Name: _____ Class: _____ Date: _____

Chapter 02 - Science, Matter, Energy, and Systems

1. Bormann and Likens compared the output of two river valleys, one forested and the other clear cut. What were their findings?
   a. The deforested valley had higher water flow and a decrease in nutrient loss.
   b. The forested valley had higher water flow and a decrease in nutrient loss.
   c. The forested valley had lower water flow and increase in nutrient loss.
   d. The deforested valley had lower water flow and increase in nutrient loss.
   e. The deforested valley had higher water flow and increase in nutrient loss.

ANSWER: e

2. What is the definition of a scientific hypothesis?
   a. a simulation of a system being studied
   b. a testable explanation of data
   c. the data needed to answer a question
   d. procedures carried out under controlled conditions to gather information
   e. a widely accepted theory

ANSWER: b

3. A well-tested and widely accepted scientific hypothesis or group of related hypotheses is called a ____.
   a. hypothesis
   b. scientific law
   c. scientific variable
   d. scientific theory
   e. conclusion

ANSWER: d

4. What is a well-tested and widely accepted description of what scientists find always happening in the same way in nature?
   a. theory
   b. scientific law
   c. hypothesis
   d. conclusion
   e. model

ANSWER: b

5. One way to study nature is to develop a(n) ____, which is an approximate physical or mathematical simulation of a system.
   a. theory
   b. laboratory
   c. experimental group
   d. model
   e. law

ANSWER: d

6. Which chemical formula represents an example of an organic compound?

a. H_2O
b. NaCl
c. H_2SO_4
d. N_2O
e. CH_4

ANSWER: e

7. Complex carbohydrates are a type of ____.

a. lipid
b. chemical formula
c. monomer
d. protein
e. organic polymer

ANSWER: e

8. Proteins are large polymer molecules formed by linking together long chains of monomers called ____.

a. chromosomes
b. nucleotides
c. amino acid
d. phosphate groups
e. hydrocarbons

ANSWER: c

9. What is the fundamental structural and functional unit of life?

a. atom
b. macromolecule
c. DNA
d. cell
e. organism

ANSWER: d

10. Thousands of genes make up a single ____.

a. chromosome
b. DNA
c. cell nucleus
d. trait
e. organism

ANSWER: a

11. Which statement is an example of a chemical change?

a. Confetti is cut from pieces of paper.

b. Water evaporates from a lake.
c. Ice cubes are formed in the freezer.
d. A plant converts carbon dioxide into carbohydrates.
e. A tree is cut down in the forest.

ANSWER: d

12. A(n) ____ solution has more hydrogen ions (H^+) than hydroxide ions (OH^-).
a. neutral
b. acidic
c. isotope
d. basic
e. logarithmic

ANSWER: b

13. What law states that when matter undergoes a physical or chemical change, no atoms are created or destroyed?
a. the second law of thermodynamics
b. the law of conservation of matter
c. the first law of thermodynamics
d. the atomic exchange law
e. the law of conservation of energy

ANSWER: b

14. Electromagnetic energy travels in ____.
a. waves
b. packets
c. nodes
d. modules
e. chunks

ANSWER: a

15. Which type of energy is stored in the strong forces that hold the particles (protons and neutrons) in the nuclei of atoms together?
a. chemical
b. kinetic
c. potential
d. nuclear
e. thermal

ANSWER: d

16. Matter is anything that ____.
a. has mass and takes up space
b. has the capacity to do work

c. can be changed in form
d. can produce change
e. moves mass

ANSWER: a

17. What is the basic building block of matter?
a. molecules
b. compounds
c. ions
d. atoms
e. minerals

ANSWER: d

18. Fundamental types of matter that have unique sets of properties and cannot be broken down into simpler substances by chemical means are called ____.
a. mixtures
b. compounds
c. isotopes
d. elements
e. atoms

ANSWER: d

19. Which substance is a compound?
a. water
b. oxygen
c. nitrogen
d. hydrogen
e. carbon

ANSWER: a

20. Protons, neutrons, and electrons are all ____.
a. forms of energy
b. equal in mass
c. subatomic particles
d. negative ions
e. charged particles

ANSWER: c

21. The atomic number is equal to the number of ____.
a. atoms in a molecule
b. protons in an atom
c. neutrons in a molecule
d. electrons in an atom

e. protons, electrons, and neutrons in an atom

ANSWER: b

22. The mass number of an atom is equal to the sum of the ____.

a. neutrons and isotopes
b. neutrons and electrons
c. neutrons and protons
d. protons and electrons
e. ions and isotopes

ANSWER: c

23. Isotopes are the forms of an element that differ from one another by having different ____.

a. atomic numbers
b. numbers of electrons
c. numbers of protons
d. mass numbers
e. electrical charges

ANSWER: d

24. An ion has a net positive or negative ____.

a. proton
b. isotope
c. charge
d. acid
e. electron

ANSWER: c

25. What describes the measurement of the concentration of hydrogen ions compared to the concentration of hydroxide ions in a solution?

a. ionization
b. pH
c. alkalinity
d. covalent bonding
e. isotope

ANSWER: b

26. Fossil fuels are best characterized as a type of ____.

a. atomic particle
b. renewable energy
c. nonrenewable energy
d. electromagnetic energy
e. thermal energy

ANSWER: c

27. High-quality energy can best be characterized as ____.
    a. fossilized
    b. pure
    c. electromagnetic
    d. kinetic
    e. concentrated

ANSWER: e

28. Which law states that no energy can be created or destroyed?
    a. the first law of thermodynamics
    b. the second law of thermodynamics
    c. the law of conservation of matter
    d. the environmental exchange law
    e. the law of homeostasis

ANSWER: a

29. Energy efficiency refers to ____.
    a. how much energy we use
    b. how much energy is wasted
    c. how much heat is produced
    d. getting more work out of the energy we use
    e. getting more energy out of our work

ANSWER: d

30. What is an example of low-quality energy?
    a. electricity
    b. heat in the ocean
    c. nuclear fission
    d. gasoline
    e. food

ANSWER: b

31. What percentage of the energy used to produce food for living organisms, and to heat the earth, comes from the sun?
    a. 10
    b. 29
    c. 49
    d. 79
    e. 99

ANSWER: e

32. What does the first law of thermodynamics tell us?
    a. Doing work always creates heat.

b. Altering matter is the best source of energy.
c. Energy cannot be recycled.
d. Energy is neither created nor destroyed.
e. Energy cannot be converted.

ANSWER: d

33. The matter and energy laws tell us that we can recycle ____.
a. both matter and energy
b. neither matter nor energy
c. matter but not energy
d. energy but not matter
e. nothing and everything

ANSWER: c

34. The energy "lost" by a system is ____.
a. converted into an equal amount of matter
b. equal to the energy the system creates
c. converted to lower quality energy
d. returned to the system eventually
e. converted to higher quality energy

ANSWER: c

35. The two major types of energy are ____.
a. chemical or physical
b. kinetic or mechanical
c. potential or mechanical
d. potential or kinetic
e. chemical or kinetic

ANSWER: d

36. Which example represents something with kinetic energy?
a. water in a reservoir behind a dam
b. a rock held in your hand
c. chemical energy stored in food
d. water in a stream
e. light from the sun

ANSWER: d

37. Heat is best characterized as a kind of ____ energy.
a. light
b. potential
c. kinetic

d. nuclear
e. low

ANSWER: c

38. Scientists estimate that about ____ of the energy used in the United States is unavoidably wasted.
a. 5%
b. 18%
c. 55%
d. 84%
e. 96%

ANSWER: d

39. Energy can be formally defined as ____.
a. the random motion of molecules
b. the ability to do work
c. a force that is exerted over some distance
d. the movement of molecules
e. the loss of matter

ANSWER: b

40. Which example best illustrates potential energy?
a. the wind blowing
b. water in a stream
c. steam
d. a car at the top of a hill
e. electricity

ANSWER: d

41. The process of ____ involves scientists publishing details of the methods they used, the results of their experiments, and the reasoning behind their hypotheses for other scientists working in the same field to evaluate.
a. tentative science
b. unreliable science
c. reliable science
d. peer review
e. scientific law

ANSWER: d

42. A(n) ____ is a combination of two or more atoms of the same or different elements held together by chemical bonds.
a. nucleus
b. molecule
c. isotope
d. lipid
e. cell

ANSWER: b

43. Scientific results and hypotheses that are presented as reliable without having undergone peer review, or are discarded as a result of peer review or additional research, are considered to be ____.

a. theories
b. unreliable science
c. models
d. scientific laws
e. projections

ANSWER: b

44. Some preliminary scientific results will be validated and classified as reliable, while some will be discredited and classified as unreliable. Until one of those two things happen, these results are viewed as ____.

a. theories
b. proof
c. tentative science
d. biased
e. uncontrolled experiments

ANSWER: c

45. Most systems have ____.

a. inputs of energy but not matter
b. only positive feedbacks
c. only negative feedbacks
d. inputs, flows, and outputs
e. outputs greater than the inputs

ANSWER: d

46. One property of a system is that it ____.

a. functions in some regular way
b. is highly randomized in its processes
c. cannot be accurately modeled
d. consists solely of inputs and outputs
e. exists only in models

ANSWER: a

47. A change in a system can either be increased or decreased by ____.

a. feedback
b. efficiency
c. energy quality
d. electromagnetic radiation
e. conduction

ANSWER: a

48. Which example illustrates a negative feedback loop?
    a. melting polar ice
    b. exponential population growth
    c. a thermostat maintaining a certain temperature in your house
    d. the greenhouse effect
    e. vegetation removed from a stream valley

ANSWER: c

49. Reaching and exceeding a ____ is somewhat like stretching a rubber band until it breaks.
    a. negative feedback
    b. positive feedback
    c. tipping point
    d. time delay
    e. synergistic point

ANSWER: c

50. A negative feedback loop can also be described as a ____ feedback loop.
    a. chaotic
    b. corrective
    c. tipping point
    d. harmful
    e. throughput

ANSWER: b

51. Scientists tend to be highly skeptical of new data, hypotheses, and models until they can be tested and verified.
    a. True
    b. False

ANSWER: True

52. When someone says that evolution is not important, “after all, it’s just a theory,” it is probable that they do not understand how scientists use the term “theory.”
    a. True
    b. False

ANSWER: True

53. Tentative science is performed by amateur scientists whose work will never be accepted by their peers.
    a. True
    b. False

ANSWER: False

54. Scientists can disprove things but they cannot prove anything absolutely, which means there is always some uncertainty in science.
    a. True

b. False

ANSWER: True

55. Atoms generally have a net positive electrical charge.

a. True
b. False

ANSWER: False

56. A chemical formula is a shorthand way of indicating the number of each type of atom or ion in a compound.

a. True
b. False

ANSWER: True

57. Methane, a hydrocarbon, is considered an organic molecule even though it contains only one carbon atom.

a. True
b. False

ANSWER: True

58. One limitation of science is that the scientific method is inherently unreliable.

a. True
b. False

ANSWER: False

59. A basic solution has a pH lower than 7.

a. True
b. False

ANSWER: False

60. According to the law of conservation of matter, once trash decomposes in a landfill, we have completely gotten rid of the matter that made up the trash.

a. True
b. False

ANSWER: False

61. Energy cannot be recycled.

a. True
b. False

ANSWER: True

62. Burning coal demonstrates the conversion of energy from kinetic to potential.

a. True
b. False

ANSWER: False

63. Using energy to, for example, cook a meal, causes the disappearance of that energy.

a. True
b. False

ANSWER: False

64. The transfer of heat energy within liquids or gases when warmer areas of the liquid or gas rise to cooler areas and cooler liquid or gas takes its place is called conduction.

a. True
b. False

ANSWER: False

65. A negative feedback loop causes a system to further change in the same direction.

a. True
b. False

ANSWER: False

66. Briefly describe the scientific process outlined in this chapter.

ANSWER: Identify a problem, find out what is known about the problem, ask a question to investigate, perform an experiment to collect data, analyze the data, propose a hypothesis to explain the data, use the hypothesis to make projections that can be tested, test projections with further experiments, accept or revise hypothesis.

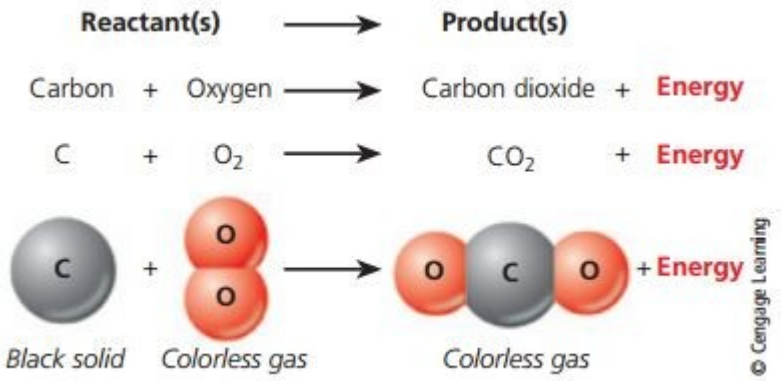
67. Explain the difference between a scientific law and a scientific theory.

ANSWER:

A scientific theory is a well-tested and widely accepted scientific hypothesis or group of related hypotheses. A scientific law is simply a well-accepted pattern in data such as the law of gravity—all objects fall to the earth's surface at predictable speeds.

68. Draw the basic chemical reaction of carbon and oxygen ($C + O_2$).

ANSWER: See page 39.



69. Explain how heat is a form of kinetic energy.

ANSWER: Heat is a form of kinetic energy because it is the total kinetic energy of all moving atoms, ions, and molecules in an object. The atoms, ions, and molecules are all vibrating, and kinetic energy is the energy of movement.

70. Give an example of a positive feedback loop and explain the process.

ANSWER: Answers may vary.

Melting sea ice is one positive feedback loop. As sea ice melts, there is less light-colored ice to reflect sunlight, so more sunlight is absorbed, which warms the water and air and causes more melting.

71. Why is some energy wasted when coal is burned to produce electricity that lights up an incandescent light bulb?

ANSWER: Much of the energy in burning coal is lost as heat rather than being converted into electrical energy. And most of the electrical energy that flows into an incandescent light bulb is lost as heat rather than being converted into visible electromagnetic radiation.

72. Differentiate between a hypothesis, a guess, and a theory. Explain why it is important for nonscientists to understand how scientists use these terms when discussing something like global warming or evolution. Why might it be incorrect when a nonscientist dismisses a topic as being "just a theory"?

ANSWER: A hypothesis is an effort to explain phenomenon based on prior experience with the same or similar phenomena. It is often defined as an educated guess. The usual way to define a "guess" is the suggestion of an answer without prior experience. A theory is a structure intended to explain a series of phenomena, and is constructed from hypotheses that have been tested and not proven wrong. As such, a theory is based on substantial amounts of data.

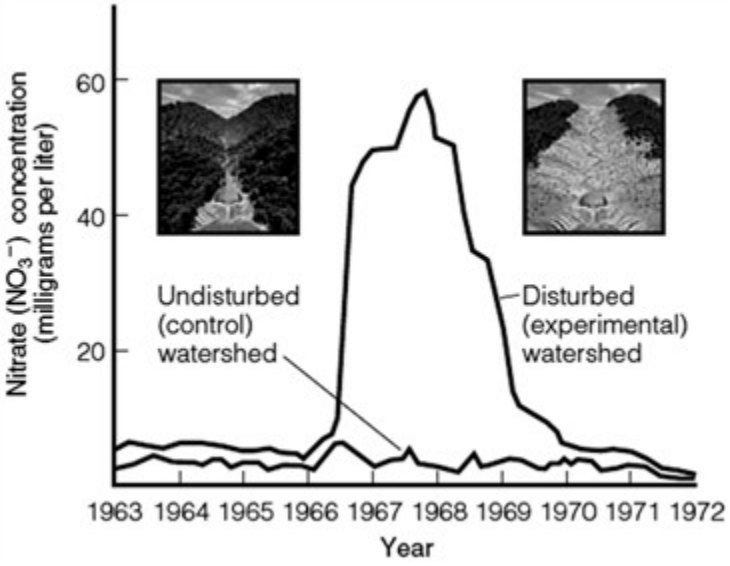


Figure 2.5 Loss of nitrate ions (NO_3^-) from a deforested watershed in the Hubbard Brook Experimental Forest (Core Case Study, Figure 2.1, p. 30).

73. With reference to the accompanying figure, explain the significant difference that occurred between 1966 and 1970 in terms of the two lines representing the control watershed and the experimental watershed.

ANSWER: The line labeled "Disturbed (experimental) watershed" represents the level of loss of nitrates following the removal of vegetation in the experimental watershed. Without vegetation the soil rapidly lost the nitrates to rainfall until they were substantially gone.

74. Much of the energy produced is lost before it can become useful. Explain how energy efficiency and the second law of

thermodynamics may be useful in a discussion with another person on how to reduce CO_2 and other greenhouse gas emissions.

ANSWER: Machines that use fossil fuels are very energy-inefficient, converting a small percentage of the energy in the fuel source to useful activities. An effort to increase the level of efficiency would substantially reduce the amount of fossil fuel that needed to be converted and would reduce the amount of emissions of CO_2 and other greenhouse gases.

75. How is the concept of an environmental threshold or tipping point important in regards to global warming?

ANSWER: A tipping point is a level at which a critical mass has been reached that causes an event to occur, an event that may be irreversible. If humans cause the climate of the earth to warm beyond a certain level, it may be impossible to correct the situation, and the climate may be irreversibly altered for the worse.

76. Scientists are human and not always free of bias about their own results and hypotheses.

a. True
b. False

ANSWER: True

77. Conduction is the transfer of heat from one solid substance to another cooler one when they are in physical contact.

a. True
b. False

ANSWER: True

78. Visible light is an example of electromagnetic radiation.

a. True
b. False

ANSWER: True

79. If you drop a rock you were holding, the rock's kinetic energy changes to potential energy.

a. True
b. False

ANSWER: False

80. In an experiment, the chosen key variable is manipulated in the control group. The variable is left unchanged in the experimental group.

a. True
b. False

ANSWER: False

Match the term with the most appropriate description.

a. protein
b. complex carbohydrate
c. lipids
d. nucleic acids
e. chromosome

Chapter 02 - Science, Matter, Energy, and Systems

81. a chemically diverse group of large organic compounds that do not dissolve in water
ANSWER: c

82. large polymer molecules formed by linking together long chains of monomers called amino acids
ANSWER: a

83. consist of two or more monomers of simple sugars linked together
ANSWER: b

84. double helix DNA molecule wrapped around one or more proteins
ANSWER: e

85. large polymer molecules made by linking large numbers of monomers called nucleotides
ANSWER: d

Match the term with the most appropriate description.

a. positive feedback loop
b. negative feedback loop
c. feedback
d. system
e. tipping point

86. any set of components that function and interact in some regular way
ANSWER: d

87. beyond this, the system can change so drastically that it suffers from severe degradation or collapse
ANSWER: e

88. causes a system to change further in the same direction
ANSWER: a

89. any process that increases or decreases a change to a system
ANSWER: c

90. causes a system to change in the opposite direction of the initial change, enhancing stability
ANSWER: b