumn: \_\_\_\_\_
2. I am also called the boreal forest; I have long and cold winters: \_\_\_\_\_
3. I am an Earth system made up of all of Earth's water, ice, and water vapor: \_\_\_\_\_
4. I am also called the Mediterranean shrubland; I have hot, dry summers and cool, moist winters: \_\_\_\_\_
5. I am an area where the primary plant life is grass: \_\_\_\_\_
6. I am a unique coastal habitat found in cold, nutrient-rich waters; I am made up of communities of seaweed: \_\_\_\_\_
7. I am a partially enclosed body of water formed where a river flows into an ocean: \_\_\_\_\_
8. I am an Earth system made up of all the features on Earth's surface, including the continents, rocks, and sea floor; and everything below Earth's surface: \_\_\_\_\_
9. I am a type of tree that retains its needles all year long: \_\_\_\_\_
10. I am a biome located in far northern latitudes; I am covered by a layer of permafrost: \_\_\_\_\_
11. I am the uppermost branches of trees: \_\_\_\_\_
12. I am an Earth system made up of all the air that covers Earth: \_\_\_\_\_
13. I am a region that drains into a river, river system, or another body of water: \_\_\_\_\_
14. I am a biome with a very dry, arid climate: \_\_\_\_\_
15. I am a unique coastal habitat found in the tropical zone; I support large communities of tropical fish: \_\_\_\_\_

VOCABULARY PRACTICE, CONTINUED

**C. Put It in a Box** For each vocabulary term, fill in the box with words that will help you to remember its meaning.

**DECIDUOUS**

1. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**TUNDRA**

2. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CHAPARRAL**

3. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CONIFEROUS**

4. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**TAIGA**

5. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ESTUARY**

6. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**DESERT**

7. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**BIOSPHERE**

8. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CLIMATE**

9. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## VOCABULARY PRACTICE, CONTINUED

**D. Categorize Words** List the vocabulary words that belong in each category.

abyssal zone	desert	littoral zone
atmosphere	geosphere	neritic zone
bathyal zone	hydrosphere	phytoplankton
benthic zone	intertidal zone	taiga
biosphere	kelp forest	tundra
coral reef	limnetic zone	zooplankton

Ocean Zones	Earth Systems	Lake Zones
a.	a.	a.
b.	b.	b.
c.	c.	c.
d.	d.	
Coastal Habitats	Types of Plankton	Biomes
a.	a.	a.
b.	b.	b.
		c.

**E. Find the Odd Word** Circle the word that does not belong and explain why.

- \_\_\_\_\_ tundra

\_\_\_\_\_ coniferous

\_\_\_\_\_ taiga

Explanation \_\_\_\_\_

\_\_\_\_\_
- \_\_\_\_\_ coral reef

\_\_\_\_\_ desert

\_\_\_\_\_ kelp forest

Explanation \_\_\_\_\_

\_\_\_\_\_