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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) The theory of evolution states that life's diversity results from changes in genes.
   - ◎ 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) Which of the below are examples of emergent properties?
   - A) Reproduction
   - B) Metabolism
   - C) Cellular organization
   - D) Consciousness
   - E) Growth

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

4) The simplest organisms do not have nuclei. In the list below, which group has the simplest organisms?
   - A) Bacteria
   - B) Fungi
   - C) Plantae
   - D) Animalia
   - E) Protista

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5) The process of using and transforming energy in living cells is called
   A) response to stimulation.
   B) complexity.
   C) metabolism.
   D) homeostasis.
   E) evolution.

6) There are five properties of living things. Which of the following properties provides an increase in the number of organisms within a population?
   A) growth and reproduction
   B) metabolism
   C) cellular organization
   D) homeostasis
   E) heredity

7) 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.
   E) growth and reproduction.

8) In a multicellular organism, different tissues that function together are grouped into
   A) organisms.
   B) cells.
   C) organs.
   D) tissue systems.
   E) atoms.

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9) All the populations of a particular kind of organism, that are able to interbreed with each other, are members of the same
   A) community.
   B) species.
   C) habitat.
   D) ecosystem.
   E) kingdom.

10) The different populations of all the species in a given area make up a(n)
   A) community.
   B) association.
   C) ecosystem.
   D) population.
   E) habitat.

11) Charles Darwin applied his observations of_____ to visualize the mechanism of natural selection.
   A) artificial selection
   B) chromosome segregation
   C) disease in humans
   D) microscopic cells
   E) CFC concentrations

12) There are five general themes that serve to both unify and explain the science of biology: cooperation, evolution, structure determines function, homeostasis, and
   A) distribution.
   B) chemical bonding.
   C) evaporation.
   D) flow of energy.
   E) branching patterns.

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13) The proper order for steps in the scientific process is
A) predictions→testing→observation→hypothesis.
B) testing→observation→predictions→hypothesis.
C) hypothesis→observation→testing→predictions.
D) observation→hypothesis→predictions→testing.
E) predictions→observation→hypothesis→testing.

14) All organisms possess a genetic system that is based on
A) LDL lipids.
B) protein.
C) DNA.
D) cells.
E) sugars.

15) 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.

16) The test of a hypothesis is called a(n)
A) control.
B) experiment.
C) variable.
D) prediction.
E) conclusion.

17) Who is credited with discovering cells?
A) Charles Darwin
B) Anton van Leeuwenhoek
C) Robert Hooke
D) Francis Crick
E) Joseph Farman

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18) DNA (deoxyribonucleic acid)
A) contains the information specifying what a cell is like.
B) is a source of energy that can be harvested by a cell.
C) is only present in higher cells.
D) is not passed from cell to cell.
E) is the main structural protein of a cell.

19) It is often publicized that excess dietary fats are linked to higher incidences of heart disease and cancer in humans. Choose the hypothesis that a scientist could test to examine this observation.
A) Eating more meat causes cancer.
B) Eating a diet of lard makes you fat.
C) Dietary fat, heart disease, and cancer are all somehow interrelated.
D) Calories from fat are correlated with an increase in heart disease.
E) The intake of 30% more than the recommended dietary fat, is correlated with an increase in heart disease and cancer.

20) A biologist wants to test the effectiveness of a new food additive on growth in mice. An effective control group would be one that
A) ate a higher concentration of food additive.
B) was kept in different conditions across the city with altering food additives.
C) was fed the same ration without the food additive.
D) ate a lower concentration of the food additive.
E) was kept under the same conditions and fed the same ration but without the food additive.

21) A scientist wants to study the effect of vitamin C on colds. He recruits 100 people with colds and gives the experimental group a pill containing 1,000 mg of vitamin C per day. The appropriate control group of this study would be given
A) nothing.
B) 2,000 mg of vitamin C per day.
C) orange juice every day.
D) a pill similar to the one containing vitamin C but lacking vitamin C.
E) 1,000 mg of another brand of vitamin C per day.

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22) Scientists employ_____ at the very beginning of the scientific process.
A) observations
B) deductions
C) predictions
D) experiments
E) theories

23) After scientists observed that an ozone hole was developing over Antarctica, they measured levels of chemicals in the upper atmosphere. They found a surprising concentration of ozone-destroying
A) chlorofluorocarbons.
B) helium.
C) super nitric oxide.
D) mercury.
E) nitrogen.

24) In 1865, Gregor Mendel stated that all genes of an organism are inherited as discrete units. This is known as the
A) theory of evolution.
B) theory of heredity.
C) natural selection observation.
D) gene theory.
E) cell theory.

25) The cell theory
A) is supported by evidence provided by Hooke, van Leeuwenhoek, Schleiden, and Schwann.
B) states cells come from preexisting cells.
C) states living organisms are composed of cells.
D) states cells are the basic unit of life.
E) All of the answer choices are correct.

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26) At the end of an experiment, a conclusion is formed based on the
A) analysis of the results of an experiment.
B) general observations during the experiment.
C) needs of the group funding the experiment.
D) feelings or beliefs of the scientist conducting the experiment.
E) All of these choices are used by scientists to form conclusions.

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

28) Which kingdom contains non-photosynthetic multicellular organisms that digest their food externally?
A) Fungi
B) Plantae
C) Animalia
D) Protista
E) Archaea

29) Which kingdom contains non-photosynthetic multicellular organisms that digest their food internally?
A) Fungi
B) Plantae
C) Animalia
D) Protista
E) Archaea

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30) Which statement would lose points on an exam about the scientific process?

A) Hypotheses can be rejected.
B) Alternative hypotheses can be proposed and tested after initial experimentation.
C) A scientific theory is mainly an educated "guess."
D) Supernatural phenomena are not scientifically testable.
E) In a control experiment, the variable of interest is not altered.

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

31) The kingdom that includes mushrooms and yeast is the_____.

32) All living things are composed of one or more_____, tiny compartments that are the basic units of life.

33) As life-forms become more advanced, new properties occur. These properties are referred to as_____.

34) The information that determines what a cell is like, and how it interacts with other cells, is stored in the_____ molecule.

35) The final step in the scientific process is the development of a_____.

36) A collection of related hypotheses that have not been rejected after extensive testing can be collectively called a_____.

37) A discrete unit of genetic information is called a_____.

38) Imagine that you have discovered a new organism that has all five properties of life. What hereditary material would it have?

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39) The theory of _____ explains the diversity of finches observed on the Galápagos Islands.

40) Heat maps of the atmosphere indicate where the ozone layer is thinning. In thinner areas, you could hypothesize that there are higher amounts of _____ being emitted.

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

41) At the cellular level, explain the hierarchical relationship between macromolecules, atoms, and molecules.

42) 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.

43) Explain how a depletion in ozone might lead to a rise in the incidence of skin cancer.

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Answer Key

Test name: Chapter 01

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

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38) DNA
39) evolution
40) [chlorofluorocarbons, or CFCs]
41) Essay
Review section 1.3 in your eBook by using the eBook button in the resources area.

42) Essay
Please see section 1.6 in your eBook by using the eBook button in the resources area. Evolution has been highly tested for over a century in various ways.

43) Essay
Please see sections 1.5 in your eBook by using the eBook button in the resources area. Successful hypotheses can be used to make predictions about the future.

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Instructor's Manual

to accompany

Essentials of The Living World

Seventh Edition

George Johnson
Washington University

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1 THE SCIENCE OF BIOLOGY
CHAPTER OUTLINE

LEARNING OBJECTIVES

- List the six kingdoms of life (1.1.1).
- Name and describe the five basic properties shared by all living things (1.2.1).
- List the 13 hierarchical levels of the organization of life (1.3.1).
- Explain the origin of emergent properties (1.3.2).
- Explain the five general themes that define biology as a science (1.4.1).
- Explain how the six stages of a scientific investigation allow biologists to discover general principles by careful examination of specific cases (1.5.1)
- Distinguish between hypothesis and theory (1.6.1).
- State the cell theory (1.7.1).
- Define the term gene (1.7.2).
- State how the theory of heredity is related to the chromosomal theory of inheritance (1.7.3).
- State how the theory of evolution is related to the gene theory (1.7.4).

Biology and the Living World (p. 18)

1.1 The Diversity of Life (p. 18; Fig. 1.1)

A. Biology is the study of living things.
B. All living things can be grouped into six kingdoms.
   1. The six kingdoms are 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 share common attributes.

1.2 Properties of Life (p. 19; Figs. 1.2, 1.3)

A. All living things share certain properties.
   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 grow and reproduce.
   5. All living things possess a genetic system based on DNA and transmit characteristics from parent to offspring in a process called heredity.

1.3 The Organization of Life (p. 20; Fig. 1.4)

A. There is a hierarchy of complexity within cells, within organisms, and within 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.
   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 and its physical habitat makes up an ecosystem.
B. Emergent properties are properties present at a 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 structural organization that characterizes all life.

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3. Functional properties, such as metabolism, emerge as the organization becomes more complex.

1.4 Biological Themes (p. 22)

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 results from 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. 24)

1.5 Stages of a Scientific Investigation (p. 24; Figs. 1.5, 1.6)

A. Scientists employ a series of steps, called the scientific method, to carry out scientific investigations.
B. The scientific method can be said to have six steps.
   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 analysis of the experiment, a conclusion is formed; a collection of related hypotheses that have withstood repeated experimentation is called a theory.

1.6 Theory and Certainty (p. 26; Fig. 1.7)

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; scientific intuition and creativity play a large role.
D. Science cannot explain every facet of life, nor can it solve all problems.

Core Ideas of Biology (p. 28)

1.7 Four Theories Unify Biology as a Science (p. 28; Figs. 1.8–1.13)

A. The Cell Theory
   1. All organisms are composed of cells, and all cells come from other cells.
B. The Gene Theory
   1. Organisms encode their genes (units of hereditary information) in molecules of DNA.
C. The Theory of Heredity
   1. The genes of an organism are passed on to offspring as discrete units.
D. The Theory of Evolution
   1. Modifications in genes are passed to offspring and, through natural selection, these changes lead to a diversity of organisms.

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KEY TERMS

- **Severe Acute Respiratory Syndrome (SARS)** (p. 17)
- **Middle East Respiratory Syndrome (MERS)** (p. 17)
- **SARS CoV2 (SARS Corona Virus, version 2)** (p. 17)
- **Coronavirus Disease-2019 (COVID-19)** (p. 17)
- **kingdoms** (p. 18)
- **metabolism** (p. 19)
- **homeostasis** (p. 19, 23)
- **population** (p. 21)
- **species** (p. 21)
- **community** (p. 21)
- **ecosystem** (p. 21)
- **emergent properties** (p. 21)
- **natural selection** (p. 22)
- **symbiosis** (p. 23)
- **hypothesis** (p. 24, 25)
- **variable** (p. 25)
- **theory** (p. 25)
- **DNA (deoxyribonucleic acid)** (p. 28)
- **theory of evolution** (p. 30)

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, and so forth); and an outline of any other expectations.
2. List ways students can enhance their performance in class (good note-taking, class attendance, asking questions, reviewing notes soon after taking them, studying 2 hours per lecture or more).
3. You might ask students to list topics they would like to see covered in a biology course. 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 and 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 enjoyable, such as incorporating a slideshow about the diversity of life on Earth, or include a DVD about the ozone hole or science in the making. Any colorful, lively DVD 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 design.
6. Differentiate between DNA and 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.
9. Direct your students to online resources to augment their learning process. If you have a website designated to the course, post a weekly discussion question and a list of online references to consult in order to enhance student engagement.

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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 if weight loss can be induced in the mice and thus increase their fertility. What should the researcher use for a control group? Design a simple experiment to test the relationship between weight loss and increased fertility in white lab mice.
4. Explain why it is so important to develop hypotheses that can be tested, instead of those that cannot.
5. How is the process of science different from other disciplines that describe the natural world?
6. Other than the examples given in the book, give two species that might be studied to see if one species’ presence limits the size of the other. Briefly explain why you have chosen these species, and which factors you would choose to study to document one species’ effect on the other.

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