

# Directed Reading

## Section: Characteristics of the Atmosphere

1. Define *atmosphere*.

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2. Describe two important functions served by Earth's atmosphere.

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### COMPOSITION OF THE ATMOSPHERE

\_\_\_\_\_ 3. The most abundant elements in air include all of the following gases EXCEPT

- a. oxygen.
- b. hydrogen.
- c. nitrogen.
- d. argon.

\_\_\_\_\_ 4. The composition of air is approximately the same all over Earth up to an altitude of about

- a. 40 km.
- b. 60 km.
- c. 80 km.
- d. 100 km.

\_\_\_\_\_ 5. The two most abundant compounds in air are the gases carbon dioxide and

- a. carbon monoxide.
- b. smog.
- c. water vapor.
- d. hydrocarbons.

\_\_\_\_\_ 6. In addition to containing gaseous elements and compounds, the atmosphere carries various kinds of tiny solid particles such as dust and

- a. pollution.
- b. pollen.
- c. insects.
- d. rocks.

**Directed Reading** *continued*

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\_\_\_\_\_ **7.** How much of Earth's atmosphere is composed of nitrogen?

- a. 26%
- b. 78%
- c. 52%
- d. 87%

\_\_\_\_\_ **8.** The process by which nitrogen moves from air to the soil and then to plants and animals and eventually returns to the air is called the

- a. life cycle.
- b. atmospheric cycle.
- c. earth cycle.
- d. nitrogen cycle.

\_\_\_\_\_ **9.** Nitrogen is removed from the air primarily by

- a. salt water.
- b. airborne bacteria.
- c. nitrogen-fixing bacteria.
- d. evaporation.

**10.** Describe the four steps of the nitrogen cycle.

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**11.** What percentage of Earth's atmosphere is made up of oxygen?

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**12.** Identify six ways oxygen is removed from the atmosphere.

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**Directed Reading** *continued*

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**13.** Explain how oxygen is returned to the atmosphere.

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**14.** Is the current oxygen content of the atmosphere lower, higher, or about the same as it was millions of years ago? Explain your answer.

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**15.** As water evaporates from oceans, lakes, streams, and soil, it enters air as \_\_\_\_\_.

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**16.** What is the life process by which plants and animals give off water vapor?

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**17.** How is water vapor removed as it enters the atmosphere?

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**18.** What are three factors that affect the percentage of water vapor in the air?

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**19.** What percentage of water is in dry air?

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**20.** What percentage of water is in moist air?

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**21.** What is ozone? How does it differ from oxygen?

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**Directed Reading** *continued*

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**22.** What purpose does the ozone layer serve?

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**23.** Describe the effect of chlorofluorocarbons (CFCs) on the ozone layer.

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**24.** What are particulates?

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**25.** List seven different particulates.

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**26.** Describe four common sources of particulates.

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**Directed Reading** *continued*

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27. How do large particles in the atmosphere differ from small particles?

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**ATMOSPHERIC PRESSURE**

\_\_\_\_\_ 28. What holds the gases of the atmosphere near Earth's surface?

- a. molecules
- b. air
- c. gravity
- d. pressure

\_\_\_\_\_ 29. The pressure exerted on a surface by the atmosphere is called

- a. water pressure.
- b. gravitational pressure.
- c. surface pressure.
- d. atmospheric pressure.

\_\_\_\_\_ 30. The pressure of the atmosphere is exerted

- a. unequally in all directions.
- b. equally in all directions.
- c. unequally sideways.
- d. unequally up and down.

\_\_\_\_\_ 31. How much of the total mass of the atmosphere does gravity keep within 32 km of Earth's surface?

- a. 1%
- b. 32%
- c. 99%
- d. 78%

\_\_\_\_\_ 32. Because the pull of gravity is not as strong at higher altitudes, the air molecules there are farther apart and exert

- a. less pressure.
- b. more pressure.
- c. the same pressure.
- d. no pressure.

\_\_\_\_\_ 33. It can be said that atmospheric pressure decreases as altitude

- a. decreases.
- b. disappears.
- c. increases.
- d. remains the same.

**Directed Reading** *continued*

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**34.** Besides altitude, what are two other factors that cause atmospheric pressure to change?

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**35.** In general, what happens to atmospheric pressure at sea level when the temperature increases?

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**36.** Why is air that contains a lot of water vapor less dense than drier air?

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**37.** What three units do meteorologists use to measure atmospheric pressure?

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**MEASURING ATMOSPHERIC PRESSURE**

**In the space provided, write the letter of the description that best matches the term or phrase.**

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| _____ <b>38.</b> standard atmospheric pressure | <b>a.</b> instrument that measures atmospheric pressure using a column of liquid mercury   |
| _____ <b>39.</b> barometer                     | <b>b.</b> instrument that measures atmospheric pressure; changes in atmospheric pressure cause the sides of a sealed metal container to bend inward or bulge out |
| _____ <b>40.</b> mercurial barometer           | <b>c.</b> an instrument used to measure atmospheric pressure   |
| _____ <b>41.</b> aneroid barometer             | <b>d.</b> an aneroid barometer that registers altitude above sea level rather than air pressure  |
| _____ <b>42.</b> altimeter                     | <b>e.</b> 1 atmosphere; the average atmospheric pressure at sea level, equalling 760 mm of mercury or 1,000 millibars  |

**Directed Reading** *continued*

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**43.** In Earth's atmosphere, what causes the distinctive pattern of temperature changes with increasing altitude?

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**LAYERS OF THE ATMOSPHERE**

**In the space provided, write the letter of the description that best matches the term or phrase.**

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|-------------------------------|--|
| _____ <b>44.</b> troposphere  | <b>a.</b> the layer of atmosphere between the troposphere and the mesosphere, in which temperature increases as altitude increases                 |
| _____ <b>45.</b> tropopause   |  |
| _____ <b>46.</b> stratosphere | <b>b.</b> the uppermost layer of atmosphere, in which temperature increases as altitude increases  |
| _____ <b>47.</b> stratopause  | <b>c.</b> upper boundary of the stratosphere   |
| _____ <b>48.</b> mesosphere   | <b>d.</b> the upper boundary of the troposphere  |
| _____ <b>49.</b> mesopause    | <b>e.</b> upper boundary of the mesosphere   |
| _____ <b>50.</b> thermosphere | <b>f.</b> the coldest layer of the atmosphere, between the stratosphere and the thermosphere, in which temperature decreases as altitude increases |
| _____ <b>51.</b> ionosphere   | <b>g.</b> the lowest layer of the atmosphere, in which temperature drops at a constant rate as altitude increases                                  |
| _____ <b>52.</b> auroras      |  |
| _____ <b>53.</b> exosphere    | <b>h.</b> the region above the ionosphere, where Earth's atmosphere blends into the almost complete vacuum of space                                |
|                               | <b>i.</b> phenomena caused by interactions between solar radiation and the ionosphere  |
|                               | <b>j.</b> the lower region of the thermosphere   |

**54.** Explain why the temperature in the troposphere decreases as altitude increases.

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**55.** Why does temperature begin to increase in the upper stratosphere?

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**Directed Reading** *continued*

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**56.** Explain why the temperature in the thermosphere steadily rises.

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**TEMPERATURE INVERSIONS**

**57.** What is an air pollutant?

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**58.** How do fossil fuels cause air pollution?

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**59.** What is a temperature inversion?

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**60.** What is smog?

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Skills Worksheet

# Directed Reading

## Section: Solar Energy and the Atmosphere

1. How is Earth's atmosphere heated?

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2. Name the two primary sources of heat in the atmosphere.

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### RADIATION

In the space provided, write the letter of the description that best matches the term or phrase.

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|-----------------------------------|--|
| _____ 3. radiation                | a. the waves that make up all forms of radiation   |
| _____ 4. wavelength               | b. the distance from any point on a wave to the identical point on the next wave                                 |
| _____ 5. electromagnetic waves    | c. all of the frequencies or wavelengths of electromagnetic radiation  |
| _____ 6. electromagnetic spectrum | d. all forms of energy that travel through space as waves, including the energy that Earth receives from the sun |

7. What form of radiation can humans see?

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8. What are three forms of radiation that humans cannot see?

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9. How fast do waves of radiation travel through space?

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10. How are the wavelengths of visible light seen?

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**Directed Reading** *continued*

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**11.** Which wavelengths are shorter than visible light? Which are longer?

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**THE ATMOSPHERE AND SOLAR RADIATION**

\_\_\_\_\_ **12.** Almost all radiation that has a wavelength shorter than the wavelengths of visible light is absorbed by the  
**a.** lower atmosphere.  
**b.** thermosphere.  
**c.** upper atmosphere.  
**d.** stratosphere.

\_\_\_\_\_ **13.** X rays, gamma rays, and ultraviolet rays are absorbed by molecules of nitrogen and oxygen in the mesosphere and  
**a.** lower atmosphere.  
**b.** thermosphere.  
**c.** upper atmosphere.  
**d.** stratosphere.

\_\_\_\_\_ **14.** Ultraviolet rays are absorbed and act upon oxygen molecules to form ozone in the  
**a.** lower atmosphere.  
**b.** thermosphere.  
**c.** upper atmosphere.  
**d.** stratosphere.

\_\_\_\_\_ **15.** Solar rays with longer wavelengths, such as visible and infrared waves, reach the  
**a.** lower atmosphere.  
**b.** thermosphere.  
**c.** upper atmosphere.  
**d.** stratosphere.

**16.** Most incoming infrared radiation is absorbed by carbon dioxide, water vapor, and other complex molecules in the \_\_\_\_\_.

**Directed Reading** *continued*

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**17.** How much of the radiation from visible light waves is absorbed as they pass through the atmosphere?

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**18.** What causes scattering?

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**19.** What happens when particles and gas molecules in the atmosphere reflect and bend solar rays?

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**20.** What does scattering do to solar rays that are traveling to Earth?

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**21.** What effect does scattering have on the sky's appearance?

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**22.** What happens to solar energy that reaches Earth's surface?

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**Directed Reading** *continued*

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**23.** What are eight characteristics on which the amount of energy that is absorbed or reflected by Earth's surface depends?

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**24.** What is the fraction of solar radiation that is reflected off a particular surface called?

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**25.** What is Earth's albedo? Explain your answer.

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**ABSORPTION AND INFRARED ENERGY**

\_\_\_\_\_ **26.** Solar radiation that is not reflected is

- a.** absorbed.
- b.** scattered.
- c.** radiated.
- d.** dissipated.

\_\_\_\_\_ **27.** When Earth's surface absorbs solar radiation, the surface materials are heated by

- a.** longer-wavelength infrared rays and ultraviolet light.
- b.** short-wavelength infrared rays and visible light.
- c.** short-wavelength microwaves and infrared light.
- d.** longer-wavelength microwaves and ultraviolet light.

**Directed Reading** *continued*

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- \_\_\_\_\_ **28.** Heated materials on Earth's surface convert energy into infrared rays of longer wavelengths and
- a.** reabsorb energy as infrared waves.
  - b.** reabsorb energy as radio waves.
  - c.** reemit energy as infrared rays.
  - d.** reemit energy as radio waves.

**29.** What happens to the infrared rays that are reemitted into the atmosphere?

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**30.** What does the absorption of thermal energy from the ground do to Earth's surface?

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**31.** Warm air near Earth's surface sometimes bends light rays to cause an effect called a \_\_\_\_\_.

**32.** One process that helps heat Earth's atmosphere that is similar to the process that heats a greenhouse is called the \_\_\_\_\_.

**33.** The warming of the surface and lower atmosphere of Earth that occurs when carbon dioxide, water vapor, and other gases in the air absorb and reradiate infrared radiation is called the \_\_\_\_\_.

**34.** How does the amount of solar energy that enters Earth's atmosphere generally compare to the amount that escapes into space?

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**35.** What is one human activity that may have caused the average temperature of the atmosphere to increase in recent years?

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**Directed Reading *continued***

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**VARIATIONS IN TEMPERATURE**

- \_\_\_\_\_ **36.** What is the primary factor that affects how much solar energy reaches any point on Earth's surface?
- a.** surface features
  - b.** time of year
  - c.** latitude
  - d.** time of day
- \_\_\_\_\_ **37.** Near the equator, the rays of the sun strike the ground at an angle of about
- a.** 90%.
  - b.** 45%.
  - c.** 60%.
  - d.** 10%.
- \_\_\_\_\_ **38.** Temperatures are higher at the equator because
- a.** solar energy is spread out over a larger area.
  - b.** solar energy is concentrated in a small area.
  - c.** clouds hold in the solar energy.
  - d.** more solar energy is reflected into space.
- \_\_\_\_\_ **39.** Seasonal variations in temperature occur because of
- a.** the changing distance between Earth and the sun.
  - b.** the speed of Earth's rotation.
  - c.** the tilt of Earth's axis.
  - d.** the variations in the sun's energy.
- \_\_\_\_\_ **40.** Why does the amount of water in the air affect the temperature of a region?
- a.** Water vapor reflects sunlight.
  - b.** Water vapor cools the air.
  - c.** Water vapor creates clouds.
  - d.** Water vapor stores heat.
- \_\_\_\_\_ **41.** Which regions will generally have more moderate temperatures?
- a.** regions in which winds blow from the land
  - b.** regions receiving ocean winds
  - c.** regions receiving high winds
  - d.** regions receiving little rain
- 42.** Why are the warmest hours of the day usually mid- to late afternoon?

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**Directed Reading** *continued*

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**43.** What happens to the energy when sunlight hits Earth at an angle smaller than  $90^\circ$ ?

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**44.** Why are average temperatures higher at the equator than near the poles?

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**45.** Why does the Northern Hemisphere have higher temperatures for one part of the year and lower temperatures the rest?

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**46.** Why does the amount of water in the air affect the temperature of a region?

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**47.** Why do areas of high elevation become warm during the day and cool quickly at night?

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**48.** Why do desert temperatures vary widely between day and night?

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**49.** Why are land areas close to large bodies of water generally cooler during the day and warmer at night than similar inland areas?

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**Directed Reading *continued***

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**CONDUCTION**

- \_\_\_\_\_ **50.** As they become heated, molecules in a substance
- a.** move at the same rate as when they are cooled.
  - b.** move faster.
  - c.** move more slowly.
  - d.** do not move at all.
- \_\_\_\_\_ **51.** What effect do collisions between molecules have on the molecules?
- a.** It changes their structure.
  - b.** It breaks them apart.
  - c.** It cools them.
  - d.** It warms them.
- \_\_\_\_\_ **52.** The transfer of energy as heat from one substance to another by direct contact is called
- a.** conduction.
  - b.** collision.
  - c.** firing.
  - d.** baking.
- \_\_\_\_\_ **53.** Solid substances are good conductors because
- a.** molecules are close together.
  - b.** molecules are far apart.
  - c.** molecules cannot collide.
  - d.** molecules move slowly.
- \_\_\_\_\_ **54.** Air is a poor conductor because
- a.** molecules are close together.
  - b.** molecules are far apart.
  - c.** molecules cannot collide.
  - d.** molecules move slowly.
- \_\_\_\_\_ **55.** Conduction heats only the lowest few centimeters of the atmosphere because
- a.** air does not come into direct contact with Earth.
  - b.** air comes into direct contact with Earth.
  - c.** molecules of air in the lower atmosphere are closer together.
  - d.** molecules in the upper atmosphere do not collide.

**CONVECTION**

- 56.** What is the primary cause of the heating of the lower atmosphere?

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**Directed Reading** *continued*

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**57.** The movement of matter due to differences in density caused by temperature variations resulting in the transfer of heat is called \_\_\_\_\_.

**58.** When does convection occur?

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**59.** What happens to air heated by radiation or conduction?

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**60.** How is Earth's atmosphere warmed evenly?

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**61.** Why is the atmospheric pressure lower beneath a mass of warm air?

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**62.** Explain how atmospheric pressure differences create winds.

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# Directed Reading

## Section: Atmospheric Circulation

1. What causes the movement of air worldwide?

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2. In what pattern does air near Earth's surface generally flow?

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3. Why does air near Earth's surface flow from the poles to the equator?

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4. Where do high pressure regions form?

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5. Where do low-pressure regions form?

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### THE CORIOLIS EFFECT

\_\_\_\_\_ 6. The circulation of the atmosphere and of the oceans is affected by

- a. the rotation of Earth at the equator.
- b. the rotation of Earth on its axis.
- c. the rotation of the moon on its axis.
- d. seasonal storms.

\_\_\_\_\_ 7. Earth's rotation causes its diameter to be

- a. greatest through the equator.
- b. greatest through the poles.
- c. equal through the equator and the poles.
- d. greater at the North Pole than at the South Pole.

**Directed Reading** *continued*

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**8.** Do points near the equator or points near the poles travel farther and faster in a day?

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**9.** Why does air follow a curved path?

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**10.** The curving of the path of a moving object from an otherwise straight path due to earth's rotation is called the \_\_\_\_\_.

**11.** What impact does the Coriolis effect have on the winds?

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**12.** What determines the path along which the Coriolis effect deflects moving objects?

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**13.** In which direction does the Coriolis effect deflect moving objects in the Northern Hemisphere? In the Southern Hemisphere?

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**14.** How does the speed of an object relate to the Coriolis effect?

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**Directed Reading** *continued*

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**15.** How do the mass and travel distances of air or ocean currents relate to the Coriolis effect?

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**16.** In general, on what type of objects is the Coriolis effect detectable?

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**GLOBAL WINDS**

\_\_\_\_\_ **17.** What are the three looping patterns of air flow in each hemisphere called?

- a. wind belts
- b. convection cells
- c. prevailing winds
- d. global air flow

\_\_\_\_\_ **18.** A wind belt is characterized by prevailing winds that

- a. flow in one main direction.
- b. flow from the southwest.
- c. flow from the northeast.
- d. flow in all directions.

\_\_\_\_\_ **19.** The prevailing winds that blow from east to west from 30° latitude to the equator in both hemispheres are called the

- a. trade winds.
- b. polar easterlies.
- c. wind belts.
- d. westerlies.

\_\_\_\_\_ **20.** In the Northern Hemisphere, trade winds flow from the

- a. southeast.
- b. south.
- c. northeast.
- d. northwest.

\_\_\_\_\_ **21.** From what direction do trade winds flow in the Southern Hemisphere?

- a. the northeast
- b. the southeast
- c. the north
- d. the southwest

**Directed Reading** *continued*

- \_\_\_\_\_ **22.** The prevailing winds that blow from west to east through the contiguous United States are the
- trade winds.
  - doldrums.
  - polar easterlies.
  - westerlies.
- \_\_\_\_\_ **23.** What are the prevailing winds that blow from east to west between 60° and 90° in both hemispheres?
- the westerlies
  - the polar easterlies
  - wind belts
  - the trade winds
- \_\_\_\_\_ **24.** A stormy region created where the polar easterlies meet warm air from the westerlies is called a
- trade wind.
  - doldrum.
  - front.
  - wind belt.
- \_\_\_\_\_ **25.** The sun's rays shift northward and southward during the changing seasons of the year causing a shift in the position of
- convection zones and horse latitudes.
  - fronts and trade winds.
  - pressure belts and wind belts.
  - convection zones and pressure belts.

**In the space provided, write the letter of the description that best matches the term or phrase.**

- |  |  |
|--|--|
| _____ <b>26.</b> doldrums                | <b>a.</b> narrow bands of winds formed when warm equatorial air meets the cooler air of the middle latitudes                     |
| _____ <b>27.</b> horse latitudes         | <b>b.</b> narrow bands of strong winds that blow in the upper troposphere  |
| _____ <b>28.</b> jet streams             | <b>c.</b> bands of winds formed as a result of density differences between cold polar air and warmer air of the middle latitudes |
| _____ <b>29.</b> subtropical jet streams | <b>d.</b> subtropical high-pressure zones with weak and variable winds   |
| _____ <b>30.</b> polar jet streams       | <b>e.</b> a zone of low pressure at the equator where the trade wind systems meet  |

**Directed Reading** *continued*

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**LOCAL WINDS**

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

valley breeze	breezes	sea breeze
land breeze	mountain breeze	local winds

- 31.** Air movement influenced by local conditions and local temperature variations often cause \_\_\_\_\_, which are not part of the global wind belts.
- 32.** Gentle winds that extend over distances of less than 100 km are called \_\_\_\_\_.
- 33.** As warm air above land rises and cool air from above water moves in to replace it, a cool wind moving from water to land, called a \_\_\_\_\_, forms in the afternoon.
- 34.** Overnight, the land offshore cools more rapidly than the water does, and a sea breeze is replaced by a \_\_\_\_\_, which flows from the cool land toward the warmer water.
- 35.** During the day in mountainous regions, a gentle breeze called a \_\_\_\_\_ forms when warm air from the valleys moves upslope.
- 36.** At night in the mountains, cool air descends from the peaks to the valleys, creating a \_\_\_\_\_.