

**Chapter 01: The Nature of Science**

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**MULTIPLE CHOICE**

1. When scientists generate a single informed, logical, and plausible explanation for a question and observations of the natural world, they are proposing a scientific
- a. hypothesis.
  - b. observation.
  - c. theory.
  - d. correlation.

ANS: A

DIF: Easy

REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Remembering

2. Experimentation is the primary, but not only, means used to verify or refute the \_\_\_\_\_ made by a hypothesis.
- a. variables
  - b. theories
  - c. laws
  - d. predictions

ANS: D

DIF: Moderate

REF: 1.3 Catching the Culprit

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Understanding

3. A scientific hypothesis must be constructed with which of the following characteristics?
- a. It is always provable and clearly states what is already known to be fact.
  - b. It provides a reasonable explanation to a question and is consistent with current observations; it must also be testable and falsifiable.
  - c. It provides an explanation consistent with accepted theological ideas and does not need to be tested.
  - d. It does not require testing by experimentation or additional observations. It is not falsifiable.

ANS: B

DIF: Easy

REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Remembering

4. Is it important for scientists to communicate their results to fellow scientists?
- a. Yes. Scientists want to receive recognition and monetary reward for their work.
  - b. No. There is no reason for scientists to communicate their results to fellow scientists.
  - c. Yes. The quality and accuracy of the scientific work can be enhanced by input, further review, and possibly even repetition by other scientists working in the same field.
  - d. No. Communication between scientists is discouraged because it can confuse the details of the experiments.

ANS: C

DIF: Easy

REF: 1.3 Catching the Culprit

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Remembering

5. A scientific hypothesis must be \_\_\_\_\_; if not, science cannot evaluate it.
- a. provable
  - b. testable
  - c. accepted
  - d. rejected

ANS: B

DIF: Easy

REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Remembering

6. Whenever we \_\_\_\_\_, we are proceeding scientifically.
- invoke a supernatural power as an explanation for how a natural phenomenon occurred
  - stop questioning our observations
  - try to solve a problem by systematically evaluating the plausibility of various solutions
  - develop an unchangeable and definitive explanation

ANS: C                      DIF: Moderate                      REF: 1.0 Intro

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Applying

7. Is it possible for scientists to study events that happened to animals or plants that lived millions of years ago?
- Yes. Apply the laws of physics and nature that we know exist today to evaluate the evidence of past events. For example, observe modern animal behavior, structure, and function, and compare them to the structures of fossilized animals to deduce the function of the fossilized structures.
  - No. The laws of physics that exist today are not the same laws of physics that existed in the past, so there is no way to compare plant or animal fossils to those of modern organisms and deduce the function of fossilized structures.
  - Yes. Genetic manipulation of fossils allows scientists to directly test metabolic and behavioral characteristics of plants and animals from the past.
  - No. There is no way to analyze plant or animal fossils that lived millions of years ago because the laws of nature that exist today have changed dramatically from the past.

ANS: A                      DIF: Difficult                      REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Applying

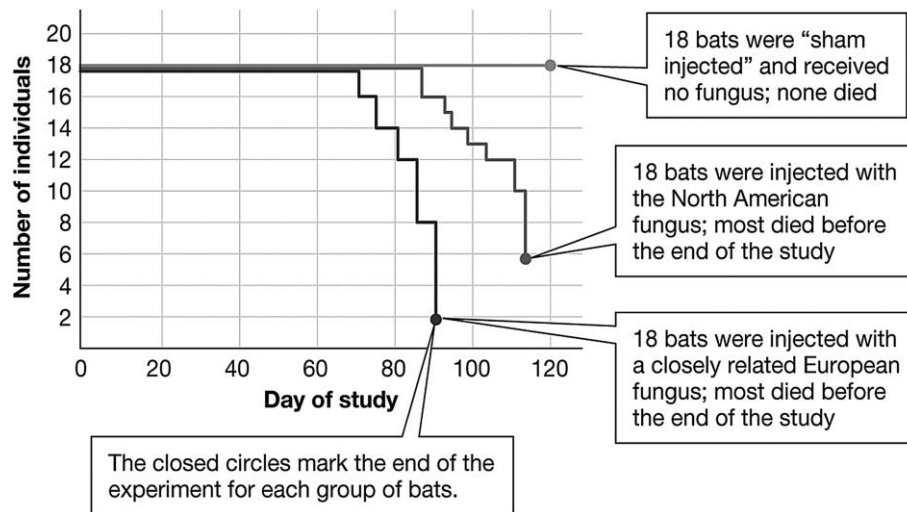
8. Victoria, who is 10 years old, wants to be a zoologist when she grows up because she loves animals. So, she decided to begin her training by “doing something scientific.” Specifically, she weighed and measured the lengths of all the earthworms she could find in her yard and recorded the data in a notebook. She then made a graph showing the maximum, minimum, and average weights and heights of the earthworms. Was she doing something scientific?
- No, because she is too young to think like a scientist.
  - No, because she had no hypothesis to direct her data collection or interpretation.
  - Yes, because scientists always make measurements.
  - Yes, because scientists always construct graphs with the data they collect.

ANS: B                      DIF: Difficult                      REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Understanding

9. A group of researchers conducted an experiment and collected the data presented in the graph below. The graph shows that the hypothesis was \_\_\_\_\_ because all members of the control group \_\_\_\_\_ while most of the members of both treatment groups \_\_\_\_\_ by the end of the study.



- proven beyond a doubt; survived; died
- proven; survived; died
- not supported; died; survived
- supported; survived; died

ANS: D                      DIF: Difficult                      REF: 1.3 Catching the Culprit

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Analyzing

- A scientist notices that a population of birds has decreased dramatically within one year and suspects that a newly introduced snail population may be affecting the bird population. Some individuals within the bird population eat snails, primarily, while other individuals avoid eating snails. Which of the following statements represents a prediction based on a well-constructed hypothesis for this observation?
  - If birds are affected by eating snails, then there will be a difference in the survival rate of birds that eat snails and those that avoid snails.
  - If snails live in moist habitats, then snails will be eaten more frequently by birds.
  - If birds consume snails, then they will have a higher body mass index than birds that do not eat snails.
  - If snails that are sick leave their shells so that birds will consume them, then snail populations are protected from illness.

ANS: A                      DIF: Moderate                      REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Analyzing

- Recently, beekeepers have noticed an alarming and sudden disappearance of honeybees from their hives. Some beekeepers and environmentalists worry that crops genetically engineered to produce Bt insecticidal toxin may be killing the bees. Without data from a scientific experiment, is it reasonable to state that Bt-containing crops are responsible for the loss of honeybees?
  - Yes, because it is obviously the Bt crops killing the bees.
  - Yes, because there cannot possibly be any other explanation for the loss of the honeybees.
  - No, because there is no reason to suspect that an insecticide would kill honeybees.
  - No, because there could be some other unknown or unmentioned factor affecting the survival of honeybees.

ANS: D                      DIF: Moderate                      REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Understanding

12. The hypothesis that there is a common ancestor to all living organisms is strengthened by what observation?
- Almost all cells in all living organisms use DNA to direct their structure, function, and behavior.
  - All living organisms use energy acquired directly from the environment or from other organisms.
  - All living organisms reproduce.
  - Each type of living organism adheres to the general principles of the biological hierarchy.

ANS: A                      DIF: Moderate                      REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Applying

13. Which of the following statements is true?
- Once 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.
  - If properly designed, experiments always prove hypotheses to be wrong.
  - The scientific method or process can help people make informed medical and environmental decisions.

ANS: D                      DIF: Moderate                      REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Applying

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

ANS: C                      DIF: Moderate                      REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Applying

15. Recently, beekeepers have noticed an alarming and sudden disappearance of honeybees from their hives. Some beekeepers and environmentalists worry that crops genetically engineered to produce Bt insecticidal toxin may be killing the bees. Which of these experiments tests the hypothesis that Bt toxin is killing the bees?
- spraying Bt toxin on a field and counting the number of bees present before and after spraying
  - collecting hundreds of bees; half of the bees would be kept in a facility with plants genetically engineered to contain the gene for Bt toxin, while the other half would be kept in a facility with plants not genetically engineered to contain the gene for Bt toxin. The survival rate for both sets of bees would be calculated and compared.
  - collecting hundreds of bees and spraying only half of them with Bt toxin; the survival rate for both sets of bees would be calculated and compared
  - The number of bees in two adjacent fields would be counted before and after spraying one of the fields with Bt toxin. The survival rate of bees in both fields would be calculated and compared.

ANS: B                      DIF: Difficult                      REF: 1.2 Prove Me Wrong

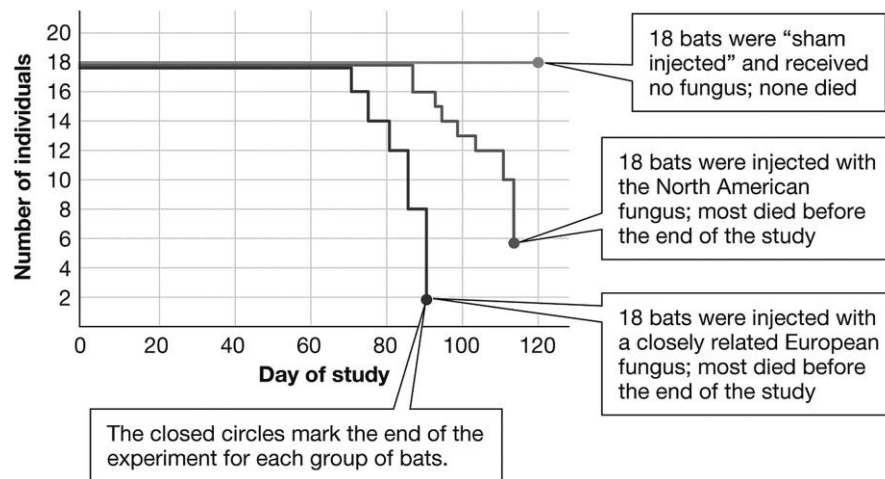
OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Applying

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

ANS: D                      DIF: Difficult                      REF: 1.0 Intro

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Applying

17. Researchers hypothesized that a North American fungus not only caused symptoms of white-nose syndrome (WNS) but also caused death. The results from their experiment are shown in the graph below. Based on this graph, which of the following hypotheses would be the MOST logical hypothesis for further studies?



- "Sham injected" bats have a higher mortality rate than bats that are not injected.
- Bats injected with the North American fungus are less likely to care for their offspring than "sham injected" bats.
- Bats injected with European fungus have a lower mortality rate than "sham injected" bats.
- Other species of bats injected with European fungus will experience death.

ANS: D                      DIF: Moderate                      REF: 1.3 Catching the Culprit

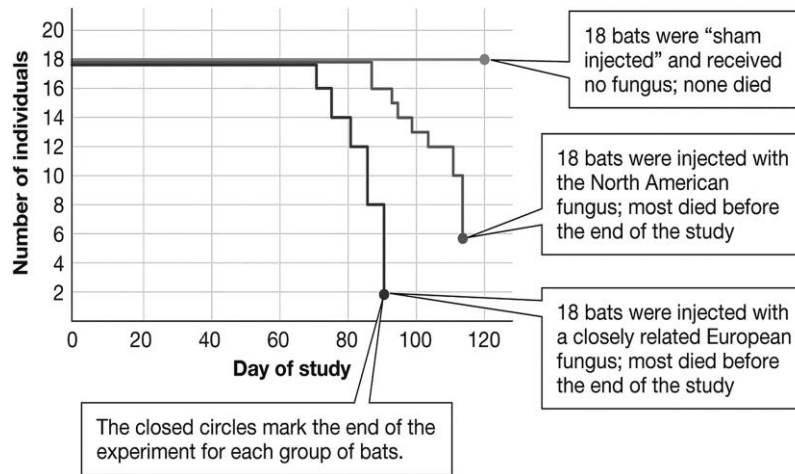
OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis.                      MSC: Understanding

18. New medications undergo extensive human testing before receiving FDA approval. These tests represent an experiment, and variations in the dosage given to participants represents the
- dependent variable.
  - independent variable.
  - correlation coefficient.
  - invariable.

ANS: B                      DIF: Easy                      REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment.                      MSC: Applying

19. The group of 18 bats that were "sham injected" represents a \_\_\_\_\_ group that experienced \_\_\_\_\_.



- control; no change in the independent variable
- control; a change in the dependent variable
- treatment; no change in the independent variable
- treatment; no change in the dependent variable

ANS: A                      DIF: Easy                      REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment.                      MSC: Understanding

20. Once 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 Prove Me Wrong

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment.                      MSC: Understanding

21. David Blehert and his research team captured 117 healthy bats to study in the laboratory and divided them into four groups. Group 1 was housed in an area free from the fungus *Geomyces destructans*. Group 2 was housed in an area that shared the same air as bats infected with WNS, but these bats did not have direct contact with the infected bats. Group 3 was housed in direct contact with other bats infected with WNS. Bats in group 4 were directly exposed to *Geomyces destructans* when it was applied to their wings. During the study period the bats were monitored for signs of WNS. Which group is the control group?
- group 1
  - group 2
  - group 3
  - group 4

ANS: A                      DIF: Moderate                      REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment.                      MSC: Applying

22. Which of the following represents conducting an experiment?
- dialing a telephone number
  - comparing prices of computers
  - checking midterm grades online
  - predicting the outcome of a basketball game

ANS: A                      DIF: Difficult                      REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an

experiment.

MSC: Analyzing

23. David Blehert and his research team captured 117 healthy bats to study in the laboratory and divided them into four groups. Group 1 was housed in an area free from *Geomyces destructans*. Group 2 was housed in an area that shared the same air as bats infected with WNS, but these bats did not have direct contact with the infected bats. Group 3 was housed in direct contact with other bats infected with WNS. Bats in group 4 were directly exposed to *Geomyces destructans* when researchers applied it to the bats' wings. During the study period the bats were monitored for signs of WNS. What is the specific hypothesis being tested by the inclusion of group 4 in this experiment?
- Geomyces destructans* causes WNS, and it can be transmitted through the air.
  - Geomyces destructans* causes WNS, and it is only transmitted by direct contact with other infected bats.
  - Geomyces destructans* causes WNS, and it can be transmitted by direct contact with the fungus; no contact with infected bats is needed for transmission of the fungus.
  - Group 4 is the control.

ANS: C

DIF: Difficult

REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment.

MSC: Analyzing

24. David Blehert and his research team captured 117 healthy bats to study in the laboratory and divided them into four groups. Group 1 was housed in an area free from *Geomyces destructans*. Group 2 was housed in an area that shared the same air as bats infected with WNS, but these bats did not have direct contact with the infected bats. Group 3 was housed in direct contact with other bats infected with WNS. Bats in group 4 were directly exposed to *Geomyces destructans* when it was applied to their wings. During the study period the bats were monitored for signs of WNS. In this experiment, the independent was \_\_\_\_\_ and the dependent variable was \_\_\_\_\_.
- the type of exposure to *Geomyces destructans*; whether the bats became sick with WNS
  - whether the bats became sick with WNS; the type of exposure to *Geomyces destructans*
  - whether the bats became sick with WNS; the number of bats included in the study
  - the number of bats included in the study; the type of exposure to *Geomyces destructans*

ANS: A

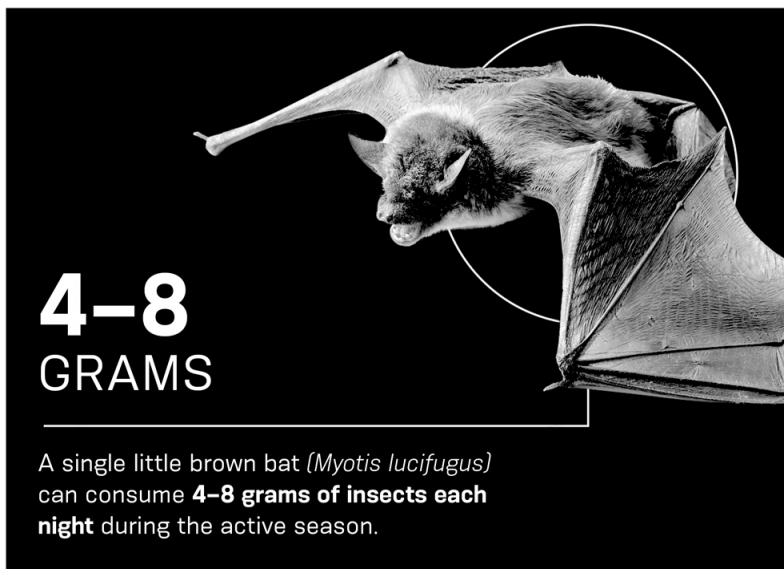
DIF: Difficult

REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment.

MSC: Analyzing

25. The information presented in the following figure represents a scientific



- a. theory.
- b. hypothesis.
- c. observation.
- d. fact.

ANS: D                      DIF: Easy                      REF: Chapter 1 Infographic  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Understanding

26. Scientists are human beings and, like all human beings, are susceptible to personal and group biases that may influence how they interpret evidence. Before original research work is accepted and added to a growing body of scientific understanding, perhaps even contributing to our understanding of an important scientific theory, it must be scrutinized by experts in the field who have no direct connection to the research under review. The main mechanism for doing this is
- a. popular magazines.
  - b. the Discovery Channel.
  - c. peer-reviewed publications.
  - d. Wikipedia.

ANS: C                      DIF: Easy                      REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Understanding

27. A patient is coughing and producing a wheezing sound as she breathes; she also has a fever. She goes to the doctor who listens to her chest, takes X-rays of her chest, and determines that she probably has something called croup. Which of the following are the facts in this scenario?
- a. The patient is coughing, wheezing, and has a fever.
  - b. The patient probably has croup.
  - c. The patient probably has whooping cough.
  - d. The patient probably needs antibiotics.

ANS: A                      DIF: Easy                      REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Applying

28. In science, when a hypothesis or group of hypotheses supported by repeated experimental evidence holds true through time, it can be developed into a
- a. law.
  - b. mathematical theorem.
  - c. hypothesis.
  - d. theory.

ANS: D                      DIF: Easy                      REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Understanding

29. The human heart pumps blood throughout the blood vessels in the body. This is a scientific
- a. theory.
  - b. hypothesis.
  - c. fact.
  - d. experiment.

ANS: C                      DIF: Moderate                      REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Applying

30. A patient often experiences numbness and pain in the thumb and first two fingers on his right hand. He goes to the doctor, who suspects that carpal tunnel syndrome is the reason for the numbness and pain. The doctor then orders a simple test to see how fast nerve impulses are moving up and down the patient's arm. The doctor's preliminary diagnosis of carpal tunnel syndrome is a(n)
- a. theory.
  - b. fact.
  - c. experiment.
  - d. hypothesis.

ANS: D                      DIF: Moderate                      REF: 1.3 Catching the Culprit



OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.

MSC: Analyzing

31. Which of the following would be a theory?
- Specific pathogens are directly responsible for specific diseases and conditions.
  - A fungal infection is responsible for the spread of white noses and associated higher mortality across bat populations and species.
  - Bats with white noses have been observed in the wild.
  - A fungal infection causes bats to wake up repeatedly during the winter and use up their fat reserves.

ANS: A                      DIF: Moderate                      REF: 1.3 Catching the Culprit

OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.

MSC: Understanding

32. In 1890, Robert Koch developed a hypothesis regarding the cause of communicable diseases. He designed an experiment and collected data that supported his hypothesis. Later, his experiment was repeated by many other scientists who used other pathogens and documented similar results that not only supported their hypotheses but also supported Koch's original hypothesis. These many experiments that supported multiple hypotheses regarding the cause of communicable diseases contributed to the development of the
- theory of evolution.
  - germ theory of disease.
  - theory of relativity.
  - law of gravity.

ANS: B                      DIF: Moderate                      REF: 1.3 Catching the Culprit

OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.

MSC: Understanding

33. Scientific understanding can always be challenged, and even changed, with new ways of observing and with different interpretations. For example, new tools and techniques have resulted in new observations and the discovery of additional information. This has resulted in revised ways of understanding how molecules are moved across the plasma membrane of cells. Hence, there is no certainty in science, only degrees of probability (likelihood) and potential for change. In light of this understanding, which of the following statements is MOST meaningful?
- Scientific knowledge is absolute knowledge.
  - Scientific knowledge is based on current knowledge.
  - Scientific knowledge is a static and unchanging collection of facts.
  - Scientific knowledge is a rigid collection of invariable facts.

ANS: B                      DIF: Moderate                      REF: 1.3 Catching the Culprit

OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.

MSC: Applying

34. Which of the following would be a fact?
- Specific pathogens are directly responsible for specific diseases and conditions.
  - A fungal infection is solely responsible for the spread of white noses and associated higher mortality across bat populations and species.
  - Bats with white noses have been observed in the wild.
  - A fungal infection causes bats to wake up repeatedly during the winter and use up their fat reserves.

ANS: C                      DIF: Moderate                      REF: 1.3 Catching the Culprit

OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.

MSC: Understanding

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

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

ANS: A                      DIF: Easy                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Applying

36. A tissue is defined as

- a. a group of cells that performs a unique set of tasks in the body.
- b. two or more atoms held together by strong chemical bonds.
- c. the basic unit of life.
- d. a network of organs that perform a wide range of functions.

ANS: A                      DIF: Easy                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Remembering

37. A researcher studying a group of individuals of the same species living and interacting in a shared environment is said to be working at the level of a

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

ANS: D                      DIF: Easy                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Understanding

38. Carbon, hydrogen, and oxygen atoms are held together by chemical bonds to form \_\_\_\_\_ of sugar.

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

ANS: B                      DIF: Easy                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Understanding

39. Bats use echolocation to orient themselves and locate objects. Doing this requires special adaptations in their inner ear, midbrain, and auditory cortex of their cerebrum. The echolocation system of bats is an example of a(n)

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

ANS: D                      DIF: Easy                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Understanding

40. The caves in upstate New York, where Alan Hicks's team first noticed the deaths of thousands of bats, represent the \_\_\_\_\_ where the bats lived.

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

ANS: C                      DIF: Moderate                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Applying

41. Which term best describes the temperate deciduous forests that cover the northeastern United States, including the Adirondack Mountains?
- a. biosphere
  - b. biome
  - c. ecosystem
  - d. community

ANS: B                      DIF: Moderate                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Analyzing

42. Land biomes are most commonly defined by
- a. their climate, physical characteristics, and dominant animal life.
  - b. only the dominant plant life in them.
  - c. the dominant plant life that influences the dominant animal life in them.
  - d. their climate and physical characteristics that influence the dominant plant life and, subsequently, animal life in them.

ANS: D                      DIF: Difficult                      REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Applying

43. What characteristic is NOT shared by all living organisms?
- a. They make their own energy.
  - b. They grow and develop.
  - c. They evolve through time.
  - d. They are composed of one or more cells.

ANS: A                      DIF: Easy                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.

MSC: Remembering

44. Living organisms maintain a constant internal environment by sensing and responding to their internal conditions. This stable maintenance of internal conditions is known as
- a. homeostasis.
  - b. evolution.
  - c. reproduction.
  - d. sensation.

ANS: A                      DIF: Easy                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.

MSC: Remembering

45. DNA is one of the features common to all known forms of life; it
- a. forms the protective outer membrane of cells.
  - b. is used to transfer information from parents to their offspring.
  - c. is used to obtain energy from the environment.
  - d. is used in sensing changes within the environment.

ANS: C                      DIF: Moderate                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.

MSC: Remembering

46. The roots of a sunflower plant growing downward while the shoot grows upward and the flower turns toward the sun are examples of what characteristic of all living organisms?
- a. They reproduce using DNA.
  - b. They evolve through time.

- c. They make their own energy.
- d. They sense the environment and respond to it.

ANS: D                      DIF: Moderate                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.                      MSC: Understanding

47. A species of butterflies gradually becomes darker in color over many generations; this is an example of which characteristic of living organisms?
- a. They reproduce using DNA.
  - b. They obtain energy from the environment to support metabolism.
  - c. They can evolve as groups.
  - d. They sense the environment and respond to it.

ANS: C                      DIF: Moderate                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.                      MSC: Analyzing

48. Which of these characteristics of living organisms are present in viruses?
- a. composed of one or more cells
  - b. can evolve as groups
  - c. maintain a constant internal environment
  - d. obtain energy from their environment

ANS: B                      DIF: Moderate                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.                      MSC: Understanding

49. What is the MOST likely explanation for why all living organisms use the same genetic code stored in DNA?
- a. DNA is a molecule that was found in the earliest life-form and has been passed on to all offspring.
  - b. DNA is more compact than other molecules and therefore fits more easily into cells.
  - c. DNA is required for organisms to sense and respond to changes in the environment.
  - d. DNA is required for organisms to maintain a stable internal environment when conditions vary.

ANS: A                      DIF: Difficult                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.                      MSC: Evaluating

50. A small, potentially living object was found. For this object to be considered alive, the object must
- a. be composed of tissues.
  - b. be found with offspring.
  - c. have evolved from a known life-form.
  - d. contain one or more cells.

ANS: D                      DIF: Easy                      REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.                      MSC: Applying

## COMPLETION

1. The first two steps of the scientific process typically include making \_\_\_\_\_ and forming a \_\_\_\_\_.

ANS: observations; hypothesis

DIF: Easy REF: 1.0 Intro

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Remembering

2. After observing that students who regularly attend class appear to be making good grades, I propose the hypothesis that regular class attendance increases the probability that students earn higher grades. If I attend classes regularly this semester, I should make higher grades than I did last semester when I often missed class. This is a \_\_\_\_\_.

ANS: prediction

DIF: Moderate REF: 1.2 Prove Me Wrong

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Applying

3. When a hypothesis is well constructed, a prediction can be made using a(n) “\_\_\_\_\_” statement.

ANS:

if

then

DIF: Easy REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis. MSC: Remembering

4. When Dr. Blehert and his team set out to determine the cause of death for thousands of bats, they determined that the sick and dead bats had a strange white fuzz on their noses and wings along with depleted fat reserves and damaged wing tissue. After performing observational studies, the researchers used a branch of mathematics called \_\_\_\_\_ to quantify the reliability of their data.

ANS: statistics

DIF: Moderate REF: 1.2 Prove Me Wrong

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Applying

5. During an experimental study, a control group is maintained under a standard set of conditions with no change in the independent variable. The \_\_\_\_\_ group is maintained under the same standard set of conditions as the control group, but the independent variable is adjusted.

ANS:

treatment

experimental

DIF: Easy REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Remembering

6. A direct and repeatable observation of any aspect of the natural world can be considered a scientific \_\_\_\_\_.

ANS: fact

DIF: Easy                      REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Remembering

7. A way to visualize the breadth and scope of life, from the smallest structures of atoms and cells to the broadest interactions between living and nonliving systems that we can comprehend, is typically referred to as the biological \_\_\_\_\_.

ANS: hierarchy

DIF: Easy                      REF: 1.4 No End in Sight  
OBJ: 1.5 Create a graphic showing the levels of biological organization.  
MSC: Remembering

8. The genetic material used for reproduction by those organisms conventionally considered to be living is \_\_\_\_\_.

ANS: DNA

DIF: Moderate              REF: 1.1 Bat Crazy  
OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.  
MSC: Applying

## SHORT ANSWER

1. Explain the self-correcting nature of science.

ANS:

The process of science is based on evidence that can be demonstrated through observations and experiments. Scientific findings are subject to peer review and independent validation and can, therefore, be challenged by anyone on the basis of evidence. When new evidence demonstrates that current scientific thinking is incorrect, hypotheses are adjusted or discarded and investigation continues.

DIF: Moderate              REF: 1.1 Bat Crazy | 1.2 Prove Me Wrong  
OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.  
MSC: Applying

2. Explain why hypotheses can be *supported*, but never *proven* absolutely true.

ANS:

A hypothesis is based on the best evidence available at a given time. There may be alternative explanations for supported hypotheses.

DIF: Moderate              REF: 1.2 Prove Me Wrong  
OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.  
MSC: Understanding

3. A student complains about the requirement of taking a biology course. She states that she is capable of following the “set recipe” of the scientific method, but she does not believe that science is useful because it cannot answer *all* questions. Explain to this student the types of questions science can answer. Also address her misunderstanding of the scientific method.

ANS:

Science provides answers to questions about the natural world. Science cannot provide answers to questions regarding supernatural beings or anything that cannot be detected and measured. Science is often referred to as a process to emphasize that science is more flexible than a “set recipe.” Scientists do not follow a rigid pattern to answer questions. Instead, scientists use evidence-based methods for acquiring knowledge. Evidence is used to support hypotheses and the best evidence at any given time may change previously held ideas.

DIF: Moderate REF: 1.0 Intro

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Understanding

4. Describe the main mechanism used to reduce researcher bias, or even prevent fraud, in science.

ANS:

When scientists communicate their results to fellow scientists during the peer-reviewed publication process, reviewers who are subject experts with no direct contact in the study being reviewed scrutinize the submitted work. If there are any concerns about the methodology, results, or analysis, the researcher submitting the work must address those concerns before his or her work is published.

DIF: Moderate REF: 1.3 Catching the Culprit

OBJ: 1.1 Caption a diagram of the scientific method, identifying each step in the process.

MSC: Understanding

5. People who exercise regularly have a lower average resting heart rate and blood pressure than people who do not exercise. Given this observation, develop a hypothesis and provide one prediction relating to that hypothesis.

ANS:

Hypothesis: Daily exercise reduces average resting heart rate and blood pressure.

Prediction: If one group of people exercises for thirty minutes every day and another group does not exercise, the first group will experience a reduction in average resting heart rate and blood pressure. The second group will not experience a change in average resting heart rate and blood pressure.

DIF: Difficult REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis. MSC: Applying

6. A parent heard a celebrity on television stating there was a study published in 1998 that asserted a connection between the measles-mumps-rubella (MMR) vaccine and the onset of autism in children. The celebrity went on to say that after the MMR vaccine replaced the old simple measles vaccine in 1988 there was a 273 percent increase in autism rates during the next 11 years. The celebrity, however, did not reveal that the study published in 1998 included a sample size of 12 children who were already known to have some form of autism or similar developmental difficulties. He also did not present the evidence from hundreds of studies conducted since 1998 that show no connection between vaccines and the onset of autism. What was the hypothesis, regarding vaccines and autism, implied by the celebrity? State at least two obvious problems with the structure of the 1998 study.

ANS:

The celebrity’s implied hypothesis was, “Vaccines cause autism.” Two obvious problems with the structure of the 1998 study include the extremely small sample size of 12 children and the bias introduced because all of the children had already been diagnosed with some form of autism or developmental difficulties. It was hardly a random sample.

DIF: Difficult REF: 1.2 Prove Me Wrong

OBJ: 1.2 Develop a hypothesis from a given observation and suggest one or more predictions based on that hypothesis. MSC: Applying

7. The claim has been made that women may be able to achieve significant improvements in memory by taking *Ginkgo biloba* supplements. To determine if the claim is fraudulent and prior to accepting this claim, what type of evidence would you like to see? Provide brief details of an investigative design.

ANS:

The hypothesis to be examined is, "Taking *Ginkgo biloba* supplements significantly improves the memory of women." The prediction is that if women take *Ginkgo biloba* supplements their memory function will improve. This can be tested by setting up an experiment that includes a control group of randomly selected women who receive a placebo and an experimental group of women who will actually receive *Ginkgo biloba* supplements. Consuming the *Ginkgo biloba* supplement would be the independent variable. The experiment should attempt to control for other possible factors such as age, amount of daily exercise, and other dietary considerations when selecting participants. Both groups of women would be tested before the study begins to determine their average memory capabilities (dependent variable) prior to the experiment. Both groups of women would be retested at the end of the experiment. Statistical analyses should be conducted to determine if any differences in memory function between the two groups are significant and if the data supports the hypothesis.

DIF: Difficult REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Evaluating

8. Terrance observes that tomato seeds sprouting in his fresh compost pile seem to grow at a faster rate than tomato seeds that he planted in potting soil that was previously used to grow house plants. Describe an experiment that he could use to test the hypothesis that tomato seeds grown in fresh compost grow faster than those grown in used potting soil. Include information about appropriate variables, treatments, and controls.

ANS:

A large group of tomato seeds would be randomly assigned to one of two groups. One group, the control group, would be grown in used potting soil. The second group, the experimental group, would be grown in fresh compost. The only difference in the treatment of the groups would be the single independent variable of the compost. The dependent variable would be the measured growth rate.

DIF: Moderate REF: 1.3 Catching the Culprit

OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Applying

9. Your friend says to you, "You do not need to understand evolution to understand biology because evolution is *just* a theory." How would you explain to your friend that a "theory" in science is not "*just* a theory"?

ANS:

In science, a theory usually consists of a group of well-researched and supported hypotheses that are interrelated. There are so many diverse and independent lines of investigation supporting these related hypotheses that form the theory that we can rely on the theory to help guide our understanding of all related topics. In the nonscience vernacular, the word *theory* usually refers to an untested explanation.

DIF: Moderate REF: 1.3 Catching the Culprit

OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Understanding



10. Organize the following concepts in order of broadest interactions between groups to the smallest structure and give a brief explanation of the concepts: biome, biosphere, community, ecosystem, organism, and population.

ANS:

Organism (an individual), population (a group of individuals of the same species living and interacting in a shared environment), community (the populations of different species that live and interact with one another in a particular place), ecosystem (a particular physical environment and all the communities found there), biome (a large region of the world defined by its physical characteristics, especially climate, and a distinctive community of organisms), biosphere (all the world's living organisms and the places where they live)

DIF: Moderate REF: 1.4 No End in Sight

OBJ: 1.5 Create a graphic showing the levels of biological organization.

MSC: Remembering

11. Describe how DNA makes it possible for organisms to make new individuals like themselves.

ANS:

No matter how simple or complex the life-form, the genetic code found in DNA provides the instructions to build new cellular components, carry out cellular metabolism, and dictate cellular behavior, including the initiation of cell reproduction and the transfer of information from one generation to the next. The DNA is read to produce proteins that direct cellular reproduction, produce new cellular components, and initiate cellular reproduction.

DIF: Moderate REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.

MSC: Applying

12. Consider the characteristics of living organisms. Would you classify viruses as living or nonliving? Justify your response.

ANS:

Viruses are typically considered nonliving because they lack most of the characteristics of life. Viruses can evolve as groups, but they do not display any of the other characteristics of life. Viruses are not composed of cells. They are not capable of reproducing without a host cell's machinery. They also are not capable of capturing energy from their environment, sensing their environment, or maintaining homeostasis.

DIF: Moderate REF: 1.1 Bat Crazy

OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.

MSC: Evaluating

## MATCHING

Match the correct terms with the sentences below.

- tests
- communicate
- accept, reject, or modify
- observe
- analyze

1. \_\_\_\_\_ and ask questions about the natural world.
2. Suggest a \_\_\_\_\_ to explain your observations and questions.
3. Generate \_\_\_\_\_ to test your hypothesis.
4. Design \_\_\_\_\_ of the predictions of your hypothesis.
5. \_\_\_\_\_ your results to fellow scientists for their review and input.
6. \_\_\_\_\_ your hypothesis, predictions, or test according to the results.
7. \_\_\_\_\_ the results.

8. ANS: B                      DIF: Moderate                      REF: 1.3 Catching the Culprit

- OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Applying
9. ANS: C DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Applying
10. ANS: D DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Applying
11. ANS: A DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.3 Identify the use of appropriate variables, treatments, and controls in the design of an experiment. MSC: Applying

Read each statement and identify whether the statement is a scientific fact, a scientific theory, or an opinion. Choices may be used more than once or not at all.

- scientific fact
  - scientific theory
  - opinion
12. The most beautiful sunsets are those observed in deserts.
13. White-nose syndrome in bats is a disease that is spreading across the United States.
14. Treating human infections and maintaining hygiene is based on substantial knowledge of germs.
15. A disease that affects tomatoes, tomato blight, is caused by a fungus.
12. ANS: C DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Analyzing
13. ANS: A DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Analyzing
14. ANS: B DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Analyzing
15. ANS: A DIF: Moderate REF: 1.3 Catching the Culprit  
OBJ: 1.4 Give specific examples of a scientific fact and a scientific theory.  
MSC: Analyzing

Match each term describing a level of biological hierarchy with its proper description. Terms may be used more than once or not at all.

- organism
  - organ
  - molecules
  - biome
  - ecosystem
  - atoms
  - biosphere
16. The individual building blocks of life, such as oxygen, are referred to as \_\_\_\_\_.
17. Chemical bonds hold hydrogen and oxygen atoms together to form \_\_\_\_\_.
18. The physical environment, especially the climate, and the organisms that live in deserts throughout the world make up a(n) \_\_\_\_\_.
19. The liver, a body part composed of different tissue types, is considered a(n) \_\_\_\_\_.
16. ANS: F DIF: Moderate REF: 1.4 No End in Sight

- OBJ: 1.5 Create a graphic showing the levels of biological organization.  
MSC: Understanding
17. ANS: C                      DIF: Moderate                      REF: 1.4 No End in Sight  
OBJ: 1.5 Create a graphic showing the levels of biological organization.  
MSC: Understanding
18. ANS: D                      DIF: Moderate                      REF: 1.4 No End in Sight  
OBJ: 1.5 Create a graphic showing the levels of biological organization.  
MSC: Understanding
19. ANS: B                      DIF: Moderate                      REF: 1.4 No End in Sight  
OBJ: 1.5 Create a graphic showing the levels of biological organization.  
MSC: Understanding

Match the following terms with the corresponding characteristic of life.

- a. evolution  
b. homeostasis  
c. metabolism  
d. cell  
e. DNA
20. maintaining a relatively constant internal environment  
21. genetic material used to transfer information from parent to offspring  
22. the smallest living unit  
23. a change in the characteristics of a group of organisms over time  
24. the way organisms capture, store, and use energy from the environment
20. ANS: B                      DIF: Easy                      REF: 1.1 Bat Crazy  
OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.  
MSC: Remembering
21. ANS: E                      DIF: Easy                      REF: 1.1 Bat Crazy  
OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.  
MSC: Remembering
22. ANS: D                      DIF: Easy                      REF: 1.1 Bat Crazy  
OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.  
MSC: Remembering
23. ANS: A                      DIF: Easy                      REF: 1.1 Bat Crazy  
OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.  
MSC: Remembering
24. ANS: C                      DIF: Easy                      REF: 1.1 Bat Crazy  
OBJ: 1.6 Determine whether something is living or nonliving based on the characteristics of living things.  
MSC: Remembering