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Correct Answers are located at the end of each chapter.

TRUE/FALSE - Write 'T' if the statement is true and 'F' if the statement is false.

1) Evolution is the genetic change in a species over time.
   - ◎ true
   - ◎ false

2) Some living organisms possess RNA as their only genetic material.
   - ◎ true
   - ◎ false

CHECK ALL THE APPLY. Choose all options that best completes the statement or answers the question.

3) Select all of the following that are observed in the science of biology.
   - A) animal behavior
   - B) supernatural occurrences
   - C) hereditary molecules
   - D) collecting fossils

4) Select all of the following that are properties of all living things.
   - A) homeostasis
   - B) cellular organization
   - C) thought
   - D) metabolism

5) Select all of the following that are underlying themes of biology.
   - A) decomposition
   - B) structure determines function
   - C) flow of energy
   - D) evolution

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MULTIPLE CHOICE - Choose the one alternative that best completes the statement or answers the question.

6) Which kingdom contains photosynthetic multicellular organisms that live on the land?
   A) Fungi
   B) Plantae
   C) Animalia
   D) Protista
   E) Archaea

7) Which kingdom contains nonphotosynthetic multicellular organisms that digest their food externally?
   A) Fungi
   B) Plantae
   C) Animalia
   D) Protista
   E) Archaea

8) Which kingdom contains nonphotosynthetic multicellular organisms that digest their food internally?
   A) Fungi
   B) Plantae
   C) Animalia
   D) Protista
   E) Archaea

9) Which group includes the simplest of organisms that do not have a nucleus?
   A) Animalia
   B) Plantae
   C) Protista
   D) Fungi
   E) Archaea and Bacteria

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10) The transmission of characteristics from parent to offspring is called
A) movement.
B) complexity.
C) homeostasis.
D) heredity.
E) metabolism.

11) The process of using and transforming energy is known as
A) response to stimulation.
B) complexity.
C) metabolism.
D) homeostasis.
E) cellular organization.

12) All living things are able to maintain stable internal conditions, whether they are unicellular or complex, multicellular organisms. This property is called
A) metabolism.
B) homeostasis.
C) heredity.
D) cellular organization.

13) The proper order for the hierarchy of increasing complexity is
A) organelles - cells - molecules - tissues - organs.
B) cells - molecules - organs - tissues - organelles.
C) molecules - organs - cells - tissues - organelles.
D) molecules - organelles - cells - tissues - organs.
E) organs - organelles - cells - molecules - tissues.

14) In a multicellular organism, different tissues that function together are grouped into
A) molecules.
B) cells.
C) organs.
D) communities.

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15) All the populations of a particular kind of organism are members of the same
A) community.
B) species.
C) habitat.
D) ecosystem.

16) The populations of all the different species that live in a given area are called the
A) community.
B) habitat.
C) ecosystem.
D) population.

17) As life forms become more advanced, new functions called _____ properties tend to occur as a result of the interaction of simpler components.
A) emergent
B) mutated
C) deductive
D) control

18) In tissues, the gain of new processes and abilities that individual cells do not possess is termed
A) coherency.
B) nucleation.
C) emergent properties.
D) independent assortment.
E) growth and reproduction.

19) What biological process exhibited by flowering plants and their insect pollinators is responsible for much of the diversity of these groups?
A) absorption
B) cooperation
C) artificial selection
D) homeostasis

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20) Scientists employ what type of reasoning when forming new hypotheses and discovering general principles?
A) inductive
B) deductive
C) controlled
D) variable

21) After Joseph Farman discovered, in 1985, that an ozone hole was developing over Antarctica, scientists measured levels of chemicals in the upper atmosphere. They found a surprising concentration of ozone-destroying
A) chlorine.
B) helium.
C) nitrates.
D) mercury.

22) The proper order for the scientific process is
A) predictions - experiment - observation - hypothesis.
B) experiment - observation - predictions - hypothesis.
C) hypothesis - observation - experiment - predictions.
D) observation - hypothesis - predictions - experiment.

23) In the scientific method, a proposed explanation of observations is called a/an
A) hypothesis.
B) control.
C) experiment.
D) conclusion.

24) In what part of a scientific experiment is the variable kept constant?
A) the control experiment
B) the hypothesis and theory
C) observation and prediction
D) conclusion

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25) A generally accepted scientific principle that is uniformly supported by a broad range of observations is called a/an
A) hypothesis.
B) theory.
C) truth.
D) observation.

26) Many physicians and nutritionists say that dietary fats are linked to higher incidences of heart disease in humans. Choose a hypothesis that a scientist could use to test this statement.
A) Diets that contain higher levels of meat are correlated with higher levels of cancer.
B) Eating a diet of lard increases body fat.
C) Dietary fat, heart disease, and cancer are all somehow interrelated.
D) Diets containing foods composed of at least 30% fat are correlated with an increase in heart disease.

27) A biologist wants to test the effectiveness of a new food additive on causing growth in mice. An effective control group is one that
A) ate a higher concentration of food additive.
B) was kept in different conditions than the treatment group.
C) was fed the same ration without the food additive.
D) ate a lower concentration of the food additive.

28) At the end of an experiment, a conclusion is formed by
A) accepting or rejecting the hypothesis.
B) proving the hypothesis.
C) the needs of the group funding the experiment.
D) the feelings or beliefs of the scientist conducting the experiment.

29) Testing of a hypothesis is called a/an
A) theory.
B) experiment.
C) variable.
D) prediction.
E) conclusion.

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30) A group of scientists wants to study the effect of vitamin C on colds. They recruit 100 people with colds and give the experimental group 1000 mg of vitamin C per day. What would be an appropriate control?

A) Give the control group nothing.
B) Give the control group 2000 mg of vitamin C per day.
C) Give the control group orange juice every day.
D) Give the control group a pill that is inert and does not contain vitamin C (a placebo).
E) Give the control group 1000 mg of another brand of vitamin C per day.

31) Who is credited for discovering cells?

A) Marie Curie
B) Anton van Leeuwenhoek
C) Robert Hooke
D) Francis Crick
E) Barbara McClintock

32) Who made discoveries that helped determine the structure of DNA?

A) Francis Crick and James Watson
B) Martha Chase and Alfred Hershey
C) Peter and Rosemary Grant
D) Matthias Schleiden and Theodor Schwann
E) Mary Lyon

33) All organisms possess a genetic system that is based on

A) glucose.
B) proteins.
C) DNA.
D) lipids.
E) sugars.

34) Which scientific theory states that genes are located on chromosomes?

A) cell theory
B) chromosomal theory of inheritance
C) theory of evolution
D) theory of connectivity

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35) What does the theory of heredity state?
A) Genes are inherited as discrete units.
B) All organisms are made of functional units called cells.
C) The traits that determine the unique characteristics of organisms are encoded by DNA.
D) Genes are made of DNA.

36) The most inclusive group in scientific classification is a
A) family.
B) domain.
C) kingdom.
D) species.

37) Charles Darwin proposed what process of evolutionary change in which favorable traits increase survival and are passed on to offspring?
A) natural selection
B) migration
C) independent assortment
D) mutation

38) What theory states that many forms of a gene may exist among members of a population and that those members with a form better suited to their particular habitat will tend to reproduce more successfully, and so their traits become more common in the population?
A) chromosomal theory of inheritance
B) cell theory
C) theory of relativity
D) theory of evolution

FILL IN THE BLANK. Write the word or phrase that best completes each statement or answers the question.

39) The kingdom that includes mushrooms and yeasts is the_____.

40) Groups of cells with a similar structure and function are called _____, several of which in turn work together to form organs in the body of more advanced multicellular organisms.

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41) The process where organisms act to maintain a relatively stable internal environment is called_____.

42) Using general principles to explain specific observations is called_____ reasoning, which is the reasoning of mathematics, philosophy, and computer science.

43) The method of uncovering general principles by carefully using the scientific method is called_____ reasoning.

44) Contaminants called chlorofluorocarbons (CFCs) in the upper atmosphere were found to be destructive to_____, which normally forms a layer that shields Earth from some of the sun's harmful UV rays.

45) A collection of related hypotheses that have been shown to be true after extensive testing can be collectively called a_____.

46) The information that determines what an organism will be like is stored in a molecule called_____.

47) A discrete unit of hereditary information called a_____ consists of a specific sequence of nucleotides in a DNA molecule.

48) The entire set of DNA instructions that specifies a cell is called its_____.

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

49) Explain why a student of biology needs to study the hierarchy of levels of organization within and among living things.

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50) Why is the study of biology central to the understanding and solving of the world's great environmental problems?

51) Explain the relationship between ozone depletion and rising incidence of skin cancer.

52) Many people think the term "theory" means someone's idea about something. Explain the scientific use of the term "theory," especially as it relates to the biological concept of evolution.

53) Why is it impossible for supernatural, religious, and unexplained phenomena to be explained by biology?

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Answer Key

Test name: Chapter 01

1) TRUE
2) FALSE
3) [A, C, D]
4) [A, B, D]
5) [B, C, D]
6) B
7) A
8) C
9) E
10) D
11) C
12) B
13) D
14) C
15) B
16) A
17) A
18) C
19) B
20) A
21) A
22) D
23) A
24) A
25) B
26) D
27) C
28) A
29) B
30) D
31) C
32) A
33) C
34) B
35) A
36) B
37) A

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38) D
39) Fungi
40) tissues
41) homeostasis
42) deductive
43) inductive
44) ozone
45) theory
46) DNA
47) gene
48) genome
49) Essay
50) Essay
51) Essay
52) Essay
53) Essay

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1 THE SCIENCE OF BIOLOGY CHAPTER OUTLINE

Biology and the Living World (p. 16)

1.1 The Diversity of Life (p. 16; Figure 1.1)

A. Biology is the study of living things.

B. All living things can be grouped into six kingdoms.

1. The six kingdoms include Archaea, Bacteria, Protista, Fungi, Plantae, and Animalia.

C. Biologists study the diversity of life in many ways.

1. Biologists observe behavior, study fossils, and examine DNA.

D. All living things have much in common.

1.2 Properties of Life (p. 17; Figures 1.2 and 1.3)

A. All living things share certain properties as a result of millions of years of evolution from the first organisms.

1. All living things are composed of one or more cells and thus show cellular organization.
2. Living organisms carry out metabolism in which they use and transform energy.
3. All living things maintain stable internal conditions or homeostasis.
4. Living organisms reproduce.
5. All living things possess a genetic system based on DNA and transmit characteristics from parents to their offspring in a process called heredity.

1.3 Organization of Life (p. 18; Figure 1.4)

A. There is a hierarchy of complexity within cells, organisms, and populations.

1. The hierarchy begins at the molecular level, at which the chemistry of life occurs.
2. Next is the organelle level at which cellular activities are organized.
3. The cell is the smallest living level of organization.
4. In multicellular organisms, cells are arranged into tissues that consist of cells working together.

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5. Different tissues may be combined into organs that carry out a function; various organs work together and comprise organ systems.
6. Individuals of the same type of organism living together make up a population.
7. All of the populations of a single kind of organism are members of the same species.
8. All the different species that live together in an area make up a community.
9. A community plus its physical habitat makes up an ecosystem.

B. Emergent properties are present at each higher level in the hierarchy that were not present at the simpler levels.

1. Emergent properties are the result of interactions between components.
2. These properties are the natural consequence of the structural organization that characterizes all life.
3. Functional properties, such as metabolism, emerge as organization becomes more complex.

1.4 Biological Themes (p. 20; Table 1.1)

A. The living world is organized by major themes.

B. Evolution is the change in species over time.

1. Charles Darwin proposed the idea of the process of natural selection.
2. Humans have long carried out artificial selection on domesticated organisms.
3. The diversity of life on earth today is the result of a long history of natural selection.

C. The flow of energy through the food chain is a key factor in shaping ecosystems.

D. Cooperation between different organisms has led to coevolution and is responsible for much of the diversity of living things.

E. Biological structures are closely related to their functions.

F. Maintaining homeostasis has contributed to the specialization of complex organisms.

The Scientific Process (p. 22)

1.5 How Scientists Think (p. 22; Figure 1.5)

A. Deductive reasoning is the reasoning of everyday thinking and how we make decisions; deductive reasoning uses logic rather than observation.

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B. Inductive reasoning is a way of discovering general scientific principles by the careful examination, or observation, of specific examples.

   1. From a series of observations, a hypothesis could be formed.

1.6 Science in Action: A Case Study (p. 23; Figure 1.6)

A. In 1985, British scientist Joseph Farman observed a 30% drop in the ozone levels in the Antarctic atmosphere.

B. Detailed evidence suggested that chlorofluorocarbons (CFCs), used as coolants, propellants, and foaming agents, were broken down in the upper atmosphere by UV light to produce chlorine (Cl), which acted as a catalyst to destroy ozone.

C. Thinning of the protective layer of ozone above the earth causes greater exposure to the sun's ultraviolet radiation, which can lead to skin cancer and other problems.

D. Even though CFC production has been reduced, ozone depletion continues due to previously manufactured CFCs, and ozone holes still exist over the Antarctic.

1.7 Stages of a Scientific Investigation (p. 24; Figures 1.7 and 1.8)

A. Scientists employ a series of steps, called the scientific method, to carry out scientific discovery.

B. The scientific method can be said to have six stages.

   1. The first step in the scientific method is observation.

   2. Next, a set of hypotheses is formed.

   3. Based on the hypotheses, predictions are made.

   4. Experiments are conducted to test the hypotheses.

   5. Experiments should include a control in which the variable is not altered.

   6. Based on the statistical analysis of the experiment, a conclusion is formed. A collection of related hypotheses that have withstood repeated experimentation is called a theory.

1.8 Theory and Certainty (p. 27; Figure 1.9)

A. A scientific theory is one that has withstood repeated observation and experimentation and holds true.

B. The term *theory* is used differently in common speech.

C. Scientists often do not just apply the scientific method in a series of steps; usually, scientific intuition and creativity play a large role.

D. Science cannot explain every facet of life, nor can it solve all problems.

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Core Ideas of Biology (p. 29)

1.9 Four Theories Unify Biology as a Science (p. 29; Figures 1.10–1.15)

A. The Cell Theory: Organization of Life

B. The Gene Theory: Molecular Basis of Inheritance

C. The Theory of Heredity: Unity of Life

D. The Theory of Evolution: Diversity of Life

KEY TERMS

- **kingdoms (p. 16)**
- **emergent properties (p. 19)**
- **natural selection (p. 20)**
- **artificial selection (p. 20)**
- **symbiosis (p. 20)**
- **deductive reasoning (p. 22)**
- **inductive reasoning (p. 22)**
- **hypothesis (p. 24)**
- **experiment (p. 24)**
- **observation (p. 24)**
- **alternative hypothesis (p. 25)**
- **prediction (p. 25)**
- **variable (p. 25)**
- **control experiment (p. 25)**
- **theory (p. 25)**
- **scientific method (p. 27)**
- **cell theory (p. 29)**
- **DNA (deoxyribonucleic acid) (p. 29)**
- **gene theory (p. 29)**

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- **genome** (p. 29)
- **theory of heredity** (p. 31)
- **chromosomal theory of inheritance** (p. 31)
- **theory of evolution** (p. 31)

LECTURE SUGGESTIONS AND ENRICHMENT TIPS

1. During the first lecture in biology, students are often unsure of themselves and insecure about their ability to excel in a science course. Help to put students' fears aside by discussing what you expect from them at the outset of class, including how you write your exams (emphasizing lecture or textbook or both); the nature of your exams (multiple choice, short answer, essay, etc.); and an outline of any other expectations.
2. List ways students can enhance their performance in class (good note-taking, attending class, asking questions, reviewing notes soon after taking them, and studying 2 hours per lecture or more).
3. You might ask students to list topics they would like to see covered in a course on biology. Alternatively, give them a list of potential topics, and ask them to check off a certain number that they find most intriguing. Then try to incorporate at least a few suggestions to help personalize the class for your students as well as to engage them in the learning process.
4. This chapter allows you to introduce the topics that will be covered throughout the course. Find a way to make it interesting, such as incorporating a slideshow about the diversity of life on earth, or include a video about the ozone hole or science in the making. Any colorful, lively video is suitable at this point when you are introducing students to the realm of biology.
5. Emphasize the scientific process and discuss a few hypothetical (or real) examples of simple experiments. Have students attempt to design experiments or contribute to their designs.
6. Differentiate between DNA and the genome and discuss the importance of the Human Genome Project.
7. Be prepared with articles from the local newspaper dealing with topics in biology. Show them biology in the news, and have them be on the lookout for related stories.
8. Choose a topic that has bioethical/legal considerations. Discuss how these issues might be decided at the voting booth, and why it is important to have a working knowledge of biology to make informed decisions.

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CRITICAL THINKING QUESTIONS

1. How would you address the statement: “biologically speaking, humans have the same inherent worth as do all other living things on this planet”? Is this true for biological ecosystems? Explain.
2. George Perkins Marsh once said, “Animal and vegetable life is too complicated a problem for human intelligence to solve, and we can never know how wide a circle of disturbance we produce in the harmonies of nature when we throw the smallest pebble into the ocean of organic life.” Based on this quote, explain whether the ozone hole created by human activities constitutes a small or large pebble.
3. Obesity in white lab mice has been related to increased problems with infertility. To verify this, a researcher wishes to try a new high-fiber diet ration on a group of obese white mice to see whether they can induce weight loss in the mice and thus increase their fertility. What should they use for a control group? Design a simple experiment to test the relationship between weight loss and increased fertility in white lab mice.

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