11-2 What are the layers of the atmosphere?

Objective ▹ Name and describe the layers of the atmosphere.

TechTerms

- **ionosphere** (Y-on-uh-sfeer): upper layer of the atmosphere
- **stratosphere** (STRAT-uh-sfeer): middle layer of the atmosphere
- **tropopause** (TROHP-oh-pawz): place where the troposphere ends
- **troposphere** (TROHP-uh-sfeer): lowest layer of the atmosphere

Layers of the Atmosphere The atmosphere begins at the earth's surface and goes more than 700 km into space. Not all parts of the atmosphere are the same. The atmosphere is made up of three main layers. These layers are the troposphere (TROHP-uh-sfeer), the stratosphere (STRAT-uh-sfeer), and the ionosphere (Y-on-uh-sfeer).

List: Name three layers of the atmosphere?

The Troposphere The **troposphere** is the layer of the atmosphere closest to the earth. The air you breathe is part of the troposphere. Winds occur in the troposphere. Most of the water vapor in the atmosphere is in the troposphere. This water vapor forms clouds. Weather takes place in the troposphere.

The higher you go in the troposphere, the colder it gets. Near the top of the troposphere, the temperature stops getting colder. This part of the troposphere is called the **tropopause** (TROHP-oh-pawz).

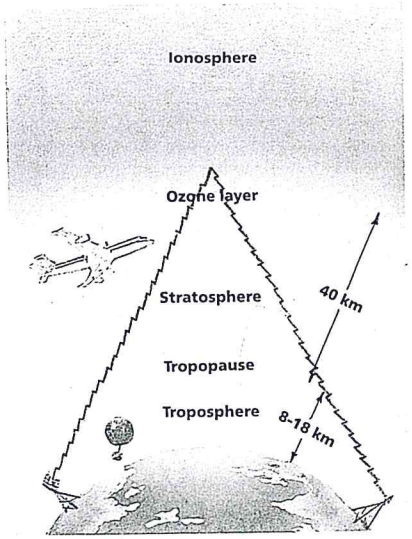
Define: What is the tropopause?

The Stratosphere The stratosphere is the middle layer of the atmosphere. The temperature of the air hardly changes here. There is no weather in the stratosphere. Airplanes travel in this layer. A layer of ozone (OH-zohn) is found in the upper stratosphere. Ozone is a form of oxygen. Ozone stops most of the ultraviolet (ul-truh-VY-uh-lit) light from the sun from reaching the earth. Ultraviolet light causes sunburn. Small amounts of ultraviolet light are needed by living things. Large amounts are harmful.

Predict: What might happen if the ozone layer of the stratosphere were destroyed?

The Ionosphere The ionosphere is an upper-layer of the atmosphere. Charged particles called ions (Y-onz) are found in this layer. Radio waves sent from the earth are reflected, or bounced off, these ions. Because of the ionosphere, radio signals can be transmitted, or sent, from one part of the earth to another.

Describe: How is the ionosphere used in communication?



Name _____ Class _____ Date _____

11–2 What are the layers of the atmosphere?

Lesson Review

Part A *Write true if the statement is true. If the statement is false, change the underlined term to make the statement true.*

_____ 1. The atmosphere is made up of <u>four</u> main layers.

_____ 2. The place where the troposphere ends is called the <u>ionosphere</u>.

_____ 3. Ozone is a form of <u>oxygen</u>.

_____ 4. The higher you go in the <u>ionosphere</u>, the colder it gets.

_____ 5. Ozone stops most of the <u>ultraviolet light</u> from the sun.

_____ 6. The <u>stratosphere</u> is the closest layer to the earth's surface.

_____ 7. The <u>ionosphere</u> is the middle layer of the atmosphere.

Part B *Decide which layer of the atmosphere is described by each characteristic listed in the table. Place a check mark in the proper column.*

Table 1 Characteristics of the Layers of the Atmosphere

Characteristic	Ionosphere	Stratosphere	Troposphere
1. Contains a layer of ozone			
2. Weather takes place here			
3. Made up of ions			
4. Airplanes travel here			
5. Most winds occur here			
6. Most water vapor is found here			
7. Allows radio signals to be sent across the earth			
8. Air temperature hardly changes here			

Skill Challenge

Skills: *applying concepts, diagraming*

On the back of this worksheet, draw a diagram that shows the layers of the atmosphere. Include these labels on your diagram: troposphere, tropopause, stratosphere, ozone layer, and ionosphere. Draw clouds, an airplane, and a weather balloon in the layer in which they would most likely be located.

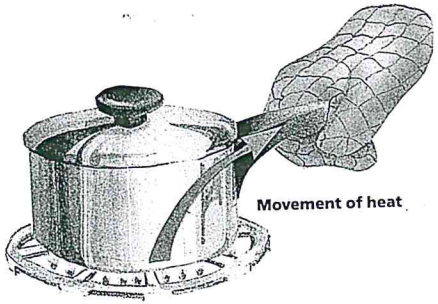
11-4 How is the earth's atmosphere heated?

Objective ▹ Explain how the atmosphere is heated.

TechTerms

- ▹ **conduction** (kon-DUCK-shun): movement of heat through a solid
- ▹ **convection** (kon-VEK-shun): movement of heat through a liquid or a gas

Conduction A metal pan placed over a flame will get hot. The metal molecules directly over the flame begin to move faster. They bump into slower-moving molecules around them and make the slower-moving molecules move faster. In this way, heat moves through the metal pan. The heat moves from an area of higher temperature to an area of lower temperature. This kind of movement of heat is called **conduction** (kon-DUCK-shun). Heat moves through solids by conduction.

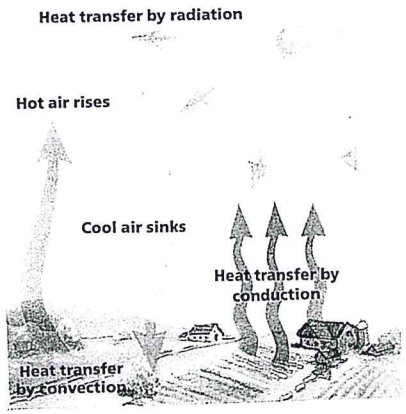


Name: How does heat move through solids?

Heating the Atmosphere The troposphere, or lower layer of the atmosphere, is heated by conduction. The sunlight that is absorbed by the earth's surface is changed to heat. This heat warms the surface. Air in the troposphere touches the warm surface. It is heated by conduction.

The atmosphere also is heated by radiation. Radiant energy travels through space in waves. Most of the sun's energy is short-wave radiation. Short-wave radiation passes through the atmosphere and is absorbed by the earth. The earth warms up and radiates energy back to the atmosphere. The earth's radiant energy is long-wave radiation. The long-wave radiation is absorbed by the atmosphere and helps to heat the atmosphere.

Describe: What happens to the energy radiated by the earth?



Convection The movement of heat in a gas or liquid is called **convection** (kon-VEK-shun). Heat moves through the atmosphere by convection. When air is heated, it expands. As warm air expands, it becomes lighter. Warm air is lighter than cool air. Warm air rises. Cooler, heavier air sinks.

Define: What is convection?

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11–4 How is the earth's atmosphere heated?

Lesson Review

Part A *Write true if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.*

_____ 1. Heat moves from areas of high temperature to areas of low temperature.

_____ 2. Warm air is heavier than cool air.

_____ 3. The earth's radiant energy is short-wave radiation.

_____ 4. Air in the troposphere is heated by conduction.

_____ 5. Heat moves through solids by convection.

Part B *Write the term that best completes each statement in the space provided.*

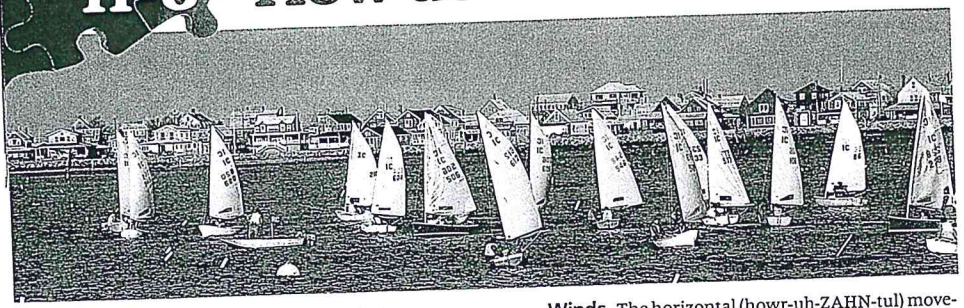
1. Heat moves through gases and liquids by _____.
2. Heat from the earth's surface warms the atmosphere by _____.
3. Radiant energy travels through space in _____.
4. Air _____ as it is heated.
5. As warm air rises, cool air _____.

Skill Challenge

Skills: *modeling, diagraming*

Draw a diagram showing the exchange of radiant energy between the Earth and the sun. Include the following labels in your diagram: Earth, sun, short-wave radiation, long-wave radiation. Use your textbook for help if necessary.

11-8 How do winds form?



Objective ▹ Explain how winds form.

TechTerms

- ▹ **air current** (KUR-unt): up-and-down movement of air
- ▹ **wind:** horizontal movement of air

Air Currents Up-and-down movements of air are called **air currents** (KUR-unts). Air currents are formed because the sun does not heat all parts of the earth equally. Some areas of the earth are warmed more than others. As air over the warmer regions is heated, it expands, or takes up more space. As the warmer air expands, it becomes less dense. As air over cooler regions is cooled, it becomes heavier, or more dense. The cool air moves in under the warm air. It pushes the warm air upward. As the warm air mixes with the cool air, it becomes heavier, and moves downward.

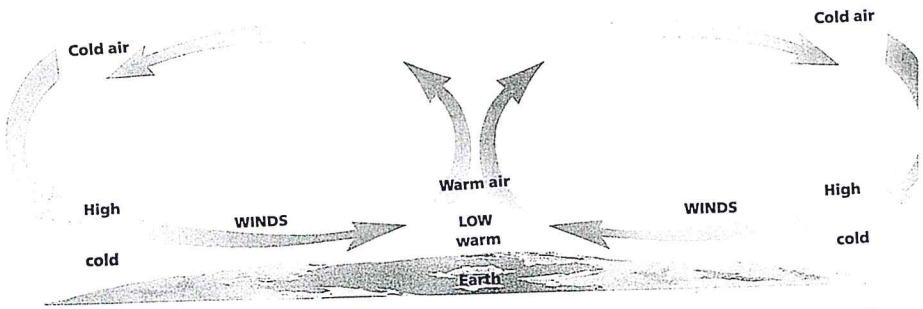
Define: What is an air current?

Winds The horizontal (howr-uh-ZAHN-tul) movement of air along the earth's surface is called **wind.** Winds form as cool, heavy air moves toward warm, light air. Cool air moves in under warm air. The cool air moves along the surface of the earth toward warmer air.

Explain: How are winds formed?

Winds and Air Pressure Winds are caused by differences in air pressure. Regions of cold, heavy air have high air pressure. These regions are called "highs." Regions of warm, light air have low air pressure. These regions are called "lows." Air moves from regions of high pressure to regions of low pressure. Winds form when air moves. The speed of the wind depends on the differences in air pressure.

Predict: Will the speed of a wind be greater if the difference in air pressure is high or low?



Name _____ Class _____ Date _____

11–8 How do winds form?

Lesson Review

Part A *Write true if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.*

_____ 1. As warm air expands, it becomes more dense.

_____ 2. The sun does not heat all parts of the earth equally.

_____ 3. Cool air pushes warm air downward.

_____ 4. Regions of cold air have low air pressure.

_____ 5. Cool air moves along the surface of the earth toward warm air.

Part B *Match each term in Column B with its description in Column A. Write the correct letter in the space provided.*

Column A	Column B
_____ 1. regions of warm, light air	a. air currents
_____ 2. up-and-down movements of air	b. air pressure
_____ 3. differences in this cause winds	c. highs
_____ 4. regions of cold, heavy air	d. lows
_____ 5. horizontal movement of air along the earth's surface	e. wind

Skill Challenge

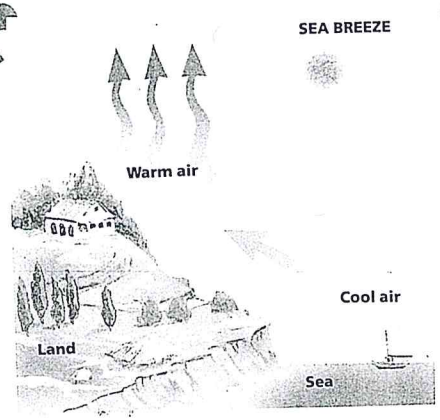
Skills: *diagraming, interpreting*

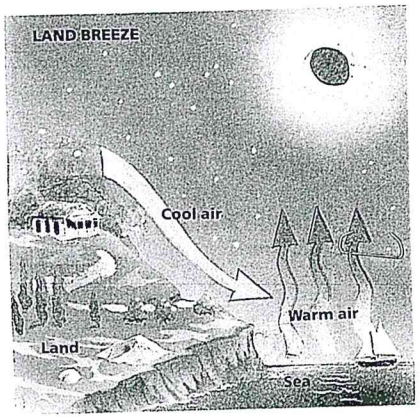
In the space provided, draw a flow chart that shows how winds form. Use your textbook for help if necessary. Then, answer the questions.

1. What causes winds to form? _____

2. What are winds? _____

11-10 What causes local winds?





Objective ▹ Describe patterns of local winds.

TechTerm

▹ **monsoon:** wind that changes direction with the seasons

Sea and Land Breezes A breeze coming from the sea toward the land is a sea breeze. A breeze coming from the land toward the sea is a land breeze. Land and sea breezes are local winds.

The sun heats land faster than water. As a result, air over the land is warmer and lighter than air over the water. The cooler, heavier air over the ocean moves in toward the land. The warm light air over the land is pushed upward. The result is a sea breeze.

At night, the land cools faster than the water. The air over the land becomes cooler than the air over the water. The heavier air over the land moves toward the water. The warmer, lighter air over the water is pushed upward. The result is a land breeze.

Compare: Which cools faster, land or water?

Mountain and Valley Breezes Mountain regions also have local winds. During the day, the air on a mountaintop is warmer than the air in the valleys. Warm air has low pressure. Air in the valley is cooler and has high pressure. Air moves from the high pressure of the valley to the low pressure of the mountaintop. This is a valley breeze. At night, the valleys are warmer than the mountaintops. The heavier mountain air moves downhill toward the valley. This is a mountain breeze.

Describe: In which direction do valley breezes move?

Monsoons Parts of some continents have winds that change direction with the seasons. These winds are called **monsoons.** In the summer, the continent remains warm both day and night. Winds move from the ocean toward the land all summer. In the winter, the land gets very cold. The air above the oceans is warmer. Winds blow toward the oceans all winter. Monsoons happen near India. The summer monsoon brings warm, moist air with heavy rains. The winter monsoon carries dry air. There is little rain in winter.

Define: What are monsoons?

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11–10 What causes local winds?

Lesson Review

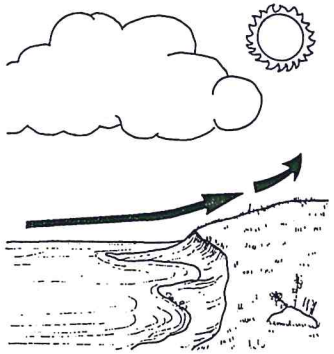
Match each term in Column B with its description in Column A. Write the correct letter in the space provided.

Column A	Column B
_____ 1. breeze coming from the sea toward land	a. land breeze
_____ 2. wind that changes direction with the seasons	b. monsoon
_____ 3. air moving down a mountain toward a valley	c. mountain breeze
_____ 4. breeze coming from the land toward the sea	d. sea breeze
_____ 5. air moving from a valley up a mountain	e. valley breeze

Skill Challenge

Skills: *applying concepts, observing*

Use the diagram to answer the questions. Write your answers in the spaces provided.



1. The air is warmest over the _____.
2. The air is coolest over the _____.
3. Air over the _____ is rising.
4. Air over the _____ is sinking.
5. The lightest air is found over the _____.
6. The heaviest air is found over the _____.
7. The diagram shows a _____ breeze.