

Chapter 01

True / False

1. These sayings are based on close observations, and most likely have some truths in them, but they are not based on the scientific method. Sayings about the weather, such as "red sky at morning, sailor take warning; red sky at night, sailor's delight" are based on the scientific method.

- a. True
- b. False

ANSWER: False

2. Earth's second atmosphere was denser than its first atmosphere (which formed some 4.6 billion years ago), and developed through the impact of a series of meteorites.

- a. True
- b. False

ANSWER: True

3. Atmospheric concentration of CO₂ has increased from below 300 ppm historically to over 400 ppm presently.

- a. True
- b. False

ANSWER: True

4. Carbon dioxide is a naturally occurring component of the atmosphere.

- a. True
- b. False

ANSWER: True

5. The ozone hole is an actual hole in the atmosphere, a region of complete vacuum.

- a. True
- b. False

ANSWER: False

6. Of the four most abundant gases in our atmosphere, water vapor shows the greatest variation at Earth's surface.

- a. True
- b. False

ANSWER: True

7. Soil dust, salt from ocean waves, forest fire smoke, volcanic ash particles, and pollutants are some of the aerosols found in the atmosphere.

- a. True
- b. False

ANSWER: True

8. On the basis of temperature, the layers of the atmosphere from the lowest layer to the highest are the thermosphere, mesosphere, stratosphere, and troposphere.

- a. True
- b. False

ANSWER: False

9. On average, temperature increases from the surface to the tropopause (around 10 km, then decreases to the stratopause (around 50 km), then decreases to the mesopause (around 90 km), then increases through the thermosphere.

- a. True
- b. False

ANSWER: False

10. Someone who says that "the wind direction today is south" likely means that the wind is blowing toward the south.

- a. True
- b. False

ANSWER: False

11. Fronts are a sharp change in temperature, humidity, and wind direction.

- a. True
- b. False

ANSWER: True

12. Meteorology is the study of the atmosphere and its phenomena. The term itself goes back to a Roman emperor who, about 12 B.C., wrote a book on natural philosophy entitled Meteorologica.

- a. True
- b. False

ANSWER: False

13. Weather in the middle latitudes tends to move from east to west.

- a. True
- b. False

ANSWER: False

14. Storms rank in size from largest to smallest, as follows: middle-latitude cyclonic storm, hurricane, thunderstorm, tornado.

- a. True
- b. False

ANSWER: True

15. The lowest average air temperature can be found in the stratosphere.

a. True

b. False

ANSWER: False

16. The main atmospheric component of the planet Mercury is CO₂.

a. True

b. False

ANSWER: False

17. A decrease in stratospheric ozone would be beneficial for plants, animals, and humans.

a. True

b. False

ANSWER: False

18. Ultraviolet light from the sun destroys nitrous oxide.

a. True

b. False

ANSWER: True

Multiple Choice

19. The most abundant gases in Earth's atmosphere by volume are ____.

a. carbon dioxide and nitrogen

b. oxygen and water vapor

c. nitrogen and oxygen

d. oxygen and helium

e. oxygen and ozone

ANSWER: c

20. Water vapor can best be described as a ____.

a. gas

b. cloud droplet

c. raindrop

d. snowflake

e. liquid

ANSWER: a

21. In a volume of air near Earth's surface today, ____ occupies 78 percent and ____ nearly 21 percent.

a. nitrogen; oxygen

- b. hydrogen; oxygen
- c. oxygen; hydrogen
- d. nitrogen; water vapor
- e. hydrogen; helium

ANSWER: a

22. Which of the following is considered a variable gas in Earth's atmosphere?

- a. Water vapor
- b. Nitrogen
- c. Oxygen
- d. Argon
- e. Helium

ANSWER: a

23. Water vapor molecules ____.

- a. are invisible
- b. color the sky blue
- c. make clouds white
- d. are very small drops of liquid water
- e. can exist in the frozen state

ANSWER: a

24. Typically, water vapor occupies about what percentage of the air's volume near Earth's surface?

- a. About 78 percent
- b. About 21 percent
- c. Close to 10 percent
- d. Less than 4 percent
- e. Less than 1 percent

ANSWER: d

25. The only substance near Earth's surface that is found naturally in the current atmosphere as a solid, liquid, and a gas is ____.

- a. carbon dioxide
- b. water
- c. molecular oxygen
- d. ozone
- e. carbon

ANSWER: b

26. The most abundant greenhouse gas in Earth's current atmosphere is ____.

- a. carbon dioxide (CO₂)
- b. nitrous oxide (N₂O)
- c. water vapor (H₂O)
- d. methane (CH₄)

e. chlorofluorocarbons (CFCs)

ANSWER: c

27. Since 1958, CO₂ in the atmosphere has ____.

- a. increased in concentration by 30 percent
- b. decreased in concentration by 30 percent
- c. remained at about the same concentration from year to year
- d. disappeared entirely
- e. has doubled in concentration

ANSWER: a

28. Which process acts to remove carbon dioxide from the atmosphere?

- a. Lightning
- b. Deforestation
- c. Photosynthesis
- d. Burning fossil fuels
- e. Volcanic eruptions

ANSWER: c

29. Which of the following is NOT a way for CO₂ to enter the atmosphere?

- a. Volcanic eruptions
- b. Through phytoplankton fixing CO₂ into organic tissues
- c. Burning fossil fuels
- d. Exhalations of animal life
- e. Deforestation

ANSWER: b

30. The unit of pressure most commonly found on a surface weather map is ____.

- a. inches of mercury (Hg)
- b. millibars or hectopascals
- c. pounds per square inch
- d. millimeters of mercury (Hg)
- e. kilograms per square meter

ANSWER: b

31. Which weather element ALWAYS decreases as we climb upward in the atmosphere?

- a. Wind
- b. Temperature
- c. Pressure
- d. Moisture
- e. Dew point

ANSWER: c

32. Earth's atmosphere is divided into named layers based on the vertical profile of ____.

- a. air pressure
- b. air temperature
- c. air density
- d. wind speed
- e. chemical composition

ANSWER: b

33. Almost all of Earth's weather occurs in the ____.

- a. exosphere
- b. stratosphere
- c. mesosphere
- d. thermosphere
- e. troposphere

ANSWER: e

34. The most abundant gas in the stratosphere is ____.

- a. oxygen (O₂)
- b. nitrogen (N₂)
- c. carbon dioxide (CO₂)
- d. ozone (O₃)
- e. chlorofluorocarbons (CFCs)

ANSWER: b

35. The atmospheric layer in which we live is called the ____.

- a. troposphere
- b. stratosphere
- c. thermosphere
- d. ionosphere
- e. exosphere

ANSWER: a

36. The temperature of the tropopause ____.

- a. is close to the temperature at Earth's surface
- b. is much colder than the temperature at Earth's surface
- c. has never been measured
- d. is much warmer than the temperature at Earth's surface
- e. is nearly the same as the sun's temperature

ANSWER: b

37. In a temperature inversion, air temperature ____.

- a. increases with increasing height
- b. decreases with increasing height
- c. remains constant with increasing height
- d. is warmer at night than during the day
- e. is warmer during winter than during summer

ANSWER: a

38. The rate at which temperature decreases with increasing altitude is known as the ____.

- a. temperature slope
- b. lapse rate
- c. sounding
- d. thermocline
- e. sudden temperature drop

ANSWER: b

39. Most of the ionosphere is found in which of the following atmospheric layers?

- a. Troposphere
- b. Stratosphere
- c. Mesosphere
- d. Thermosphere
- e. Homosphere

ANSWER: d

40. Over millions of years, this process provided a rich supply of water vapor into the atmosphere, which formed into clouds.

- a. Evaporation
- b. Condensation
- c. Precipitation layering
- d. Outgassing
- e. The greenhouse effect

ANSWER: d

41. The word "weather" is defined as ____.

- a. the average of the weather elements
- b. the climate of a region
- c. the climate averaged over a year's time
- d. any type of falling precipitation
- e. the condition of the atmosphere at a particular time and place

ANSWER: e

42. Wind direction is ____.

- a. the direction from which the wind is blowing
- b. the direction to which the wind is blowing
- c. always directly from high toward low pressure
- d. always directly from low toward high pressure
- e. the vertical displacement of air

ANSWER: a

43. Meteorology is the study of ____.

- a. landforms
- b. the oceans
- c. the atmosphere
- d. outer space
- e. extraterrestrial meteoroids that enter the atmosphere.

ANSWER: c

44. Middle latitude cyclonic storms are also known as ____.

- a. anticyclones
- b. hurricanes
- c. extratropical cyclones
- d. tornadoes
- e. blizzards

ANSWER: c

45. Humidity is ____.

- a. the same in different climates
- b. any form of water that falls from clouds and reaches the ground
- c. a measure of the amount of water vapor in the air
- d. the degree of hotness or coldness of the air
- e. the force of the air above an area

ANSWER: c

46. Precipitation is ____.

- a. the same in different climates
- b. any form of water that falls from clouds and reaches the ground
- c. a measure of the amount of water vapor in the air
- d. the degree of hotness or coldness of the air
- e. the force of the air above an area

ANSWER: b

47. On a weather map, sharp changes in temperature, humidity, and wind direction are marked by ____.

- a. a front
- b. an anticyclone
- c. a ridge
- d. blowing dust
- e. a low

ANSWER: a

48. Which of the following is MOST likely associated with fair weather?

- a. High pressure area
- b. Low pressure area
- c. A cold front
- d. A warm front

e. Large storm systems

ANSWER: a

49. Which statement relates to weather rather than climate?

- a. The average temperature for the month of January is 28 degrees Fahrenheit.
- b. The lowest temperature ever recorded in Frozenlake, Minnesota is -57 degrees Fahrenheit.
- c. The foggiest month of the year is December.
- d. I like the warm, humid summers.
- e. It is cloudy and snowing outside.

ANSWER: e

50. With regard to natural disasters, most people die from ____.

- a. lightning
- b. earthquakes
- c. tornadoes
- d. flash floods and flooding
- e. droughts

ANSWER: d

51. Ozone in the stratosphere ____.

- a. is a health hazard for people with respiratory illnesses
- b. protects life from harmful ultraviolet radiation
- c. is one of the main ingredients of photochemical smog
- d. provides healthy levels of vitamin D to humans
- e. is an aerosol found in the ionosphere

ANSWER: b

52. Which atmospheric layer contains the most mixing and overturning of air?

- a. Stratosphere
- b. Troposphere
- c. Mesosphere
- d. Exosphere
- e. Ionosphere

ANSWER: b

53. When applying the scientific method to investigating the atmosphere, scientists study ____.

- a. the chemistry and physics of water samples
- b. the chemistry and physics of air
- c. animal behavior in different climates
- d. human behavior in different climates
- e. the chemical composition of plants occurring in different climates

ANSWER: b

54. Earth's earliest atmosphere was most likely composed of ____.

- a. water vapor and nitrogen
- b. carbon dioxide and helium
- c. hydrogen and helium
- d. hydrogen and oxygen
- e. noble gases

ANSWER: c

55. Much of the carbon dioxide found in earlier atmospheres is currently locked up in ____.

- a. granite
- b. volcanic rocks
- c. sandstone
- d. shale
- e. carbonate rocks

ANSWER: e

56. Most human-made impurities found in the atmosphere present a health and environmental hazard. These are called ____.

- a. nutrients
- b. pollutants
- c. aerosols
- d. dust
- e. particles

ANSWER: b

57. There are considerably more air molecules near Earth's surface than higher up, which means, in comparison, air near the surface ____.

- a. is less dense
- b. has the same density
- c. is denser
- d. has no density
- e. is only half as dense

ANSWER: c

58. Weather maps with isobars have been utilized in meteorology since ____.

- a. 1799
- b. 1950
- c. 1843
- d. 1920
- e. 1869

ANSWER: e

59. A geostationary satellite takes pictures of ____.

- a. the moon as it is seen from Earth
- b. other planets as they are seen from Earth
- c. different areas on Earth when it is stationary
- d. one area on Earth as it moves at the same rate as Earth's spin
- e. any recurring geologic event on Earth

ANSWER: d

60. On weather maps cold fronts are drawn ____.

- a. in blue, with arrowheads showing the front's general direction of movement
- b. in red, with arrowheads showing the front's general direction of movement
- c. in blue, with arrowheads pointing away from the front's general direction of movement
- d. in black, with arrowheads showing the front's general direction of movement
- e. in red, with arrowheads pointing away from the front's general direction of movement

ANSWER: a

61. Weather and climate affect human lives in many ways, but the most immediate effect is related to ____.

- a. the economy
- b. the environment
- c. comfort
- d. health
- e. infrastructure

ANSWER: c

62. A tropical storm system, with its swirling band of rotating clouds and sustained surface winds of 65 knots, is known as a ____.

- a. thunderstorm
- b. hurricane
- c. tornado
- d. cyclical front
- e. downburst

ANSWER: b

63. The Sun is surrounded by Earth, and how many other planets?

- a. Five
- b. Ten
- c. Eight
- d. Twelve
- e. Seven

ANSWER: e

64. The average surface temperature on Earth is ____.

- a. 59 degrees Fahrenheit
- b. 55 degrees Fahrenheit
- c. 50 degrees Fahrenheit

- d. 61 degrees Fahrenheit
- e. 57 degrees Fahrenheit

ANSWER: a

65. Recorded temperatures on Earth range from ____.

- a. -40 to 120 degrees Fahrenheit
- b. -55 to 115 degrees Fahrenheit
- c. -100 to 150 degrees Fahrenheit
- d. -111 to 159 degrees Fahrenheit
- e. -121 to 122 degrees Fahrenheit

ANSWER: e

66. Falling rain and snow is called ____.

- a. condensation
- b. evaporation
- c. sublimation
- d. crystallization
- e. precipitation

ANSWER: e

67. Over the past 100 years or so, Earth's surface temperature has increased by ____.

- a. 1.4 degrees Fahrenheit
- b. 5.4 degrees Fahrenheit
- c. 0 degrees Fahrenheit
- d. 3.0 degrees Fahrenheit
- e. 2.1 degrees Fahrenheit

ANSWER: a

68. Air molecules are held near Earth through _____.

- a. intermolecular forces
- b. chemical reactions
- c. air pressure
- d. winds in the atmosphere
- e. gravity

ANSWER: e

Completion

69. _____, _____, _____, and water vapor are the four most abundant gases in today's atmosphere.

ANSWER: Nitrogen; argon; oxygen

70. The two most abundant greenhouse gases in Earth's atmosphere are _____ and _____.

ANSWER: carbon dioxide; water vapor

71. In the middle latitudes of the Northern Hemisphere, surface winds tend to blow _____ and _____ around an area of surface low pressure.

ANSWER: inward; counterclockwise

72. The atmosphere protects inhabitants at Earth's _____.

ANSWER: surface

73. The average or standard _____ in the troposphere is about 6.5°C for every 1000 m or about 3.6°F for every 1,000-foot rise in elevation.

ANSWER: lapse rate

74. A zone known as _____ is one in the atmosphere in which, on average, the air temperature remains constant with height.

ANSWER: an isothermal zone

75. The layer of the atmosphere that contains all of our weather is the _____.

ANSWER: Troposphere

76. The ozone hole is located over _____.

ANSWER: Antarctica

77. The concentration of _____ is close to 21 percent (by volume) in the upper stratosphere (the same concentration as in the troposphere), but without proper breathing apparatus you would not be able to survive there.

ANSWER: oxygen

78. Wind blows _____ around low-pressure areas, and _____ around high-pressure areas in the Northern Hemisphere.

ANSWER: counterclockwise; clockwise

79. _____ describes conditions averaged over a region or over a period, whereas _____ describes the condition of the atmosphere at a particular time and place.

ANSWER: Climate, weather

80. In the mid-1990s, the National Weather Service replaced original radars with sophisticated instruments known as _____ that have the ability to peer into a severe thunderstorm, unveil its winds, and show precipitation intensity.

ANSWER: Doppler radars

81. The _____ of air in a rigid container is the same everywhere in the universe.

ANSWER: mass

82. Our understanding of the atmosphere and how it produces weather is built on knowledge acquired and applied through the _____.

ANSWER: scientific method

83. The physical laws that control atmospheric behavior can be represented in software packages known as _____.

ANSWER: numerical models

84. Any form of water, either liquid or solid (rain or snow), that falls from clouds and reaches the ground is called _____.

ANSWER: precipitation

85. A(n) _____ is an intense rotating column of air that extends downward from the base of a thunderstorm with a circulation reaching the ground.

ANSWER: tornado

Subjective Short Answer

86. Under what circumstances might a person breathe stratospheric air? How often is it likely to happen in a student's lifetime?

ANSWER: Students need to understand that the stratosphere is located above 11,000 m. Mount Everest has an altitude of 8,848 m, which means it is extremely unlikely that any person will ever breathe in stratospheric air.

87. Why is there very little water vapor above the tropopause?

ANSWER: Students should state that rising air currents transform the invisible water vapor into many billions of tiny liquid droplets that appear as puffy cumulus clouds. If the rising air in the cloud should extend to greater heights, where air temperatures are quite low, some of the liquid droplets would freeze into minute ice crystals.

88. What instruments are used in meteorology? What role did the discovery of instruments play in the emergence of the science of meteorology?

ANSWER: Students should discuss the role of instruments such as hygrometers, barometers, thermometers, radiosondes, radar, numerical models, and satellites in the advancement of meteorology.

89. Describe the various types of storms found in Earth's atmosphere.

ANSWER: Students need to list at least the four main storm types: tornadoes, thunderstorms, hurricanes, and middle-latitude cyclonic storm systems (or extratropical cyclones).

90. If the air temperature at the surface (0 feet) is 60 degrees Fahrenheit, what would be the approximate air temperature at an altitude of 10,000 feet, assuming an average atmospheric lapse rate of 3.6 degrees Fahrenheit per 1,000 feet?

ANSWER: The approximate air temperature would be 24 degrees Fahrenheit.

Essay

91. What causes air pressure? Why does air pressure decrease with increasing altitude?

ANSWER: The amount of force exerted over an area of surface is called atmospheric pressure or, simply, air pressure. The pressure at any level in the atmosphere may be measured in terms of the total mass of air above any point. As we climb in elevation, fewer air molecules are above us; hence, atmospheric pressure always decreases with increasing height. Like air density, air pressure decreases rapidly at first, then more slowly at higher levels.

92. Describe some of the processes that release and remove carbon dioxide from the atmosphere. Is there any evidence that suggests that these processes are not in balance?

ANSWER: Carbon dioxide enters the atmosphere mainly from the decay of vegetation, but it also comes from volcanic eruptions, the exhalations of animal life, the burning of fossil fuels (such as coal, oil, and natural gas), and deforestation. The removal of CO₂ from the atmosphere takes place during photosynthesis as plants consume CO₂ to produce oxygen and sugars. The CO₂ is then stored in roots, branches, and leaves. Rain and snow can react with silicate minerals in rocks and remove CO₂ from the atmosphere through a process known as chemical weathering. The oceans serve as a large reservoir for CO₂, as phytoplankton (tiny drifting plants) in surface water fix CO₂ into organic tissues. Carbon dioxide that dissolves directly into surface water mixes downward and circulates through greater depths. Estimates are that the oceans hold more than 50 times the total atmospheric CO₂ content. Evidence that the release and removal of carbon dioxide is not in balance includes the fact that the atmospheric concentration of CO₂ has risen by almost 30 percent since 1958, when regular measurements began at Mauna Loa Observatory in Hawaii. The increase in atmospheric CO₂ indicates that CO₂ is entering the atmosphere at a greater rate than it is being removed. The increase appears mainly to be due to the burning of fossil fuels; however, deforestation also plays a role as cut timber, burned or left to rot, releases CO₂ directly into the air, perhaps accounting for circa 10 to 15 percent of the observed increase in recent years. Measurements of CO₂ also come from ice cores. In Greenland and Antarctica, for example, tiny bubbles of air trapped within ice sheets reveal that before the industrial revolution CO₂ levels were stable at approximately 280 parts per million (ppm). Since the early 1800s, however, CO₂ levels have increased more than 40 percent. With CO₂ levels are presently increasing by more than 0.5 percent annually (2.0 ppm/year), scientists now estimate that the concentration of CO₂ will likely rise from its current value of 400 ppm to a value exceeding 550 ppm by the end of this century, assuming that fossil fuel emissions continue at or above current

levels.

93. Although data indicates some improvement, there is still concern regarding the concentration of ozone in the stratosphere. Why would a decrease in ozone concentration be important?

ANSWER: Stratospheric ozone is important because it shields plants, animals, and humans from the Sun's harmful ultraviolet rays. Stratospheric ozone provides a natural protective shield in the upper atmosphere so that plants on the surface may survive.

94. Draw a diagram showing how air temperature normally changes with height. Begin at the ground and end in the upper thermosphere. Be sure to label the four main layers. Give one important characteristic of each layer. Where on your diagram would the top of Mt. Everest, the ozone layer, and the ionosphere be found?

ANSWER: Diagrams should include the terms troposphere, stratosphere, mesosphere, and thermosphere. In the troposphere, temperature decreases with altitude, whereas in the stratosphere it increases with altitude, decreases again in the mesosphere, then rises again in the thermosphere. The troposphere contains all the weather we see on Earth. In the stratosphere we see a temperature inversion. In the mesosphere the percentage of nitrogen and oxygen is approximately the same as at sea level. However, given air's low density in this region, humans could not survive breathing this air. The thermosphere is the so-called "hot layer." Here, oxygen molecules (O_2) absorb energetic solar rays, warming the air. Since Mt. Everest has an altitude of 8,848 m, the top of the mountain would be located in the troposphere; the ozone layer is located in the stratosphere; and the ionosphere is located in both the mesosphere and thermosphere.

95. What are the principal gaseous components of Earth's atmosphere? Where do scientists believe these gases originated?

ANSWER: Nitrogen and oxygen are the main (total 99 percent) gas phases found in Earth's atmosphere. Nitrogen is removed from the atmosphere primarily by biological processes that involve soil bacteria. In addition, nitrogen is removed from the air by tiny ocean-dwelling plankton that convert it into nutrients that help fortify the ocean's food chain. Nitrogen is returned to the atmosphere largely through the decay of plant and animal matter. Oxygen, on the other hand, is removed from the atmosphere when organic matter decays and when oxygen combines with other substances, producing oxides. Oxygen is also taken from the atmosphere during breathing, as the lungs take in oxygen and release carbon dioxide (CO_2). The addition of oxygen to the atmosphere occurs during photosynthesis, as plants, in the presence of sunlight, combine carbon dioxide and water to produce sugar and oxygen. Other gas phases in the atmosphere include greenhouse gases (i.e., water vapor, carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons) and argon. Scientists believe nitrogen in our current atmosphere arose from the degassing of volcanoes. Since nitrogen gas (N_2) is not reactive, it built up in the Earth's atmosphere over time. Oxygen gas (O_2) in our current atmosphere rose to its current concentration of circa 21 percent due to the photodissociation of water vapor in the Earth's atmosphere and the rise of plants, which used the CO_2 in Earth's early atmosphere to create O_2 through photosynthesis.

96. Describe the relationship between gravity and weight.

ANSWER: Weight is defined as the mass of an object times the acceleration of gravity; thus, the relationship is $\text{weight} = \text{mass} \times \text{gravity}$. Gravity has an effect on the weight of objects, including air. In fact, weight is the force acting on an object due to gravity.

97. A decreasing number of fish have been recorded in a nearby lake. Design a research project, using the scientific method, to explain this observation. List and explain every step of your research.

ANSWER: The steps within the scientific method involve creating a hypothesis, predicting an outcome, describing that outcome's implications, and proposing ways to test the hypothesis. A good hypothesis would be that fish number is decreasing because fish are dying due to an increase in temperature and a lack of oxygen in the water. If this hypothesis is true, fish stocks should continue to decrease until all fish are gone. Implications could include explanations that the overall fish population in the area will decrease, with some species potentially becoming extinct. To test the hypothesis, it would be necessary to measure the water temperature of the lake and to compare it to that of nearby lakes. Researching past records of water temperature obtained by other researchers or government agencies (e.g., fish or wildlife services) would also be advantageous. In addition, researchers must collect water samples and test them for oxygen content and potential pollutants. To ensure representative data, each scientific test should contain replicates.

98. Briefly explain the difference between the concepts "weather" and "climate."

ANSWER: "Weather" refers to the condition of the atmosphere at any particular time and place. Weather, which is always changing, includes: air temperature, air pressure, humidity, clouds, precipitation, visibility, and wind. "Climate," by contrast, refers to measuring and observing the same weather elements over an interval of time, usually for several years or longer, in order to obtain a "weather average." Climate includes the extremes of weather and considers the frequency of these extremes.

99. How has the composition of Earth's atmosphere changed over time? Briefly outline the evolution of Earth's atmosphere.

ANSWER: Earth's first atmosphere (some 4.6 billion years ago) was most likely hydrogen and helium—the two most abundant gases found in the universe—as well as hydrogen compounds such as methane and ammonia. A second, denser atmosphere gradually enveloped the Earth as gases from molten rock within its hot interior escaped through volcanoes and steam vents. We assume that volcanoes spewed out the same gases then as they do today: mostly water vapor (circa 80 percent), carbon dioxide (circa 10 percent), and up to a few percent nitrogen. As millions of years passed, the constant outpouring of gases from the hot interior (outgassing) provided a rich supply of water vapor, which formed clouds. Rain fell upon the earth for many thousands of years. Large amounts of CO₂ were dissolved in the oceans. The atmosphere gradually became rich in nitrogen (N₂). Oxygen (O₂), the second most abundant gas in today's atmosphere, probably began an extremely slow increase in concentration as energetic rays from the sun split water vapor (H₂O) into hydrogen and oxygen during a process called photodissociation. Hydrogen, being lighter, likely rose and escaped into space whereas oxygen remained in the atmosphere. After plants evolved, the atmospheric oxygen content increased more

rapidly, likely reaching its present concentration several hundred million years ago.

100. Describe the effect weather can have on human health.

ANSWER: The following health issues could be of concern: frostbite, hypothermia, discomfort/fainting due to high humidity, heat exhaustion, heat stroke, circulatory issues amongst infants and the elderly, arthritic pain, headaches, depression, and irritability.