

Chapter 01: The Nature of Science and the Characteristics of Life

MULTIPLE CHOICE

1. Developing a scientific understanding of a natural phenomenon typically begins by
- making a prediction.
 - testing a hypothesis.
 - proving an answer.
 - making an observation.

ANS: D

DIF: Easy

REF: 1.1

OBJ: 1.1 | 1.2

MSC: Remembering

2. The scientific method cannot be used to evaluate untestable hypotheses. Which of the following types of questions are untestable?
- questions about topics other than the natural world
 - questions about the events that immediately followed the origin of the universe
 - questions about the behavior of plants and animals
 - questions whose possible answers are socially controversial

ANS: A

DIF: Difficult

REF: 1.1

OBJ: 1.1

MSC: Applying

3. A medical diagnosis is a(n)
- observation.
 - experiment.
 - theory.
 - hypothesis.

ANS: D

DIF: Difficult

REF: 1.1 | 1.2

OBJ: 1.2

MSC: Applying

4. When you call a telephone number, you are
- making an observation.
 - testing a hypothesis by conducting an experiment.
 - constructing a theory, which can then be tested.
 - testing a theory.

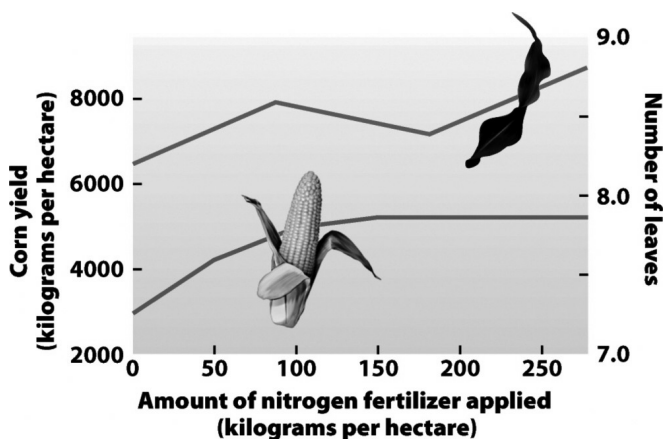
ANS: B

DIF: Difficult

REF: 1.1 | 1.2

OBJ: 1.3

MSC: Understanding



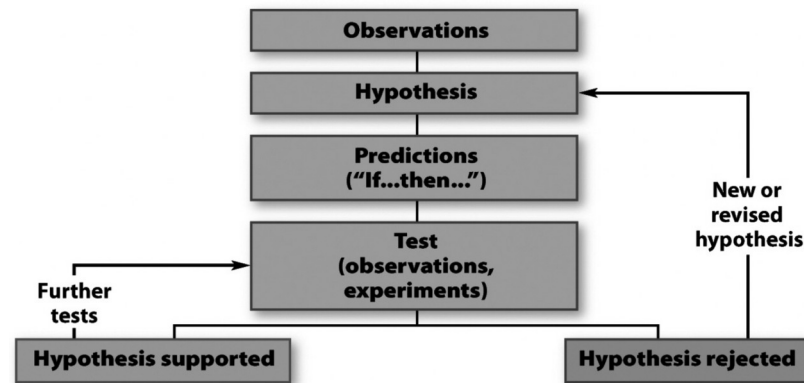
5. Which of the following statements best summarizes the information presented in this graph?
- There is a strong correlation between the amount of applied fertilizer and the average number of leaves per corn plant.

- b. Higher applications of fertilizer produce proportional increases in corn yield.
- c. Fertilizer application is a cost-effective means of increasing farm profits.
- d. Leaf growth represents energy that is not directed to corn production, and the two variables show a negative correlation.

ANS: A DIF: Moderate REF: 1.1 | 1.2 OBJ: 1.4
 MSC: Applying

6. Which of the following actions is an example of conducting an experiment?
- a. calling a telephone number
 - b. comparing prices of computers
 - c. checking your midterm grades online
 - d. predicting the outcome of a basketball game

ANS: A DIF: Difficult REF: 1.1 | 1.2 OBJ: 1.4
 MSC: Understanding

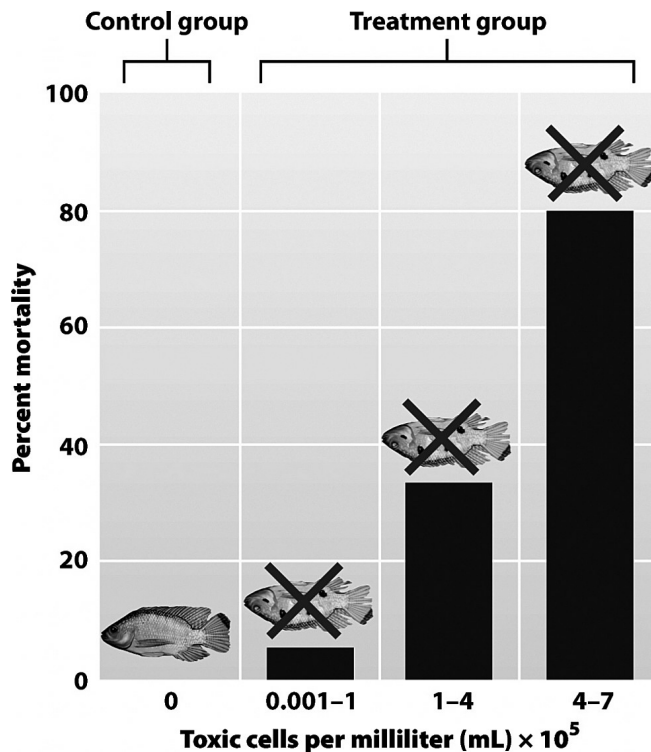


7.

This figure shows the steps in the scientific method. In her research on fish die-offs in North Carolina caused by the dinoflagellate *Pfiesteria*, researcher Dr. Burkholder came to believe that previous experiments by independent laboratories looking for a fish-killing toxin were using the wrong strains of *Pfiesteria*. Which step in the scientific method would her contention represent?

- a. observation
- b. hypothesis
- c. prediction
- d. test

ANS: B DIF: Difficult REF: 1.1 | 1.2 OBJ: 1.4
 MSC: Understanding



8.

This graph shows the 16-hour mortality resulting from exposing tilapia to different concentrations of the dinoflagellate *Pfiesteria*. If high mortality had occurred in the control group, we could conclude that

- a more robust fish species should have been used; the experiment had a fundamental design flaw.
- the tilapia were immune to the effects of the toxic *Pfiesteria*.
- Pfiesteria* was not the toxic agent responsible for the death of the fish.
- tilapia are not suitable for captive experiments.

ANS: C

DIF: Moderate

REF: 1.2

OBJ: 1.4

MSC: Applying

9. A scientist named Dr. Burkholder hypothesized that the dinoflagellate *Pfiesteria* was associated with the massive die-offs of fish in North Carolina rivers. Subsequent observations supported her hypothesis. Which of the following observations would support that hypothesis?

- Pfiesteria* was shown to be capable of living within the climatic ranges of North Carolina.
- A predicted increase in *Pfiesteria* populations coincided with a fish die-off.
- New observations revealed that *Pfiesteria* could kill laboratory fish.
- A virulent toxin was isolated from *Pfiesteria* cultures grown in the laboratory.

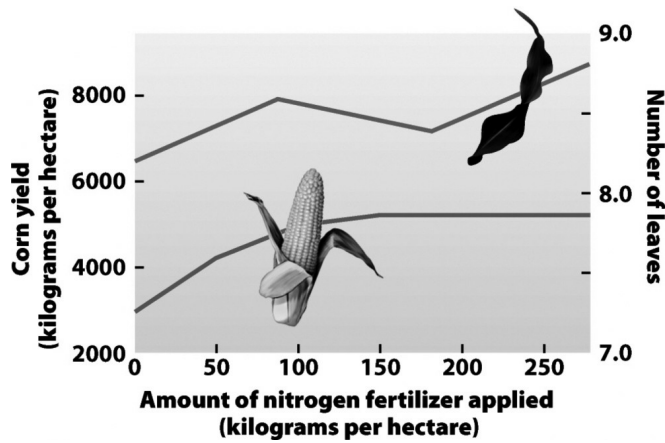
ANS: B

DIF: Difficult

REF: 1.2

OBJ: 1.4

MSC: Applying



10.

Which of the following statements best summarizes the information presented in this graph?

- Higher applications of fertilizer produce proportional increases in corn yield.
- Fertilizer application up to about 100 kg/ha increases farm yields and profits.
- Proportional increases in irrigation are needed to maximize the growth potential of applied fertilizer.
- Factors other than fertilizer availability have no effect on corn yield.

ANS: B

DIF: Difficult

REF: 1.2

OBJ: 1.4

MSC: Applying

11. Which of the following activities is an example of an experiment?

- reading a blood pressure gauge
- examining an X-ray
- taking prescription medicine
- making a medical diagnosis

ANS: C

DIF: Difficult

REF: 1.2

OBJ: 1.4

MSC: Applying

12. Although the idea seems contradictory, science cannot prove a hypothesis to be true. Why?

- All true hypotheses will be rejected by the scientific method because they can be proven false.
- Future experiments or discoveries may provide data that refute the hypothesis.
- Science is a human endeavor, and like all human endeavors, it is limited by human understanding.
- The scientific method is limited to examination of the natural world.

ANS: B

DIF: Difficult

REF: 1.2

OBJ: 1.5

MSC: Understanding

13. After it has been supported by a predictable experimental outcome, a scientific hypothesis

- is never reexamined.
- still cannot be considered to have been proven true.
- can be used to predict the outcome of all future similar events.
- is elevated to the status of theory.

ANS: B

DIF: Moderate

REF: 1.2

OBJ: 1.3 | 1.4 | 1.5

MSC: Applying

14. Which of the following statements about the scientific method is true?

- After a hypothesis has been proposed, it can never be challenged.
- A valid scientific hypothesis is self-evident and does not need to be tested by experimentation.

- c. The scientific method can help people make informed medical and environmental decisions.
- d. If they are properly designed, experiments always prove hypotheses to be wrong.

ANS: C DIF: Moderate REF: 1.2 OBJ: 1.4 | 1.5 | 1.6
 MSC: Applying

15. Which of the following questions could NOT be used to develop a testable hypothesis?
- a. Does exposure to secondhand smoke affect the probability of developing lung cancer?
 - b. Do organic vegetables contain harmful substances?
 - c. Should everyone drink bottled water only?
 - d. Does a can of vegetable juice contain more salt than the same size can of iced tea?

ANS: C DIF: Moderate REF: 1.2 OBJ: 1.4
 MSC: Applying

16. Some questions fall outside the realm of science. Which of the following questions could NOT be answered using the scientific method?
- a. What is the function of the appendix in the human body?
 - b. Why is it unethical to test newly developed drugs in animals?
 - c. Why do smokers develop lung cancer more frequently than nonsmokers?
 - d. Why is it so difficult to quit smoking?

ANS: B DIF: Difficult REF: 1.2 OBJ: 1.4 | 1.5
 MSC: Applying

17. Which of the following observations strengthens the hypothesis that a common ancestor gave rise to all living organisms?
- a. Almost all cells in all living organisms use DNA to direct their structure, function, and behavior.
 - b. All living organisms use energy acquired directly from the environment or from other organisms.
 - c. All living organisms sense their environment and respond to it.
 - d. Each type of living organism adheres to the general principles of the biological hierarchy.

ANS: A DIF: Moderate REF: 1.2 OBJ: 1.7
 MSC: Applying



18.

What aspect of the germ theory of disease has influenced the behavior of most of the people in this picture?

- a. Coughing in a public place is socially unacceptable.
- b. Disease-causing pathogens are communicable; they can spread from an infected person to an uninfected person.
- c. Medications like antibiotics are a selection mechanism that ultimately strengthens the disease.
- d. The pathogens that cause disease are too small to be seen without a microscope.

ANS: B DIF: Moderate REF: 1.2 | 1.3 OBJ: 1.5 | 1.6
 MSC: Applying

19. The basic unit of life is the

- a. cell.
- b. organ.
- c. organelle.
- d. tissue.

ANS: A DIF: Easy REF: 1.4 OBJ: 1.7
 MSC: Remembering

20. Living cells are separated from the outside environment by a flexible

- a. nucleus.
- b. plasma membrane.
- c. cell wall.
- d. DNA circle.

ANS: B DIF: Easy REF: 1.4 OBJ: 1.7
 MSC: Remembering

21. Which of the following organisms has a reproductive strategy that does NOT depend on eggs and sperm?

- a. a grasshopper
- b. a black widow spider
- c. a turtle
- d. a bacterium

ANS: D DIF: Easy REF: 1.4 OBJ: 1.7
 MSC: Remembering

22. Consider each of the following true statements; which statement supports the theory that all living organisms descended from one common ancestor?

- a. Bacteria have a cell wall outside the plasma membrane.
- b. Offspring resemble their parents.
- c. All living organisms use DNA as their hereditary material.
- d. Some organisms are consumers, whereas others are producers.

ANS: C DIF: Easy REF: 1.4 OBJ: 1.7
 MSC: Applying

23. DNA is one of the features common to all known forms of life. Which of the following statements about DNA is true?

- a. It forms the protective outer membrane of cells.
- b. It is expressly produced for reproduction and is found only in eggs and sperm.
- c. It is the blueprint that guides the growth, development, behavior, and reproduction of all organisms.
- d. Its absence in viruses is the basis for classifying them as nonliving.

ANS: C DIF: Moderate REF: 1.4 OBJ: 1.7
 MSC: Applying

24. Which of the following characteristics is NOT shared by all living organisms?

- a. They make their own energy.
- b. They grow and develop.

- c. They evolve over time.
- d. They are composed of one or more cells.

ANS: A DIF: Easy REF: 1.4 OBJ: 1.7
MSC: Remembering

25. Which of the following organisms might harvest energy from iron, a nonliving part of the environment?

- a. a human
- b. a cricket
- c. a bacterium
- d. a goat

ANS: C DIF: Easy REF: 1.4 OBJ: 1.7
MSC: Remembering

26. In which of the following foods would the energy content be most directly connected to solar energy?

- a. an apple
- b. a hamburger
- c. a slice of pizza
- d. a grilled cheese sandwich

ANS: A DIF: Moderate REF: 1.4 OBJ: 1.7
MSC: Applying

27. Which of the following statements about how organisms obtain energy is true?

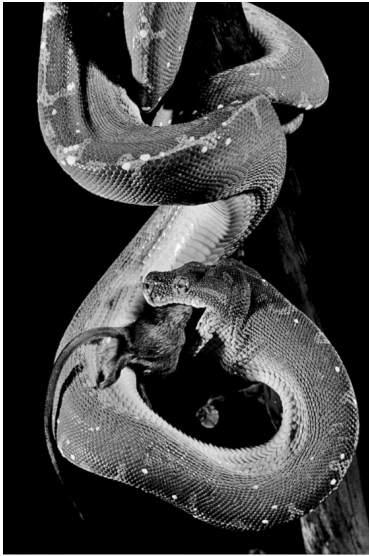
- a. Producers obtain their energy from other organisms.
- b. Producers represent the final energy transfer in the sequence of energy transfers between the environment and living organisms.
- c. Consumers obtain their energy from other organisms.
- d. Consumers represent the initial energy transfer in the sequence of energy transfers between the environment and living organisms.

ANS: C DIF: Moderate REF: 1.4 OBJ: 1.7
MSC: Applying

28. Which of the following statements does NOT describe a characteristic of living organisms?

- a. All living organisms require energy.
- b. All living organisms consume other living things to obtain their energy.
- c. All living organisms can sense their environment and respond to it.
- d. All living organisms reproduce.

ANS: B DIF: Moderate REF: 1.4 OBJ: 1.7
MSC: Applying



29.

Examine this figure. Which of the following statements best explains the motivation of the snake?

- a. Mice will eat snake eggs that are unprotected in the nest; the snake is protecting its eggs.
- b. Snakes are highly territorial and attack intruders; the mouse wandered into the snake's territory.
- c. The snake is a consumer; it is eating the mouse to obtain energy.
- d. The snake is an autotroph; it is eating the mouse to obtain energy.

ANS: C DIF: Difficult REF: 1.4 OBJ: 1.7
 MSC: Understanding

30. Homeostasis is the ability to detect and correct disturbances that develop within an organism. Which of the following things is NOT regulated by homeostasis?

- a. hunger
- b. thirst
- c. external temperature
- d. exhalation

ANS: C DIF: Easy REF: 1.4 OBJ: 1.7
 MSC: Applying

31. All animals have the capacity to sense their environment and respond to it. Which of the following statements is an example of this process?

- a. Humans can see better than any other animal.
- b. Humans can hear better than any other animal.
- c. Humans have a better sense of smell than any other animal.
- d. Although humans are not the fastest or strongest animal, they have a set of sensory adaptations that are entirely compatible with human biology and environment.

ANS: D DIF: Moderate REF: 1.4 OBJ: 1.7
 MSC: Understanding

32. Mediterranean gardeners' repeated replanting of seeds from wild mustard plants that showed unusually prolific flower bud and flower growth led to the creation of what modern cruciferous plants?

- a. turnips and kohlrabi
- b. kale and cabbage
- c. cauliflower and kale
- d. broccoli and cauliflower

ANS: D DIF: Easy REF: 1.4 OBJ: 1.8
 MSC: Applying

33. Multicellular organisms are constructed from many types of specialized cells. Why might having specialized cells be more advantageous than being a single-celled organism?
- Specialized cells can do a given job better than general-purpose cells can.
 - Specialized cells can survive independently of the organism.
 - Nonspecialized cells do not live as long as specialized cells.
 - Nonspecialized cells are unable to stick together to make up a multicellular organism.

ANS: A DIF: Difficult REF: 1.4 OBJ: 1.7
MSC: Understanding

34. All living organisms share a unity in their characteristics because they
- are all multicellular.
 - are all producers.
 - have been stable and unchanging throughout time.
 - descended from a common ancestor.

ANS: D DIF: Moderate REF: 1.4 | 1.5 OBJ: 1.7 | 1.8
MSC: Applying

35. In the following list, the best evidence for evolution is
- predators culling the very young, very old, and diseased individuals in a prey population.
 - the adaptive traits that almost all living organisms display.
 - the changes in the overall genetic characteristics of a group of organisms.
 - the existence in the ocean of organisms like whales and seals whose ancestors used to live on land.

ANS: C DIF: Moderate REF: 1.4 | 1.5 OBJ: 1.8
MSC: Understanding

36. More than one adaptive trait in the pronghorn has been influenced by the presence of predators; in addition to its great speed, the pronghorn also has
- a four-chambered stomach.
 - strong teeth.
 - camouflage coloration.
 - hollow hair.

ANS: C DIF: Moderate REF: 1.5 OBJ: 1.8
MSC: Applying

37. Charles Darwin introduced the concept of adaptation, which he defined as features that
- help organisms survive and reproduce.
 - enable organisms to resist the pressures of evolutionary change.
 - enable organisms to change their environment in ways that best ensure continued survival.
 - enable organisms to alter their DNA in a selective fashion.

ANS: A DIF: Moderate REF: 1.5 OBJ: 1.8
MSC: Applying

38. Biologists hypothesize that the now-extinct American cheetah provided the selection pressure that led to the swiftness of the pronghorn. Which of the following statements is the most likely prediction of how pronghorn speed might change in the next few thousand years?
- Pronghorns will continue to become even faster; it is always better to run as fast as possible.
 - Pronghorns will become slower as individuals divert energy and resources away from running and toward other features that improve their fitness to survive.
 - Pronghorns will maintain their speed; once a characteristic is developed, it is always retained.

- d. Pronghorns will maintain their speed because predators such as cougars, wolves, and coyotes, will remove slower individuals.

ANS: B DIF: Difficult REF: 1.5 OBJ: 1.8
MSC: Understanding

39. Modern life often masks the struggles that have characterized human life through much of its history. In the past, human survival was critically dependent on our ability to
- run faster than most human predators.
 - solve complex problems.
 - hear sounds at much lower intensities than other animals.
 - sense a wider range of smells than other animals.

ANS: B DIF: Difficult REF: 1.5 OBJ: 1.8
MSC: Understanding

40. Groups of different species that live and interact in a given area are referred to as a
- biosphere.
 - population.
 - community.
 - habitat.

ANS: C DIF: Easy REF: 1.5 OBJ: 1.9
MSC: Remembering

41. A group of interbreeding organisms whose offspring are themselves fertile is defined as a
- web.
 - biome.
 - unit.
 - species.

ANS: D DIF: Easy REF: 1.5 OBJ: 1.9
MSC: Remembering

42. Viruses cannot reproduce on their own; they do so by taking over the machinery that exists in the cells of the organisms they invade, whether those organisms are bacteria, plants, or animals. Vaccinations can provide lifelong protection against some diseases, but flu vaccines are rarely effective against the next year's flu virus. Which of the following statements is most likely to explain this fact?
- Viruses are not alive.
 - Viruses can evolve quickly.
 - A virus can change its cell membranes to block the action of the vaccine.
 - Viruses can develop into immune bacteria that neutralize the action of the vaccine.

ANS: B DIF: Difficult REF: 1.5 OBJ: 1.4 | 1.8
MSC: Applying

43. Which of the following groups of organisms is NOT included in the domain Eukarya?
- Protista
 - Archaea
 - Fungi
 - Plantae

ANS: B DIF: Difficult REF: 1.5 OBJ: 1.9
MSC: Applying

44. Which of the following groups of organisms is NOT included in the domain Eukarya?
- Protista
 - Prokaryotes
 - Fungi
 - Animalia

ANS: B DIF: Difficult REF: 1.5 OBJ: 1.9
MSC: Applying



45.

Which of the following terms best describes the North American rocky intertidal zone shown in the photograph?

- a. a population
- b. a community
- c. an ecosystem
- d. a biome

ANS: C DIF: Moderate REF: 1.6 OBJ: 1.9
 MSC: Understanding

46. Which of the following sequences correctly represents the biological hierarchy of a multicellular organism?

- a. cells → tissues → organs → organ systems → individual
- b. tissues → organs → organ systems → cells → individual
- c. individual → organs → cells → organ systems → tissues
- d. organ systems → organs → tissues → cells → individual

ANS: A DIF: Easy REF: 1.6 OBJ: 1.9
 MSC: Applying

47. An organ is defined as a body structure composed of two or more

- a. molecules.
- b. cells.
- c. tissues.
- d. organ systems.

ANS: C DIF: Easy REF: 1.6 OBJ: 1.9
 MSC: Remembering

48. When compared with natural systems, a college campus—including its facilities—is most similar to a(n)

- a. ecosystem.
- b. community.
- c. biome.
- d. population.

ANS: A DIF: Easy REF: 1.6 OBJ: 1.9
 MSC: Applying

49. Which of the following ecological features would NOT be considered a component of an ecosystem?
- a. an individual
 - b. a community
 - c. a population
 - d. a biome

ANS: D DIF: Moderate REF: 1.6 OBJ: 1.9
MSC: Understanding

50. Which of the following features is LEAST likely to be used to define a biome?
- a. shared physical characteristics
 - b. the presence or absence of humans
 - c. a distinctive community of organisms
 - d. the climate

ANS: B DIF: Easy REF: 1.6 OBJ: 1.9
MSC: Remembering

51. Which of the following statements about the biological hierarchy is true?
- a. Ecosystems are composed of one or more biomes.
 - b. Communities are composed of one or more ecosystems.
 - c. The biosphere includes all life forms and the places where they live.
 - d. The biosphere is an intermediate classification that falls between ecosystems and biomes.

ANS: C DIF: Moderate REF: 1.6 OBJ: 1.9
MSC: Remembering

52. Microbiologists quickly responded to the paper by Dr. Wolfe-Simon in which she claimed to have discovered bacteria that were using arsenic to construct their DNA. One of the most challenging criticisms was that she and her colleagues
- a. were unable to account for arsenic's toxicity to other organisms.
 - b. published the paper before going through the conventional peer review process.
 - c. had an inadequate protocol for eliminating all phosphorus from the test tubes that contained the bacteria.
 - d. lacked comparative information about closely related bacteria within the Halomonadaceae family.

ANS: C DIF: Moderate REF: Applying What We Learned
OBJ: 1.2 | 1.3 | 1.4 | 1.5 MSC: Understanding

53. Which of the following statements is NOT a reason why humans are the most difficult organism to study?
- a. For ethical reasons, an ideal experimental design may not be allowed to be performed with human subjects.
 - b. Some types of double-blind experiments cannot be performed with human subjects.
 - c. Long-term (longitudinal) studies may involve inaccurate reporting by the participants.
 - d. Longitudinal studies of human subjects can be very expensive.

ANS: D DIF: Moderate REF: Biology in the News
OBJ: 1.3 | 1.4 MSC: Understanding

COMPLETION

1. Biology is the scientific study of _____.

ANS: life

DIF: Easy REF: Introduction OBJ: 1.1 MSC: Remembering

2. The discovery that bacteria living in Mono Lake may have replaced the phosphorus in certain biomolecules with _____ has challenged long-held assumptions about the chemical nature of life.

ANS: arsenic

DIF: Easy REF: Introduction | Applying What We Learned
OBJ: 1.1 | 1.2 MSC: Applying

3. The scientific method begins with _____.

ANS: observations

DIF: Easy REF: 1.1 OBJ: 1.2 MSC: Remembering

4. In the scientific method, observations are most often followed by _____ and then _____.

ANS: hypotheses; experiments

DIF: Easy REF: 1.1 | 1.2 OBJ: 1.2 | 1.3 | 1.4 MSC: Remembering

5. Scientists can propose testable predictions after first developing a(n) _____.

ANS: hypothesis

DIF: Easy REF: 1.1 | 1.2 OBJ: 1.2 | 1.3 MSC: Applying

6. Experimentation is the primary means that verifies or refutes the _____ made by a hypothesis.

ANS: predictions

DIF: Moderate REF: 1.1 | 1.2 OBJ: 1.3 | 1.4 MSC: Applying

7. New medications undergo extensive human testing before receiving FDA approval. These tests represent an experiment, and the variations in the dosage given to test participants represents the _____.

ANS: independent variable

DIF: Moderate REF: 1.2 OBJ: 1.4 MSC: Applying

8. The observation that polar ice floes are thinning or melting much earlier each spring than they did 20 years ago is an example of a scientific _____.

ANS: fact

DIF: Easy REF: 1.3 OBJ: 1.5 MSC: Applying

9. The genetic material used for reproduction by organisms that are conventionally considered to be living is _____.

ANS: DNA

DIF: Moderate REF: 1.4 OBJ: 1.7 MSC: Applying

10. Using a process called photosynthesis, plants make energy-rich substances by using the energy contained in _____.

ANS: sunlight

DIF: Easy REF: 1.4 OBJ: 1.7 MSC: Remembering

11. Plants and animals need a variety of resources to carry out and maintain life processes; the most important of these resources is _____.

ANS: energy

DIF: Moderate REF: 1.4 OBJ: 1.7 MSC: Applying

12. To survive, living organisms must be able to sense and respond to both their internal and external _____.

ANS: environments

DIF: Moderate REF: 1.4 OBJ: 1.7 MSC: Applying

13. A group of organisms can develop new characteristics over time through the process of _____.

ANS: evolution

DIF: Easy REF: 1.4 | 1.5 OBJ: 1.8 MSC: Remembering

14. The directions for the specific genetic characteristics in all living things are functionally organized into discrete segments called genes; these genes are composed of _____.

ANS: deoxyribonucleic acid, DNA

DIF: Easy REF: 1.4 | 1.5 | 1.6 OBJ: 1.7 MSC: Remembering

15. Advantageous genetic features that evolve over time and help an organism survive or reproduce are called _____.

ANS: adaptations

DIF: Easy REF: 1.5 OBJ: 1.8 MSC: Remembering

16. Because the California sea lions that live along the Pacific Coast freely migrate and regularly interbreed with one another, biologists classify this group as a _____.

ANS: population

DIF: Moderate REF: 1.5 | 1.6 OBJ: 1.9 MSC: Applying

17. One of the largest long-term clinical trials in the United States, which encompassed about 14,000 male physicians ages 50 and older, found that the incidence of cancer could be decreased by 8 percent by taking a common combination of essential _____ and _____ daily, compared with taking a placebo.

MSC: Remembering

10. DNA is an example of the molecular level of biological organization.

ANS: T DIF: Easy REF: 1.4 | 1.6 OBJ: 1.7
MSC: Remembering

11. The organs that constitute an organ system often work cooperatively to maintain homeostasis.

ANS: T DIF: Moderate REF: 1.4 | 1.6 OBJ: 1.9
MSC: Applying

12. Because polar bears are white, they are difficult to see as they stalk seals; their white fur is an example of an adaptation.

ANS: T DIF: Moderate REF: 1.5 OBJ: 1.8
MSC: Applying

13. A molecule is constructed when two or more atoms become bonded to each other.

ANS: T DIF: Easy REF: 1.6 OBJ: 1.9
MSC: Remembering

14. The brain is considered an organ because it is constructed from nerve cells.

ANS: F DIF: Difficult REF: 1.6 OBJ: 1.9
MSC: Applying

15. Living organisms are intimately connected to the environments in which they live; this connection is called a biome, and a forest is a good example.

ANS: F DIF: Moderate REF: 1.6 OBJ: 1.9
MSC: Applying

16. Phosphorus is considered to be an essential element for life; if the bacteria found in Mono Lake actually incorporate arsenic into their DNA, this assessment will need to be reevaluated.

ANS: T DIF: Moderate REF: Applying What We Learned
OBJ: 1.7 | 1.9 MSC: Applying

17. Some clinical trials of high doses of nutrients that were thought to be cancer fighters have been shut down prematurely because they drove up cancer rates.

ANS: T DIF: Easy REF: Biology in the News
OBJ: 1.5 | 1.6 MSC: Remembering