

Geosystems Core (Christopherson)
Chapter 2 Atmosphere and Surface Energy Balances

2.1 Multiple Choice Questions

- 1) Earth's main energy inputs are
- A) thermal infrared and ultraviolet light.
 - B) ultraviolet, visible, and near infrared radiation.
 - C) near infrared and thermal infrared.
 - D) gamma rays, X-rays, and ultraviolet radiation.
 - E) ultraviolet radiation, thermal infrared, and X-rays.

Answer: B

Diff: 2

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.1 **Define** energy and heat.

- 2) Earth's main energy outputs is (are)

- A) X-rays.
- B) ultraviolet radiation.
- C) near infrared radiation.
- D) visible light.
- E) thermal infrared radiation.

Answer: E

Diff: 2

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.1 **Define** energy and heat.

- 3) Energy is defined as

- A) the rate at which work is done.
- B) motion of particles of matter.
- C) the capacity to do work.
- D) state change of a substance.
- E) motion of charges.

Answer: C

Diff: 1

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.1 **Define** energy and heat.

- 4) Kinetic energy is defined as
- A) stored energy.
 - B) energy flow between molecules.
 - C) the energy of motion.
 - D) energy gained or lost when a substance changes states.
 - E) energy that passes through a system to its surroundings.

Answer: C

Diff: 1

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.1 **Define** energy and heat.

- 5) Molecule-to-molecule transfer of heat energy is

- A) conduction.
- B) convection.
- C) advection.
- D) latent heat.
- E) sensible heat.

Answer: A

Diff: 1

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

- 6) Conduction refers to

- A) strong vertical movement of air in the atmosphere.
- B) strong horizontal movement of air in the atmosphere.
- C) the molecule-to-molecule transfer of heat energy.
- D) the behavior of something.
- E) the ability to do work.

Answer: C

Diff: 2

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

7) A stove that circulates heated air to uniformly cook food is an example of _____ heat transfer.

- A) conduction
- B) convection
- C) kinetic
- D) latent
- E) sensible

Answer: B

Diff: 1

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

8) Which of the following is correctly matched?

- A) conduction — molecule-to-molecule heat transfer
- B) advection — strongly vertical mixing
- C) radiation — assimilation and conversion of energy
- D) convection — strongly horizontal mixing
- E) sensible heat — energy involved in state change of a substance

Answer: A

Diff: 2

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

9) A vertical air current that is generated by temperature-induced density differences is an example of heat transfer by

- A) advection.
- B) convection.
- C) conduction.
- D) transmission.
- E) diffusion.

Answer: B

Diff: 2

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

10) For the Earth's energy budget, _____ is energy income and _____ energy expenditures.

- A) transmission; reflection
- B) reflection; albedo
- C) insolation; radiation to space
- D) refraction; scatter
- E) albedo; reflection

Answer: C

Diff: 1

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

11) The passage of shortwave and longwave energy through the atmosphere and water is an example of

- A) absorption.
- B) transmission.
- C) refraction.
- D) insolation.
- E) reflection.

Answer: B

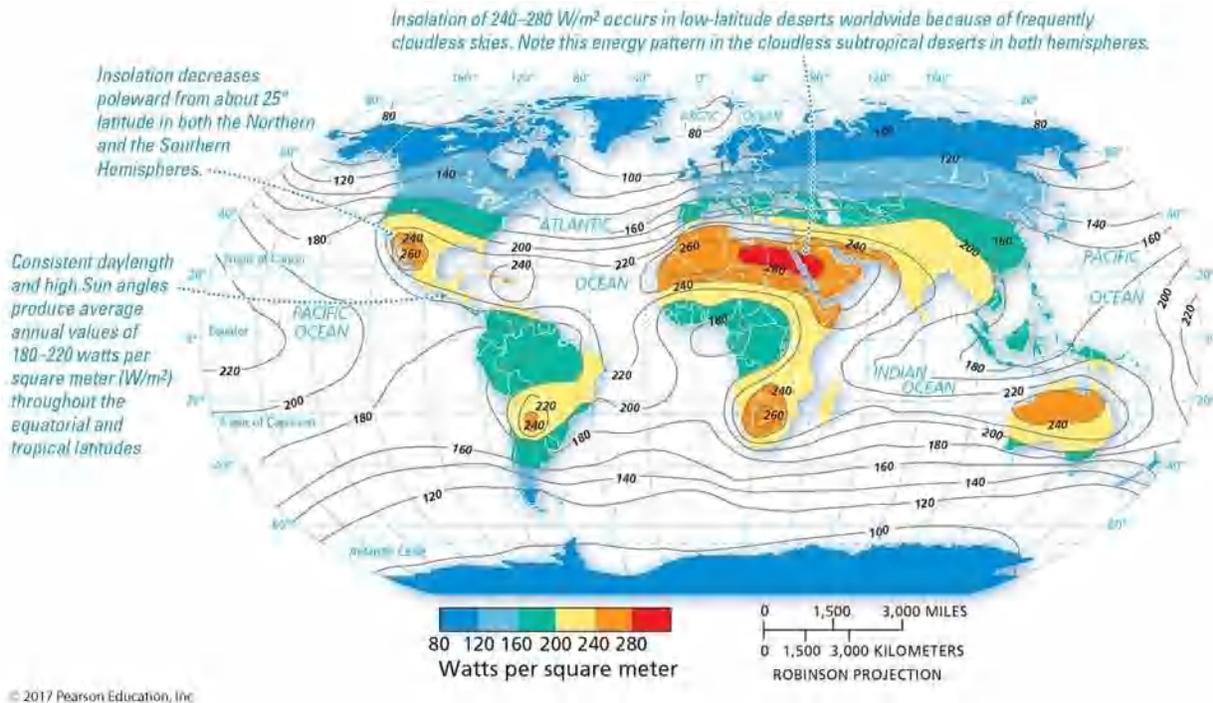
Diff: 1

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.



- 12) The insolation received at Earth's surface is
- A) usually low at the equator.
 - B) generally greater at high latitudes because of day length.
 - C) greatest over low-latitude deserts with their cloudless skies.
 - D) inadequate to sustain life.
 - E) highest in northern Europe.

Answer: C

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

13) Which of the following is **true**?

- A) The poles receive the highest amount of insolation.
- B) The highest levels of insolation occur in the equatorial and tropical latitudes.
- C) The latitudinal gradient of insolation is always predictable.
- D) Insolation is equal at all surfaces across the globe.
- E) Insolation is lowest in the equatorial region.

Answer: B

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

14) The principle that explains the differential scattering of shorter wavelength radiation and accounts for the Earth's blue sky is

- A) Mie scattering.
- B) refraction.
- C) Rayleigh scattering.
- D) transmission.
- E) greenhouse effect.

Answer: C

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

15) The sky (lower tropopause) appears blue in color because of

- A) reflection.
- B) scattering.
- C) absorption of blue wavelengths of visible light.
- D) diffuse radiation.
- E) transmission.

Answer: B

Diff: 1

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

16) When light passes from one medium to another, resulting in a change in speed and direction of insolation

- A) transmission happens.
- B) Rayleigh scattering is the predominant effect.
- C) refraction occurs.
- D) it is usually not affected physically.
- E) reflection occurs.

Answer: C

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

17) Refraction results in changes in both _____ and _____ of light.

- A) color and reflection
- B) conduction and convection
- C) Rayleigh scattering and Mie scattering
- D) albedo and absorption
- E) speed and direction

Answer: E

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

18) A mirage is an example of

- A) albedo.
- B) Rayleigh scatter.
- C) reflection.
- D) Mie scatter.
- E) refraction.

Answer: E

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

19) Because of the process known as _____ the Sun appears above the horizon _____ it has actually risen.

- A) transmission; before
- B) transmission; after
- C) refraction; before
- D) refraction; after
- E) reflection; before

Answer: C

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

20) The reflective quality of a surface is known as its

- A) conduction.
- B) absorption.
- C) albedo.
- D) scattering.
- E) specific heat.

Answer: C

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.4 **Explain** the concept of albedo (reflectivity).

21) The albedo of a surface is a measure of which of the following processes?

- A) transmission
- B) reflection
- C) scattering
- D) solar radiation receipt
- E) refraction

Answer: B

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.4 **Explain** the concept of albedo (reflectivity).

22) Which of the following has the highest albedo?

- A) forests
- B) asphalt
- C) grassy areas
- D) any dark surface
- E) fresh snow

Answer: E

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.4 **Explain** the concept of albedo (reflectivity).

23) If the surface of Earth were to suddenly turn white, the temperature of the planet would _____ because _____ insolation would be absorbed.

- A) decrease; less
- B) decrease; more
- C) increase; less
- D) increase; more
- E) stay the same; the same amount of

Answer: A

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.4 **Explain** the concept of albedo (reflectivity).

24) Earth's average overall albedo is

- A) 15 percent.
- B) 31 percent.
- C) 51 percent.
- D) 69 percent.
- E) unknown.

Answer: B

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.4 **Explain** the concept of albedo (reflectivity).

25) The assimilation of radiation by molecules of matter is

- A) refraction.
- B) absorption.
- C) reflection.
- D) transmission.
- E) scattering.

Answer: B

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

26) Differential transmissivity of shortwave insolation and longwave terrestrial radiation by various atmospheric gases is better known as the

- A) global dimming.
- B) greenhouse effect.
- C) cloud-albedo forcing.
- D) global warming.
- E) latent energy.

Answer: B

Diff: 3

Chapter/section: 2.3 The Greenhouse Effect, Clouds, and Atmospheric Warming

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.6 **Explain** the greenhouse concept as it applies to Earth.

27) The analogy of a greenhouse is

- A) completely unrelated to our Earth-atmosphere system, and should never have been used to describe global warming.
- B) exactly how the Earth-atmosphere system operates.
- C) a useful, but inaccurate model since atmospheric gases do not trap, but absorb and then reradiate heat.
- D) used incorrectly describes shortwave energy transmission, it perfectly encapsulates how longwave terrestrial radiation is trapped.
- E) designed to confuse those who have not studied the science of climate change.

Answer: C

Diff: 2

Chapter/section: 2.3 The Greenhouse Effect, Clouds, and Atmospheric Warming

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.6 **Explain** the greenhouse concept as it applies to Earth.

28) Which of the following is **true**?

- A) Clouds only cool the surface by reducing insolation.
- B) Clouds only warm the surface by absorbing and reradiating longwave radiation back to Earth
- C) Clouds can both cool and warm Earth by absorbing insolation and absorbing and reradiating longwave radiation.
- D) Clouds are a neutral factor in cooling and warming of Earth.
- E) While clouds do absorb some incoming radiation, this is mostly negligible.

Answer: C

Diff: 2

Chapter/section: 2.3 The Greenhouse Effect, Clouds, and Atmospheric Warming

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.6 **Explain** the greenhouse concept as it applies to Earth.

29) Which of the following was **not** an impact of the Mount Pinatubo eruption in June 1991?

- A) Increase in atmospheric albedo
- B) Worldwide transport of aerosols
- C) A temporary average cooling of 0.5° C (0.9° F)
- D) A decrease in atmospheric aerosols
- E) Injection of 15 - 20 million tons of sulfur dioxide droplets into the stratosphere

Answer: D

Diff: 2

Chapter/section: 2.3 The Greenhouse Effect, Clouds, and Atmospheric Warming

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.5 **Analyze** the effect of clouds and aerosols on atmospheric heating and cooling.

30) The 1991 eruption of Mount Pinatubo in the Philippines _____ global albedo, resulting in a temporary _____ of the Earth.

- A) increased; cooling
- B) decreased; cooling
- C) increased; warming
- D) decreased; warming
- E) decreased; rapid heating

Answer: A

Diff: 2

Chapter/section: 2.3 The Greenhouse Effect, Clouds, and Atmospheric Warming

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.5 **Analyze** the effect of clouds and aerosols on atmospheric heating and cooling.

31) The general term describing the pollution related decline in insolation to the Earth's surface is

- A) greenhouse effect.
- B) earthshine.
- C) global dimming.
- D) atmospheric albedo.
- E) contrails.

Answer: C

Diff: 2

Chapter/section: 2.3 The Greenhouse Effect, Clouds, and Atmospheric Warming

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.5 **Analyze** the effect of clouds and aerosols on atmospheric heating and cooling.

32) Which of the following is **not** a reason for the energy surplus between the tropics?

- A) high insolation
- B) indirect solar radiation
- C) consistent daylength
- D) little seasonal variations
- E) high angle of incoming insolation

Answer: B

Diff: 2

Chapter/section: 2.4 Earth-Atmosphere Energy Balance

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.8 **Describe** Earth-atmosphere energy balance and the patterns of global net radiation.

33) Which of the following is **not** a reason for the energy deficit in the polar regions?

- A) little seasonal variability
- B) low sun angle
- C) high albedo due to snow and ice
- D) up to six months without insolation
- E) diffuse insolation

Answer: A

Diff: 2

Chapter/section: 2.4 Earth-Atmosphere Energy Balance

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.8 **Describe** Earth-atmosphere energy balance and the patterns of global net radiation.

- 34) Which of the following is **true** of differences in latitudinal energy?
- A) an energy balance between energy gains and losses around 36° latitude
 - B) a year-round energy deficit at the Tropic of Capricorn
 - C) The equator has an energy balance in the summer, but a deficit in the winter.
 - D) Energy imbalances between the tropics and the poles are negligible.
 - E) The polar regions have an energy surplus.

Answer: A

Diff: 2

Chapter/section: 2.4 Earth-Atmosphere Energy Balance

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.8 *Describe* Earth-atmosphere energy balance and the patterns of global net radiation.

- 35) On the average, which of the following is **true** regarding the distribution of shortwave and longwave energy at Earth's surface by latitude?

- A) The equatorial zone is a region of net deficits.
- B) The polar regions are areas of net surpluses.
- C) The distribution shows an imbalance of net radiation from equator to poles.
- D) More energy is lost than is gained in the equatorial regions.
- E) An energy balance between energy gains and losses around 45° latitude.

Answer: C

Diff: 3

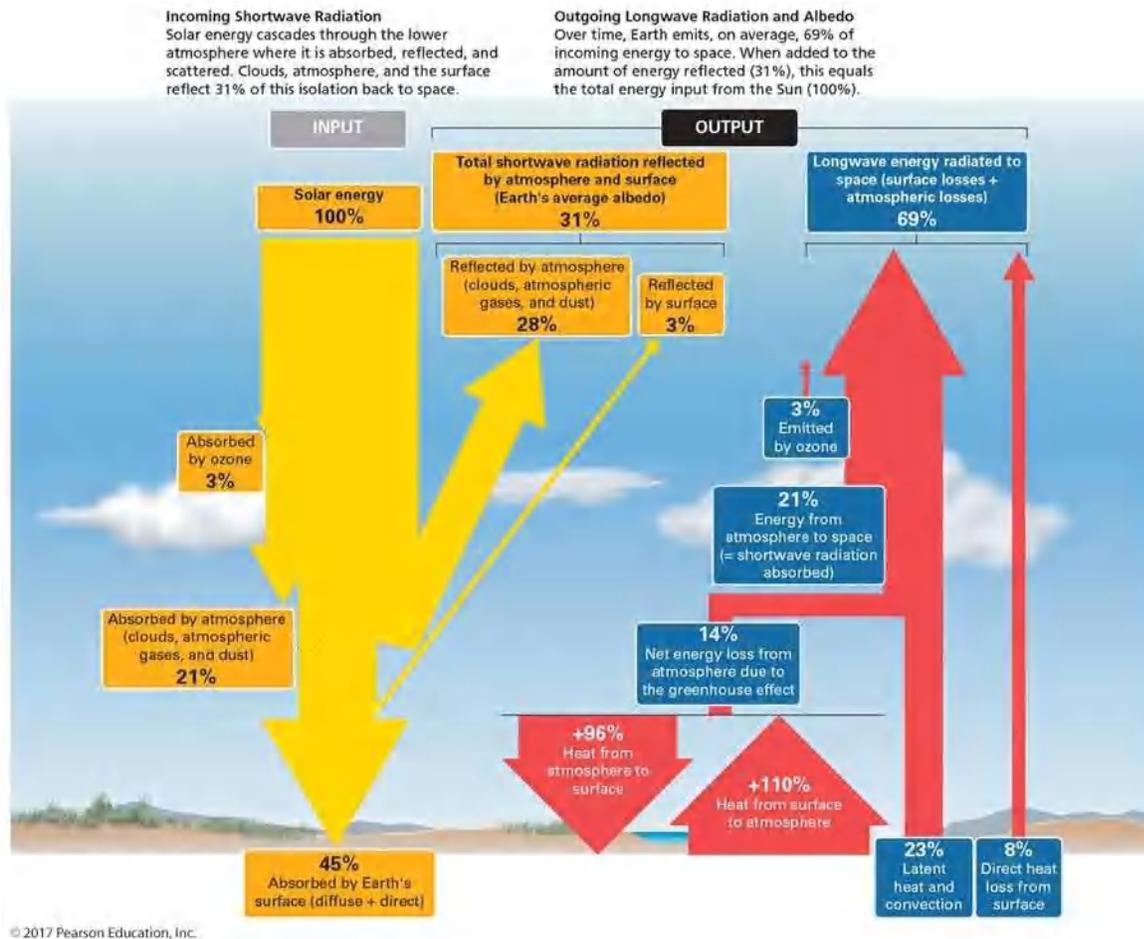
Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.8 *Describe* Earth-atmosphere energy balance and the patterns of global net radiation.

36)



Which of the following is **true** regarding inputs of shortwave radiation and outputs of longwave radiation?

- A) Earth's average albedo is 31%.
- B) 35% of incoming shortwave radiation is absorbed by ozone.
- C) Only a tiny fraction (< 3%) of incoming insolation transmits through to Earth's surface.
- D) Longwave radiation radiated to space accounts for only about 1/10th of all incoming shortwave radiation.
- E) Surface albedo is greater than that of atmospheric constituents, such as clouds, gases, and dust.

Answer: A

Diff: 3

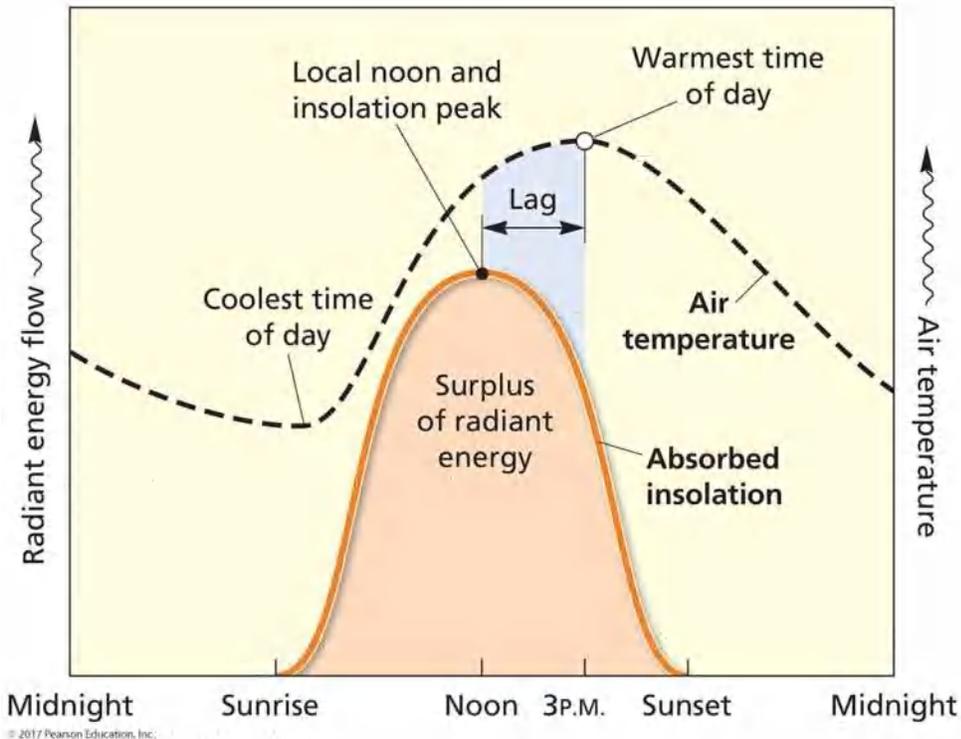
Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.8 *Describe* Earth-atmosphere energy balance and the patterns of global net radiation.



- 37) The relationship between the insolation curve and the air temperature curve on a graph of daily surface energy
- A) exhibits a lag of several hours between the plotted lines.
 - B) Little or no relationship exists between the two variables.
 - C) Peak temperatures occur near noon, whereas peak insolation receipt is at 3:00 or 4:00 P.M.
 - D) They coincide at noon.
 - E) The warmest time of day is immediately before sunset, corresponding with maximum radiant energy.

Answer: A

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

38) The relationship between insolation and air temperature through the course of day indicates that

- A) air temperature reaches a maximum at noon when insolation also reaches a maximum.
- B) air temperature reaches a maximum afternoon, whereas insolation reaches a maximum at noon.
- C) air temperature maximum and minimums are not related to insolation.
- D) air temperature reaches a minimum at midnight when no insolation is received.
- E) the point of highest insolation corresponds to the warmest time of day.

Answer: B

Diff: 2

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

39) The time of maximum daily temperature occurs

- A) at the same time that maximum insolation occurs, because that is when maximum energy is available for heating the air.
- B) before the time of maximum insolation, because the residual heat energy left over in the atmosphere from the previous day adds to the energy supplied by insolation.
- C) before the time of maximum insolation occurs, because the thermosphere transfers heat energy to the surface during the early morning hours as the D and E layers in the ionosphere become active.
- D) after the time of maximum insolation, because an energy surplus accumulates in the atmosphere while the Sun is still high in the sky and reaches a peak in mid-afternoon.
- E) after the time of maximum insolation, because the ground starts to reflect heat energy in the late afternoon, and this creates an energy surplus.

Answer: D

Diff: 3

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

40) Net radiation (NET R) refers to

- A) the net energy expended for ground heating and cooling.
- B) the balance of all incoming and outgoing radiation at Earth's surface.
- C) the amount of insolation coming into the surface.
- D) the amount of insolation not absorbed at the surface.
- E) the amount of outgoing longwave radiation.

Answer: B

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

41) In the surface energy budget, - SW represents

- A) heat.
- B) incoming energy.
- C) reflected shortwave energy.
- D) NET R.
- E) emitted longwave radiation.

Answer: C

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

42) Longwave radiation (+ LW) arriving at the Earth's surface

- A) comes primarily from infrared energy emitted by the atmosphere.
- B) comes directly from the Sun.
- C) comes from diffuse solar radiation.
- D) comes from UV radiation reflected from the bottoms of clouds.
- E) comes mostly from Earth's surface.

Answer: A

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.8 **Describe** Earth-atmosphere energy balance and the patterns of global net radiation.

43) Sensible heat transfer (H) refers to energy transfer between the air and the surface through

- A) convection and conduction.
- B) evaporation of water.
- C) reflection of insolation.
- D) ground heating.
- E) state changes of water.

Answer: A

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

44) Which of the following is a nonradiative transfer of longwave radiation to the atmosphere?

- A) the greenhouse effect
- B) latent heat transfer
- C) stratospheric ozone radiation
- D) conduction from the surface
- E) insolation

Answer: B

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.8 **Describe** Earth-atmosphere energy balance and the patterns of global net radiation.

45) When water evaporates from a surface, which of the following occurs?

- A) Energy is stored within the water.
- B) Energy is released to the surface.
- C) The surface is warmed.
- D) Heat is transferred back and forth between the air and surface.
- E) Turbulent heat fluxes.

Answer: A

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

46) When water evaporates, the energy that was used to evaporate the water

- A) is stored as sensible heat in the evaporated water.
- B) is stored as latent heat in the evaporated water.
- C) is transferred to the air by advection when the water evaporates.
- D) is conducted into the underlying layer of water.
- E) flows through water via convection.

Answer: B

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

- 47) Temperature is
- A) a form of energy.
 - B) heat, as perceived by humans and other living things.
 - C) a function of insolation and windspeed.
 - D) the flow of kinetic energy between molecules.
 - E) a measure of the average kinetic energy of individual molecules.

Answer: E

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.10 *Define* the concept of temperature.

- 48) Most countries use the _____ temperature scale.

- A) Fahrenheit
- B) Kelvin
- C) Celsius
- D) Rankine
- E) Newton

Answer: C

Diff: 1

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.11 *Distinguish* between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.

- 49) Which of the following is **not** true?

- A) Freezing of water occurs at a single point, 0° C (32° F).
- B) Ice only has one melting point, but that point can be measured by different scales.
- C) The Celsius scale is divided into 100 degrees between the melting and boiling points of water at sea level.
- D) The freezing point of mercury is 39° C.
- E) The Kelvin scale starts at absolute zero.

Answer: A

Diff: 1

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.11 *Distinguish* between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.

- 50) -273°C (-459.4°F) is
- A) the same as 273 Kelvin.
 - B) an average boiling point temperature.
 - C) freezing point for water.
 - D) 0° absolute temperature.
 - E) not possible on any scale.

Answer: D

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.11 ***Distinguish*** between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.

51) The Celsius scale

- A) is used exclusively in the United States.
- B) places freezing at 0° and was formerly called centigrade.
- C) was developed by the British physicist Lord Kelvin.
- D) was developed by Fahrenheit, who also developed the alcohol and mercury thermometers.
- E) places freezing at 32° and boiling at 212° .

Answer: B

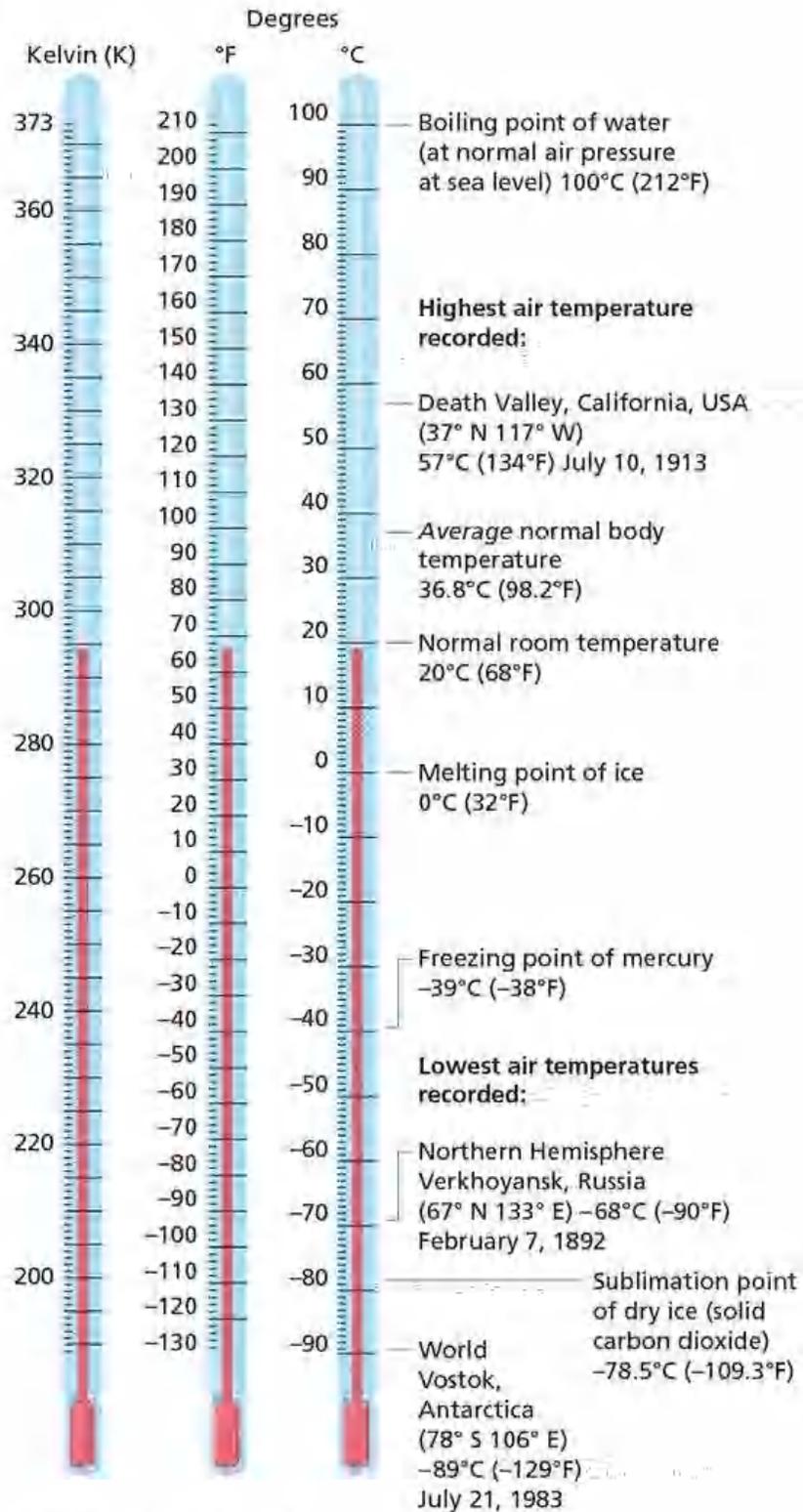
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Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.11 ***Distinguish*** between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.



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52) The Celsius and Fahrenheit scales only coincide at

- A) -273° .
- B) -40° .
- C) 0° .
- D) 212° .
- E) 273° .

Answer: B

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.11 **Distinguish** between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.

53) The size of one Kelvin unit is

- A) twice as large as one Celsius degree.
- B) the same size as one Celsius degree.
- C) two times smaller than one Celsius degree.
- D) the same size as one Fahrenheit degree.
- E) two times smaller than one Fahrenheit degree.

Answer: B

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.11 **Distinguish** between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.

54) Official temperatures are measured using thermometers placed in shelters that are

- A) non-ventilated and black boxes, placed at ground level.
- B) placed a few feet above the ground and have high albedo.
- C) in black boxes placed in direct sunlight for maximum insolation absorption.
- D) at ground level, in direct sunlight.
- E) above man-made surfaces in direct sunlight.

Answer: B

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.10 **Define** the concept of temperature.

55) Land surface temperature (LST) is

- A) a measurement of reflectivity of a surface.
- B) often much cooler than air temperature due to vegetation cover.
- C) highest in areas with high albedo and dense cloud cover.
- D) a measure of the heating of the land surface and is distinct from air temperature.
- E) of little practical use beyond map making.

Answer: D

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.10 **Define** the concept of temperature.

56) The principal controls and influences of temperature patterns include

- A) Earth's tilt, rotation, revolution, and sphericity.
- B) latitude, altitude, land-water heating differences, cloud cover, ocean currents, and sea-surface conditions.
- C) the distance of the Earth from the Sun and the amount of sunspot activity within the eleven year sunspot cycle.
- D) the seasons and human activity.
- E) the amount of atmospheric carbon dioxide.

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

57) The most important control on annual average temperature and temperature range is

- A) latitude.
- B) altitude.
- C) distribution of land and water.
- D) sea-surface temperatures.
- E) ocean currents.

Answer: A

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

58) Relative to latitude and surface energy receipts, which of the following is **true**?

- A) Insolation intensity increases with distance from the subsolar point.
- B) Day length decreases with increasing latitude in summer.
- C) Insolation intensity decreases with distance from the subsolar point.
- D) Seasonal effects increase toward the equator.
- E) The greatest seasonal variability occurs at exceptionally high latitudes.

Answer: C

Diff: 2

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

59) Salvador, Brazil is located at 13° S (and at an elevation of 9 m). Based on its latitudinal position, which of the following likely best describes its temperature?

- A) Seasonal variations of temperature are most pronounced in the summer.
- B) Temperatures can range from -10°C (14°F) in the winter to 21°C (70°F) in the summer.
- C) Cool and mild temperatures predominate throughout the year.
- D) The temperature is consistently high throughout the year.
- E) Summers are exceptionally hot, but winters are typically quite mild.

Answer: D

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

60) Which of the following is correct?

- A) Altitude refers to the height of a point on Earth's surface.
- B) Elevation refers to an object height above Earth's surface.
- C) Elevation refers to the height of a point on Earth's surface.
- D) Altitude is used in reference to height above sea level, whereas elevation is depth below sea level.
- E) Altitude and elevation are the same thing.

Answer: C

Diff: 1

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

61) Elevation typically refers to _____ whereas altitude refers to _____.

- A) the height of a point on Earth's surface; the height above Earth's surface
- B) the height above Earth's surface; the height of a point on Earth's surface
- C) both refer to the height above Earth's surface
- D) both refer to the height of a point on Earth's surface
- E) both refer to the depth of a point below sea level

Answer: A

Diff: 1

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

62) Within the troposphere, temperatures and density _____ with increasing altitude above the Earth's surface.

- A) both increase
- B) decrease and increase, respectively
- C) both decrease
- D) increase and decrease, respectively
- E) both decrease, stabilize, then both increase

Answer: C

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

63) 6.4°C/1000 m (3.5°F/1000 ft.) refers to

- A) a latitudinal lapse rate.
- B) the normal lapse rate.
- C) an environmental lapse rate.
- D) air pressure at sea level.
- E) changes in sensible heat with altitude.

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

64) Air pressure at 5500 m (18,000 ft.) is _____ percent of that at sea level.

- A) 0
- B) 10
- C) 30
- D) 50
- E) 75

Answer: D

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

65) Imagine two hypothetical cities, both located at 12° N. However, one is located near sea level, while the other at an elevation of 4,000 m (13,123 ft) above sea level. Which of the following is likely **true**?

- A) The climate of the two cities are quite similar.
- B) Annual temperatures for the city at the lower elevation are lower than those at the city at the higher elevation.
- C) The city at the higher elevation has extremely cold winters (similar to those at high latitudes)
- D) The city at the higher elevation has both average monthly and yearly temperatures lower than the city near sea level.
- E) The city at the higher elevation will have warmer summers, but colder winters than the city at the lower elevation.

Answer: D

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

66) If the temperature at the surface of Earth (at sea level) is 100°F, what is the temperature at 2000 feet if the normal lapse rate is 3.5°F/1000 feet?

- A) 86°F
- B) 93°F
- C) 96.5°F
- D) 103.5°F
- E) 107°F

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

67) If the temperature at the surface of Earth (at sea level) is 40°C, what is the temperature at 2000 m if the normal lapse rate is 6.4°C/1000 m?

- A) 27.2°C
- B) 33.6°C
- C) 46.4°C
- D) 52.8°C
- E) 60°C

Answer: A

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

68) At any given moment, what percentage of Earth is cloud-covered?

- A) 5
- B) 25
- C) 50
- D) 75
- E) 90

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

69) Which of the following is **true** regarding clouds?

- A) They decrease night time temperature minimums.
- B) They cover about 15 percent of Earth's surface at any one time.
- C) They have a moderating influence on temperatures.
- D) They increase daytime temperatures.
- E) They are the least variable factor influencing Earth's radiation budget.

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

70) An estimated _____ percent of all evaporation on Earth is from oceans.

- A) 22
- B) 37
- C) 86
- D) 74
- E) 15

Answer: C

Diff: 1

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

71) How does evaporation affect land-water heating differences?

- A) Evaporation tends to increase temperatures over land.
- B) Evaporation tends to lower temperatures more over water bodies than over land.
- C) Evaporation tends to increase the temperature over water.
- D) Evaporation affects land more than ocean surfaces.
- E) Evaporation affects the temperature of land surfaces and water bodies the same amount.

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

72) The land-water heating difference that is related to the land's opaqueness is

- A) altitude.
- B) specific heat.
- C) transparency.
- D) evaporation.
- E) movement.

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

73) As it pertains to differences in land-water heating, transparency

A) is greater in land than water.

B) refers to the fact that land is opaque and water is transparent.

C) produces a heat loading at the surface of water bodies.

D) produces a photic layer that normally is 2000 m (6600 ft.) deep.

E) has little affect on heating differences.

Answer: B

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

74) Imagine a profile of soil going to a depth of approximately 10 ft. On a sunny day, the soil at a depth of 5ft will be _____ the soil at the surface because _____.

A) warmer; soil is a good conductor of heat

B) cooler; land is opaque preventing heating at depths

C) warmer; geothermal processes heat the deeper soils

D) cooler; plate movement mixes the soils and dissipates the heat

E) cooler; convective heating will warm the subsurface more than the surface

Answer: B

Diff: 3

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

75) On average, the illuminated zone in oceans reaches to a depth of _____, but in some oceans may be as deep as _____.

A) 20 m (66 ft); 30 m (100 ft)

B) 100 m (330 ft); 500 m (1,640 ft)

C) 60 m (200 ft); 300 m (1,000 ft)

D) 30 m (100 ft); 900 m (3,000 ft)

E) 200 m (660 ft); 1000 m (3,280 ft)

Answer: C

Diff: 3

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

- 76) The land surface cools off more rapidly at night than water does because
- A) water, on average has a specific heat about four times that of land.
 - B) the amount of energy stored in the water column is less than that stored in land.
 - C) heat is transferred to deeper depths on land via conduction.
 - D) ocean is more plentiful than land, so more ocean is being heated than land.
 - E) evaporation over land at night is greater.

Answer: A

Diff: 3

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

- 77) The specific heat of land is _____ water and, therefore, land heats _____ water.

- A) higher than; slower than
- B) higher; than; quicker than
- C) lower than; slower than
- D) the same as; evenly with
- E) lower than; quicker than

Answer: E

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

- 78) The temperature control that includes the heat capacity of a substance is

- A) movement.
- B) evaporation.
- C) cloud cover.
- D) specific heat.
- E) transparency.

Answer: D

Diff: 2

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

79) Which of the following is incorrect regarding the differences in the heating of land and water?

- A) Land has a higher specific heat than water.
- B) Water has mobility and is mixed in ocean currents.
- C) Light transmits through water better than soil.
- D) A greater amount of evaporation occurs over oceans than over land.
- E) The oceans have a moderating effect along coastlines.

Answer: A

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

80) _____ refers to the greater range between maximum and minimum temperatures that occurs in inland areas distant from large bodies of water.

- A) The maritime effect
- B) Specific heat
- C) Heat dome
- D) Continentality
- E) Transparency

Answer: D

Diff: 3

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

81) As a result of the characteristics of water, cities located near a coast should experience a temperature range that is _____ those of cities located in the interior at the same latitude.

- A) the same as
- B) smaller than
- C) larger than
- D) larger than at lower latitudes only
- E) smaller than at higher latitudes only

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

82) Both City A and City B are located at the same latitude and have the same amount of cloud cover. City A has a mean annual temperature of 27°C and a temperature range of 22°C. City B has a mean annual temperature of 26°C and a temperature range of 14°C. Which city likely is located in the interior of the continent?

- A) City A
- B) City B
- C) Both City A and B are located in the interior.
- D) Neither City A nor B are located in the interior.
- E) Not enough information is given here to determine.

Answer: A

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

83) During summer, cities located near the coast are typically _____ than those in the interior at the same latitude, while in the winter they are _____.

- A) warmer; warmer
- B) warmer; cooler
- C) cooler; warmer
- D) cooler; cooler
- E) cooler; much colder

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

84) In general, more moderate temperature patterns

- A) are created by continentality.
- B) are exemplified by cities such as Winnipeg and Wichita.
- C) indicate maritime influences.
- D) occur in continental interiors.
- E) are associated with high elevations.

Answer: C

Diff: 2

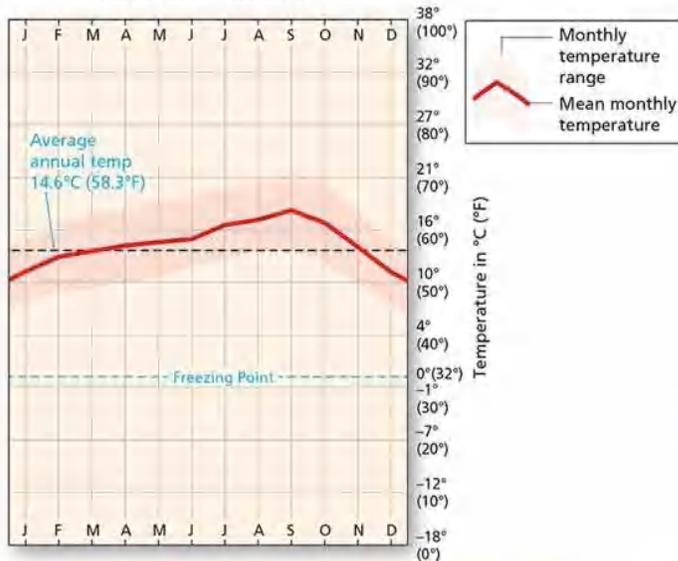
Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

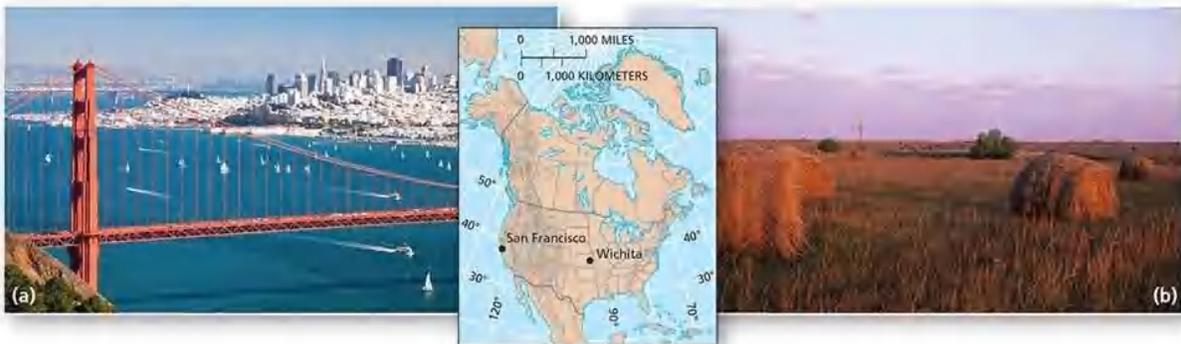
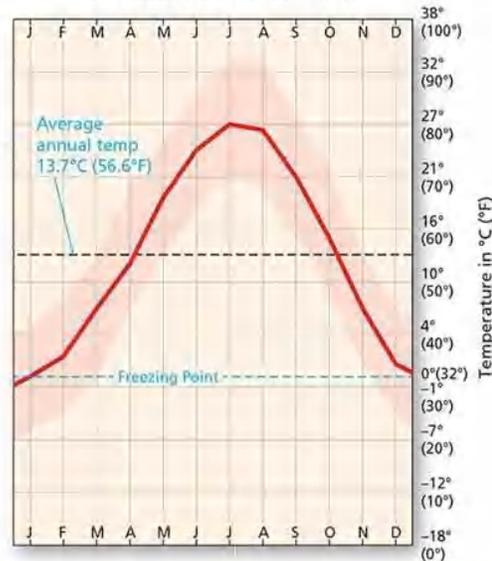
Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

MARINE CLIMATE: San Francisco, California
 Lat/long: 37° 46' N 122° 23' W
 Elevation: 5 m (16.4 ft)



CONTINENTAL CLIMATE: Wichita, Kansas
 Lat/long: 37° 39' N 97° 25' W
 Elevation: 402.6 m (1,321 ft)



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85) San Francisco, CA and Wichita, KS are located at approximately the same latitude. Which of the following is **true**?

- A) San Francisco experiences several months with average temperatures below the freezing point.
- B) Annual temperature ranges in Wichita are greater than those in San Francisco.
- C) Summer temperatures in San Francisco far exceed those of Wichita.
- D) Minimum average temperatures in Wichita are consistently lower than those in San Francisco.
- E) On average, December temperatures in San Francisco tend to be lower than those in Wichita.

Answer: B

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

86) San Francisco, CA and Wichita, KS are located at approximately the same latitude. Which of the following is **true**?

- A) San Francisco's average monthly temperature peak occurs later than that of Wichita.
- B) Maximum average temperatures are higher year-round in Wichita.
- C) San Francisco experiences more days below the freezing point than Wichita.
- D) San Francisco is more influenced by continentality than Wichita.
- E) Wichita's annual temperature range is less than that of San Francisco's.

Answer: A

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

87) Which of the following U.S. cities would experience the least continentality?

- A) Las Vegas, Nevada
- B) Oklahoma City, OK
- C) Seattle, Washington
- D) Boise, ID
- E) Bismarck, ND

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

88) Trondheim, Norway is located at approximately 63° N. Despite its high latitude, it has a relatively moderate annual temperature regime. What likely accounts for this moderation?

- A) Trondheim's high degree of continentality.
- B) Trondheim's maritime location.
- C) The urban heat island of Trondheim.
- D) Thick cloud cover in Trondheim traps in longwave radiation.
- E) Trondheim is located at a high elevation.

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

89) Which of the following is incorrectly matched?

- A) San Francisco, CA, USA — marine
- B) Trondheim, Norway — continentality
- C) Verkhoyansk, Russia — continentality
- D) Wichita, KS, USA — continentality

Answer: B

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 *Describe* the land-water heating differences that produce continental and marine effects on temperature ranges.

90) The Gulf Stream

- A) moves southward and moderates temperatures in eastern South America.
- B) moves equatorward, warming the California coast.
- C) moves northward in the western Atlantic, moderating temperatures in Iceland.
- D) creates a warming effect on Japan and the Aleutians.
- E) is a cold ocean current with minimal evaporation.

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 *Describe* the land-water heating differences that produce continental and marine effects on temperature ranges.

91) If the Gulf Stream shifted away from Iceland and England, winter temperatures in these locations would likely

- A) become cooler, thereby decreasing the average winter temperature.
- B) become warmer, thereby increasing the average winter temperature.
- C) remain the same.
- D) change in a random and impossible to predict manner.
- E) results in Iceland becoming cooler, while England would become warmer.

Answer: A

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 *Describe* the land-water heating differences that produce continental and marine effects on temperature ranges.

92) The region with the highest average ocean temperatures in the world are

- A) in the Western Pacific Warm Pool in the southwestern Pacific Ocean.
- B) along the Gulf Stream in the North Atlantic.
- C) east of the Humboldt Current long South America's Pacific Coast.
- D) near the Benguela Current in the South Atlantic.
- E) along the California Current in the Pacific Ocean.

Answer: A

Diff: 3

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.14 *List* typical urban heat island conditions and their causes.

93) Places located near warm ocean currents have _____ because _____.

- A) less humidity; warm water evaporates more easily than cold water
- B) higher humidity; warm water evaporates less than cold water
- C) higher humidity; warm water evaporates more easily than cold water
- D) less humidity; cool water evaporates more than warm water
- E) average humidity; all water surfaces have the same potential evaporation

Answer: C

Diff: 2

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.13 *Describe* the land-water heating differences that produce continental and marine effects on temperature ranges.

94) Small areas, ranging from square meters to square kilometers, with climates that are different from the region around them are called

- A) macroclimates.
- B) niches.
- C) microclimates.
- D) proxies.
- E) ravines.

Answer: C

Diff: 3

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.14 *List* typical urban heat island conditions and their causes.

95) Which of the following is **false**?

- A) Urban heat island effect is greater in bigger cities than small ones.
- B) Cities surrounded by forests rather than dry, sparse vegetation have more pronounced urban heat island effects.
- C) In New York City, the day temperatures in Central Park are similar to those in all of the greater metropolitan area.
- D) The urban heat island is hotter toward the downtown central business district than toward areas with trees and parks.
- E) Pollution and other human activity can increase the urban heat island effect.

Answer: C

Diff: 2

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 14. How human actions modify the physical environment

LO: 2.14 **List** typical urban heat island conditions and their causes.

96) A(n) _____ is trapped airborne pollution that can raise temperatures by absorbing insolation and reradiating heat to the surface.

- A) urban heat island (UHI)
- B) "cool" roof
- C) urban canyon effect
- D) apparent temperature
- E) dust dome

Answer: E

Diff: 2

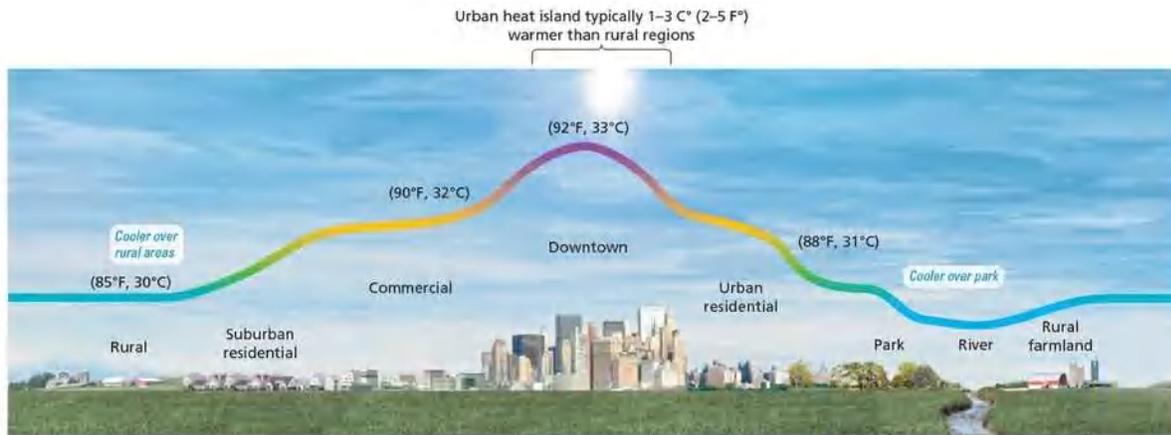
Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 14. How human actions modify the physical environment

LO: 2.15 **Describe** ways that cities can reduce the urban heat island effect.

97)



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Following the urban heat island profile from rural areas to a typical downtown urban area, which of the following is **true**?

- A) Commercial and urban residential areas have the highest late afternoon temperatures.
- B) Large urban parks do not mitigate against the urban heat island.
- C) On average, urban area temperatures are 1 to 3° C higher than nearby rural areas.
- D) The temperature variations between urban and rural environments are negligible.
- E) Rural farmlands are as warm as urban areas due to emission of methane by cows.

Answer: C

Diff: 2

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 14. How human actions modify the physical environment

LO: 2.14 **List** typical urban heat island conditions and their causes.

98) Which of the following is **not** a strategy used planners and architects to mitigate against the effects of the urban heat island?

- A) planting of urban forests (parks and open spaces)
- B) using dark covered asphalt
- C) designing rooftop gardens ("green" roofs)
- D) using lighter-colored materials on roofs and other surfaces
- E) use of solar panels, which can cool roofs

Answer: B

Diff: 2

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 14. How human actions modify the physical environment

LO: 2.15 **Describe** ways that cities can reduce the urban heat island effect.

99) Lines on a temperature map connecting points of equal temperature is called an

- A) isobar.
- B) isohyet.
- C) isotherm.
- D) isobath.
- E) isotach.

Answer: C

Diff: 2

Chapter/section: 2.9 Earth's Temperature Patterns

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.16 **Interpret** the pattern of Earth's temperatures on January and July temperature maps and on a map of annual temperature ranges.

100) An isoline that connects all points of highest mean temperature on a world map is called

- A) an isobar.
- B) the highest mean temperature isoline.
- C) the thermal equator.
- D) min/max line.
- E) the temperature range line.

Answer: C

Diff: 2

Chapter/section: 2.9 Earth's Temperature Patterns

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.16 **Interpret** the pattern of Earth's temperatures on January and July temperature maps and on a map of annual temperature ranges.

101) The thermal equator

- A) corresponds with the geographic equator.
- B) trends into the interior of landmasses.
- C) is highest over ocean basins.
- D) remains in the same location throughout the year.
- E) is the same as the subsolar point.

Answer: B

Diff: 2

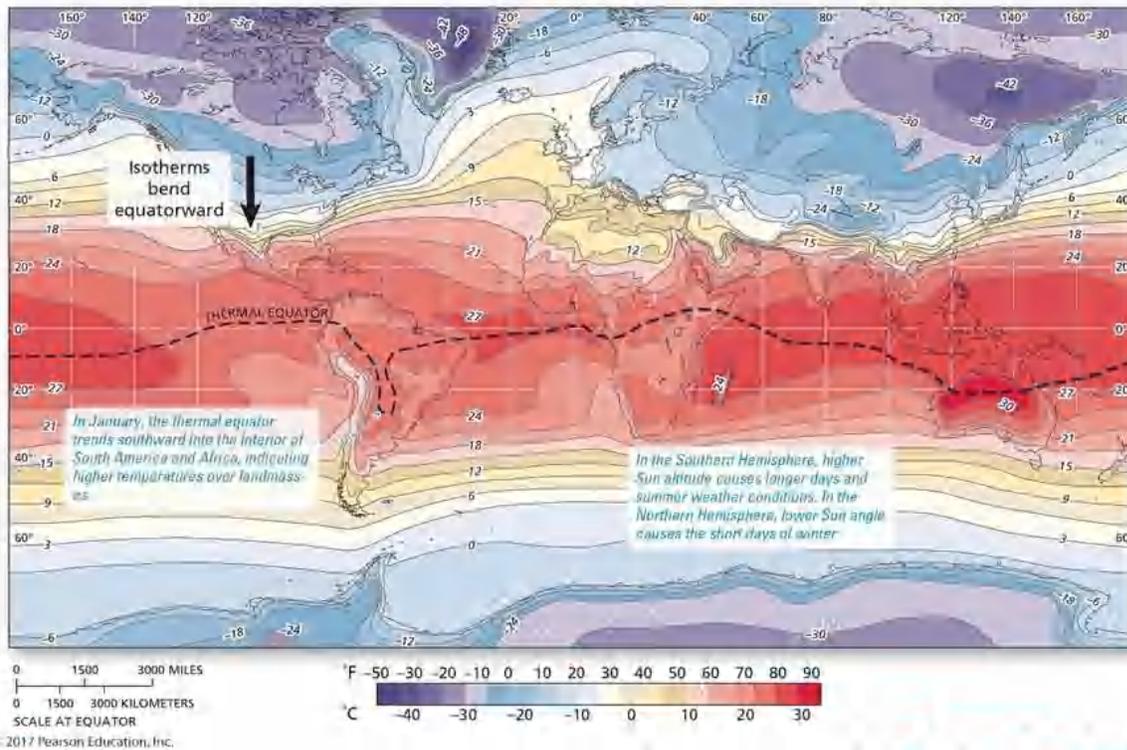
Chapter/section: 2.9 Earth's Temperature Patterns

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.16 **Interpret** the pattern of Earth's temperatures on January and July temperature maps and on a map of annual temperature ranges.



In January, the thermal equator

- A) trends southward into the interior of South America and Africa
- B) trends northward over all ocean basins.
- C) peaks in the interior of Eurasia.
- D) is not influenced by continentality.
- E) shows the greatest variability over oceans.

Answer: A

Diff: 3

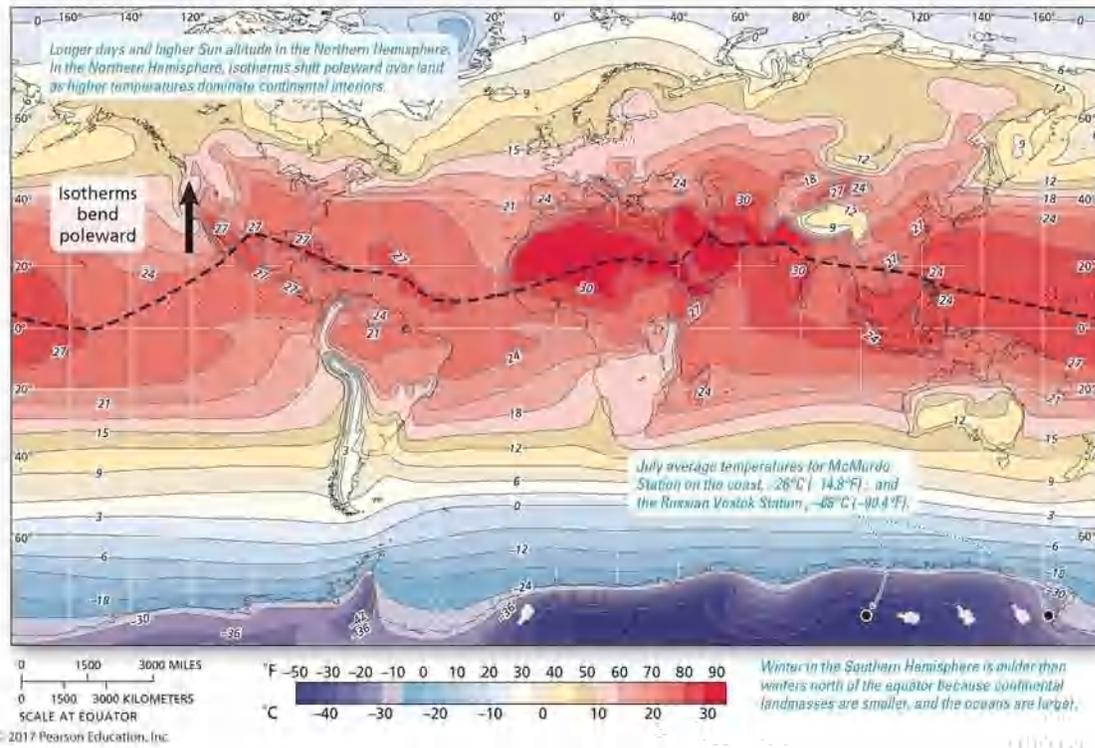
Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.14 **List** typical urban heat island conditions and their causes.

103)



In July, the thermal equator

- A) trends equatorward over continents and poleward over the oceans.
- B) trends poleward over continents and equatorward over the oceans.
- C) assumes an orientation that closely parallels that of the equator.
- D) is apparently random and has yet to be adequately explained.
- E) primarily follows the subsolar point.

Answer: B

Diff: 2

Chapter/section: 2.9 Earth's Temperature Patterns

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.14 **List** typical urban heat island conditions and their causes.

104) Which of the following is **true**?

- A) Northern Hemisphere temperatures are more strongly dominated by continentality than are Southern Hemisphere temperatures.
- B) Southern Hemisphere temperatures are more strongly dominated by continentality than are Northern Hemisphere temperatures.
- C) The Northern and Southern hemispheres are dominated equally by maritime influences.
- D) The Northern and Southern hemispheres are dominated equally by continentality.
- E) The Northern Hemisphere is mostly dominated by maritime temperatures.

Answer: A

Diff: 3

Chapter/section: 2.9 Earth's Temperature Patterns

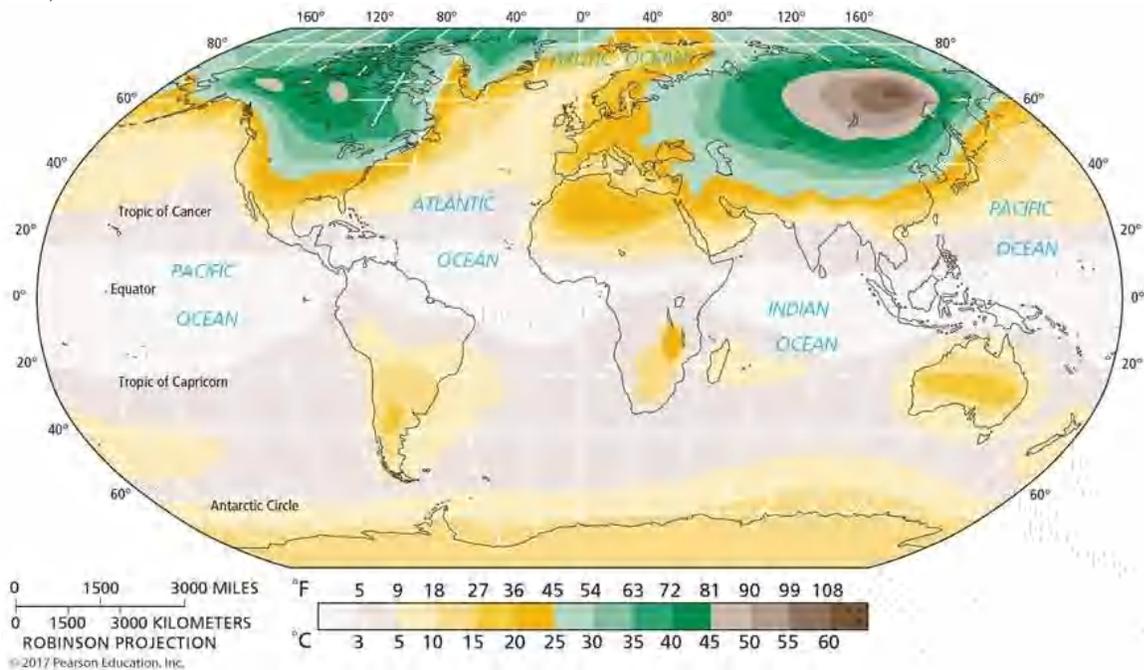
Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.16 **Interpret** the pattern of Earth's temperatures on January and July temperature maps and on a map of annual temperature ranges.

105)



Which is **true** for global annual temperature ranges?

- A) The lowest ranges occur over continental interiors in the Northern Hemisphere.
- B) The greatest ranges occur in the subtropics over the oceans.
- C) The greatest ranges occur over the continental masses in the Southern Hemisphere.
- D) High latitude land masses in the Northern Hemisphere have small temperature ranges.
- E) The greatest ranges occur in east central Siberia in Russia.

Answer: E

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.14 **List** typical urban heat island conditions and their causes.

106) _____ is the general term for the outdoor temperature as it is perceived by humans.

- A) Wind chill
- B) Latent heat
- C) Apparent temperature
- D) Sensible heat
- E) Specific heat

Answer: C

Diff: 2

Chapter/section: 2.10 Windchill, the Heat Index, and Heat Waves

Bloom's Taxonomy: 3/4 Application/Analysis

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.17 **Discuss** wind chill, heat waves, and the heat index as they relate to human heat response.

107) _____ is a prolonged period (3 or more days) of abnormally high temperatures, usually in association with humid weather.

- A) A temperature anomaly
- B) Sensible heat
- C) Apparent temperature
- D) Radiative forcing
- E) A heat wave

Answer: E

Diff: 2

Chapter/section: 2.10 Windchill, the Heat Index, and Heat Waves

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.17 **Discuss** wind chill, heat waves, and the heat index as they relate to human heat response.

108) As reported by the National Weather Service, the heat index

- A) relates temperature and relative humidity.
- B) combines air pressure and temperature in a comfort index.
- C) gives you an indication of the effect of wind on the skin.
- D) is generally reported during critical winter months.
- E) is the general term for temperature as perceived by humans.

Answer: A

Diff: 2

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 15. How physical systems affect human systems

LO: 2.15 **Describe** ways that cities can reduce the urban heat island effect.

109) On a cold, windy day, the air feels _____ because the wind _____.

- A) colder; increases the heat loss from cooling of the air
- B) warmer; mitigates against the cold temperatures
- C) colder; increases evaporative heat loss from our skin
- D) warmer; disperses clouds, allowing more sunlight to reach the ground
- E) warmer; winds, in general, have a warming effect

Answer: C

Diff: 3

Chapter/section: 2.4 Earth-Atmosphere Energy Balance

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.15 **Describe** ways that cities can reduce the urban heat island effect.

110) The effect of wind and temperature on the human skin is called the

- A) heat index.
- B) sensible heat measurement.
- C) wind-chill factor.
- D) apparent temperature index.
- E) specific heat metric.

Answer: C

Diff: 2

Chapter/section: 2.10 Windchill, the Heat Index, and Heat Waves

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.17 **Discuss** wind chill, heat waves, and the heat index as they relate to human heat response.

111) Global temperatures are

- A) rising at a rate of 0.17 C° (0.3 F°) per decade on average.
- B) higher than any time in the last 800,000 years.
- C) increasing at a decreasing rate.
- D) increasing by 3% per year.
- E) not changing in any discernible manner.

Answer: A

Diff: 2

Chapter/section: 2.10 Windchill, the Heat Index, and Heat Waves

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.17 **Discuss** wind chill, heat waves, and the heat index as they relate to human heat response.

112) What percentage of the Earth's population lives in urban areas?

- A) 5
- B) 10
- C) 15
- D) 25
- E) 50

Answer: E

Diff: 2

Chapter/section: 2.11 The Human Denominator

Bloom's Taxonomy: 1/2 Knowledge/Comprehension

Geo Standard: 15. How physical systems affect human systems

LO: 2.14 **List** typical urban heat island conditions and their causes.

2.2 Essay Questions

1) Describe the different methods of heat transfer.

Answer: Answers should include radiation (transfer of heat in electromagnetic waves), conduction (molecule-to-molecule transfer), convection (heat transfer via mixing), advection (horizontal mixing), and latent heat transfer (energy absorbed or released via state change).

Diff: 3

Chapter/section: 2.1 Energy Balance Essentials

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

2) Describe the energy pathways of insolation as it enters the Earth's atmosphere.

Answer: Answers should include transmission, scattering, reflection, refraction, and absorption.

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

3) What does "albedo" mean? Discuss the albedo of different surfaces including several not explicitly discussed in the textbook.

Answer: Albedo is the reflective quality of a surface. Lighter objects have higher albedo; darker objects have lower albedo. For instance, white sand dunes have a higher albedo than a rainforest canopy.

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 3. Read and Interpret Graphs and Data.

LO: 2.4 **Explain** the concept of albedo (reflectivity).

4) Follow the flow of energy from the Sun, into Earth's atmosphere and to the surface, and back out into space.

Answer: Incoming solar radiation (insolation) can be reflected, scattered, absorbed by atmospheric constituents, or transmitted to the Earth's surface where it is absorbed or reflected. Outgoing terrestrial radiation can be transferred via radiative transfer and nonradiative transfer mechanisms. This radiation can be absorbed by atmospheric gases and re-radiated towards the Earth's surface (greenhouse effect) or transmitted back to space.

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.2 **Explain** four types of heat transfer: radiation, conduction, convection, and advection.

5) What is Rayleigh scatter? How does scattering contribute to the color of the sky.

Answer: Rayleigh is the differential scatter of visible light due to the presence of atmospheric gases and particulates smaller than the wavelengths of most visible light. As a result, mostly light in the blue and violets wavelengths are scattered, given the sky on a clear day it's blue color.

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.3 **Identify** pathways for solar energy on its way through the troposphere to Earth's surface—transmission, scattering, refraction, and absorption.

6) What is the "greenhouse effect" as applied to Earth's atmosphere? How is Earth similar and different than a greenhouse?

Answer: In the most basic of terms, the greenhouse effect refers to the differential transmissivity of shortwave insolation and longwave terrestrial radiation. In other words, certain atmospheric gases and particulates are "transparent" to incoming radiation, but "opaque" to outgoing terrestrial radiation. As a result, this outgoing radiation is absorbed and reradiated to the Earth's surface. However, the analogy to a greenhouse is not quite correct because the atmosphere doesn't trap the longwave radiation in the manner a greenhouse does. Rather, the passage of longwave radiation to space is delayed.

Diff: 3

Chapter/section: 2.2 Insolation Input and Albedo

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.6 **Explain** the greenhouse concept as it applies to Earth.

7) Why do the tropics have a positive net radiation while the poles have a negative value? How is the energy difference equalized?

Answer: The latitudinal imbalance in insolation results from differences in the angle of incoming insolation, day length, seasonal variations, and albedo. The area between the tropics has high sun angle, consistent day lengths, and little seasonal variation, resulting in an energy surplus. The poles have a low sun angle, high albedo (due to snow and ice cover), long periods of darkness, and large daily and annual temperature ranges, resulting in an energy deficit. These differences drive the global circulation patterns.

Diff: 3

Chapter/section: 2.4 Earth-Atmosphere Energy Balance

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.8 **Describe** Earth-atmosphere energy balance and the patterns of global net radiation.

8) Discuss the components of the the surface energy budget.

Answer: +SW is incoming shortwave radiation from the sun; -SW is outgoing shortwave radiation from the sun that has been reflected; +LW is incoming longwave radiation emitted by the Earth, absorbed by atmospheric gases, and reradiated to the Earth's surface. -LW is outgoing longwave terrestrial radiation.

Diff: 3

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.8 **Describe** Earth-atmosphere energy balance and the patterns of global net radiation.

9) Why is a lag found in daily temperature patterns? Discuss the roles of different sources of surface heating.

Answer: The warmest time of the day occurs after insolation has been absorbed and emitted to the atmosphere from the ground, not at the moment of maximum insolation. As long as the incoming energy exceeds the outgoing energy, air temperatures continue to increase until incoming energy begins to dissipate.

Diff: 3

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

LO: 2.9 **Explain** daily temperature patterns and surface energy flows.

10) Describe the components of net radiation (NET R).

Answer: NET R is the sum of all radiation gains and losses at any defined location on the Earth's surface. Components of NET R are the latent heat of evaporation (LE), the energy stored in water when it evaporates; sensible heat (H) the heat transferred back and forth between the air and surface through conduction and convection; and ground heating and cooling (G), the flow of energy into and out of the ground surface by conduction.

Diff: 3

Chapter/section: 2.5 Energy Balance at Earth's Surface

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.8 *Describe* Earth-atmosphere energy balance and the patterns of global net radiation.

11) Distinguish between temperature and heat. Then describe the important characteristics of the three main temperature scales.

Answer: Temperature is a measurement of the average kinetic energy of molecules in matter. Heat is the flow of kinetic energy between molecules. The three primary temperature scales are Fahrenheit, Celsius, and Kelvin. Fahrenheit places the melting point at 32° and the boiling point at 212°. Celsius divides into 100 degrees using a decimal system, between the melting point at 0° and the boiling point at 100°. The Kelvin scale starts with an absolute zero, with temperature readings proportional to the actual kinetic energy. Melting point for ice is 273° and boiling point for water is 373°.

Diff: 3

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.11 *Distinguish* between Kelvin, Celsius, and Fahrenheit temperature scales, and describe how they are measured.

12) Discuss how latitude, altitude/elevation, cloud cover, and land-water heating differences can influence global temperature patterns.

Answer: The principle controls of temperature include latitude, altitude and elevation, cloud cover, and land-water heating differences. Since the subsolar point is always somewhere between the tropics, lower latitudes receive more direct, and therefore, intense, insolation than higher latitudes. Temperatures decrease with altitude in troposphere. The density of the atmosphere also decreases. As a result, areas at higher elevation (but at the same latitude) tend to be cooler than those closer to sea level. Cloud cover can also mitigate temperature, first by reflecting and absorbing insolation and, secondly, by absorbing longwave radiation from the Earth and re-radiating it towards the surface of the Earth. Lastly, there are several land/water differences that affect temperature, these include evaporation, mixing (movement), specific heat, and transparency.

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

13) Why is the higher specific heat of water as compared to rock or soil an important factor in determining temperature characteristics and changes?

Answer: The energy needed to increase the temperature of water is greater than that for increasing the temperature of an equal volume of land. Additionally, water can hold more heat than soil. In general, the specific heat for water is about four times that as soil and, as a result, a given volume of water represents a more substantial energy reservoir. It therefore heats and cools more slowly than land.

Diff: 3

Chapter/section: 2.6 Temperature Concepts and Measurements

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.12 **Explain** the effects of latitude, altitude and elevation, and cloud cover on global temperature patterns.

14) How do ocean currents affect both water and air temperatures? Use the Humboldt Current and Gulf Stream as examples.

Answer: Ocean currents can affect land temperatures in different ways, depending on whether it is a warm or cold current. For instance, cool ocean currents along midlatitude and subtropical west coasts of continents moderate air temperature on land (e.g., the Humboldt (Peru) Current). Such land areas (e.g., Lima, Peru) may have cooler climate than expected by climate. Conversely, warm currents (such as the Gulf Stream) move warm waters to cooler areas. The Gulf Stream, in particular, moves warmer water into the North Atlantic, helping mitigate temperatures in areas that would be much cooler if driven by latitude, alone (e.g., Iceland).

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

15) Compare, contrast, and explain maritime and continental conditions.

Answer: The maritime effect refers to the moderating influences of the ocean and usually occurs in coastal areas or on islands. By contrast, continentality (the continent effect) refers to the greater range between both daily and annual maximum and minimum temperatures. Students may also make comparisons explicitly outlined in the book, for instance, between San Francisco, CA and Wichita, KS or between Trondheim, Norway and Verkhoyansk, Russia.

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

16) Why do continental locations usually have greater extremes of temperature than do maritime locations at the same latitude?

Answer: The short answer is the maritime effect with its moderating effect of the oceans.

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.13 **Describe** the land-water heating differences that produce continental and marine effects on temperature ranges.

17) Where should you move to if you wanted to live in a region with the greatest annual range of temperatures? If you changed your mind and wanted to live in the region with the lowest annual temperature range where should you go? What are the qualities that create each of these situations?

Answer: The largest average annual temperature ranges occur at subpolar, continental locations in North America and Asia. The lowest annual temperature ranges occur in tropical areas. For the former, high latitude and continentality are the dominant influences. For the latter, low latitude and direct insolation are the dominant influences.

Diff: 3

Chapter/section: 2.7 Principal Temperature Controls

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.13 *Describe* the land-water heating differences that produce continental and marine effects on temperature ranges.

18) What are the factors that tend to raise the temperature of an urban area relative to its surrounding rural areas?

Answer: Thermal properties of urban surfaces; reflective properties of urban surfaces; urban canyon effect; anthropogenic heating; pollution, and urban desert effect are among those factors listed in the book.

Diff: 3

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 14. How human actions modify the physical environment

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.14 *List* typical urban heat island conditions and their causes.

19) Review the climatic differences in urban and rural environments.

Answer: On average, urban temperatures may be 1 to 3 C° warmer than nearby rural areas on a sunny summer day. Temperatures are highest in the urban core and coolest over rural areas or large parks.

Diff: 3

Chapter/section: 2.8 The Urban Environment

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 14. How human actions modify the physical environment

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.14 *List* typical urban heat island conditions and their causes.

20) Compare and contrast Northern Hemisphere and Southern Hemisphere temperature ranges. Also, compare tropical and midlatitude temperature ranges.

Answer: The largest average annual temperature ranges occur at subpolar, continental locations in North America and Asia. By comparison, the Southern Hemisphere has smaller temperature ranges. The reason is in the domination of continentality in the Northern Hemisphere in the marine effect in the Southern Hemisphere.

Diff: 3

Chapter/section: 2.9 Earth's Temperature Patterns

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 07. The physical processes that shape the patterns of Earth's surface

Global Sci. LO.: 8. Communicate effectively in writing.

LO: 2.16 *Interpret* the pattern of Earth's temperatures on January and July temperature maps and on a map of annual temperature ranges.

21) Describe different ways in which anthropogenic activity can affect the energy balance.

Answer: Examples include burning of fossil fuels leading to climate change; climate changing leading to melting sea ice; land cover change altering albedo; aerosols and particulates altering albedo; etc.

Diff: 3

Chapter/section: 2.11 The Human Denominator

Bloom's Taxonomy: 5/6 Synthesis/Evaluation

Geo Standard: 14. How human actions modify the physical environment

Global Sci. LO.: 8. Communicate effectively in writing.