

Elements of Ecology, 9e (Smith)
Chapter 2 Climate

2.1 Short Answer Questions

1) The temperature, humidity, precipitation, wind, cloudiness, and other atmospheric conditions that occur at a specific place and time are referred to as _____.

Answer: weather

Topic: Introduction to Chapter 2

Bloom's Taxonomy: Knowledge/Comprehension

2) The long-term average pattern of weather at local, regional, or global scales is referred to as _____.

Answer: climate

Topic: Introduction to Chapter 2

Bloom's Taxonomy: Knowledge/Comprehension

3) Carbon dioxide and _____ are the major gases in the atmosphere that absorb energy from the sun.

Answer: water vapor

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

4) The absorption and re-radiation of longwave radiation by gases in the atmosphere is called the _____.

Answer: greenhouse effect

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

5) Seasonality occurs on planet Earth because of its _____ with respect to the plane it travels around the Sun.

Answer: axial tilt

Topic: Section 2.2

Bloom's Taxonomy: Knowledge/Comprehension

6) In the Northern Hemisphere, the summer _____ occurs when solar rays fall directly on the Tropic of Cancer.

Answer: solstice

Topic: Section 2.2

Bloom's Taxonomy: Knowledge/Comprehension

7) The amount of force exerted over a given area of surface is called atmospheric _____.

Answer: pressure

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

8) With increasing altitude, air density _____.

Answer: decreases

Topic: Section 2.3

Bloom's Taxonomy: Application/Analysis

9) Air masses are deflected to the _____ in the Northern Hemisphere and to the _____ in the Southern Hemisphere.

Answer: right; left

Topic: Section 2.4

Bloom's Taxonomy: Knowledge/Comprehension

10) The winds formed between the equator and about 30 degrees of latitude, blowing from the northeast in the Northern Hemisphere and southeast in the Southern Hemisphere, are referred to as _____.

Answer: trade winds

Topic: Section 2.4

Bloom's Taxonomy: Knowledge/Comprehension

11) In the Southern Hemisphere, oceanic gyres circulate in a(n) _____ direction.

Answer: counterclockwise

Topic: Section 2.4

Bloom's Taxonomy: Application/Analysis

12) The transformation of water from a liquid to a gaseous state is referred to as _____.

Answer: evaporation

Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

13) _____ is the amount of water vapor in the air expressed as a percentage of the saturation vapor pressure.

Answer: Relative humidity

Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

14) The _____ is the temperature at which atmospheric water condenses.

Answer: dew point

Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

15) The narrow region near the equator where trade winds meet is referred to as the _____.

Answer: Intertropical Convergence Zone

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

16) Rainfall is greater and the vegetation more dense on the windward side of a mountain range than on the leeward side, where a(n) _____ is formed.

Answer: rain shadow

Topic: Section 2.8

Bloom's Taxonomy: Knowledge/Comprehension

17) A period of cooling that lasted from approximately the mid-14th to the mid-19th century is referred to as the _____.

Answer: Little Ice Age

Topic: Section 2.9

Bloom's Taxonomy: Knowledge/Comprehension

18) During an El Niño event, the waters of the eastern Pacific Ocean are unusually _____.

Answer: warm

Topic: Section 2.9

Bloom's Taxonomy: Knowledge/Comprehension

19) Most organisms live in habitats that provide specific conditions or a(n) _____ that may be very different from regional weather patterns.

Answer: microclimate

Topic: Section 2.10

Bloom's Taxonomy: Knowledge/Comprehension

20) There is a strong positive correlation between rising atmospheric CO₂ concentrations and _____.

Answer: global temperature

Topic: Ecological Issues & Applications 2: Climate Warming

Bloom's Taxonomy: Knowledge/Comprehension

2.2 Multiple-Choice Questions

1) The difference between climate and weather is that

- A) weather is limited to precipitation and wind.
- B) climate is the long term pattern of weather.
- C) climate is limited to temperature.
- D) weather is a measure of climate.

Answer: B

Topic: Introduction to Chapter 2

Bloom's Taxonomy: Knowledge/Comprehension

2) The two major atmospheric gases that absorb energy from the Sun are

- A) oxygen and nitrogen.
- B) nitrogen and hydrogen.
- C) hydrogen and carbon dioxide.
- D) carbon dioxide and water vapor.

Answer: D

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

3) Without the greenhouse effect, the Earth would

- A) be much warmer than it currently is.
- B) be much colder than it currently is.
- C) have uniform temperatures and would lack seasons.
- D) have constant sunlight.

Answer: B

Topic: Section 2.1

Bloom's Taxonomy: Application/Analysis

4) Only 51 percent of incoming solar radiation actually reaches Earth's surface. Most of the remaining 49 percent of incoming radiation is reflected back to space by

- A) clouds and the atmosphere.
- B) the ocean's surface.
- C) snow and ice.
- D) land.

Answer: A

Topic: Section 2.1

Bloom's Taxonomy: Application/Analysis

5) What might be an accurate albedo measure of the surface of a glacier?

- A) 0.1
- B) 9.0
- C) 0
- D) 0.9

Answer: D

Topic: Section 2.1

Bloom's Taxonomy: Application/Analysis

6) Which of the following is a greenhouse gas?

- A) nitrogen
- B) carbon dioxide
- C) oxygen
- D) ozone

Answer: B

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

7) Solar radiation in December is greatest at

- A) the equator.
- B) the Tropic of Cancer.
- C) 90° in the Southern Hemisphere.
- D) 90° in the Northern Hemisphere.

Answer: C

Topic: Section 2.2

Bloom's Taxonomy: Knowledge/Comprehension

8) Seasonal variation in solar radiation, temperature, and day length is due to the

- A) tilt of the Earth's axis.
- B) greenhouse effect.
- C) Coriolis effect caused by the spinning of Earth on its axis.
- D) sunspot activities at the surface of the Sun.

Answer: A

Topic: Section 2.2

Bloom's Taxonomy: Knowledge/Comprehension

9) Where is temperature variation the greatest?

- A) at the poles
- B) in the temperate regions
- C) in the tropical regions
- D) at the equator

Answer: B

Topic: Section 2.2

Bloom's Taxonomy: Application/Analysis

10) Which of the following occurs near the equator?

- A) the Hadley cell
- B) the Ferrel cell
- C) the Polar cell
- D) the Westerlies

Answer: A

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

11) If the Earth spun in the opposite direction what would change?

- A) The equator would become as cold as the poles.
- B) Air masses in the Northern Hemisphere would rotate counterclockwise.
- C) Equatorial air would fall rather than rise.
- D) Winter would occur in July in the Northern Hemisphere.

Answer: A

Topic: Section 2.3

Bloom's Taxonomy: Synthesis/Evaluation

12) Incoming radiation exceeds outgoing radiation at or near

- A) the poles.
- B) the Northern Hemisphere.
- C) the Southern Hemisphere.
- D) the equator.

Answer: D

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

13) The Northeast trade winds occur

- A) between the equator and the north pole.
- B) between the equator and 30° N.
- C) between 10° N and 45° N.
- D) all along the Atlantic Ocean.

Answer: A

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

14) In the Northern Hemisphere, the shortwave radiation is highest during the

- A) March equinox.
- B) September equinox.
- C) June solstice.
- D) December solstice.

Answer: C

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

15) Of the following areas on Earth's surface, which area moves fastest and has the greatest linear velocity?

- A) North Pole (90° north)
- B) Tropic of Cancer (23.5° north)
- C) Tropic of Capricorn (23.5° south)
- D) Equator (0°)

Answer: D

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

16) A scientist traveling on a boat from Alaska to Antarctica took daily measurements of atmospheric pressure. At which latitudes were the lowest pressures found?

- A) polar ($\sim 90^\circ$) and subpolar ($\sim 60^\circ$) latitudes
- B) subpolar ($\sim 60^\circ$) and subtropical ($\sim 30^\circ$) latitudes
- C) subpolar ($\sim 60^\circ$) and tropical ($\sim 0^\circ$) latitudes
- D) subtropical ($\sim 30^\circ$) and tropical ($\sim 0^\circ$) latitudes

Answer: C

Topic: Section 2.3

Bloom's Taxonomy: Application/Analysis

17) Between 30° - 60° north latitude, wind currents typically blow from

- A) west to east and are deflected toward the left.
- B) east to west and are deflected toward the left.
- C) west to east and are deflected toward the right.
- D) east to west and are deflected toward the right.

Answer: C

Topic: Section 2.3

Bloom's Taxonomy: Application/Analysis

18) The systematic patterns of water movement are known as

- A) circulations.
- B) currents.
- C) gyres.
- D) trade winds.

Answer: B

Topic: Section 2.4

Bloom's Taxonomy: Knowledge/Comprehension

19) Surface currents in the ocean typically

- A) flow most strongly from west to east in equatorial regions.
- B) are colder on the western side of continents.
- C) flow counterclockwise in gyres in the Northern Hemisphere.
- D) flow unimpeded from east to west just north of Antarctica.

Answer: B

Topic: Section 2.4

Bloom's Taxonomy: Knowledge/Comprehension

20) Why is the ocean off the coast of Florida warmer than it is off the coast of Western Mexico?

- A) Florida is closer to the equator.
- B) Mean precipitation is higher in Mexico.
- C) Wind patterns are clockwise in the Atlantic.
- D) Ocean currents are coming from the tropics rather than the poles.

Answer: D

Topic: Section 2.4

Bloom's Taxonomy: Synthesis/Evaluation

21) Relative humidity is the

- A) amount of pressure at a given temperature at which water transforms from a liquid to a gaseous state.
- B) amount of pressure that water vapor exerts independent of the pressure of dry air.
- C) temperature at which saturation vapor pressure is achieved.
- D) amount of water vapor in the air relative to the saturation vapor pressure.

Answer: D

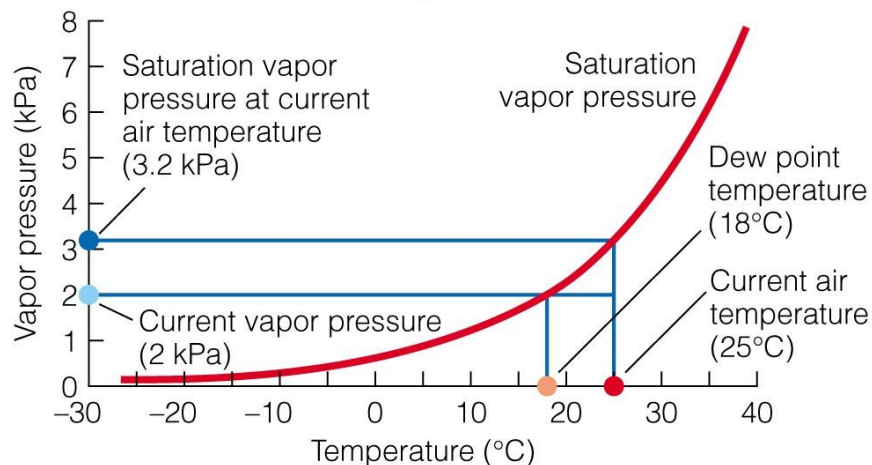
Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

22)

$$\text{Relative humidity} = \frac{\text{Current vapor pressure}}{\text{Saturation vapor pressure}} \times 100$$

$$\text{Relative humidity} = \frac{2 \text{ kPa}}{3.2 \text{ kPa}} \times 100 = 62.5\%$$



If the vapor pressure is 1 kPa, what would be the approximate dew point?

- A) 25°C
- B) 10°C
- C) 18°C
- D) 1°C

Answer: B

Topic: Section 2.5

Bloom's Taxonomy: Application/Analysis

23) The transformation of water from a liquid state to a gaseous state is known as

- A) condensation.
- B) evaporation.
- C) saturation.
- D) solidification.

Answer: B

Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

24) In the vicinity of 30° north and 30° south, air typically

- A) rises, cools, and precipitates.
- B) descends, warms, and precipitates.
- C) rises, cools, and is dry.
- D) descends, warms, and is dry.

Answer: D

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

25) During winter in the Northern Hemisphere, the Intertropical Convergence Zone

- A) sits directly over the equator.
- B) is shifted into the northern latitudes.
- C) is shifted into the southern latitudes.
- D) does not exist.

Answer: C

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

26) What causes shifts in the dry and wet seasons of the tropics?

- A) Hadley cells
- B) saturation VP
- C) ITCZ
- D) the equatorial low

Answer: C

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

27) Why do beaches often have less extreme temperature variation than inland areas?

- A) The ocean moderates the temperatures.
- B) The sand absorbs and loses heat less efficiently.
- C) The ocean waves reduce wind.
- D) Air temperatures vary with latitudes.

Answer: A

Topic: Section 2.7

Bloom's Taxonomy: Synthesis/Evaluation

28) Precipitation is generally greater

- A) in the Southern Hemisphere than in the Northern Hemisphere.
- B) in coastal areas than in interior areas.
- C) at the equator than at 30° of latitude.
- D) on the leeward side of mountains than on the windward side.

Answer: B

Topic: Sections 2.7 and 2.8

Bloom's Taxonomy: Knowledge/Comprehension

- 29) As air rises over a mountain, it
- A) cools and tends to lose moisture in the form of precipitation.
 - B) cools and tends to gain moisture without precipitating.
 - C) warms and tends to lose moisture in the form of precipitation.
 - D) warms and tends to gain moisture without precipitating.

Answer: A

Topic: Section 2.8

Bloom's Taxonomy: Knowledge/Comprehension

- 30) Which side of the mountain receives the most precipitation?

- A) leeward side
- B) Eastern side
- C) Western side
- D) windward side

Answer: D

Topic: Section 2.8

Bloom's Taxonomy: Synthesis/Evaluation

- 31) Some variation in the solar radiation striking the Earth's surface is linked to _____ activity.

- A) sunspot
- B) El Niño
- C) La Niña
- D) glacial

Answer: A

Topic: Section 2.9

Bloom's Taxonomy: Knowledge/Comprehension

- 32) _____ is considered a primary influence on microclimate.

- A) Aspect
- B) Soil temperature
- C) Rainfall
- D) Vegetation

Answer: A

Topic: Section 2.10

Bloom's Taxonomy: Knowledge/Comprehension

- 33) In contrast with north-facing slopes, south-facing slopes in the Northern Hemisphere are characterized by

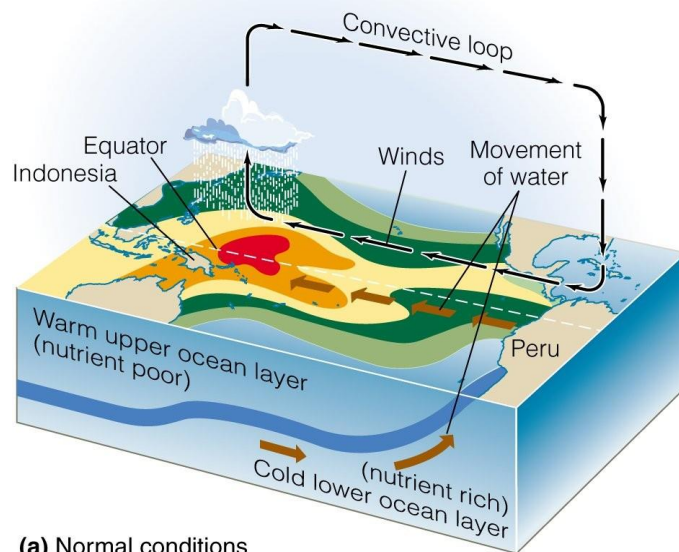
- A) a lower rate of evaporation.
- B) greater soil moisture.
- C) lower air temperatures.
- D) more vigorous growth of mosses.

Answer: B

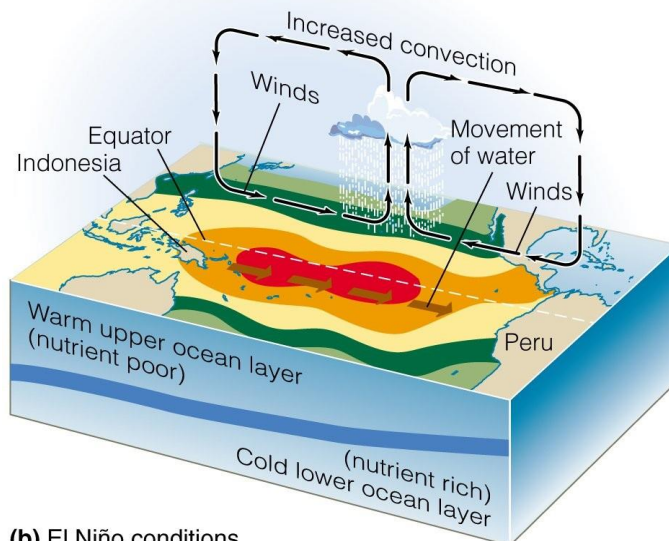
Topic: Section 2.10

Bloom's Taxonomy: Application/Analysis

34)



(a) Normal conditions



(b) El Niño conditions

Weakening of trade winds results in

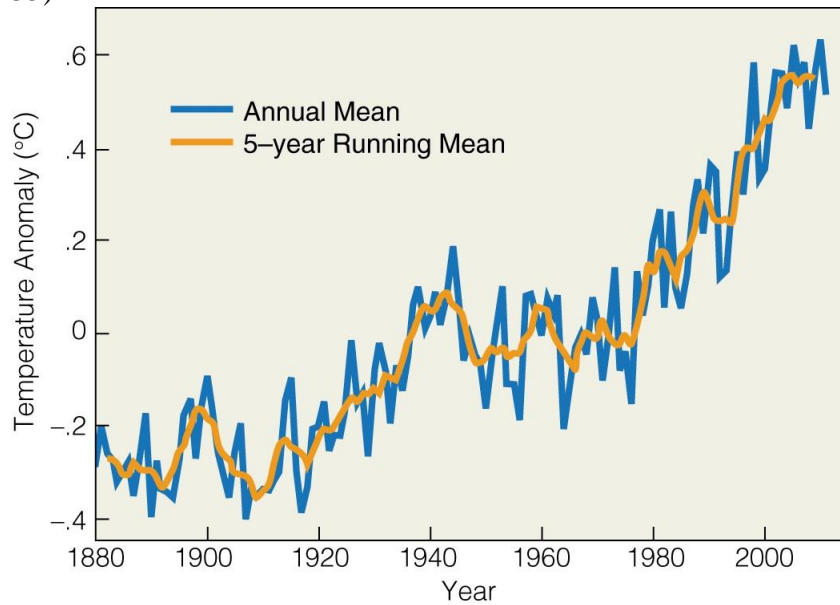
- A) flooding in Peru.
- B) flooding in Indonesia.
- C) reduced convection.
- D) cooler ocean temperatures in Peru.

Answer: A

Topic: Section 2.10

Bloom's Taxonomy: Synthesis/Evaluation

35)



If the current trend continues, what do you predict the temperature anomaly will be in 2025?

- A) 0
- B) 0.6
- C) -0.5
- D) -0.2

Answer: B

Topic: Ecological Issues & Applications 2: Climate Warming

Bloom's Taxonomy: Application/Analysis

2.3 True/False Questions

1) A hotter object emits longer wavelengths than a cooler object.

Answer: FALSE

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

2) Most of the solar radiation arriving at the Earth's surface is reflected out to space.

Answer: FALSE

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

3) Solar radiation is more direct in tropical latitudes than in temperate latitudes.

Answer: TRUE

Topic: Section 2.2

Bloom's Taxonomy: Knowledge/Comprehension

4) Daylight in the Southern Hemisphere is longest during the winter solstice in December.

Answer: TRUE

Topic: Section 2.2

Bloom's Taxonomy: Knowledge/Comprehension

5) Atmospheric pressure increases with altitude.

Answer: FALSE

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

6) Dry air cools more rapidly than moist air.

Answer: TRUE

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

7) Masses of air and water are deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Answer: TRUE

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

8) In the vicinity of the equator, air warmed by solar radiation rises.

Answer: TRUE

Topic: Section 2.3

Bloom's Taxonomy: Knowledge/Comprehension

9) Oceanic gyres circulate in a counterclockwise direction in the Northern Hemisphere and in a clockwise direction in the Southern Hemisphere.

Answer: FALSE

Topic: Section 2.4

Bloom's Taxonomy: Knowledge/Comprehension

10) The saturation vapor pressure of air increases with temperature.

Answer: TRUE

Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

11) Cold air can hold more water than warm air.

Answer: FALSE

Topic: Section 2.5

Bloom's Taxonomy: Knowledge/Comprehension

12) Rainfall in the Northern Hemisphere is greater than rainfall in the Southern Hemisphere.

Answer: FALSE

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

13) Precipitation is higher in tropical regions than in temperate and polar regions.

Answer: TRUE

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

14) Precipitation on a tropical island is greatest during June to August and lowest during January to April. This island must be located south of the equator.

Answer: FALSE

Topic: Section 2.6

Bloom's Taxonomy: Knowledge/Comprehension

15) Vegetation is usually more dense and vigorous on the windward side of mountains than on the leeward side.

Answer: TRUE

Topic: Section 2.8

Bloom's Taxonomy: Knowledge/Comprehension

16) Surface temperatures in the eastern Pacific Ocean are warmer during El Niño conditions than during La Niña conditions.

Answer: TRUE

Topic: Section 2.9

Bloom's Taxonomy: Knowledge/Comprehension

17) In temperate regions of the Northern Hemisphere, north-facing slopes are less humid than south-facing slopes.

Answer: FALSE

Topic: Section 2.10

Bloom's Taxonomy: Application/Analysis

2.4 Essay Questions

1) Explain the differences between weather, climate, and microclimate. Which is most important for individual organisms? Give an example.

Topic: Introduction to Chapter 2 and Section 2.10

Bloom's Taxonomy: Synthesis/Evaluation

2) Explain how or why the Earth's surface emits more energy than it receives from the Sun.

Topic: Section 2.1

Bloom's Taxonomy: Knowledge/Comprehension

3) Explain why seasonal changes in temperature and daylight occur and why they are more pronounced at temperate and polar latitudes than at tropical latitudes.

Topic: Section 2.2

Bloom's Taxonomy: Application/Analysis

4) Discuss the relationships between atmospheric pressure, temperature, and altitude.

Topic: Section 2.3

Bloom's Taxonomy: Synthesis/Evaluation

5) Explain how the trade winds develop and why these were so important to 17th-century merchant sailors.

Topic: Section 2.3

Bloom's Taxonomy: Synthesis/Evaluation

6) Explain why the saturation vapor pressure increases with air temperature. How does relative humidity change in response to air warming or cooling?

Topic: Section 2.5

Bloom's Taxonomy: Application/Analysis

7) Explain why more rain falls in tropical latitudes ($\sim 0^\circ$) than in subtropical latitudes ($\sim 30^\circ$).

Topic: Section 2.6

Bloom's Taxonomy: Application/Analysis

8) Why do the amount of rainfall and the composition of vegetation differ greatly on the opposite sides of a mountain range?

Topic: Section 2.8

Bloom's Taxonomy: Knowledge/Comprehension

9) Compare the causes and effects of the El Niño and La Niña events.

Topic: Section 2.9

Bloom's Taxonomy: Application/Analysis

10) You study two neighboring plant populations growing at 200 meters above sea level (asl). One population is situated on a north-facing slope, whereas the other population grows on a south-facing slope. Compare the environmental conditions and microclimates that each population experiences.

Topic: Section 2.10

Bloom's Taxonomy: Synthesis/Evaluation