

Table of Contents

Chapter: Atmosphere

Section 1: Earth's Atmosphere

Section 2: Energy Transfer in the Atmosphere

Section 3: Air Movement



CHAPTER RESOURCES



1

Importance of the Atmosphere

- Earth's **atmosphere** is a thin layer of air that forms a protective covering around the planet. 
- Earth's atmosphere maintains a balance between the amount of heat absorbed from the Sun and the amount of heat that escapes back into space.
- It also protects life-forms from some of the Sun's harmful rays.



1


Makeup of the Atmosphere

- Earth's atmosphere is a mixture of gases, solids, and liquids that surrounds the planet.
- It extends from Earth's surface to outer space.



1

Makeup of the Atmosphere

- Earth's early atmosphere, produced by erupting volcanoes, contained nitrogen and carbon dioxide, but little oxygen.
- 
- Then, more than 2 billion years ago, Earth's early organisms released oxygen into the atmosphere as they made food with the aid of sunlight.



1

Makeup of the Atmosphere

- Eventually, a layer rich in ozone (O_3) that protects Earth from the Sun's harmful rays formed in the upper atmosphere.
- This protective layer eventually allowed green plants to flourish all over Earth, releasing even more oxygen.

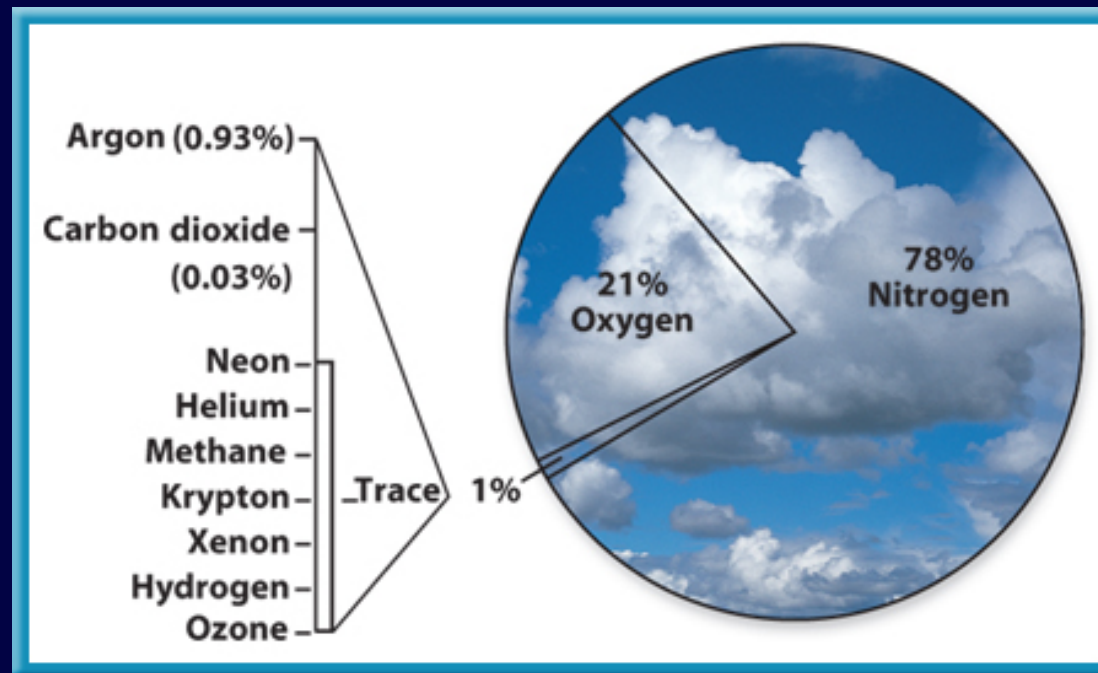


Earth's Atmosphere

1

Gases in the Atmosphere

- This circle graph shows the percentages of the gases, excluding water vapor, that make up Earth's atmosphere.



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1

Gases in the Atmosphere



- The composition of the atmosphere is changing in small but important ways. For example, car exhaust emits gases into the air.
- Humans burn fuel for energy.
- Increasing energy use may increase the amount of carbon dioxide in the atmosphere.



1

Solids and Liquids in Earth's Atmosphere

- In addition to gases, Earth's atmosphere contains small, solid particles such as dust, salt, and pollen.
- The atmosphere also contains small liquid droplets other than water droplets in clouds.



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Solids and Liquids in Earth's Atmosphere

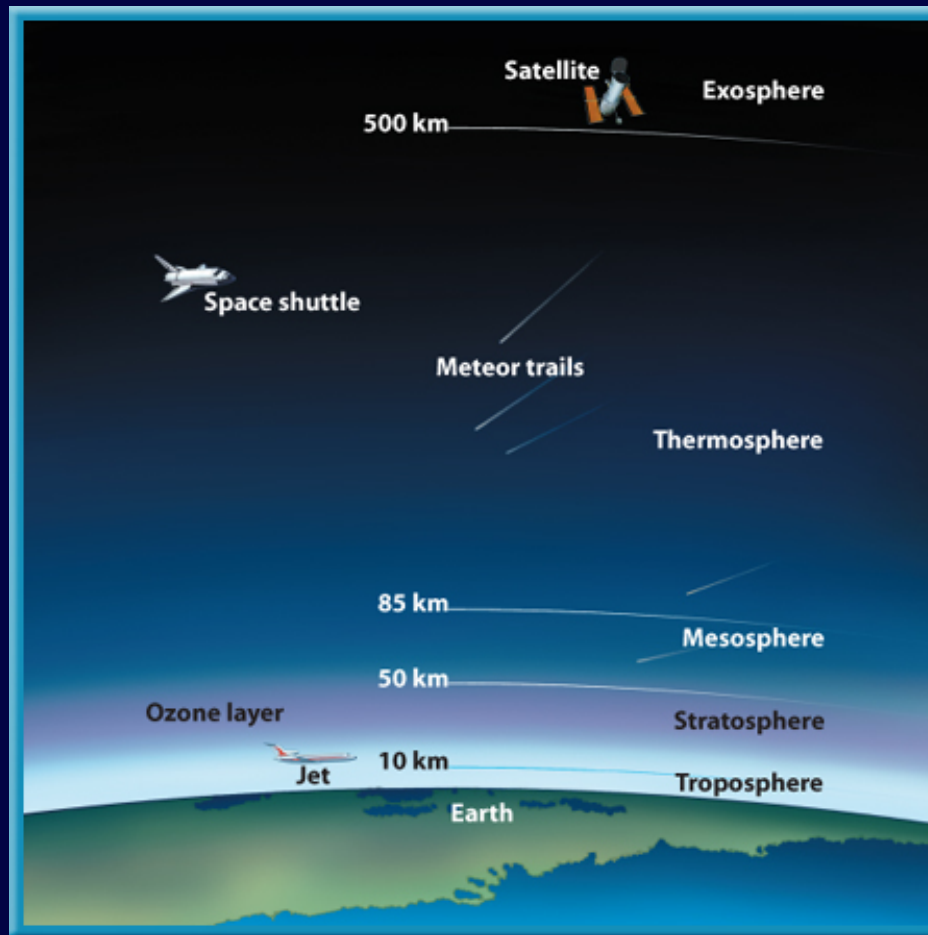
- The atmosphere constantly moves these liquid droplets and solids from one region to another.
 - For example, the atmosphere above you may contain liquid droplets and solids from an erupting volcano thousands of kilometers from your home.



Earth's Atmosphere

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Layers of the Atmosphere



- Earth's atmosphere has layers.
- There are five layers in Earth's atmosphere, each with its own properties.



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Layers of the Atmosphere

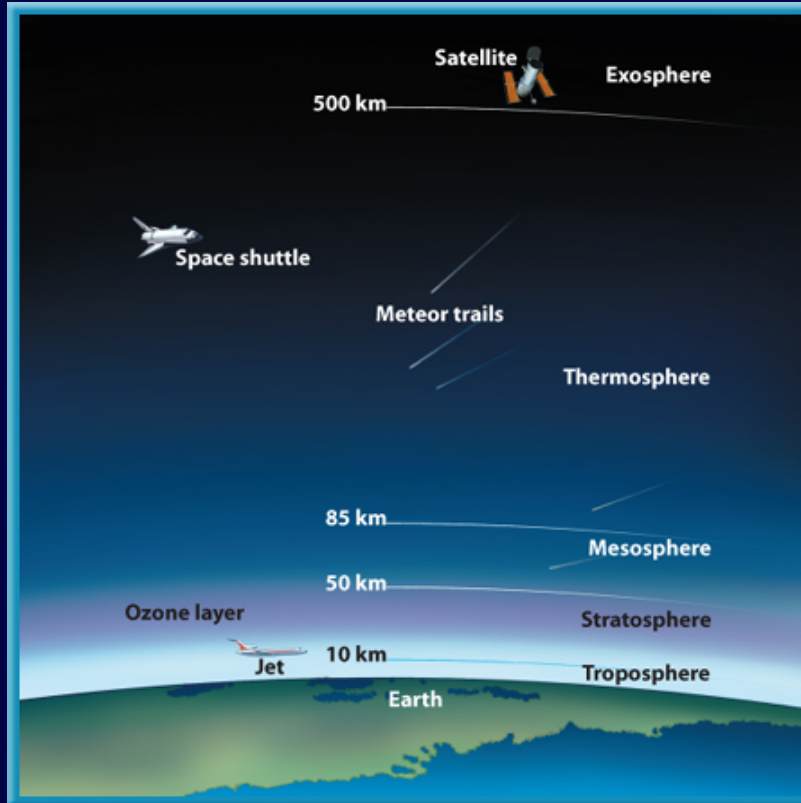
- The lower layers include the troposphere and stratosphere.
- The upper atmospheric layers are the mesosphere, thermosphere, and exosphere.
- The troposphere and stratosphere contain most of the air.



Earth's Atmosphere

1

Lower Layers of the Atmosphere



- You study, eat, sleep, and play in the **troposphere**, which is the lowest of Earth's atmospheric layers. 🔊
- It contains 99 percent of the water vapor and 75 percent of the atmospheric gases.



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END

1

Lower Layers of the Atmosphere

- The stratosphere, the layer directly above the troposphere, extends from 10 km above Earth's surface to about 50 km.
- A portion of the stratosphere contains higher levels of a gas called ozone.
- Each molecule of ozone is made up of three oxygen atoms bonded together.



1


Upper Layers of the Atmosphere

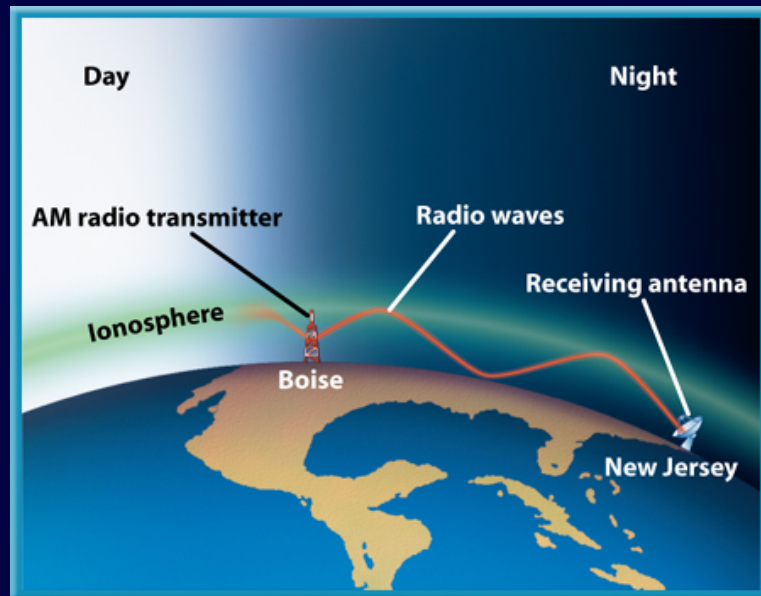
- The mesosphere extends from the top of the stratosphere to about 85 km above Earth.
- The thermosphere is named for its high temperatures.
- This is the thickest atmospheric layer and is found between 85 km and 500 km above Earth.



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Upper Layers of the Atmosphere

- Within the mesosphere and thermosphere is a layer of electrically charged particles called the **ionosphere** (I AH nuh sführ). 



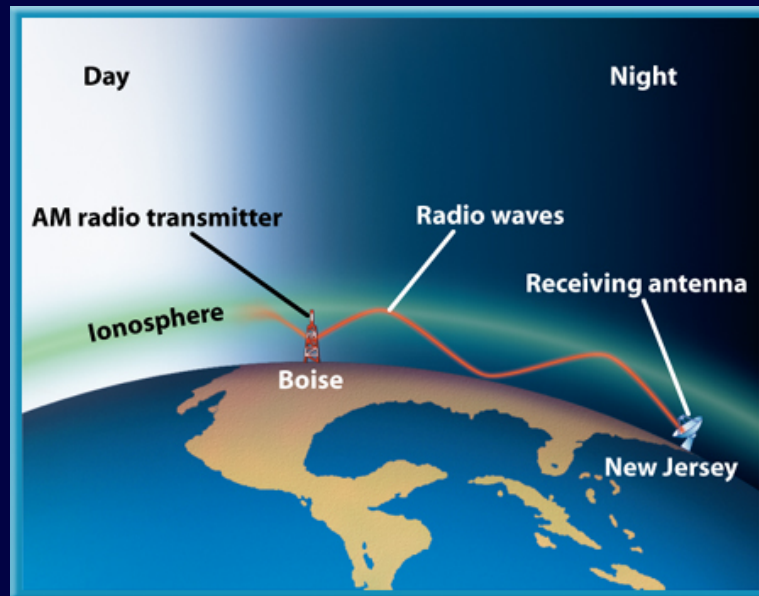
- The ionosphere allows radio waves to travel across the country to another city.



1

Upper Layers of the Atmosphere

- During the day, energy from the Sun interacts with the particles in the ionosphere, causing them to absorb AM radio frequencies.



- At night, without solar energy, AM radio transmissions reflect off the ionosphere, allowing radio transmissions to be received at greater distances.



1

Upper Layers of the Atmosphere

- The space shuttle orbits Earth in the exosphere.
- The exosphere has so few molecules that the wings of the shuttle are useless.



- In the exosphere, the spacecraft relies on bursts from small rocket thrusters to move around.
- Beyond the exosphere is outer space.



Atmospheric Pressure

- Atmospheric gases have mass.
- Atmospheric gases extend hundreds of kilometers above Earth's surface.
- As Earth's gravity pulls the gases toward its surface, the weight of these gases presses down on the air below.



Atmospheric Pressure

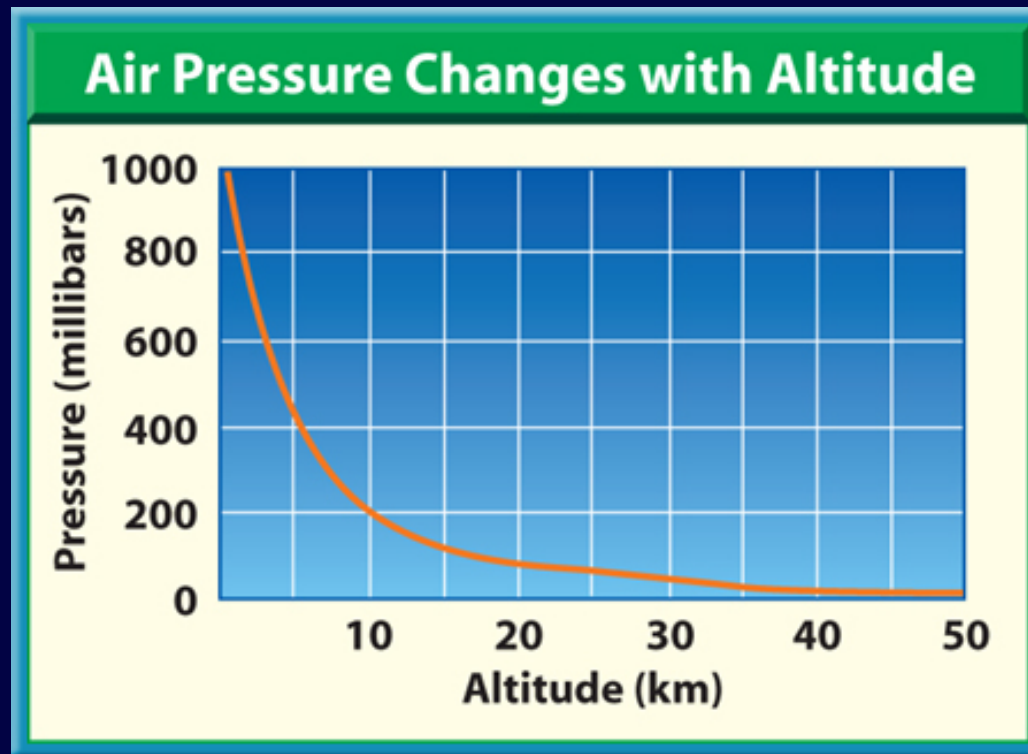
- The molecules nearer Earth's surface are closer together.
- This dense air exerts more force than the less dense air near the top of the atmosphere.
- Force exerted on an area is known as pressure.



1

Atmospheric Pressure

- Air pressure is greater near Earth's surface and decreases higher in the atmosphere.



- People find it difficult to breathe in high mountains because fewer molecules of air exist there.

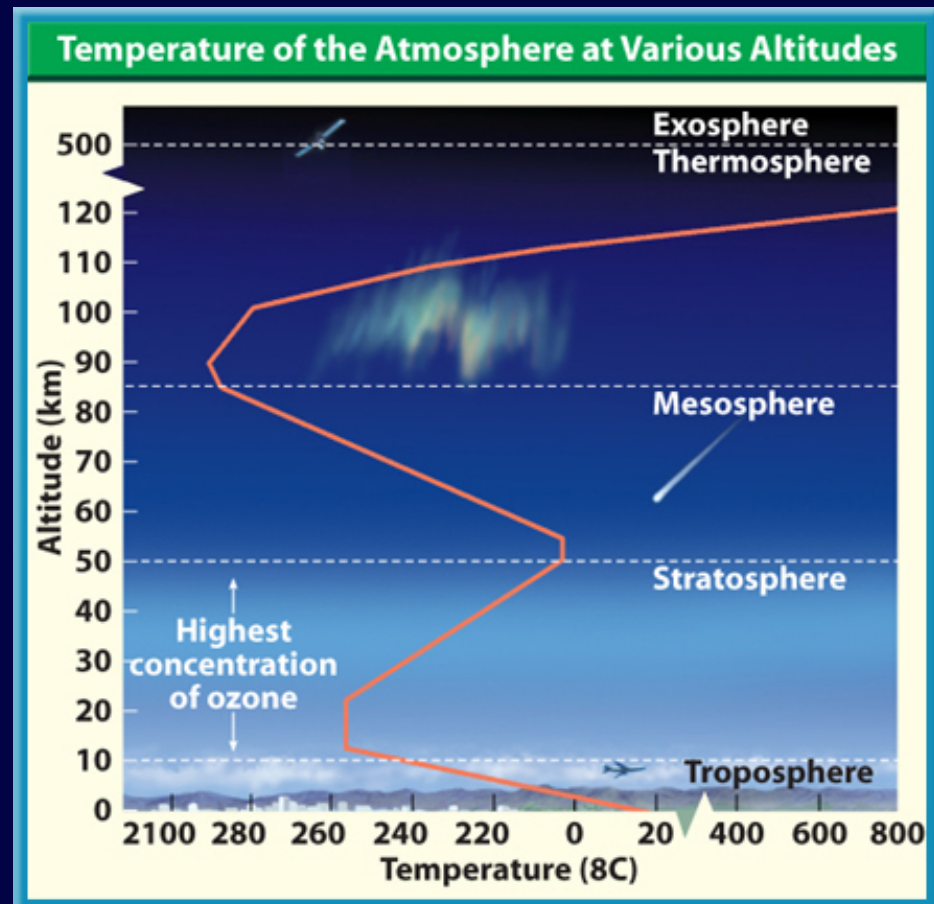


Earth's Atmosphere

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Temperature in Atmospheric Layers

- The Sun is the source of most of the energy on Earth.
- Before it reaches Earth's surface, energy from the Sun must pass through the atmosphere.



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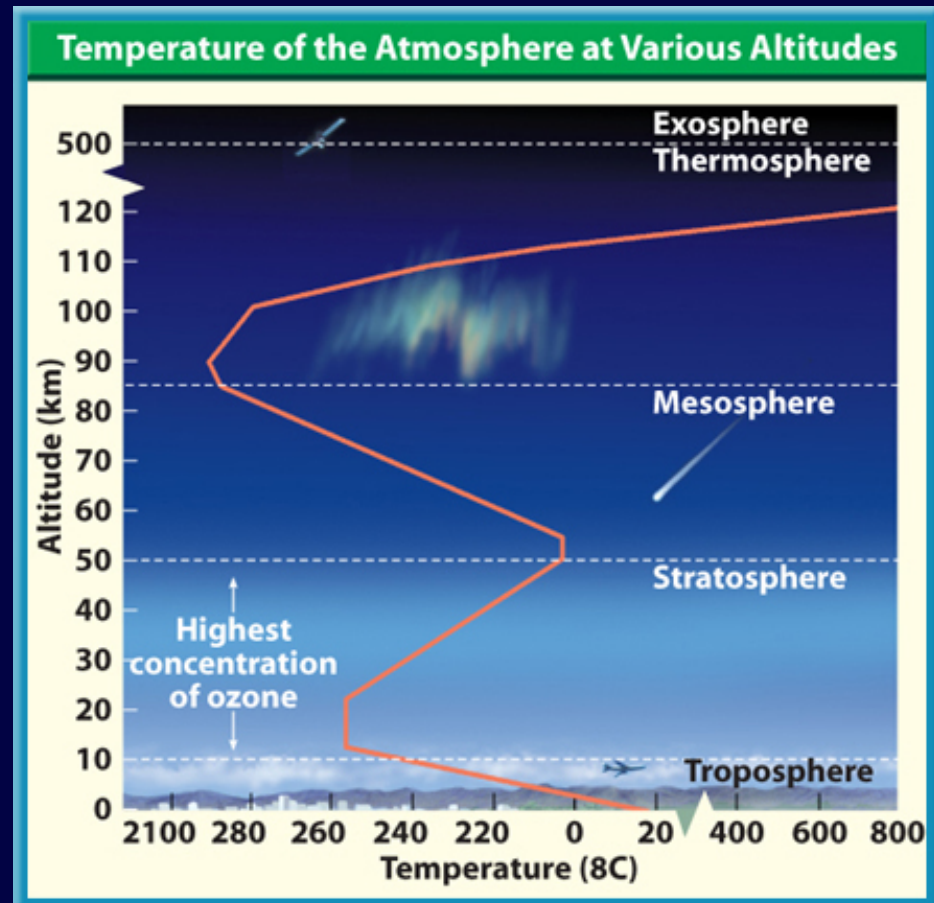


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Temperature in Atmospheric Layers

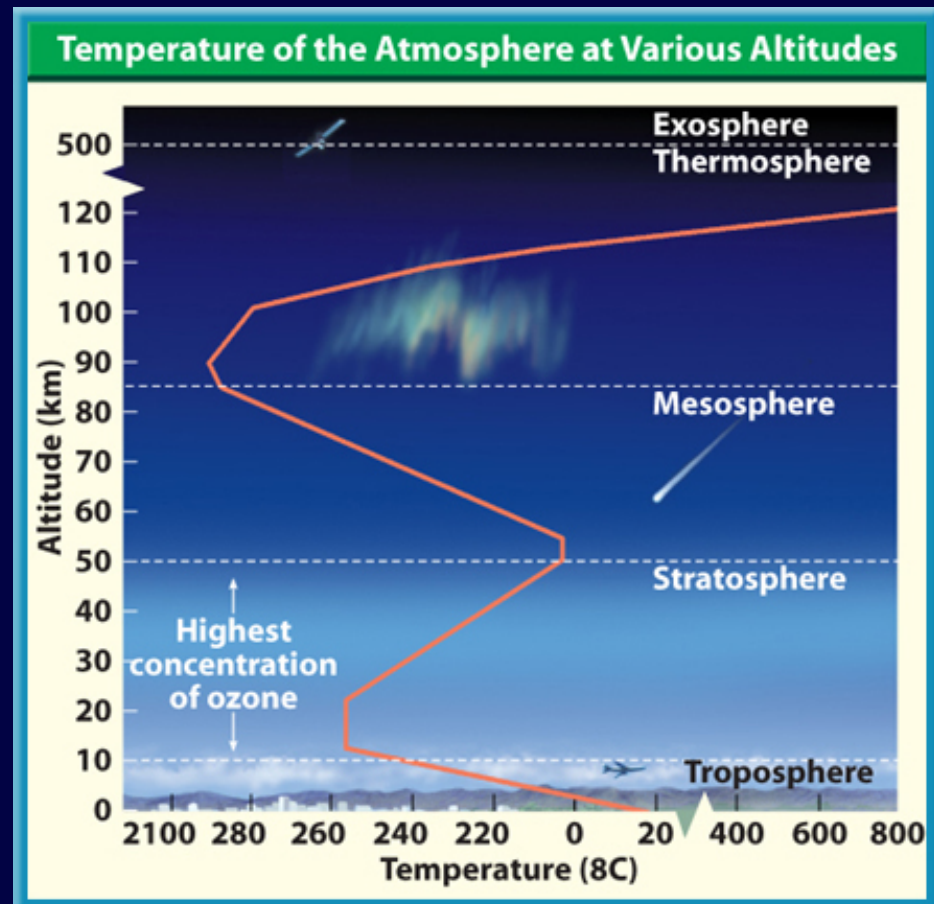
- Because some layers contain gases that easily absorb the Sun's energy while other layers do not, the various layers have different temperatures.



1

Temperature in Atmospheric Layers

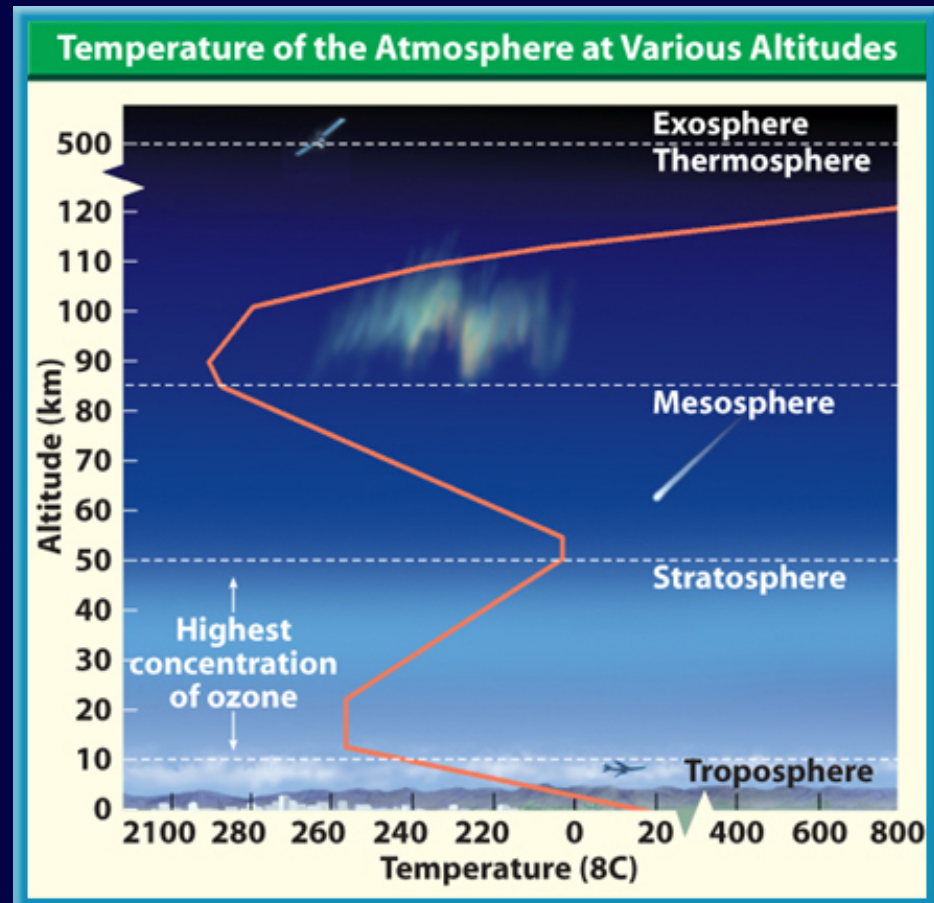
- Molecules that make up air in the troposphere are warmed mostly by heat from Earth's surface.
- The Sun warms Earth's surface, which then warms the air above it.



1

Temperature in Atmospheric Layers

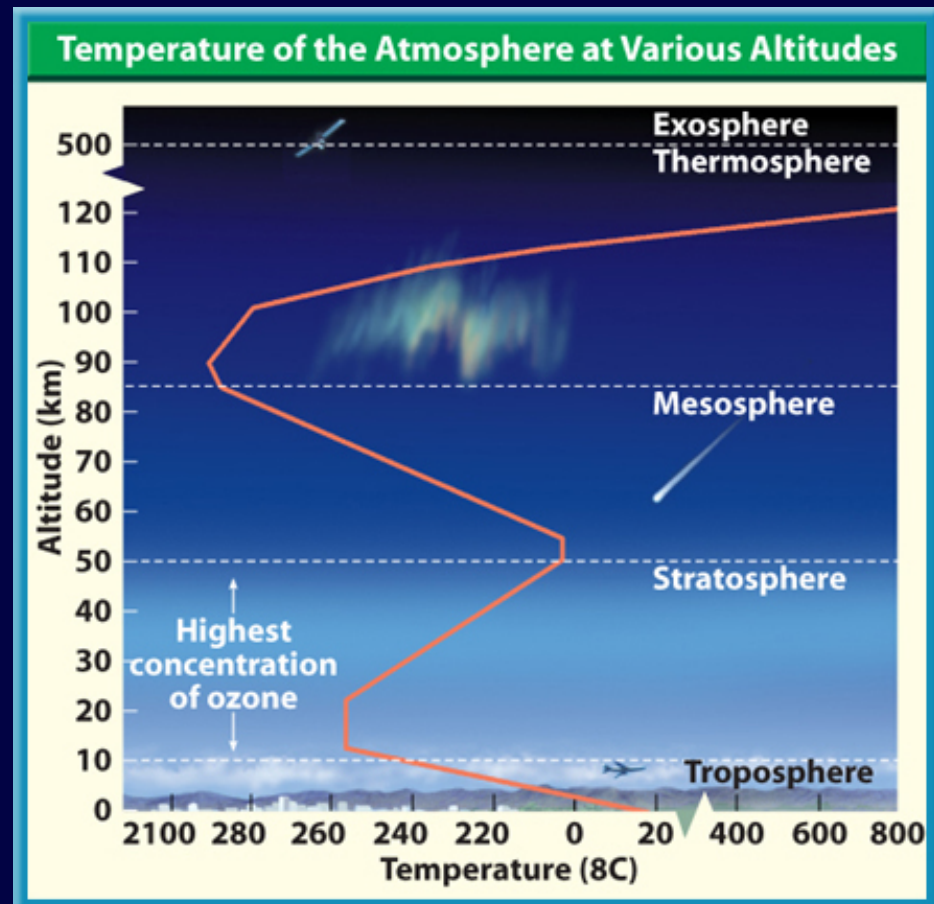
- Molecules of ozone in the stratosphere absorb some of the Sun's energy.
- Energy absorbed by ozone molecules raises the temperature.



1

Temperature in Atmospheric Layers

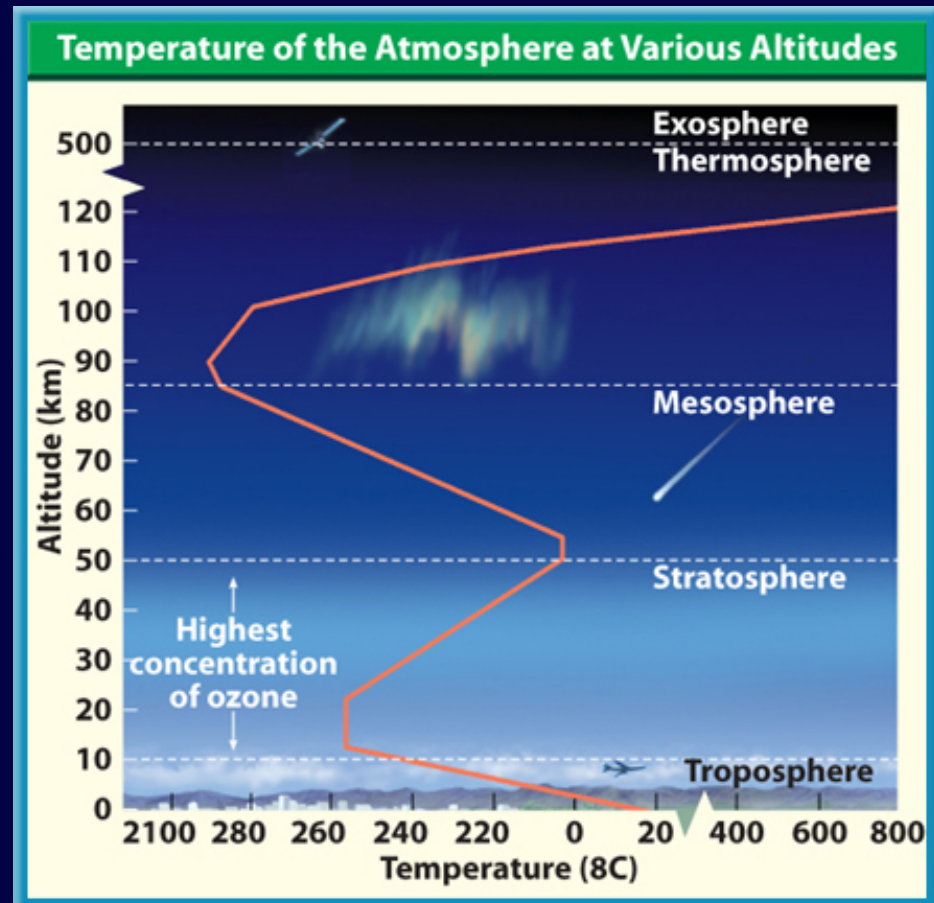
- Because more ozone molecules are in the upper portion of the stratosphere, the temperature in this layer rises with increasing altitude.



1

Temperature in Atmospheric Layers

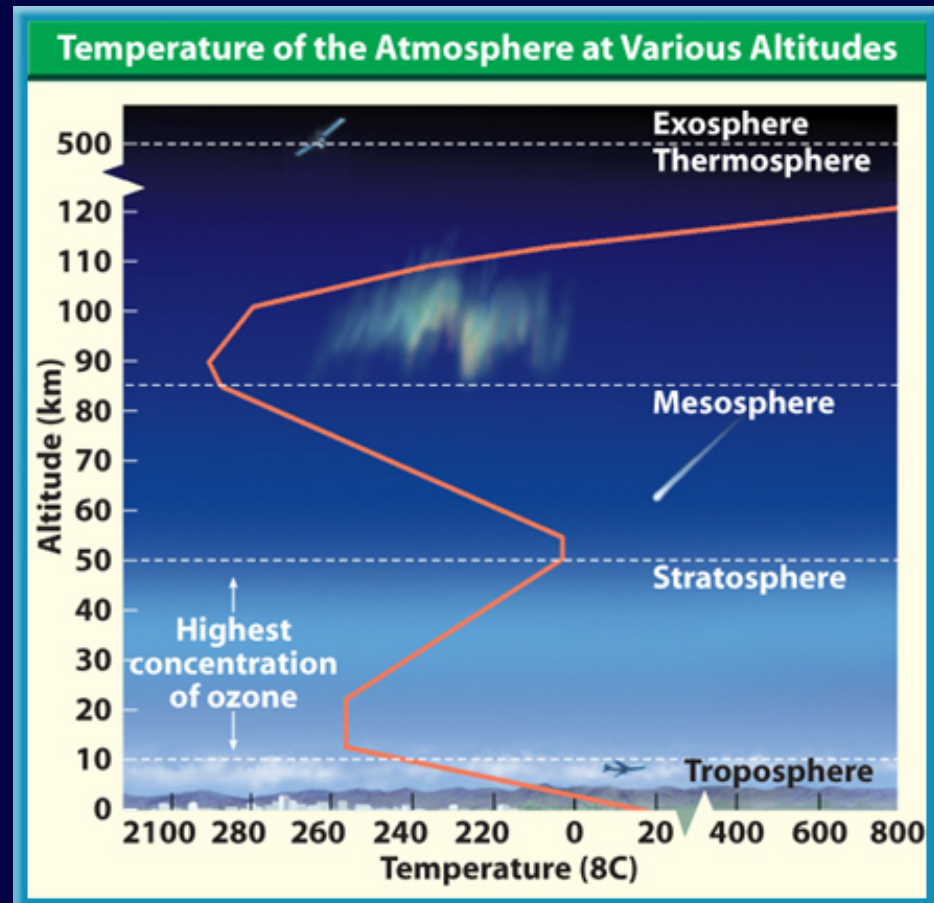
- The temperature in the mesosphere decreases with altitude.
- The thermosphere and exosphere are the first layers to receive the Sun's rays.



1

Temperature in Atmospheric Layers


- Few molecules are in these layers, but each molecule has a great deal of energy.
- Temperatures here are high.

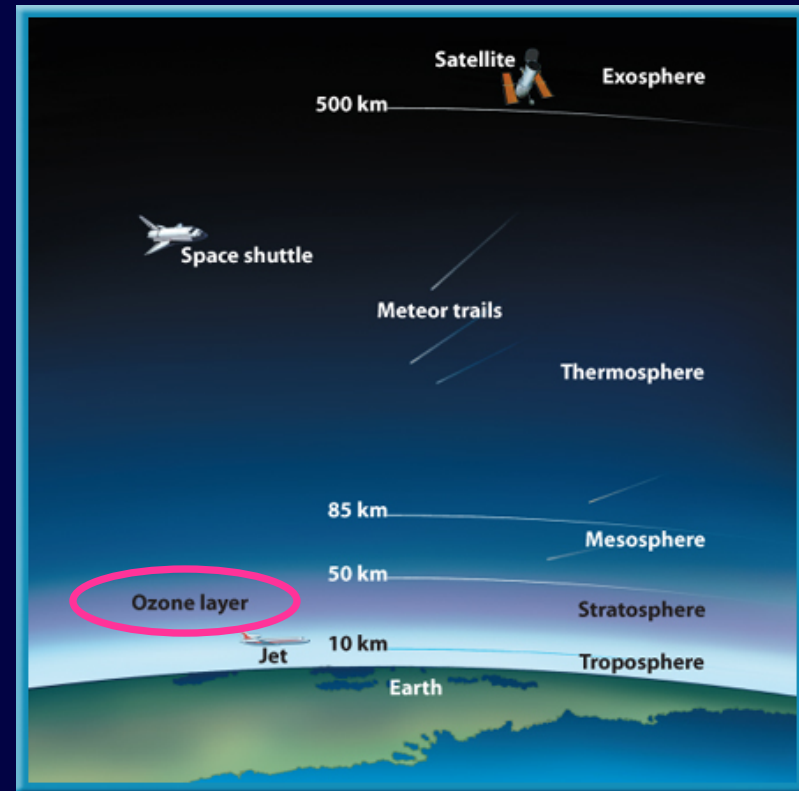


Earth's Atmosphere

1

The Ozone Layer

- Within the stratosphere, about 19 km to 48 km above your head, lies an atmospheric layer called the **ozone layer**. 
- Ozone is made of oxygen.
- Although you cannot see the ozone layer, your life depends on it.



CHAPTER RESOURCES



END

1

The Ozone Layer

- An ozone molecule is made up of three oxygen atoms bound together.
- The ozone layer contains a high concentration of ozone and shields you from the Sun's harmful energy.




CHAPTER RESOURCES



END

1

The Ozone Layer

- Ozone absorbs most of the ultraviolet radiation that enters the atmosphere.
- **Ultraviolet radiation** is one of the many types of energy that come to Earth from the Sun. 




CHAPTER RESOURCES



END

1

CFCs

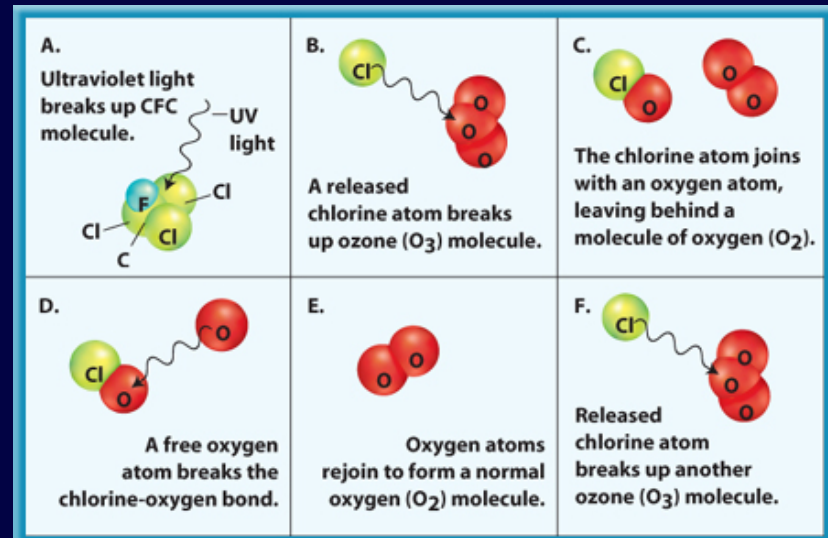
- Evidence exists that some air pollutants are destroying the ozone layer.
- Blame has fallen on **chlorofluorocarbons** (CFCs), chemical compounds used in some refrigerators, air conditioners, and aerosol sprays, and in the production of some foam packaging. 



1

CFCs

- Chlorofluorocarbon molecules destroy ozone.
- When a chlorine atom from a chlorofluorocarbon molecule comes near a molecule of ozone, the ozone molecule breaks apart.
- One of the oxygen atoms combines with the chlorine atom, and the rest form a regular, two-atom molecule.



1

CFCs

- These compounds don't absorb ultraviolet radiation the way ozone can.
- In addition, the original chlorine atom can continue to break apart thousands of ozone molecules.
- The result is that more ultraviolet radiation reaches Earth's surface.



1

The Ozone Hole

- The destruction of ozone molecules by CFCs seems to cause a seasonal reduction in ozone over Antarctica called the ozone hole.
- Every year beginning in late August or early September the amount of ozone in the atmosphere over Antarctica begins to decrease.



1

The Ozone Hole

- By October, the ozone concentration reaches its lowest values and then begins to increase again.
- By December, the ozone hole disappears.



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1

Question 1

The lowest of Earth's atmospheric layers is the

_____.

- A. exosphere
- B. ionosphere
- C. mesosphere
- D. troposphere

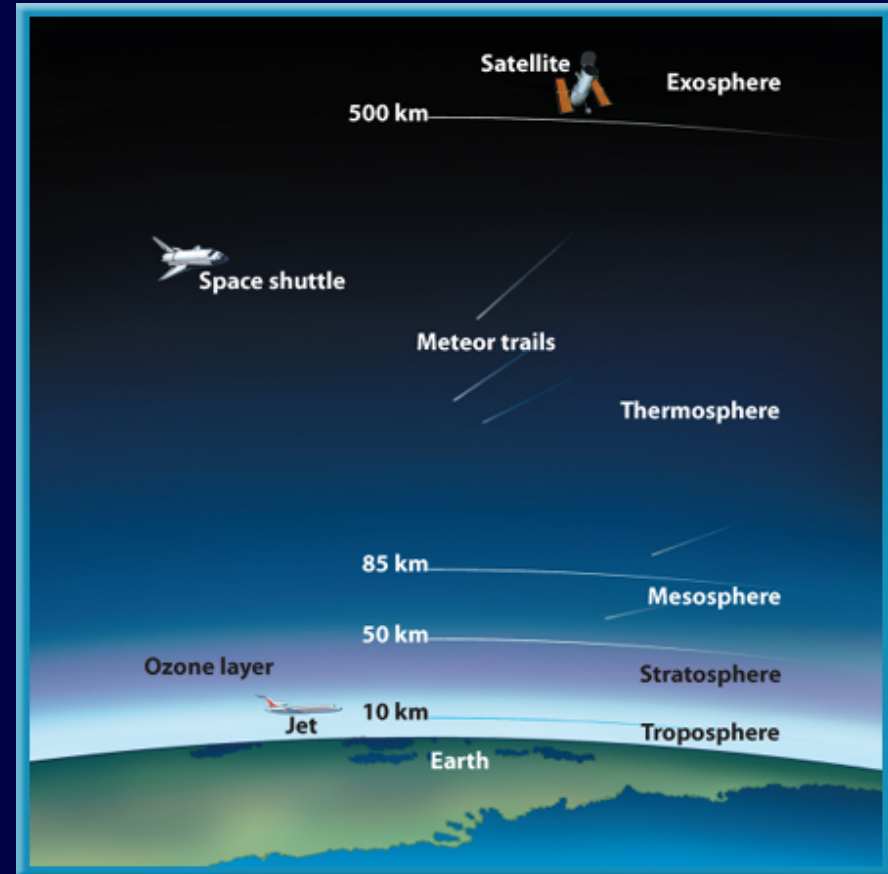


Section Check

1

Answer

The answer is D.
The troposphere extends up to about 10 km.



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END

1

Question 2

Where is the ozone layer located?

- A. mesosphere
- B. stratosphere
- C. thermosphere
- D. troposphere

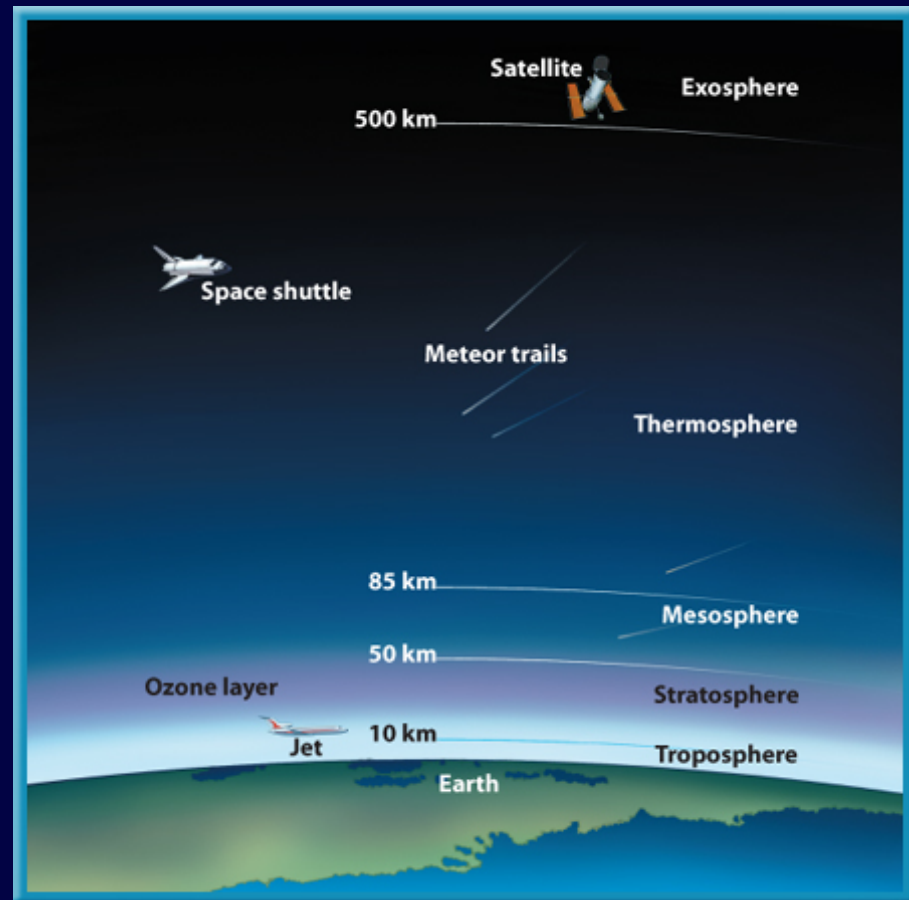


Section Check

1

Answer

The answer is B.
The ozone layer is located in the stratosphere, which extends up to about 50 km.



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END

1

Question 3

Which layer of Earth's atmosphere is the thickest?

- A. mesosphere
- B. stratosphere
- C. thermosphere
- D. troposphere

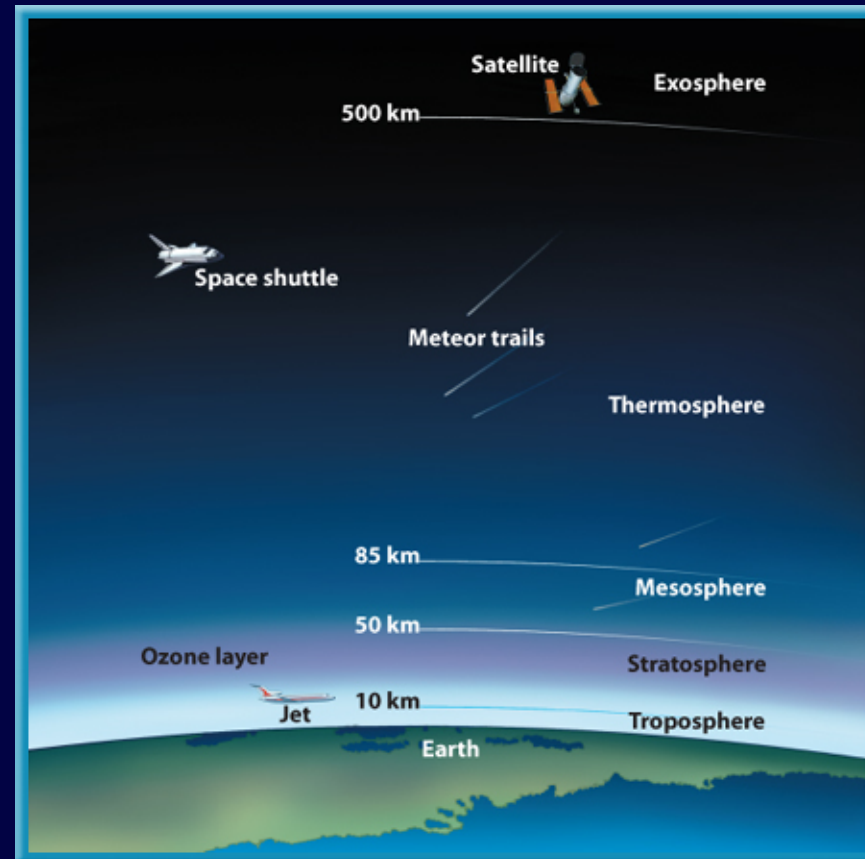


Section Check

1

Answer

The answer is C.
The thermosphere
is found between
85 km and 500 km
above Earth's
surface.



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2

Energy from the Sun

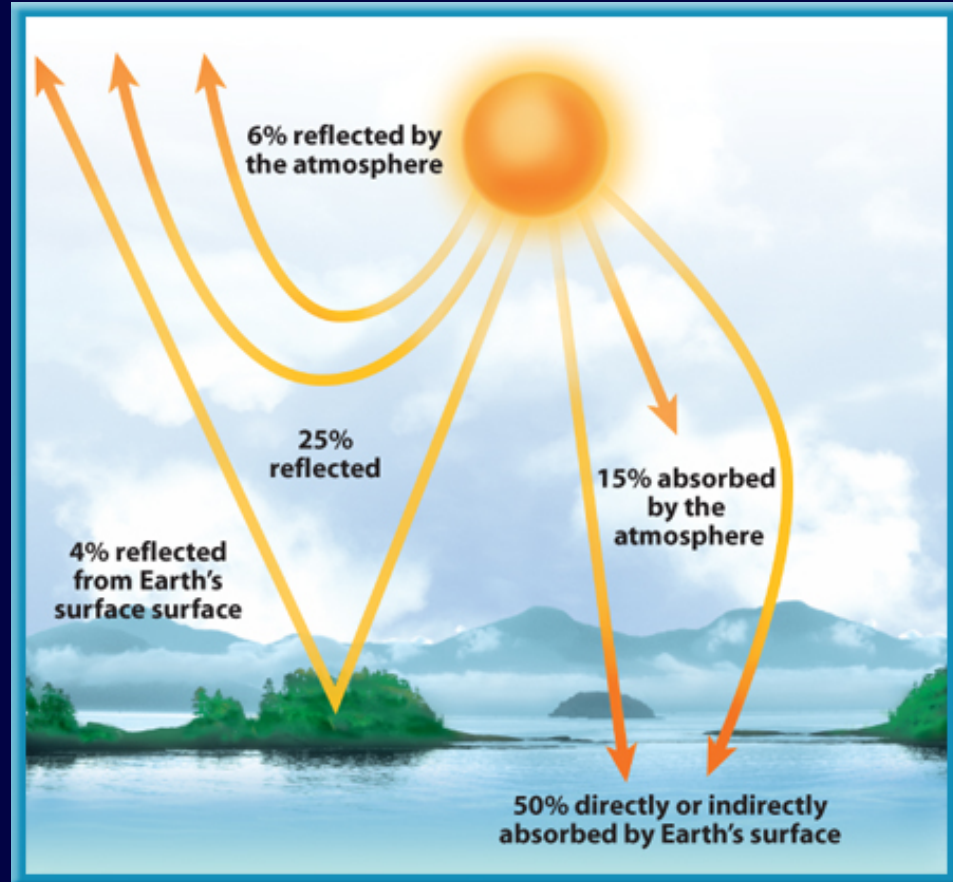
- The Sun provides most of Earth's energy.
- When Earth receives energy from the Sun, three different things can happen to that energy.



2

Energy from the Sun

- Some energy is reflected back into space by clouds, particles, and Earth's surface.
- Some is absorbed by the atmosphere or by land and water on Earth's surface.



2

Heat

- Heat is energy that flows from an object with a higher temperature to an object with a lower temperature.
- Energy from the Sun reaches Earth's surface and heats it.
- Heat then is transferred through the atmosphere in three ways—radiation, conduction, and convection.



2


Radiation

- Energy from the Sun reaches Earth in the form of radiant energy, or radiation.
- **Radiation** is energy that is transferred in the form of rays or waves. 🔊
- Earth radiates some of the energy it absorbs from the Sun back toward space.



2

Conduction

- **Conduction** is the transfer of energy that occurs when molecules bump into one another. 
- Molecules in warmer objects move faster than molecules in cooler objects.
- When objects are in contact, energy is transferred from warmer objects to cooler objects.



2

Conduction

- Earth's surface conducts energy directly to the atmosphere.
- As air moves over warm land or water, molecules in air are heated by direct contact.



2

Convection



- **Convection** is the transfer of heat by the flow of material. 🔊
- How does this happen?
- Convection circulates heat throughout the atmosphere.



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2

Convection

- When air is warmed, the molecules in it move apart and the air becomes less dense.
- Air pressure decreases because fewer molecules are in the same space.
- In cold air, molecules move closer together.



2


Convection

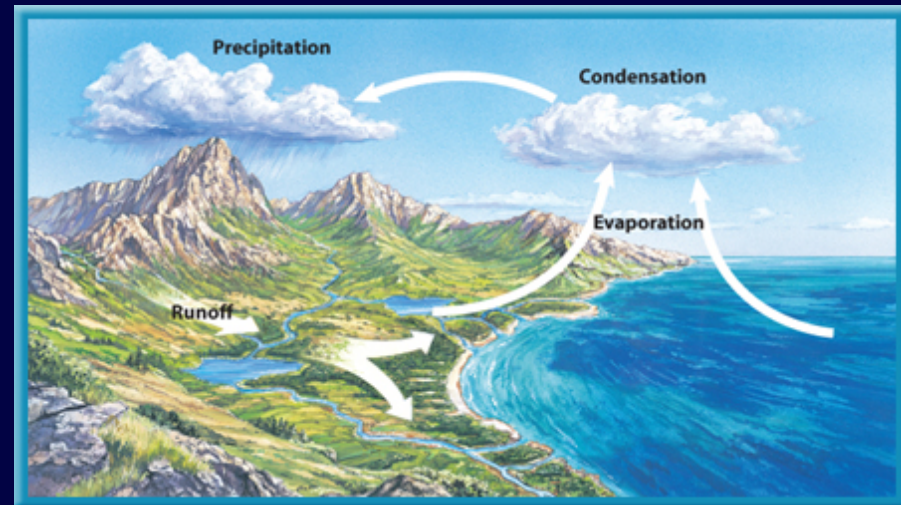
- The air becomes more dense and air pressure increases.
- Cooler, denser air sinks while warmer, less dense air rises, forming a convection current.



2

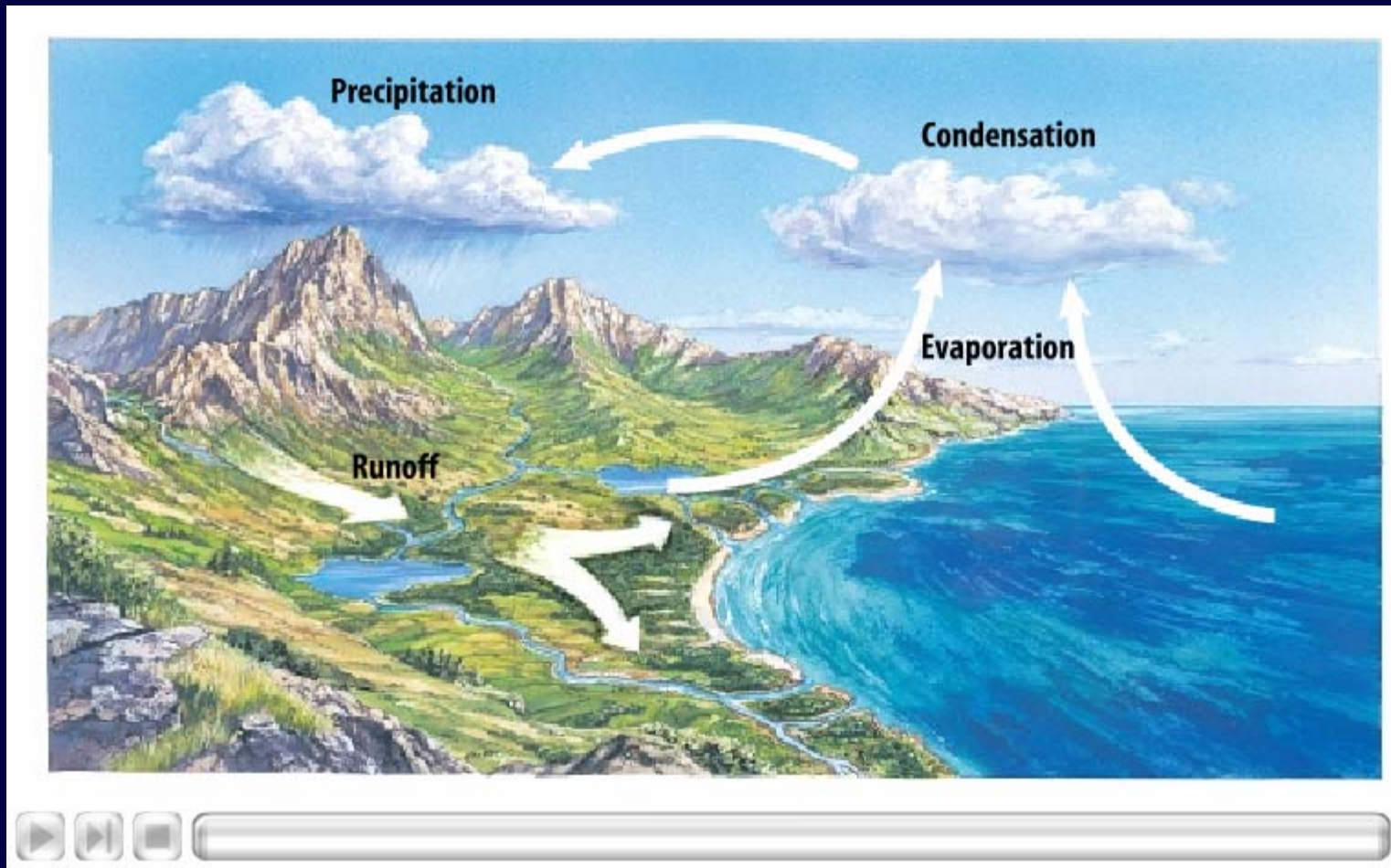
The Water Cycle

- **Hydrosphere** is a term that describes all the water on Earth's surface. 
- The constant cycling of water between the atmosphere and the hydrosphere plays an important role in determining weather patterns and climate types.



The Water Cycle

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users
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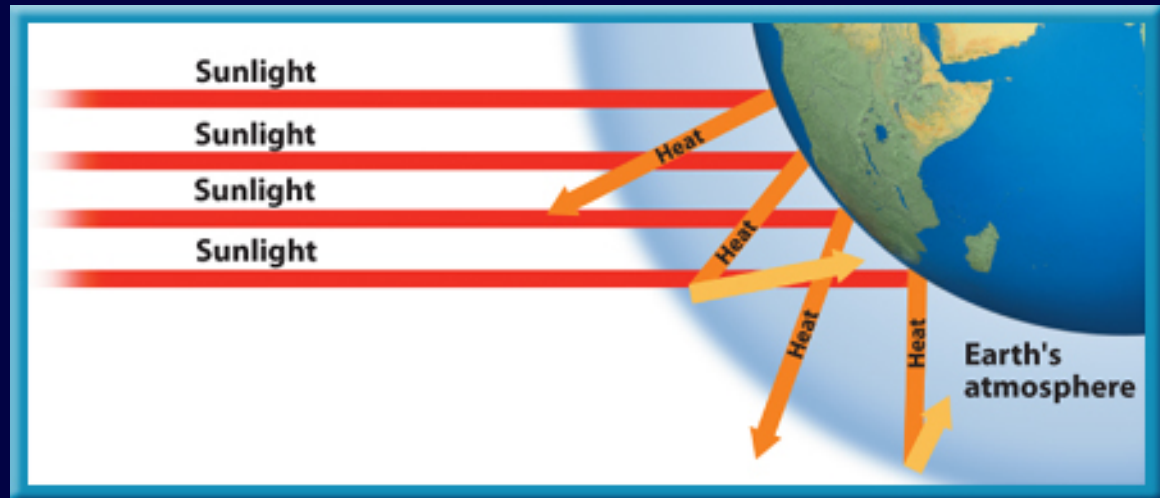


END

2

Earth's Atmosphere is Unique

- On Earth, radiation from the Sun can be reflected into space, absorbed by the atmosphere, or absorbed by land and water.
- Once it is absorbed, heat can be transferred by radiation, conduction, or convection.



2

Earth's Atmosphere is Unique

- Why doesn't life exist on Mars or Venus? Mars is a cold, lifeless world because its atmosphere is too thin to support life or to hold much of the Sun's heat.
- On the other hand, gases in Venus's dense atmosphere trap heat coming from the Sun.
- The temperature on the surface of Venus is 470°C.
- Living things would burn instantly if they were placed on Venus's surface.



2

Question 1

Energy that is transferred in the form of waves or rays is _____.

- A. electricity
- B. condensation
- C. radiation
- D. thermal power



Section Check

2

Answer

The answer is C. Radiation is one way that heat is transferred within Earth's atmosphere.



CHAPTER RESOURCES



2

Question 2

What is meant by the term “hydrosphere”?

Answer

Hydrosphere refers to all the water on Earth’s surface.



2

Question 3

Once energy from the Sun is absorbed on Earth, how can it be transferred?

Answer

Energy from the Sun can be transferred by radiation, conduction, and convection.



3

Forming Wind

- Earth is mostly rock or land, with three-fourths of its surface covered by a relatively thin layer of water, the oceans.
- These two areas strongly influence global wind systems.



3

Forming Wind

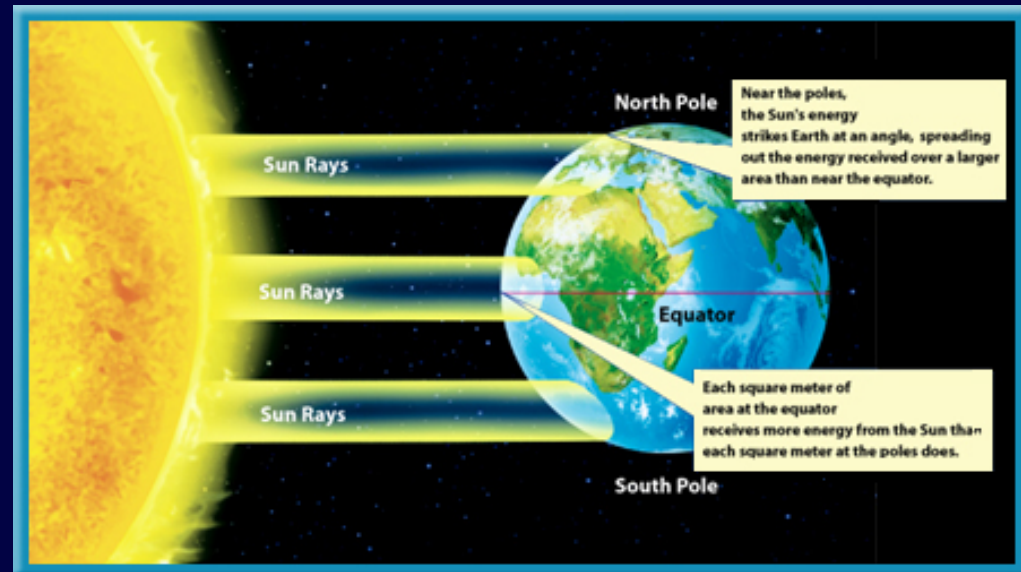
- Uneven heating of Earth's surface by the Sun causes some areas to be warmer than others.
- This causes air pressure to be generally lower where air is heated.
- Wind is the movement of air from an area of higher pressure to an area of lower pressure.



3

Heated Air

- Areas of Earth receive different amounts of radiation from the Sun because Earth is curved.
- The heated air at the equator is less dense, so it is displaced by denser, colder air, creating convection currents.



3


Heated Air

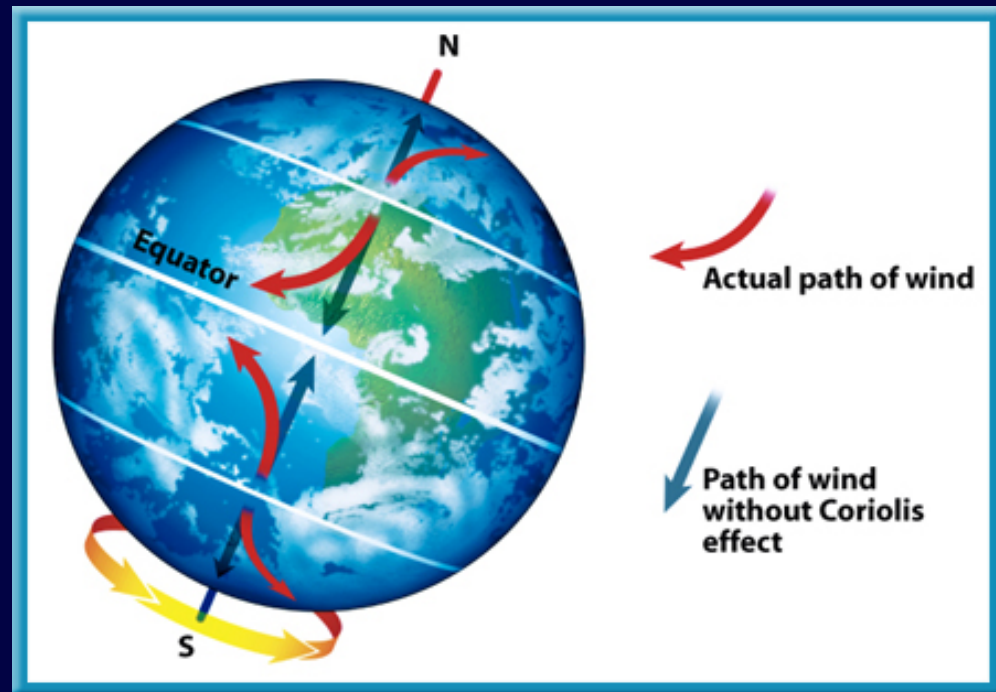
- This cold, denser air comes from the poles, which receive less radiation from the Sun, making air at the poles much cooler.
- The resulting dense, high-pressure air sinks and moves along Earth's surface.



3

The Coriolis Effect

- The rotation of Earth causes moving air and water to appear to turn to the right north of the equator and to the left south of the equator.
- This is called the **Coriolis** (kohr ee OH lus) **effect**. 



3

The Coriolis Effect

- The flow of air caused by differences in the amount of solar radiation received on Earth's surface and by the Coriolis effect creates distinct wind patterns on Earth's surface.



CHAPTER RESOURCES



3

Global Winds

- Early sailors discovered that the wind patterns on Earth helped them navigate the oceans.
- Sometimes sailors found little or no wind to move their sailing ships near the equator.
- It also rained nearly every afternoon.
- This windless, rainy zone near the equator is called the doldrums.



3

Surface Winds

- Air descending to Earth's surface near 30° north and south latitude creates steady winds that blow in tropical regions.
- These are called trade winds because early sailors used their dependability to establish trade routes.



3

Surface Winds

- Between 30° and 60° latitude, winds called the prevailing westerlies blow in the opposite direction from trade winds.
- Prevailing westerlies are responsible for much of the movement of weather across North America.



3

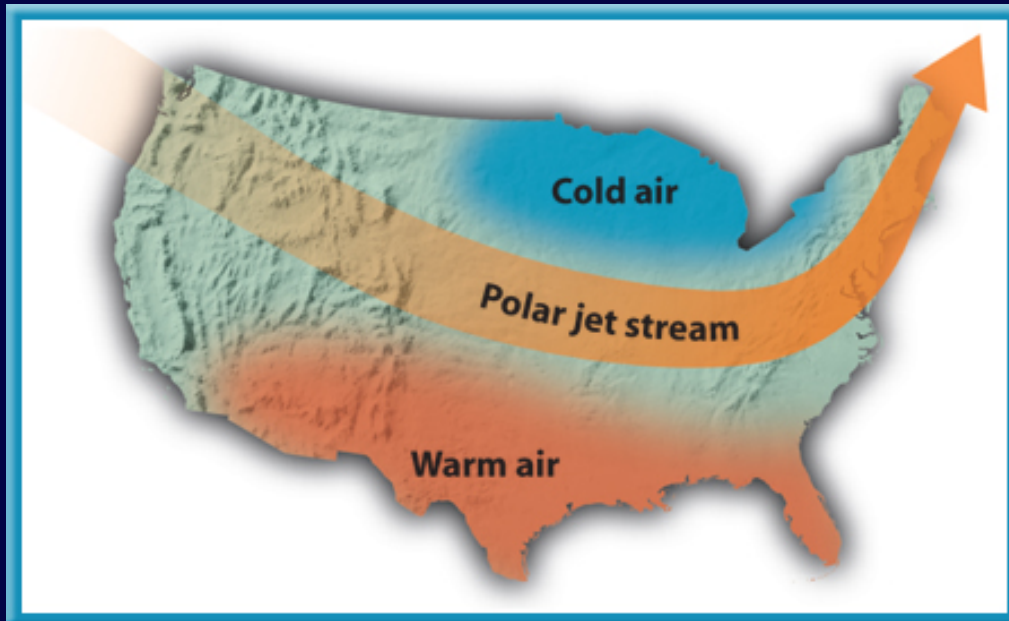
Surface Winds


- Polar easterlies are found near the poles.
- Near the north pole, easterlies blow from northeast to southwest.
- Near the south pole, polar easterlies blow from the southeast to the northwest.



3

Winds in the Upper Troposphere



- Narrow belts of strong winds, called **jet streams**, blow near the top of the troposphere. 
- The polar jet stream forms at the boundary of cold, dry polar air to the north and warmer, more moist air to the south.



3

Winds in the Upper Troposphere

- The jet stream moves faster in the winter because the difference between cold air and warm air is greater.
- The jet stream helps move storms across the country.



3


Local Wind Systems

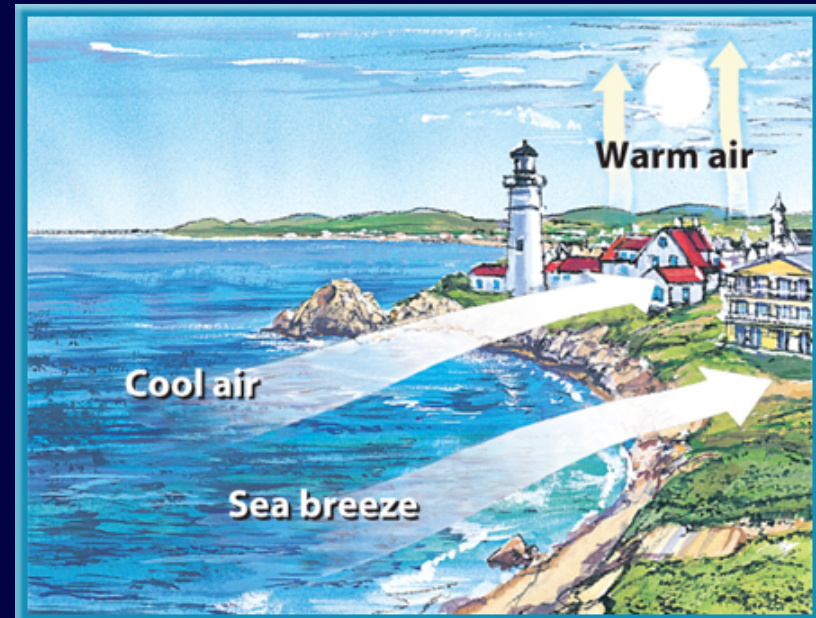
- Global wind systems determine the major weather patterns for the entire planet.
- Smaller wind systems affect local weather.
- If you live near a large body of water, you're familiar with two such wind systems—sea breezes and land breezes.



3

Sea and Land Breezes

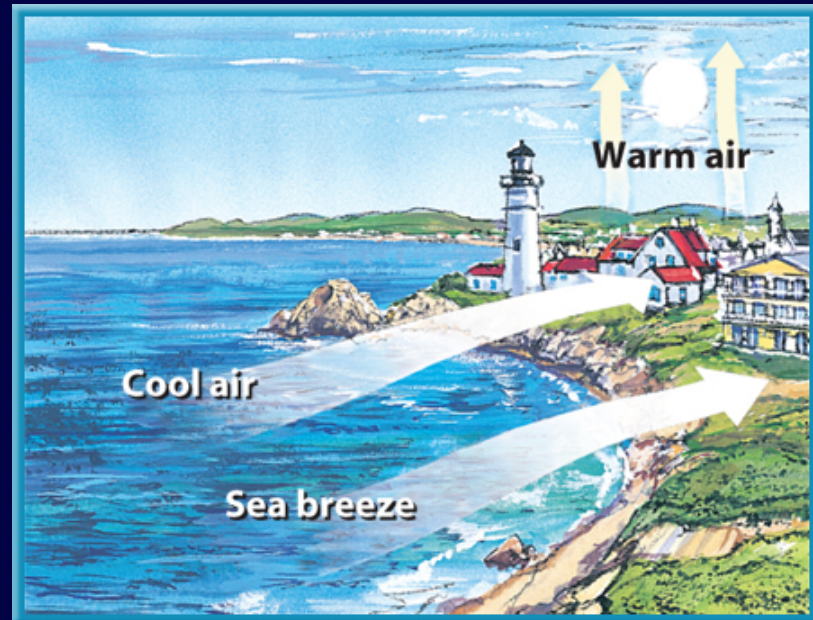
- A **sea breeze** is created during the day because solar radiation warms the land more than the water. 
- Air over the land is heated by conduction.



3

Sea and Land Breezes

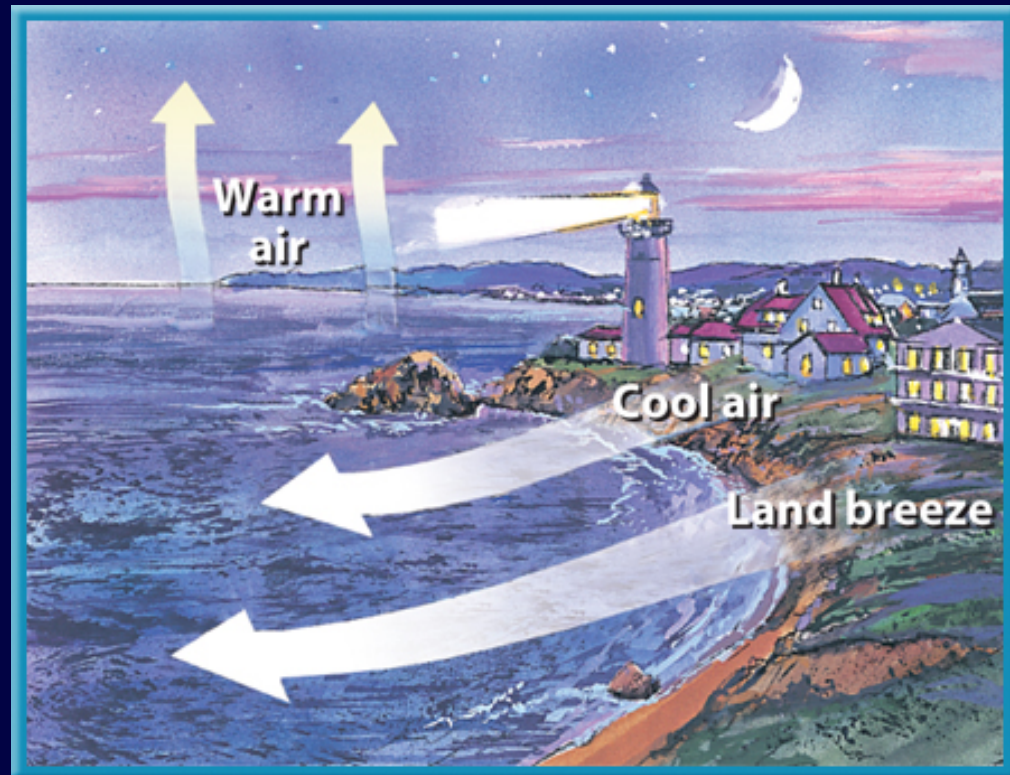
- This heated air is less dense and has lower pressure.
- Cooler, denser air over the water has higher pressure and flows toward the warmer, less dense air.
- A convection current results, and wind blows from the sea toward the land.



3

Sea and Land Breezes

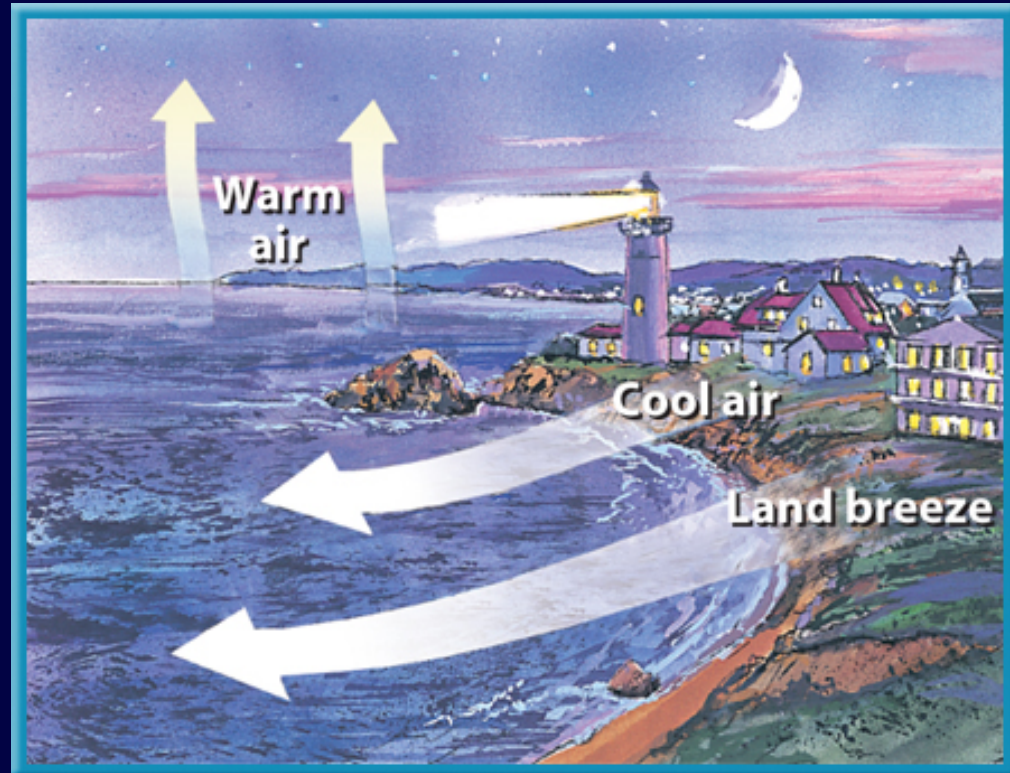
- The reverse occurs at night, when land cools much more rapidly than ocean water.
- Air over the land becomes cooler than air over the ocean.



3

Sea and Land Breezes

- Cooler, denser air above the land moves over the water, as the warm air over the water rises.
- Movement of air toward the water from the land is called a **land breeze**. 



3

Question 1

What results from the Coriolis effect?



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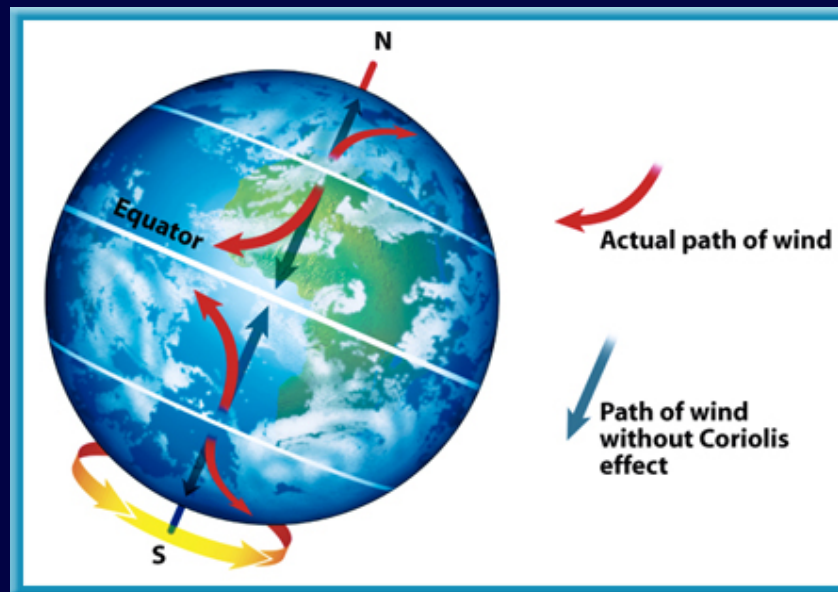


Section Check

3

Answer

Moving air turns to the right in the northern hemisphere and to the left in the southern hemisphere as a result of the Coriolis effect.



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END

3

Question 2

Narrow belts of strong winds blowing near the top of the troposphere are _____.

- A. arctic blasts
- B. doldrums
- C. El Niños
- D. jet streams



3

Answer

The answer is D. The jet stream moves faster in the winter because of the greater temperature difference between cold and warm air.



3

Question 3

Which of these is created during the day when solar radiation warms the land more than the water?

- A. jet stream
- B. land breeze
- C. polar stream
- D. sea breeze

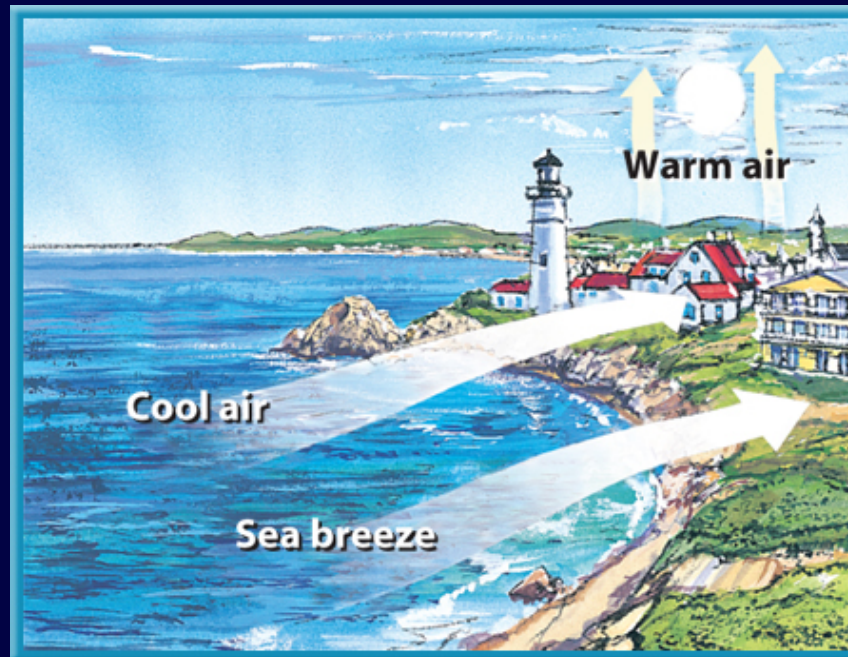


Section Check

3

Answer

The answer is D. Cooler air over the water flows toward the warmer air on land, creating a sea breeze.



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END

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Click on this icon to return to the previous slide



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