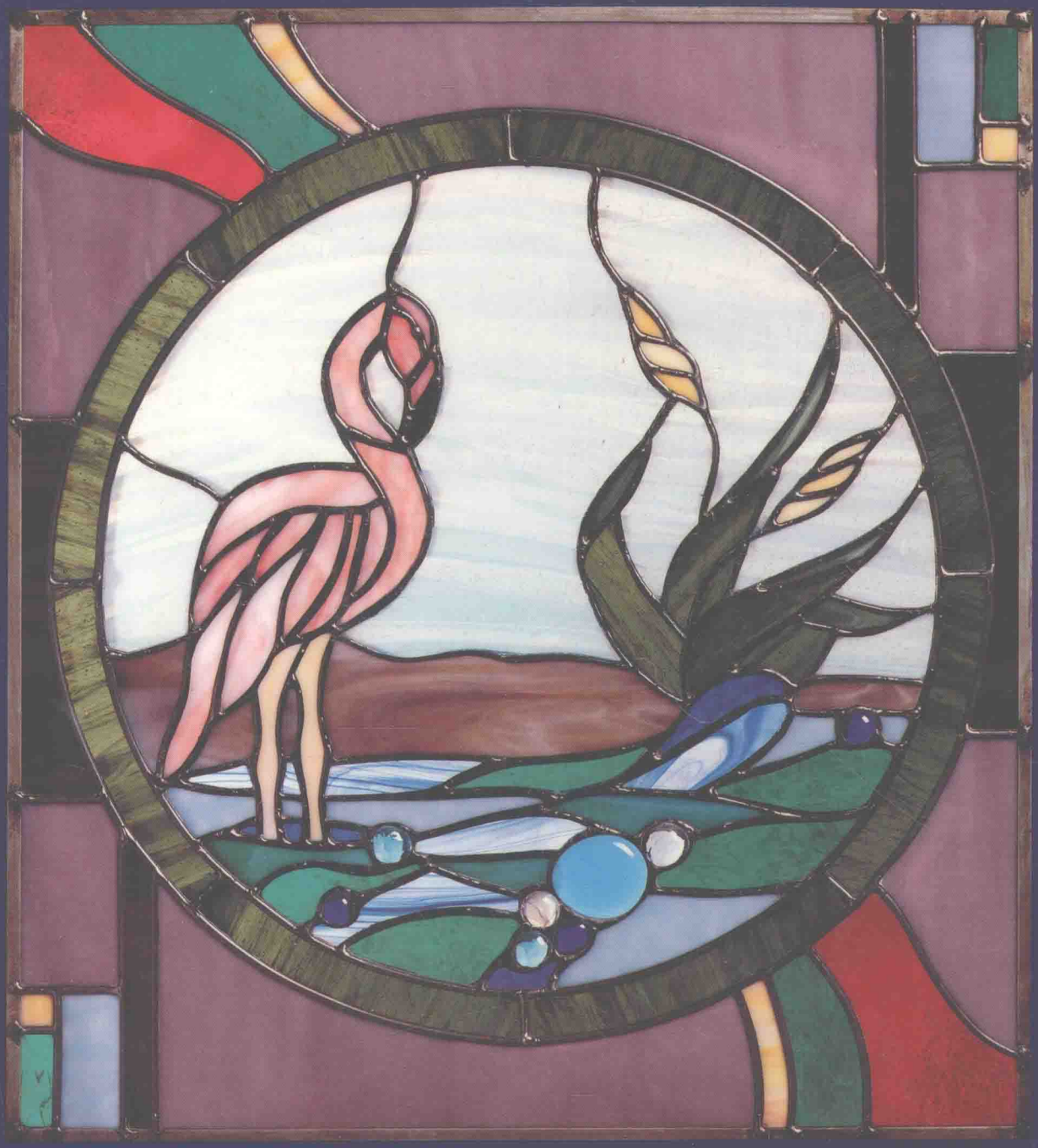
Margaret Gould Burke & Ronald M. Taylor

Study Guide
to accompany

BIOLOGY

Third Edition



Raven & Johnson

STUDY GUIDE

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BIOLOGY

THIRD EDITION

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WCB Wm. C. Brown Publishers
Dubuque, Iowa • Melbourne, Australia • Oxford, England

Wm. C. Brown Communications, Inc.

President and Chief Executive Officer *G. Franklin Lewis*
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Corporate Senior Vice President and Chief Financial Officer *Robert Chesterman*

A Times Mirror Company

ISBN 0-697-23497-5

Printed in the United States of America by Wm. C. Brown Communications, Inc., 2460 Kerper Boulevard, Dubuque, IA 52001

10 9 8 7 6 5 4 3

PREFACE

GETTING THE MOST OUT OF THIS STUDY GUIDE AND YOUR STUDYING

Welcome to the world of introductory biology. It is a fascinating and exciting world, but one that can also seem overwhelming at times. This Study Guide is designed to help you appreciate the fascination and excitement, without being overwhelmed. By reading this preface you are taking a first and very important step toward helping yourself do as well as possible in your biological endeavors. In the next few pages we (the authors) will explain the philosophy behind the way we have written this Study Guide; will tell you (the student) what is in this Study Guide; and will tell you the best way to use the Study Guide.

This Study Guide was written specifically to accompany the third edition of Raven and Johnson's BIOLOGY. Just as the textbook has changed between the second and third editions, so too has the Study Guide. It has been rewritten and incorporates a format that uses the latest in learning techniques. We believe that working through this Study Guide will help you truly understand and master the material in each chapter, rather than having you memorize seemingly random facts.

Each chapter in the Raven and Johnson textbook has an accompanying chapter in this Study Guide. To help you organize and learn the new material, and relate it to what you have already learned and to the real world, each of our chapters follows a consistent format. We start off with a section called **In the Grand Scheme.** This sets the scene for you. It not only introduces the major concepts of the chapter, but also places them in perspective. It gives you the "big picture," and shows how the material in the chapter is a part of the entire world of biology and the life of living organisms.

In the Grand Scheme is followed by the section **For Review.** Each chapter in the Raven and Johnson textbook lists terms that have been introduced earlier and that are important for understanding the material presented in the new chapter. Our for Review section provides definitions and explanations for each of the terms listed in the textbook. It should help you appreciate the importance and applicability of these terms. It is also a good review to make sure you remember the definitions of the terms. The farther you go in your studies of biology, the more you will realize that the complexities of life and biology are built upon fundamental principles. The For Review section will help make sure that you have a strong foundation on which to build your increasing knowledge.

Next comes the **Chapter Outline.** Our outline of the textbook chapter has four tiers or levels. The first three tiers match the different levels of headings in the textbook chapter. The fourth tier is a "memory jogger" for you. It lists important concepts that are not covered in the first three tiers. it is designed to help the outline stand on its own as a complete reminder of the major emphases of the chapter. We have used the fourth tier sparingly so as not to overload the outline. Each of the four tiers of the outline is set apart by its indentation and pattern of capitalization. We have listed the textbook page numbers for each first tier, to help you more easily refer to these sections in the textbook.

After you have organized your thoughts and the material in the chapter by looking at the Chapter Outline, it is time to focus on the new vocabulary. This is done in the **Key Terms** section. Studying introductory biology is in many ways similar to studying a foreign language. You must know the vocabulary to be able to communicate. Before you can hope to understand all the concepts and how they relate to one another, you must first know what

the words mean. We have listed the key terms in the sequence in which they are presented in the textbook to maintain the coherency of the material and the flow of ideas. This should help you remember the development of the various concepts much more easily than if the list of key terms was alphabetized. We have included in our Key Terms every word in the chapter that is in bold face type, as well as any others that we feel may be new and important to you. These words are taken from the figure captions and boxed essays as well as the text. We have provided the textbook page number for each term to help you in your studying.

The remaining four sections of the Study Guide chapter are designed to have you actively do something to help you test yourself and make sure you have mastered the material in the chapter. Active, rather than passive, learning is one of the guiding philosophies behind the way we have written this Study Guide. The more actively you are involved with this Study Guide the more likely you are to learn and retain the information. That is why we have you fill in charts, make drawings, label drawings, make lists, answer questions, and fill in the blanks. That is why we don't have you just passively read text summaries to yourself.

The first of these active sections is the **Topic Exercises**. These are two or three things to do that reinforce important concepts or topics in the chapter. The exact nature of each exercise varies with the different chapters, but they are all designed for you to actively draw, write, or match items; to use the knowledge you have acquired in the chapter. We have provided space in the Study Guide for many of these exercises; some will have to be done on separate sheets of paper.

The knowledge that we have of biology today, as represented in the pages of your textbook, exists because of the research conducted by scientists over the centuries. To help you remember the important people behind the science, many of the chapters have a section called **Who's Who**. This section requires you to complete the chart that is given by filling in names of the scientists or their contributions to biology.

The next active participation section in each chapter is the **Learning Checklist**. Here we ask you to answer specific questions or name specific items. This section focuses on the major concepts presented in the chapter and makes sure you can formulate a correct and complete response to short-answer type questions about the material. By asking you to write answers to questions, we are again asking you to actively participate in the learning process. This should help you much more than passively reading a list of open-ended learning objectives.

The final active section is the **Mini Exam**. This is your chance to test yourself to see if you have learned the material in the chapter. It provides excellent practice for your by presenting different types of questions that you are likely to encounter on your biology class exams. Practicing with the Mini Exam will not only let you know if you have learned the material thoroughly, but will also help you overcome test anxiety by practicing at your own speed and as often as you wish. Each Mini Exam begins with a selection of multiple choice questions. For each multiple choice question we have provided four or five answer choices; only one of them is correct. One of the most effective ways to study is to go through each question very carefully, asking yourself not only which is the correct answer, but also why is it right and the other choices wrong. This will help ensure that you really understand the material rather than just making a lucky guess. Each Mini Exam also has a group of fill-in-the-blank questions where you are asked to provide the appropriate term to complete each statement. The fill-ins require you to be able to recall and provide proper terminology, rather than simply recognizing the right term in a multiple choice format.

Many of the chapter Mini Exams also ask you to briefly answer one or a few short answer questions. These questions allow you to put the newly learned concepts into your own words and to apply your "textbook learning" to the "real world". They also serve as good practice for essay and written exams. We do not have separate true-false questions in the Mini Exam because we feel that the other question formats are more beneficial to you. If you can answer the Mini Exam questions you should not have trouble handling any true-false questions your biology instructor may give you on exams. Remember, each multiple choice question is essentially four or five true-false questions; you

have to decide if each choice is true or false.

We close each chapter with the **Answers** for each of the questions asked in the Topic Exercises, Who's Who, Learning Checklist, and Mini Exam. This way you get immediate feedback on whether your answer is correct. We have also provided the textbook page references for the Learning Checklist and Short Answer answers in case you want to reread the appropriate material in the text.

Beside using this Study Guide, there are many other things you can do to help yourself do well in your biology course. First, go to class. Your instructor will help guide you and help you focus on what he or she considers to be the most important aspects of the material. If you could master everything on your own just by reading the textbook, colleges and universities wouldn't schedule lectures.

Second, keep up with the reading. Leaving it all until the weekend or night before the exam is foolish. It will prevent you from getting the most from the weekly lectures; it will put tremendous stress on you right before the exam; and it will probably result in poor grades.

Third, ask questions. Ask your instructor, your graduate teaching assistant, your classmates. If you have questions, ask. It is better to clear up any confusion as you go along. Remember, you are trying to build a solid foundation from the very beginning. A point you don't understand early in the semester may come back to haunt you later. You may not want to interrupt the instructor in the middle of the class to ask your question, but instructors and teaching assistants almost always have office hours. And they are usually thrilled to help students who have taken the initiative to help themselves.

Fourth, study actively, not passively. Don't just sit and read your textbook and lecture notes; do something active. Study with your classmates; make up and ask each other questions. Pretend you are the instructor and write your own exam to cover the material you have gone over; and then make sure you can answer all your questions.

Finally, if you are having a hard time learning all the vocabulary, you might want to make vocabulary flash cards. Each key term can be written on one side of an index card, and its definition on the other side of the card. You will then have a stack of cards for each chapter. You can go through the stack, looking at the word side and saying the definition, or vice versa, looking at the definition and saying the key term. You can drill yourself or classmates. When you know a particular cold, you can remove it from the stack and concentrate on the remaining ones that you are still uncertain about. The night before an exam you can quickly review the entire stack.

We hope this Preface has given you good ideas about how to enjoy biology and do well in your course. We also hope this Study Guide will prove to be a valuable aid to you in your learnings. We cannot predict exactly how your instructor will test you in your biology course, but by successfully working through each of the exercises in the Study Guide chapters, you will be well on your way toward mastering the material in Raven and Johnson's BIOLOGY. Your should check with your instructor, however, to make sure you understand the format of the exams that will be given to you and the level of detail tat you are expected to know. If you have comments on the Study Guide or suggestions on how it could be improved and made more useful to you, we would be happy to hear from you. Write to us care of the Biology Editor, College Division, Mosby-Year Book, Inc., 11830 Westline Industrial Drive, St. Louis, Missouri 63146.

In closing, we wish you good luck, excitement, and appreciation of life as you explore the world of biology!

Margaret Gould Burke
Ronald M. Taylor

Acknowledgement

We wish to give our sincere thanks for the fine editorial support we have received in writing this Study Guide; for the excellent clerical help of our typists and for the understanding of our families and friends while we became asocial creatures meeting writing deadlines.

TABLE OF CONTENTS

1: THE SCIENCE OF BIOLOGY

IN THE GRAND SCHEME

Biology is the scientific study of life. This is a neat and simple definition, but it covers a fascinating and diverse world. This textbook is an introduction to the world of biology, and in it you will learn what living organisms are made of, how they function, and how they have evolved and continue to do so. Our study of life will be a scientific one, following the scientific method of asking questions, collecting data, making and testing hypotheses, and formulating theories. All the information, hypotheses, and theories presented in this textbook have been derived by countless scientists following such procedures. Biological knowledge has been steadily built up and refined over hundreds of years. Today our biological knowledge is increasing at a phenomenal rate, and biology has assumed an ever more important role in all of our lives. Only through understanding biology can we hope to address and solve vital medical and ecological problems, for example, and help improve the quality of life for all organisms on this planet. We begin our study of biology by examining the theory of evolution by natural selection - what it says, the evidence on which Darwin based his theory, and how the theory has withstood the test of time. We start with this theory because it forms the foundation of modern biology.

CHAPTER OUTLINE

KEY TERMS

p. 3: biology, deductive reasoning, science, inductive reasoning
p. 4: hypothesis, experiment
p. 5: variable, control
p. 6: theories
p. 7: scientific method, evolution, immutable
p. 8: glyptodont
p. 9: endemic
p. 11: geometric progression, arithmetic progression, natural selection, artificial selection
p. 13: homologous, Archaeopteryx
p. 14: analogous
p. 18: cell biology, genetics, ecology

TOPIC EXERCISES

1. Use the following four terms to complete a flowchart that diagrams the scientific method. Briefly explain how the method works. Terms: experiments, hypotheses, questions, theory. Flowchart: _____ --> _____ --> _____ --> _____.

2. It took Darwin many years to formulate his theory of evolution by natural selection, and he used many different pieces of evidence and ideas of different people in the process. Briefly describe the contribution made by each of the following to Darwin's thoughts:

Item	Contribution
fossils	
geographic distribution of species	
oceanic islands	

3. Explain Darwin's theory of evolution by natural selection in your own words.

WHO'S WHO

Complete the following chart:

Scientist	Contribution to Biology
Charles Darwin	a. _____
b. _____	contributed to Darwin's theory by suggesting populations grow geometrically but are limited by nature
Alfred Russel Wallace	c. _____
d. _____	contributed to Darwin's theory by proposing that the earth was very old and species had emerged and gone extinct throughout its history

LEARNING CHECKLIST

1. List the four major components of the scientific method and how they work. What role do controls play?
2. What was the common perception of species before and after Darwin formulated his theory of evolution?
3. List three things that Darwin saw during his 5-year voyage around the world that helped him later develop his theory of evolution.
4. Name three people that influenced Darwin and tell what they contributed to the development of his theory.
5. List five different types of evidence that exist today that have helped strengthen and support Darwin's theory.

MINI EXAM

A. Circle the letter of the one best answer for each question.

1. Darwin spent 5 years sailing around the world on the
   a. H.M.S. Species
   b. H.M.S. Beagle
   c. H.M.S. Evolution
   d. H.M.S. Tortoise

2. Darwin explained his theory of evolution in a book called
   a. On the Origin of Species
   b. The Principles of Population
   c. Survival of the Fittest
   d. Around the World in Eighty Days

3. Which of the following is not part of the scientific process?
   a. making predictions
   b. asking questions
   c. using creative insight
   d. proving theories are true
   e. collecting data

4. The study of the way individual traits are transmitted from one generation to the next is called
   a. ecology
   b. genetics
   c. cell biology
   d. homology
   e. analogy

5. Which of the following did not help Darwin formulate his theory of evolution?
   a. fossil evidence that species had changed over time
   b. closely related species on oceanic islands
   c.belief that the earth was approximately 4000 years old
   d. evidence of artificial selection in domestic animals
   e. all of the above did help Darwin

6. Structures that have the same evolutionary origin even though they may now have different structures or functions are said to be
   a. endemic
   b. analogous
   c. homologous
   d. immutable
   e. geometric

7. Where did Darwin observe closely related species of finches and closely related species of tortoises?
   a. the Galapagos Islands
   b. Tierro del Fuego, South America
   c. the Cape Verde Islands
   d. Australia
   e. England

8. Who wrote an essay on population growth that helped Darwin formulate his theory of evolution?
   a. Charles Lyell
   b. Eratosthenes
   c. Alfred Russel Wallace
   d. Thomas Malthus
   e. Karl Popper

9. Using general principles to analyze specific cases is called
   a. deductive reasoning
   b. inductive reasoning
   c. neutral selection
   d. artificial selection

10. Which of the following pairs are analogous structures?
   a. the front leg of a horse and a human arm
   b. the front leg of a frog and a bat wing
   c. the wing of a bird and a bat wing
   d. the front flipper of a porpoise and a human arm
   e. the wing of a bird and a butterfly wing

11. How old was Darwin when he began his voyage around the world?
   a. 5
   b. 22
   c. 30
   d. 59
   e. 75

12. Which of the following has provided direct fossil evidence of the evolutionary relationship between reptiles and birds?
   a. glyptodonts
   b. tortoises
   c. pigeons
   d. finches
   e. Archaeopteryx

13. Of the following biological levels of organization, which represents the smallest or lowest level?
   a. organs
   b. populations
   c. cells
   d. organisms
   e. biome

14. According to Darwin's theory of evolution
   a. all individuals have an equal chance of surviving and reproducing
   b. species are immutable
   c. tortoises are the modern descendents of glyptodonts
   d. all of the above
   e. none of the above

15. You are conducting an experiment to examine the influence of temperature on the rate at which a substance dissolves in water. You put 10 grams of sugar into 200 milliliters of water that is 5°C. Which of the following would be a possible control for this experiment?
   a. Put 20 grams of sugar into 200 milliliters of water that is 5°C.
   b. Put 10 grams of sugar into 400 milliliters of water that is 5°C.
   c. Put 10 grams of salt into 200 milliliters of water that is 40°C.
   d. Put 10 grams of sugar into 200 milliliters of water that is 20°C.
   e. Put 5 grams of sugar and 5 grams of salt into 200 milliliters of water that is 10°C.

B. Provide the appropriate term to complete each statement.

1. Hypotheses are tested by conducting _____.
2. The study of how organisms interact with their environment and with each other is called _____.
3. Biology is a science that uses _____ reasoning.
4. A _____ is a type of fossil armadillo that Darwin saw in South America.
5. Species that have evolved in a particular place and are unique to that area are said to be _____ to that area.
6. _____ structures have similar structure and function, but different evolutionary origins.
7. The numbers 3, 6, 9, 12, and 15 represent a(n) _____ progression.
8. Saying that species are _____ means that they do not change.
9. When dog breeders choose which individual dogs they will use as parents for the next litter and base this decision on the dogs' characteristics, they are carrying out _____ selection.
10. The scientific study of living organisms and how they have evolved is called _____.
11. In scientific experiments, each factor that influences a process is called a(n) _____.

C. Briefly answer each of the following questions.

1. Can a scientific theory ever be proved to be true?

2. Explain the statement "species evolve, but selection acts on individuals."

3. Why do <u>you</u> think biology is important?

CHAPTER 1 ANSWERS

TOPIC EXERCISES

1. Questions --> hypotheses --> experiments --> theory. A scientist asks questions about the world around him or her and formulates possible explanations to answer the questions and to explain what has been observed. Experiments are then performed to test the hypotheses. If the results do not support a hypothesis, the hypothesis is rejected and a new one is formulated. When a hypothesis has been tested many times and all the evidence supports it, it is considered to be a theory.

2. Fossils: exhibited progressive changes in characteristics over time and resembled living species, suggesting that species were not immutable but gradually change over time, living species arose from fossil species. Geographic distribution: different places with similar climates do not have the same species, evidence that species diversity is not caused strictly by climate diversity; closely related species tend to be found in the same general area, suggesting that organisms change gradually as they move from one area to another. Oceanic islands: often have unique endemic species closely related to each other but also resembling species on the nearest mainlands, suggesting that individuals from the mainland had colonized the islands and the isolated populations had gradually changed and evolved into new species over time.

3. Evolution is the process of species or populations changing over time, natural selection is the mechanism that causes the gradual changes. Individuals vary in their characteristics, and some individuals will have traits that make them more likely to survive and reproduce compared to other members of their population. They pass those "good" traits on to their offspring which in turn are more likely to reproduce and pass on the traits. Gradually, over many generations, the traits become more and more common in the population. This is how evolutionary change occurs and new species are formed with new characteristics: by differential survival and reproduction of individuals with different traits.

WHO'S WHO

a. formulated theory of evolution by natural selection.
b. Thomas Malthus
c. had similar ideas to Darwin's on evolution, stimulated Darwin to publish his ideas.
d. Charles Lyell

LEARNING CHECKLIST

1. Questions - scientists observe the world around them and ask questions about it; hypotheses - scientists formulate possible explanations to answer their questions and explain what they have observed; experiments - scientists test their hypotheses by conducting experiments to see if a particular hypothesis can be disproved (shown it is not the right explanation); theory - if a particular hypothesis has been tested many times and not disproved it is called a theory and assumed to be true although it is always subject to future revision. Control experiments allow researchers to determine how one particular variable influences a particular process. (pp. 3-7)

2. Before Darwin, most people believed that each species had been specially created by God and was unchangeable. After Darwin published his theory of evolution, people gradually accepted the idea that species change (i.e., they evolve). (pp. 7-8, 12)

3. Fossils, geographic distribution of species, species on oceanic islands (pp. 9-10)

4. Charles Lyell - earth is very old and species have been in flux over the ages; Thomas Malthus - populations grow geometrically but are limited by nature; Alfred Russel Wallace - similar ideas on evolution and natural selection, spurred Darwin to publish his ideas. (pp. 9, 11, 12)

5. An extensive fossil record; radioactive dating of the earth indicating it is approximately 4.5 billion years old; knowledge of the mechanisms of heredity; comparative anatomy of species; molecular biology, especially the biochemistry of genes (the genetic or hereditary material). (pp. 13-14)

MINI EXAM

A.

1. b	2. a	3. d	4. b	5. c	6. c
7. a	8. d	9. a	10. e	11. b	12. e
13. c	14. e	15. d			

B.

1. experiments	2. ecology	3. inductive
4. glyptodont	5. endemic	6. Analogous
7. arithmetic	8. immutable	9. artificial
10. biology	11. variable	

C. 1. No; as the textbook says, there is no absolute truth in science. A theory can be disproved if data from a legitimate experiment do not agree with the theory. But a theory can never be proved to be true because we can never perform all the possible experiments to test it. It is always possible in the future that someone will design an experiment that will provide new information that will require the theory to be revised or rejected. Theories represent our current best understanding, but are always open to revision and replacement. (pp. 3-7)

2. Evolution states that species change gradually over time. A single individual does not evolve; an individual does not change its genetic characteristics during the course of its life. But an individual will be acted on by selection. It will either survive, reproduce, and pass on its genetic traits to the next generation (selected for) or it will not survive or will not reproduce as much as other individuals (selected against). Because of the differential reproduction of individual members of a population, some traits get passed to the next generation in greater numbers than do other traits, and thus the overall nature of the population (what traits it has) changes with each generation. Over time the population can evolve into a new species. (pp. 7-14)

3. There is no single answer to this question; it is a personal opinion. Biology may be important to you for immediate and practical reasons, such as you need the course to graduate from college or you hope to have a career in some field of biology. On a more fundamental level, biology is important to everyone because we are living organisms and biology is the study of life. Only by understanding life can we hope to maintain it and improve its quality. (p. 14)