CHAPTER 2—SCIENCE, MATTER, AND ENERGY

MULTIPLE CHOICE

1. The Bormann-Likens controlled experiment in forest valleys in New Hampshire showed that water flowing out of deforested areas, when compared to undisturbed areas,
   a. was greater in volume by 30 to 40%
   b. was less in volume by 30 to 40%
   c. had more soil nutrients dissolved in the water
   d. was less in volume by 30 to 40% *and* had fewer soil nutrients dissolved in the water
   e. was greater in volume by 30 to 40% *and* had more soil nutrients dissolved in the water

   ANS: E PTS: 1 DIF: Moderate REF: New
   TOP: CORE CASE STUDY

2. The Bormann-Likens study in the Hubbard Brooks Experimental Forest in New Hampshire can be described as
   a. a comparison of a control site with an experimental site in nature
   b. what can occur in a forest watershed without plants to absorb and retain water
   c. an example of how scientists learn about the effects of our actions on natural systems
   d. all of these answers
   e. only two of these answers

   ANS: D PTS: 1 DIF: Moderate REF: New
   TOP: CORE CASE STUDY

3. Science
   a. is a study of the history of the natural world
   b. attempts to discover order in nature to interpret the past
   c. is best described as a random collection of facts
   d. is supported by small amounts of evidence
   e. is an endeavor to discover how nature works

   ANS: E PTS: 1 DIF: Moderate
   TOP: 2-1 WHAT DO SCIENTISTS DO?

4. When scientists are testing ideas to determine facts, they
   a. follow a specific set of logical steps
   b. report observations to the scientific community without data collection
   c. use different steps that are unique to each scientist
   d. use only mathematical modeling
   e. all of these answers, *except* use only mathematical modeling

   ANS: A PTS: 1 DIF: Moderate
   TOP: 2-1 WHAT DO SCIENTISTS DO?

5. Scientific hypotheses differ from scientific theories in that they are
   a. widely accepted descriptions of what we find happening over and over in nature
   b. tentative explanations that need further evaluation
   c. not subject to proper investigation and testing
   d. all of these answers
   e. tentative explanations that need further evaluation *and* not subject to proper investigation and testing

ANS: B PTS: 1 DIF: Moderate REF: New
TOP: 2-1 WHAT DO SCIENTISTS DO?

6. Which of the following statements does *not* describe scientific investigations?
   a. They can disprove things completely.
   b. They cannot prove things completely.
   c. Bias can be present but can be minimized.
   d. They are limited to understanding the natural world.
   e. They can utilize mathematical models.

   ANS: A PTS: 1 DIF: Moderate
   TOP: 2-1 WHAT DO SCIENTISTS DO?

7. Which of the following choices best describes the sequence scientists typically use in the beginning stages of their investigations about how nature works?
   a. analyze data -> search literature -> perform experiment -> identify a problem -> ask a question
   b. ask a question -> search literature -> perform experiment -> analyze data -> identify a problem
   c. search literature -> ask a question -> identify a problem -> analyze data -> perform experiment
   d. identify a problem ->search literature -> ask a question -> perform experiment -> analyze data
   e. ask a question->search literature -> identify a problem -> perform experiment -> analyze data

   ANS: D PTS: 1 DIF: Difficult REF: New
   TOP: 2-1 WHAT DO SCIENTISTS DO?

8. Which of the following does *not* characterize frontier science?
   a. It often captures news headlines because it is controversial.
   b. It may deal with preliminary data.
   c. It may eventually be validated.
   d. Scientists always agree on the meaning and accuracy of the data involved.
   e. It may eventually be discredited.

   ANS: D PTS: 1 DIF: Moderate
   TOP: 2-1 WHAT DO SCIENTISTS DO?

   A tiny, tawny colored butterfly called the Carson Wandering Skipper was always known for its small and very localized populations. Typically, it was found along the western Nevada and eastern California high desert areas. It was always located close to hot springs and other wet areas that supported salt grass, the host plant it depended on.

   Recently, the populations went into a steep decline, and a last hold-out area was threatened by imminent construction of a freeway bypass. Biologists became alarmed and began an intensive search for populations in locations other than the spot designated for the freeway bypass. They began their search by identifying all known locations of hot springs, in hopes of finding small populations of the Carson Wandering Skipper close by.

9. The biologists' observations that the Carson Wandering Skipper populations had declined is an example of
   a. data analysis
   b. identifying a problem
   c. performing an experiment

d. proposing a hypothesis
e. making testable predictions

ANS: B PTS: 1 DIF: Difficult REF: New
TOP: 2-1 WHAT DO SCIENTISTS DO?

10. As they searched for previously unknown populations of the Carson Wandering Skipper, biologists wondered if hot springs were absolutely essential to its survival. This phase of the investigation is
a. finding out what is known and asking a question
b. analyzing data and asking a question
c. Asking a question and testing predictions
d. accepting their hypothesis and analyzing data
e. accepting their hypothesis and asking a question

ANS: A PTS: 1 DIF: Difficult REF: New
TOP: 2-1 WHAT DO SCIENTISTS DO?

11. The scientists, with enough data,
a. would be able to prove that there is a correlation between butterfly populations and hot springs
b. would not be able to prove a correlation between the butterfly populations and hot springs, but could disprove it
c. Would be able to prove or disprove a correlation, depending on the numbers
d. would not be able to prove or disprove a correlation between the butterfly populations and hot springs
e. would be able to prove that there is a correlation between the butterfly populations and hot springs, but would not be able to disprove it

ANS: D PTS: 1 DIF: Moderate REF: New
TOP: 2-1 WHAT DO SCIENTISTS DO?

12. Matter
a. is anything that has mass and occupies space
b. has the capacity to do work
c. can exist as a solid, liquid, or gas
d. can produce change
e. is anything that has mass and occupies space *and* can exist as a solid, liquid, or gas

ANS: E PTS: 1 DIF: Moderate
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

13. All of the following are elements *except*
a. Water
b. oxygen
c. nitrogen
d. hydrogen
e. Carbon

ANS: A PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

14. The building blocks of matter are
a. Atoms

b. Ions
c. molecules
d. all of these answers
e. Matter is only made up of atoms.

ANS: D PTS: 1 DIF: Moderate REF: New
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

15. The atomic number is the number of
a. atoms in a molecule
b. protons in an atom
c. Nuclei in a molecule
d. electrons in an atom
e. protons and neutrons in an atom

ANS: B PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

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

ANS: C PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

17. The atomic mass number is equal to the sum of the
a. neutrons and isotopes
b. neutrons and electrons
c. neutrons and protons
d. protons, neutrons, and electrons
e. protons only

ANS: C PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

18. An element
a. is identical to a compound
b. is made up of compounds
c. can combine with one or more other element to make a compound
d. exists only in a pure form as a single element, and never combines with other elements
e. more than one of these answers

ANS: C PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

19. Isotopes differ from each other by their number of
a. Ions

b. protons
c. Atoms
d. neutrons
e. electrons

ANS: D PTS: 1 DIF: Moderate
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

20. Ions are atoms or groups of atoms that have
a. Gained or lost an electron
b. Gained or lost a proton
c. Gained or lost a neutron
d. Gained or lost either an electron or a proton
e. none of these answers

ANS: A PTS: 1 DIF: Moderate
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

21. Which list of items contains only ions?
a. CO_2, H_2O, Na^+, H^-
b. Na^+, H^-, Pb, Hg
c. Pb, Hg, CO_2,NaCl
d. Cl^-, Na^+, Ca^{2+}, NO_3^-
e. NaCl, NO, CO, NaOH

ANS: D PTS: 1 DIF: Moderate REF: New
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

22. An acidic solution would have
a. more hydroxide ions than hydrogen ions
b. more hydrogen ions than hydroxide ions
c. a pH less than 7
d. a pH greater than 7
e. more hydrogen ions than hydroxide ions and a pH less than 7

ANS: E PTS: 1 DIF: Moderate
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

23. All organic compounds are characterized by the presence of
a. Carbon
b. hydrogen
c. oxygen
d. nitrogen
e. phosphorus

ANS: A PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

24. Which of the following sources of iron would be of the highest quality?
a. iron deposits on the ocean floor

b. a field of spinach
c. a large scrap metal junkyard
d. a half-mile deep deposit of iron ore
e. none of these answers

ANS: C PTS: 1 DIF: Difficult
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

25. When matter undergoes a physical change
a. The arrangement of atoms does not change.
b. The physical or spatial pattern changes.
c. The arrangement of ions changes.
d. The physical or spatial pattern changes but the arrangement of atoms does not change.
e. All of these answers

ANS: D PTS: 1 DIF: Moderate
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

26. The smallest functional and structural unit of life is the
a. Ion
b. Atom
c. compound
d. molecule
e. Cell

ANS: E PTS: 1 DIF: Easy REF: New
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

27. The three major types of organic polymers are
a. lipids, proteins, and nucleic acids
b. proteins, nucleotides, and simple carbohydrates
c. nucleic acids, amino acids, and fatty acids
d. complex carbohydrates, nucleic acids, and proteins
e. nucleic acids, fatty acids, and simple carbohydrates

ANS: D PTS: 1 DIF: Moderate REF: New
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

28. Genetic information is contained in coded units on chromosomes called
a. DNA molecules
b. Genes
c. macromolecules
d. nucleotides
e. proteins

ANS: B PTS: 1 DIF: Moderate REF: New
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

29. The law of conservation of matter states that
a. Atoms can be created.

b. Atoms can be destroyed.
c. Atoms cannot be created or destroyed.
d. Atoms can be destroyed if we compost them.
e. Atoms can be created through nuclear fission.

ANS: C PTS: 1 DIF: Easy
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

30. If a carbon atom combines with oxygen atoms to form CO_2, this would be described as a
a. Physical change.
b. Chemical change.
c. It is both a physical and chemical change.
d. First, it is a physical change, but then it becomes a chemical change.
e. None of these answers

ANS: B PTS: 1 DIF: Easy REF: New
TOP: 2-2 WHAT IS MATTER AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

31. Energy can be formally defined as
a. the velocity of any moving object
b. the heat generated by atoms losing electrons
c. the ability to do work or produce heat transfer
d. the displacement of heat from the Sun to the Earth
e. none of these answers

ANS: C PTS: 1 DIF: Moderate
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

32. Most forms of energy can be classified as either
a. chemical or physical
b. Kinetic or mechanical
c. potential or mechanical
d. chemical or kinetic
e. potential or kinetic

ANS: E PTS: 1 DIF: Moderate
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

33. All of the following are examples of kinetic energy *except*
a. a speeding bullet
b. a car battery
c. a flow of electric current
d. a falling rock
e. flowing water

ANS: B PTS: 1 DIF: Moderate
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

34. An example of potential energy is
a. electricity flowing through a wire

b. the chemical energy in a candy bar
c. a bullet fired at high velocity
d. a leaf falling from a tree
e. water flowing

ANS: B PTS: 1 DIF: Moderate
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

35. Which of the following is the best description of the first law of thermodynamics?
a. Atoms cannot be created or destroyed.
b. Energy input always equals energy output.
c. Heat is a form of kinetic energy.
d. Solar energy is converted into chemical energy in living systems.
e. All of these answers apply to the first law of thermodynamics.

ANS: B PTS: 1 DIF: Difficult
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

36. Which of the following is an example of a lower quality energy form?
a. the electricity that runs your household appliances
b. the heat dispersed in the ocean
c. the battery that operates your laptop computer
d. the propane that powers the furnace in your residence
e. the heat dispersed in the ocean *and* the battery that operates your laptop computer

ANS: E PTS: 1 DIF: Difficult
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

37. When energy changes from one form to another
a. It goes from a less useful to a more useful form.
b. It goes from a more useful to a less useful form.
c. It maintains the same degree of usefulness.
d. It could become more or less useful, depending on the original type of energy.
e. The usefulness of energy is not altered when it changes from one form to another.

ANS: B PTS: 1 DIF: Moderate
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

38. The amount of useful work accomplished by a particular input of energy into a system is
a. Energy quality
b. Energy potential
c. Energy capacity
d. Energy efficiency
e. Energy loss

ANS: D PTS: 1 DIF: Moderate REF: Revised
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

39. Which of the following energy forms is high quality?
a. Coal

b. the heat dispersed in the ocean
c. electricity
d. Food
e. all of these answers *except* the heat dispersed in the ocean

ANS: E PTS: 1 DIF: Difficult
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

40. What percentage of useful energy in the United States is unnecessarily wasted?
a. 16%
b. 43%
c. 35%
d. 10%
e. Energy in the United States is not wasted.

ANS: B PTS: 1 DIF: Easy
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

41. Scientists Bormann and Likens demonstrated in their experiment on a clear-cut forest that
a. A cleared forest is more sustainable than an uncleared forest.
b. An uncleared forest is more sustainable than a cleared forest.
c. Cleared and uncleared forests have the same sustainability.
d. Clearing a forest violates the second law of thermodynamics.
e. At least two of these answers are correct.

ANS: B PTS: 1 DIF: Moderate
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

42. A form of kinetic energy that travels in the form of waves as a result of changes in electrical and magnetic fields is
a. wind
b. electromagnetic radiation
c. waterfalls
d. electricity
e. solar radiation

ANS: B PTS: 1 DIF: Moderate REF: New
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

43. Which of the following is the best short summary of the law of conservation of matter?
a. There is no away.
b. You cannot get something for nothing.
c. You cannot break even.
d. You can break even, but not get something for nothing.
e. You can get something for nothing, but cannot break even.

ANS: A PTS: 1 DIF: Easy REF: New
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

44. Some forms of electromagnetic radiation with short wavelengths are:

a. Visible light and IR radiation
b. Visible light and x-rays
c. x-rays and IR
d. gamma rays and UV radiation
e. Visible light and gamma rays

ANS: D PTS: 1 DIF: Moderate REF: New
TOP: 2-3 WHAT IS ENERGY AND HOW DO PHYSICAL AND CHEMICAL CHANGES AFFECT IT?

TRUE/FALSE

1. Since scientific theories are tentative explanations, they should not be taken seriously.

   ANS: F PTS: 1 DIF: Moderate REF: New

2. Scientists analyze data before they take any other steps to investigate natural processes, since that is the only logical place to start.

   ANS: F PTS: 1 DIF: Moderate REF: New

3. The two chemical forms of matter are elements and compounds.

   ANS: T PTS: 1 DIF: Easy

4. Frontier science always ends up being unreliable science.

   ANS: F PTS: 1 DIF: Easy REF: New

5. The steps in the scientific investigative process are always followed in the same sequence by every scientist, without fail.

   ANS: F PTS: 1 DIF: Easy

6. When matter undergoes physical changes, the chemical composition also changes.

   ANS: F PTS: 1 DIF: Easy

7. Hydrocarbons are organic compounds.

   ANS: T PTS: 1 DIF: Easy

8. Matter can be destroyed, but it can never be created.

   ANS: F PTS: 1 DIF: Easy

9. When electrical energy lights an incandescent light bulb, 50 percent of the energy produces light.

   ANS: F PTS: 1 DIF: Easy

10. When energy changes from one form to another, it always goes from a more useful to a less useful form.

ANS: T PTS: 1 DIF: Easy

11. The idea that all elements are made up of molecules is called the atomic theory.

ANS: F PTS: 1 DIF: Easy REF: New

12. A chemical element cannot be broken down into simpler substances by chemical means.

ANS: T PTS: 1 DIF: Easy REF: New

13. Atoms as a whole have no net electrical charge.

ANS: T PTS: 1 DIF: Easy REF: New

14. The atomic number of an atom designates the number of protons and neutrons found in its nucleus.

ANS: F PTS: 1 DIF: Easy REF: New

15. Carbon-12, carbon-13, and carbon-14 all have different numbers of protons. Thus, they can be described as isotopes.

ANS: F PTS: 1 DIF: Moderate REF: New

COMPLETION

1. The first step in the process of scientific study is to _____.

ANS: identify a problem

PTS: 1 DIF: Moderate

2. If an overwhelming body of observations and measurements supports a scientific hypothesis, it becomes known as a(n) _____.

ANS: scientific theory

PTS: 1 DIF: Moderate

3. A tentative explanation that needs further investigation is called a(n) _____.

ANS: hypothesis

PTS: 1 DIF: Easy REF: New

4. Matter that is near the Earth's surface, that is highly concentrated, and that has great potential for use as a resource is referred to as _____.

ANS: high quality

PTS: 1 DIF: Easy REF: New

5. _____ consists of elements and compounds.

ANS: Matter

PTS: 1 DIF: Easy

6. A chemical that is a combination of two or more different elements is called a(n) _____.

ANS: compound

PTS: 1 DIF: Easy

7. An atom or group of atoms with one or more net positive or negative charges is called a(n) _____.

ANS: ion

PTS: 1 DIF: Easy REF: New

8. The pH of a solution is a measure of the _____ ions and _____ ions.

ANS:
hydrogen, hydroxide
hydroxide, hydrogen

PTS: 1 DIF: Moderate REF: New

9. Na is the chemical symbol for _____.

ANS: sodium

PTS: 1 DIF: Easy REF: New

10. The nucleus of an atom contains the _____ and _____.

ANS:
protons, neutrons
neutrons, protons

PTS: 1 DIF: Easy

11. An ion that is an essential nutrient for plant growth, and which was studied by Bormann and Likens, is the _____ ion.

ANS: nitrate

PTS: 1 DIF: Moderate

12. A simple carbohydrate that plants and animals use to obtain energy is _____.

ANS: glucose

PTS: 1 DIF: Easy

13. Organic compounds always contain _____ atoms.

ANS: carbon

PTS: 1 DIF: Easy REF: New

14. Genes are segments of _____.

ANS: DNA

PTS: 1 DIF: Moderate REF: New

15. Macromolecules formed from a number of monomers are called _____.

ANS: polymers

PTS: 1 DIF: Moderate REF: New

MATCHING

Match items with their appropriate chemical description.

a. S
b. H+
c. Electron
d. Proton
e. neutron
f. CO_2
g. Na
h. Nucleus
i. mass number
j. NO^{3}-
k. Isotopes

1. The chemical symbol for sodium
2. A subatomic particle with no net electrical charge
3. The nitrate ion
4. The small, dense center of an atom
5. The total number of protons and neutrons in an atom's nucleus
6. Subatomic particle with a positive charge
7. The chemical symbol for sulfur
8. A compound
9. Atoms with variable numbers of neutrons
10. Subatomic particle with a negative charge
11. Chemical symbol for the hydrogen ion

1. ANS: G PTS: 1 DIF: Moderate REF: New
2. ANS: E PTS: 1 DIF: Moderate REF: New
3. ANS: J PTS: 1 DIF: Moderate REF: New
4. ANS: H PTS: 1 DIF: Moderate REF: New
5. ANS: I PTS: 1 DIF: Moderate REF: New
6. ANS: D PTS: 1 DIF: Moderate REF: New
7. ANS: A PTS: 1 DIF: Moderate REF: New
8. ANS: F PTS: 1 DIF: Moderate REF: New
9. ANS: K PTS: 1 DIF: Moderate REF: New
10. ANS: C PTS: 1 DIF: Moderate REF: New
11. ANS: B PTS: 1 DIF: Moderate REF: New

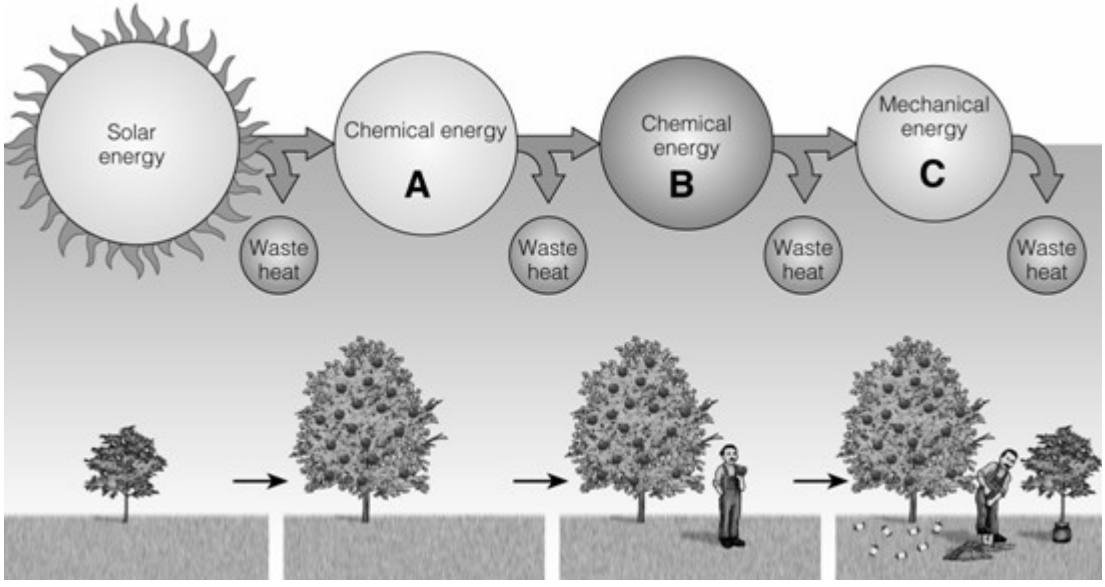
Match the items below with the correct energy or matter quality below.

a. High-quality matter
b. Low-quality matter
c. High-quality energy
d. Low-quality energy
e. Both high-quality matter and high-quality energy

12. salt
13. coal
14. gasoline
15. aluminum ore
16. salt water
17. heat in oceans
18. oil in barrels
19. automobile emissions
20. nuclear fission
21. concentrated sunlight

12. ANS: A PTS: 1 DIF: Moderate REF: New
13. ANS: E PTS: 1 DIF: Moderate REF: New
14. ANS: E PTS: 1 DIF: Moderate REF: New
15. ANS: B PTS: 1 DIF: Moderate REF: New
16. ANS: B PTS: 1 DIF: Moderate REF: New
17. ANS: D PTS: 1 DIF: Moderate REF: New
18. ANS: E PTS: 1 DIF: Moderate REF: New
19. ANS: B PTS: 1 DIF: Moderate REF: New
20. ANS: C PTS: 1 DIF: Moderate REF: New
21. ANS: C PTS: 1 DIF: Moderate REF: New

Match the items listed below with the appropriate choice



22. Which letter represents primary, secondary, and tertiary consumers?
23. Which letter represents autotrophs using photosynthesis to convert solar energy into sugar?
24. Which letter represents the least amount of energy?

22. ANS: B PTS: 1 DIF: Moderate
23. ANS: A PTS: 1 DIF: Easy
24. ANS: C PTS: 1 DIF: Easy

SHORT ANSWER

1. Name at least three things you did during the last hour that degraded high-quality energy to low-quality energy.

   ANS:
   Sample answers:
   - Drove a gasoline-powered car
   - Used a computer powered by electricity
   - Used hot water for a shower, dish washing, or laundry
   - Used a furnace or air conditioner to adjust room temperature

   PTS: 3 DIF: Difficult OBJ: Critical Thinking

2. Curiosity and skepticism are important features of the scientific process. Explain how these two attributes in a scientist come into play during a late phase of scientific investigation called *accept or reject the hypothesis.*

   ANS:
   A skeptical and curious scientist will want to know the real reason for why nature works in a certain way. He/she would not be satisfied until reaching the appropriate conclusion about the investigation being conducted.

   PTS: 3 DIF: Difficult REF: New

3. Employing the concepts of high-quality matter and low-quality matter, explain to a friend why recycling aluminum drink containers is a good idea.

   ANS:
   The aluminum needed to produce more aluminum products is more easily obtained from the concentrated metal in a recycled container than by mining aluminum ore from the soil. Aluminum ore is more widely dispersed, difficult to extract, and ends up being more costly in terms of environmental degradation.

   PTS: 3 DIF: Moderate REF: New

4. Just prior to the year when the striped bass population reached 100 percent of the established goal, what was occurring in the blue crab population? What was the implication for the striped bass population?

   ANS:
   The striped bass population reached 100 percent of the established goal in 1995. Just prior to that, the blue crab population was very high, at over 100 percent of its established goal. The implication is that the predator species population (striped bass) increased because of the high food availability.

   PTS: 5 DIF: Difficult REF: New

ESSAY

1. Explain why the Bormann-Likens scientific investigation of clear-cutting forest watersheds is considered reliable science.

   ANS:
   It has been subjected to peer review, and other scientists have repeated the study and produced similar results.

   PTS: 2 DIF: Easy

2. List an example of each of the following terms: element, compound, ion, organic molecule, simple carbohydrate.

   ANS:
   Possible answers:
   Element — carbon
   Compound — carbon dioxide
   Ion — nitrate ion
   Organic molecule — hydrocarbons
   Simple carbohydrate — glucose

   PTS: 3 DIF: Easy

3. Explain how the differences between humans and other living organisms, such as plants or animals, are controlled and encoded at the cellular level.

   ANS:
   Within the nucleus of each cell is a set of chromosomes, found in pairs. Each chromosome consists of a long DNA molecule that contains the coding in sequences called genes. The genes are distinct pieces of genetic information to make specific proteins that result in specific traits or characteristics.

   PTS: 5 DIF: Difficult REF: New

4. What are some of the ways scientists examine scientific inquiries and studies to determine if the work is reliable or unreliable?

   ANS:
   The work is subjected to the following critical thinking questions:

   Was the experiment well-designed?
   Have the results been reproduced by other scientists?
   Does the proposed hypothesis explain the data?
   Are there any more reasonable explanations for the data?
   Are the investigators unbiased in their interpretation of the results?
   Have the data and conclusions been subjected to peer review?
   Are the conclusions of the research widely accepted by other experts in the field?

   PTS: 4 DIF: Moderate REF: New

5. Briefly explain how the second law of thermodynamics affects energy changes.

   ANS:

When energy changes from one form to another, it always goes from a more useful to a less useful form. In other words, it goes from a high-quality energy form to a low-quality energy form. The lower-quality energy is usually given off as heat.

PTS: 5 DIF: Difficult REF: New