Study Guide and Workbook: An Interactive Approach

FOR STARR'S

BIOLOGY

CONCEPTS AND APPLICATIONS

THIRD EDITION

John D. Jackson
Jane B. Taylor

STUDY GUIDE AND WORKBOOK: AN INTERACTIVE APPROACH

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PREFACE

Tell me and I will forget, show me and I might remember, involve me and I will understand.
—Chinese Proverb

The proverb outlines three levels of learning, each successively more effective than the method preceding it. The writer of the proverb understood that humans learn most efficiently when they *involve* themselves in the material to be learned. This study guide is like a tutor; when properly used it increases the efficiency of your study periods. The interactive exercises actively involve you in the most important terms and central ideas of your text. Specific tasks ask you to recall key concepts and terms and apply them to life; they test your understanding of the facts and indicate items to reexamine or clarify. Your performance on these tasks provides an estimate of your next test score based on specific material. Most important, though, this biology study guide and text together help you make informed decisions about matters that affect your own well-being and that of your environment. In the years to come, human survival on planet Earth will require administrative and managerial decisions based on an informed biological background.

HOW TO USE THIS STUDY GUIDE

Following this preface, you will find an outline that shows you how the study guide is organized and that will help you use it efficiently. Each chapter begins with a title and an outline list of the 1- and 2-level headings in that chapter. The Interactive Exercises follow, wherein each chapter is divided into sections of one or more of the main (1-level) headings. These sections are labeled 1 - I, 1 - II, and so on. The Interactive Exercises begin with a list of Selected Words (other than boldfaced terms) selected by the author as those that are most likely to enhance understanding. In the text chapters, these words appear in italics, quotation marks, or roman type. This is followed by a list of Boldfaced, Page-Referenced Terms, which appear boldfaced in the text. These terms are essential to understanding each study guide section of a particular chapter. Space is provided by each term for you to formulate a definition in your own words. Next is a series of different types of exercises that includes completion, short answer, true/false, fill-in-the-blanks, matching, choice, dichotomous choice, label and match, crossword puzzles, problems, labeling, sequencing, multiple-choice, and completion of tables.

A Self-Quiz immediately follows the Interactive Exercises. This quiz is composed primarily of multiple-choice questions, although sometimes we present another examination device or some combination of devices. Any wrong answers in the quiz indicate portions of the text you need to reexamine. A series of Chapter Objectives/Review Questions follows each Self-Quiz. These are tasks that you should be able to accomplish if you have understood the assigned reading in the text. Some objectives require you to compose a short answer or long essay, while others require drawing a sketch or supplying correct words.

The final part of each chapter is named Integrating and Applying Key Concepts. It invites you to try your hand at applying major concepts to situations in which there is not necessarily a single pat answer, and so none is provided in the chapter answer section (except for a problem in Chapter 9). Your text generally will provide enough clues to get you started on an answer, but this part is intended to stimulate your thought and provoke group discussions. A separate publication titled *Critical Thinking Exercises for Starr's Biology: Concepts and Applications*, Third Edition, is available. Corresponding with the text chapters, these exercises present problem situations that concentrate on the critical and higher-level thinking skills used by scientists. Solving these problems requires you to apply chapter information to form new perspectives, analyze data, draw conclusions, make predictions, and identify basic assumptions.

A person's mind, once stretched by a new idea, can never return to its original dimension.
—Oliver Wendell Holmes

STRUCTURE OF THIS STUDY GUIDE

The outline below shows how each chapter in this study guide is organized.

Chapter Number → 8

Chapter Title → **MEIOSIS**

Chapter Outline →

COMPARISON OF ASEXUAL AND SEXUAL REPRODUCTION

MEIOSIS AND THE CHROMOSOME NUMBER
- **Think "Homologues"**
- **Two Divisions, Not One**

A VISUAL TOUR OF THE STAGES OF MEIOSIS

KEY EVENTS OF MEIOSIS I
- **Prophase I Activities**
- **Metaphase I Alignments**

FROM GAMETES TO OFFSPRING
- **Gamete Formation in Plants**
- **Gamete Formation in Animals**
- **More Gene Shufflings at Fertilization**

MEIOSIS AND MITOSIS COMPARED

Interactive Exercises → The interactive exercises are divided into numbered sections by titles of main headings and page references. Each section begins with a list of author-selected words that appear in the text chapter in italics, quotation marks, or roman type. This is followed by a list of important boldfaced, page-referenced terms from each section of the chapter. Each section ends with interactive exercises that vary in type and require constant interaction with the important chapter information.

Self-Quiz → Usually a set of multiple-choice questions that sample important blocks of text information.

Chapter Objectives/Review Questions → Combinations of relative objectives to be met and questions to be answered.

Integrating and Applying Key Concepts → Applications of text material to questions for which there may be more than one correct answer.

Answers to Interactive Exercises and Self-Quiz → Answers for all interactive exercises can be found at the end of this study guide by chapter and title, and the main headings with their page references, followed by answers for the Self-Quiz.

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METHODS AND CONCEPTS IN BIOLOGY

Interactive Exercises

Note: In the answer sections of this book, a specific molecule is most often indicated by its abbreviation. For example, adenosine triphosphate is ATP.

1 - I. ORGANIZATION IN NATURE (pp. 2 - 5)

Selected Words: *energy transfers*

In addition to the boldfaced terms, the text features other important terms essential to understanding the assigned material. "Selected Words" is a list of these terms, which appear in the text in italics, in quotation marks, and occasionally in roman type. Latin binomials found in this section are underlined and in roman type to distinguish them from other italicized words.

Boldfaced, Page-Referenced Terms

The page-referenced terms are important; they were in boldface type in the chapter. Write a definition for each term in your own words without looking at the text. Next, compare your definition with that given in the chapter or in the text glossary. If your definition seems inaccurate, allow some time to pass and repeat this procedure until you can define each term rather quickly (how fast you can answer is a gauge of your learning effectiveness).

(4) energy _____

_____

(4) DNA _____

_____

(4) cell _____

_____

(4) multicelled organism _____

_____

(4) population _____

_____

(4) community _____

_____

(4) ecosystem _____

_____

(4) biosphere _____

_____

(5) metabolism _____

_____

(5) photosynthesis _____

_____

(5) ATP _____

_____

(5) aerobic respiration _____

_____

(5) producers _____

_____

(5) consumers _____

_____

(5) decomposers _____

_____

Matching

Choose the most appropriate answer for each term.

1. ___ organ system
2. ___ cell
3. ___ community
4. ___ ecosystem
5. ___ molecule
6. ___ DNA
7. ___ organelle
8. ___ population
9. ___ subatomic particle
10. ___ tissue
11. ___ biosphere
12. ___ energy
13. ___ multicelled organism
14. ___ organ
15. ___ atom

A. One or more tissues interacting as a unit
B. A proton, neutron, or electron
C. A well-defined structure within a cell, performing a particular function
D. All of the regions of Earth where organisms can live
E. A capacity to make things happen, to do work
F. The smallest unit of life
G. Two or more organs whose separate functions are integrated to perform a specific task
H. Two or more atoms bonded together
I. All of the populations interacting in a given area
J. The smallest unit of a pure substance that has the properties of that substance
K. A special molecule; sets living things apart from the nonliving world
L. A community interacting with its nonliving environment
M. An individual composed of cells arranged in tissues, organs, and often organ systems
N. A group of individuals of the same species in a particular place at a particular time
O. A group of cells that work together to carry out a particular function

Fill-in-the-Blanks

(16) _____refers to the cell's capacity to extract and transform energy from its surroundings and use energy to maintain itself, grow, and make more cells. Leaves contain cells that carry on the process of (17) _____ by trapping energy from the sun and using it to produce molecules of the energy carrier called (18) _____. These molecules transfer energy to sites inside the cell where enzymes put together sugars, starch, and other substances. Cells store excess energy. In most organisms, stored energy is released and transferred to ATP by way of a metabolic process known as aerobic (19) _____. Plants and other photosynthetic organisms are food (20) _____ and serve as an energy entry point for the world of life. Animals feed directly or indirectly on energy stored in tissues of the photosynthesizers; they are known as (21) _____. (22) _____ are bacteria and fungi that feed on tissues or remains of other organisms. Thus, there are (23) _____ among organisms based on a one-way flow of energy through them and a cycling of materials among them.

1 - II. SENSING AND RESPONDING TO THE ENVIRONMENT (p. 6)
CONTINUITY AND CHANGE (pp. 6 - 7)

Selected Words: *variations, hemophilia*

Boldfaced, Page-Referenced Terms

(6) receptors _____

_____

(6) homeostasis _____

_____

(6) reproduction _____

_____

(7) inheritance _____

_____

(7) mutation _____

_____

(7) adaptive trait _____

_____

Fill-in-the-Blanks

Molecules and structures called (1) _____ permit organisms to detect specific information about the environment and make controlled responses to them. (2) _____ is the capacity to maintain rather constant physical and chemical conditions inside an organism within some tolerable range, even when external conditions vary. The production of offspring is known as (3) _____. (4) _____ means that parent organisms transmit specific DNA instructions for duplicating their traits to offspring. DNA assures that offspring will resemble their parents but also permit (5) _____ in the details of most traits. A person born with six fingers on each hand represents the outcome of a (6) _____, a molecular change in DNA. An (7) _____ trait is one that improves the survival and reproduction of an organism in a certain environment.

1 - III. SO MUCH UNITY, YET SO MANY SPECIES (pp. 8 - 9)

Selected Words: *family, order, class, phylum, kingdoms, prokaryotic, eukaryotic*

Boldfaced, Page-Referenced Terms

(8) species _____

_____

(8) genus _____

_____

(8) monerans _____

_____

(8) protistans _____

_____

(9) fungi _____

_____

(9) plants _____

_____

(9) animals _____

_____

Fill-in-the-Blanks

Different "kinds" of organisms are referred to as (1) _____. A (2) _____ is the first of a two-part name of each organism, and it encompasses all the species having perceived similarities to one another. The pronghorn antelope is known by the two-part name *Antilocapra americana; Antilocapra* is the (3) _____ name and *americana* is the (4) _____ name.

Complete the Table

5. Fill in the table below by entering the correct name of each kingdom of life described.

Kingdom	*Description*
a.	Eukaryotic, multicelled, photosynthetic producers
b.	Prokaryotic, single-celled producers, consumers, or decomposers
c.	Eukaryotic, mostly multicelled, decomposers and consumers
d.	Eukaryotic, diverse multicelled consumers, typically move about
e.	Eukaryotic, single-celled species and multicelled forms

Sequence

Arrange in correct hierarchical order with the largest, most inclusive category first and the smallest, most exclusive category last. This exercise classifies a plant with the common name of "false Solomon's seal." Refer to page 8 in the text and Appendix II.

6. ___ A. Class: Monocotyledonae
7. ___ B. Family: Liliaceae
8. ___ C. Genus: *Smilacina*
9. ___ D. Kingdom: Plantae
10. ___ E. Order: Liliales
11. ___ F. Division: Anthophyta
12. ___ G. Species: *racemosa*

1 - IV. AN EVOLUTIONARY VIEW OF LIFE'S DIVERSITY (p. 10)

Boldfaced, Page-Referenced Terms

(10) evolution _____

_____

(10) artificial selection _____

_____

(10) natural selection _____

_____

True/False

If the statement is true, write a T in the blank. If the statement is false, correct it by changing the underlined word and writing the correct word(s) in the blank.

_____ 1. Evolution means that one or more of the traits that characterize a population are stabilizing through successive generations.

_____ 2. Pigeon breeding is a case of artificial selection.

_____ 3. If some organisms in a population inherit traits that lend them a survival advantage, they will be more likely to produce offspring.

_____ 4. If a trait is adaptive, it means that it improves the chances of surviving and reproducing.

_____ 5. Natural selection is the outcome of similarities in survival and reproduction that have occurred among individuals that differ in one or more traits.

1 - V. THE NATURE OF BIOLOGICAL INQUIRY (p. 11)
Focus on Science: DARWIN'S THEORY AND DOING SCIENCE (p. 12)
THE LIMITS OF SCIENCE (p.13)

Selected Words: *breadth of application, alternative hypotheses, subjective, internal conviction*

Boldfaced, Page-Referenced Terms

(11) hypotheses _____

_____

(11) prediction _____

_____

(11) test _____

_____

(11) theory _____

_____

(12) experiment _____

_____

(12) control group _____

_____

(12) key variable _____

_____

Sequence

Arrange the following steps of the scientific method in correct chronological sequence. Write the letter of the first step next to 1, the letter of the second step next to 2, and so on.

1. ___ A. Develop one or more hypotheses about what the solution or answer to a problem might be.
2. ___ B. Devise ways to test the accuracy of predictions drawn from the hypothesis (use of observations, models, and experiments).
3. ___ C. Repeat or devise new tests (different tests might support the same hypothesis).
4. ___ D. Make a prediction using the hypothesis as a guide.
5. ___ E. If the tests do not provide the expected results, check to see what might have gone wrong.
6. ___ F. Objectively report the results from tests and the conclusions drawn.
7. ___ G. Identify a problem or ask a question about nature

Labeling

Assume that you have to identify what object is hidden inside a sealed, opaque box. Your only tools to test the contents are a bar magnet and a triple-beam balance. Label each of the following with an O (for observation) or a C (for conclusion).

8. ____ The object has two flat surfaces.
9. ____ The object is composed of nonmagnetic metal.
10. ____ The object is not a quarter, a half dollar, or a silver dollar.
11. ____ The object weighs x grams.
12. ____ The object is a penny.

Complete the Table

13. Complete the following table of concepts important to understanding the scientific method of problem solving. Choose from scientific experiment, variable, prediction, control group, hypothesis, and theory.

Concept	*Definition*
a.	An educated guess about what the answer (or solution) to a scientific problem might be
b.	A statement of what one should be able to observe in nature if one looks; the "if-then" process
c.	A related set of hypotheses that, taken together, form a broad explanation of a fundamental aspect of the natural world
d.	A carefully designed test that manipulates nature into revealing one of its secrets
e.	Used in scientific experiments to evaluate possible side effects of a test being performed on an experimental group
f.	The control group is identical to the experimental group except for the key factor under study

Completion

14. Questions that are _____ in nature do not readily lend themselves to scientific analysis.
15. Scientists often stir up controversy when they explain a part of the world that was considered beyond natural explanation—that is, belonging to the "_____."
16. The external world, not internal _____, must be the testing ground for scientific beliefs.

Self-Quiz

___ 1. About 12 to 24 hours after a meal, a person's blood-sugar level normally varies from about 60 to 90 mg per 100 ml of blood, though it may attain 130 mg/100 ml after meals high in carbohydrates. That the blood-sugar level is maintained within a fairly narrow range despite uneven intake of sugar is due to the body's ability to carry out _____.
a. predictions
b. inheritance
c. metabolism
d. homeostasis

___ 2. Different species of Galapagos Island finches have different beak types to obtain different kinds of food. One species removes tree bark with a sharp beak to forage for insect larvae and pupae while another species has a large, powerful beak capable of crushing and eating large, heavy coated seeds. These statements illustrate _____.
a. adaptation
b. metabolism
c. puberty
d. homeostasis

___ 3. A boy is color-blind just as his grandfather was, even though his mother had normal vision. This situation is the result of_____.
a. adaptation
b. inheritance
c. metabolism
d. homeostasis

___ 4. The digestion of food, the production of ATP by respiration, the construction of the body's proteins, cellular reproduction by

cell division, and the contraction of a muscle are all part of _____.
a. adaptation
b. inheritance
c. metabolism
d. homeostasis

___ 5. Which of the following does *not* involve using energy to do work?
a. atoms bonding together to form molecules
b. the division of one cell into two cells
c. the digestion of food
d. none of these

___ 6. The experimental group and control group are identical except for _____.
a. the number of variables studied
b. the variable under study
c. the two variables under study
d. the number of experiments performed on each group

___ 7. A hypothesis should *not* be accepted as valid if _____.
a. the sample studied is determined to be representative of the entire group
b. a variety of different tools and experimental designs yield similar observations and results
c. other investigators can obtain similar results when they conduct the experiment under similar conditions
d. several different experiments, each without a control group, systematically eliminate each of the variables except one

___ 8. The principal point of evolution by natural selection is that_____ .
a. it measures the difference in survival and reproduction that has occurred among individuals who differ from one another in one or more traits
b. even bad mutations can improve survival and reproduction of organisms in a population
c. evolution does not occur when some forms of traits increase in frequency and others decrease or disappear with time
d. individuals lacking adaptive traits make up more of the reproductive base for each new generation

___ 9. Which match is incorrect?
a. Kingdom Animalia—multicelled consumers, most move about
b. Kingdom Plantae—mostly multicelled producers
c. Kingdom Monera—relatively simple, multicelled organisms
d. Kingdom Fungi—mostly multicelled decomposers
e. Kingdom Protista—many complex single cells, some multicellular

___ 10. The least inclusive of the taxonomic categories listed is_____ .
a. family
b. phylum
c. class
d. order
e. genus

Chapter Objectives/Review Questions

This section lists general and detailed chapter objectives that can be used as review questions. You can make maximum use of these items by writing answers on a separate sheet of paper. Fill in answers where blanks are provided. To check for accuracy, compare your answers with information given in the chapter or glossary.

Page	*Objectives/Questions*
(4)	1. _____ interactions among molecules bind the parts of all structures together—they hold a rock together and they hold a frog together.
(4)	2. A special molecule called _____ acid, or DNA, sets living things apart from the nonliving world.
(4)	3. The _____ is an organized unit that can survive and reproduce on its own, given DNA, raw materials, and inputs of energy.
(4)	4. Distinguish between single-celled organisms and multicelled organisms.

(4) 5. Arrange in order, from smallest to largest, the levels of organization that occur in nature. Define each as you list it.
(5) 6. _____ means energy transfers within the cell.
(5) 7. Organisms use a molecule known as _____ to transfer chemical energy from one molecule to another.
(5) 8. By the process of aerobic _____, cells can release stored energy in food molecules and produce ATP molecules.
(5) 9. Explain how the actions of producers, consumers, and decomposers create an interdependency among organisms.
(5) 10. Describe the general pattern of energy flow through Earth's life forms and explain how Earth's resources are used again and again (cycled).
(6) 11. _____ are certain molecules and structures that can detect specific kinds of information about the environment.
(6) 12. A fairly constant level of physical and chemical conditions inside an organism represents a state of _____.
(6) 13. _____ means the production of offspring.
(7) 14. Explain the origin of trait variations that function in inheritance.
(7) 15. An _____ trait is any trait that helps an organism survive and reproduce under a given set of environmental conditions.
(8) 16. Explain the use of genus and species names by considering your Latin name, *Homo sapiens.*
(8) 17. Arrange in order, from greater to fewer organisms included, the following categories of classification: class, family, genus, kingdom, order, phylum, and species.
(8) 18. Distinguish these terms: *prokaryotic, eukaryotic.*
(8) 19. List the five kingdoms of life; briefly describe organisms placed in each.
(10) 20. As organisms move through time in successive generations, the character of populations change; this is called _____.
(10) 21. Darwin used _____ selection as a model for natural selection.
(10) 22. Define *natural selection* and briefly describe what is occurring when a population is said to evolve.
(10) 23. Explain what is meant by the term *diversity* and speculate about what caused the great diversity of life forms on Earth.
(11) 24. Define what is meant by *theory;* cite an actual example.
(11) 25. Distinguish a theory from a prediction and the hypothesis.
(12) 26. Tests performed to reveal nature's secrets are called _____.
(12) 27. Generally, members of a control group should be identical to those of the experimental group except for the key factor under study, the _____.
(13) 28. Explain the advantages of the "uncertainty" related to scientific endeavors.
(13) 29. Explain how the methods of science differ from answering questions by using subjective thinking and systems of belief.

Interpreting and Applying Key Concepts

1. Humans have the ability to maintain body temperature very close to 37°C.
   a. What conditions would tend to make the body temperature drop?
   b. What measures do you think your body takes to raise body temperature when it drops?
   c. What conditions would cause body temperature to rise?
   d. What measures do you think your body takes to lower body temperature when it rises?
2. Do you think that all humans on Earth today should be grouped in the same species?
3. What sorts of topics are usually regarded by scientists as untestable by the kinds of methods that scientists generally use?