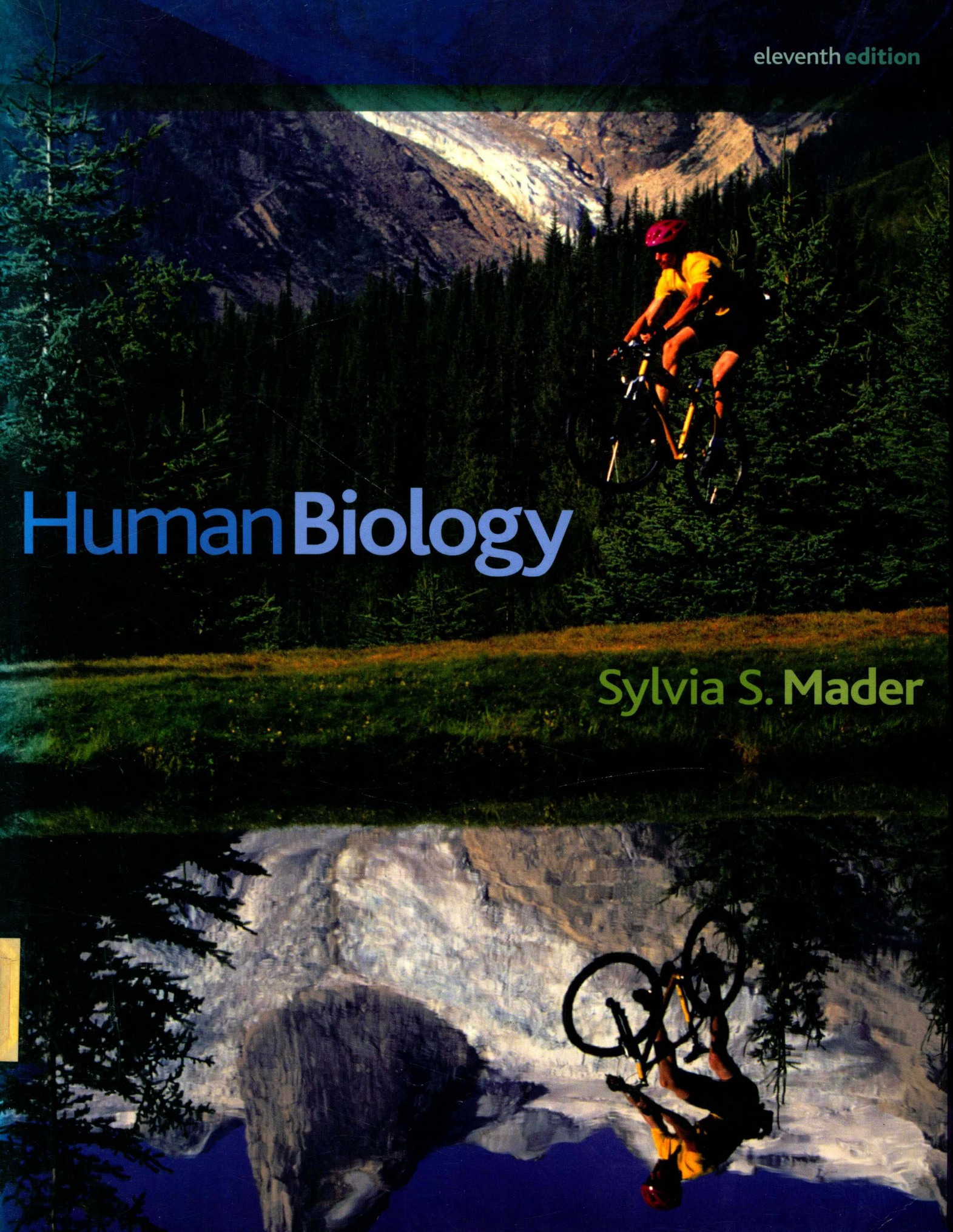
eleventh edition



Human Biology

Sylvia S. Mader

eleventh edition

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Preface

During my career as an educator, I discovered very early that students' attention was captured quickly when the topic was themselves: how their bodies worked, how to keep them healthy, and how they can occasionally malfunction. In addition, students in all fields of study are becoming increasingly concerned with the state of the environment. *Human Biology* integrates the topics of health, wellness, and concern for the environment in a way that perfectly suits the nonmajors' course.

Regardless of profession, citizens are frequently called upon to make health and environmental decisions. Therefore, it would not be appropriate for a college graduate to lack a basic knowledge of anatomy, physiology, genetics, and biotechnology. Students should also understand how the human population can become more fully integrated into the biosphere. Further, every educated individual should appreciate how scientists think and know how research is properly conducted. Wise choices require adequate knowledge and can help ensure our continued survival as individuals and as a species.

In this edition, as in previous editions, the text presents concepts using simple, concise, and clear descriptions. Detailed, high level scientific data and terminology are excluded, because I believe that all learners should have a working understanding of concepts rather than technical facility. This approach ensures that students will feel confident and capable of achieving an adult level of understanding.

The Eleventh Edition of *Human Biology*

Human Biology continues to grow and evolve to better suit the needs of a changing student population. Compelling new features will engage learners of all disciplines and interests. Clear, concise explanations have been teamed with attractive illustrations and sound pedagogy. Features from previous editions have been refined and supplemented where appropriate. Factual information has been updated to reflect current findings. As always, this new edition seeks to keep its sound basic content, making changes to improve relevancy and student appeal.

Producing this fresh, vibrant update was achieved with the very able assistance of three highly talented professors of nonmajors—Susannah Nelson Longenbaker from Columbus State Community College, Kimberly Lyle-Ippolito from Anderson University, and Linda Smith-Staton from Pellissippi State Technical Community College. Together, they are recognized for their significant contributions on the title page of the book. Many other professors also lent their talents, and their names are listed in the acknowledgment section.

Engaging New Chapter Case Studies

The new case study feature that opens each chapter will immediately encourage student interest in the content of the chapter. Each story unfolds at the chapter's beginning and continues throughout the chapter. Accompanying each introduction are photographs that effectively compliment the story. These case studies present real-life scenarios related to each chapter's content, and each is designed to appeal to every learner. In addition, the case studies will have additional appeal to specific disciplines. For example, students in African American studies and women's studies will find the special health needs of African American women described in the case study of Louise Hairston (Chap. 5). The topic of special education is addressed through the story of Jeremy Callen, a young man with fragile X syndrome (Chap. 20). The work of Andrew Scott and Jamie Barrett (Chap. 22) details the discipline and hard work of field anthropologists. Further, case studies dealing with sports themes and those addressing modern wellness issues (e.g., heart disease, diabetes, obesity, and cancer) will interest both students and their professors.

The "Thinking Critically About the Concepts" feature completes each chapter, and once again chapter case studies are incorporated to continue the learning process. Questions combine case concepts with chapter content. Students are challenged to thoughtfully integrate these ideas. The answers to the questions are given in Appendix B.

Updated and Reorganized Chapters and New Applications

Changes to this eleventh edition of *Human Biology* has been undertaken with several goals in mind. Constantly improving student involvement in the text is a primary aim. Equally important, this revision seeks to provide accurate, timely information. As you enjoy the book, you will notice:

Cutting Edge Data

The factual content for each chapter has been edited to reflect the most current findings available, so that professors can rely on the text to provide up-to-date information. Information about different forms of contraception presents all options—both existing and new—available to couples (Chap. 16). Treatments for Alzheimer disease describe the actions of modern drugs (Chap. 17). Data from the American Cancer Society reports the latest statistics on the types and incidence of the disease in both men and women (Chap. 19). These examples and many others show ongoing dedication to reporting state-of-the-art technologies and information.

Infectious Diseases Supplement

The AIDS supplement has been reorganized and titled "Infectious Diseases Supplement." The goal of this effort was two-fold. Recent findings regarding the AIDS epidemic were necessary to provide students with information critical to their health and safety. In addition, descriptions of new and emerging diseases will enable classroom discussion of present-day health concerns. The return of tuberculosis is explained, along with the symptoms and epidemiology of the disease. Antibiotic resistance will inevitably affect most, if not all, present and future populations. Its evolution, as well as strategies to overcome resistant organisms, is also addressed in this supplement.

Have You Ever Wondered . . .

A new feature has been added. Reading and studying new information, especially in the health sciences, often leads students to wonder about their bodies and how they work. **HAVE YOU EVER WONDERED,** presents the type of impulsive, off-the-cuff questions that might be asked in a typical human biology classroom. Questions can be sober and serious or comical and silly:

HAVE YOU EVER WONDERED . . . How do lungs stay open and keep from collapsing? (Chap. 2)
. . . How do you use an automatic external defibrillator, like the ones you see in the airport? (Chap. 5)
. . . Can you drink through your nose? (Chap. 8)
. . . Why does that annoying song you hear seem to replay in your head all day? (Chap. 14)

Inquiries like these are asked and answered several times in each chapter throughout the text. Each will capture attention—informing, entertaining, and educating at the same time.

New Boxed Readings

All boxed readings have been revised and updated. Many are new to this edition. All topics were chosen for relevancy and interest to students.

- *Science Focus* readings, which pertain to biological topics of interest, remain a popular feature of the text. New *Science Focus* readings include a discussion of the genetics of breast cancer (Chap. 3), recent news of a face transplant (Chap. 4), and the problem of diminishing honeybee populations (Chap. 24), among others.
- *Health Focus* articles discuss topics of disease and wellness that are important to all students. New *Health Focus* articles describe how to determine trans-fat content in food (Chap. 8), and how to obtain help for a disabled child (Chap. 18).
- *Bioethical Focus* issues present modern ethical concerns regarding health, culture, and the environment. For example, a new article, "Male and Female Circumcision: Medical Option, Cultural Practice, or Child Abuse?" (Chap. 16) addresses female circumcision as both a legal and moral issue. "Guaranteeing Access to Safe Drinking Water" (Chap. 23) will help students to think about the moral responsibility to provide potable water to all nations.
- *Historical Focus,* a brand-new feature of this text, will allow students to enjoy human biology in a historical context. This unique highlight will appeal to learners in all disciplines: history, philosophy, sociology, women's studies, African American studies, and many others. Individuals such as Vivien Thomas, who helped to develop modern cardiac surgery ("Heart Surgeon Without a Degree," Chap. 5) and Ignaz Semmelweis, who made safe childbirth possible ("An End to Laudable Pus," Chap. 17) will interest and inspire students. Sports fans will discover the story of Lou Gehrig ("The Iron Horse," Chap. 12). Those interested in European history will enjoy "Hemophilia: The Royal Disease" (Chap. 20).

Excellent Pedagogical Features

"During my career as an educator, I discovered very early that students' attention was captured quickly when the topic was themselves: how their bodies worked, how to keep them healthy, and how they can occasionally malfunction."

Sylvia Mader

Check Your Progress features end each section in every chapter. The questions function as a "mini-quiz," testing student understanding before the student moves on to the next section. *Check Your Progress* questions are answered in Appendix B.

Chapter Summaries An extensive review is organized according to the major sections of the chapter. Brief statements, lists, and tables help students re-examine the important topics and concepts. Artwork is included to provide a visual reminder of the important ideas presented. Key terms give students a working vocabulary for the chapter. Finally, a complete set of objective questions is a self-test that will allow the student to determine where further study might be needed.

Thinking Critically About the Concepts Each chapter's case study provides a framework for critical thinking. Students are first prompted with factual questions, then asked to consider future implications for the individuals described in the case study. For example, Chapter 5 presents the case of Louise Hairston, an African American woman who suffers a heart attack. *Critical Thinking* questions then ask the reader to furnish the not-so-typical symptoms often seen when a woman suffers a heart attack. Additional questions focus on ways to avoid a second heart attack. Answers to this style of question are presented in Appendix B. Subjective inquiries with no right or wrong answer prompt learners to form opinions about a health or wellness issue. Chapter 21 first describes recombinant growth hormone, then asks the reader to reflect on situations when the hormone should be used.

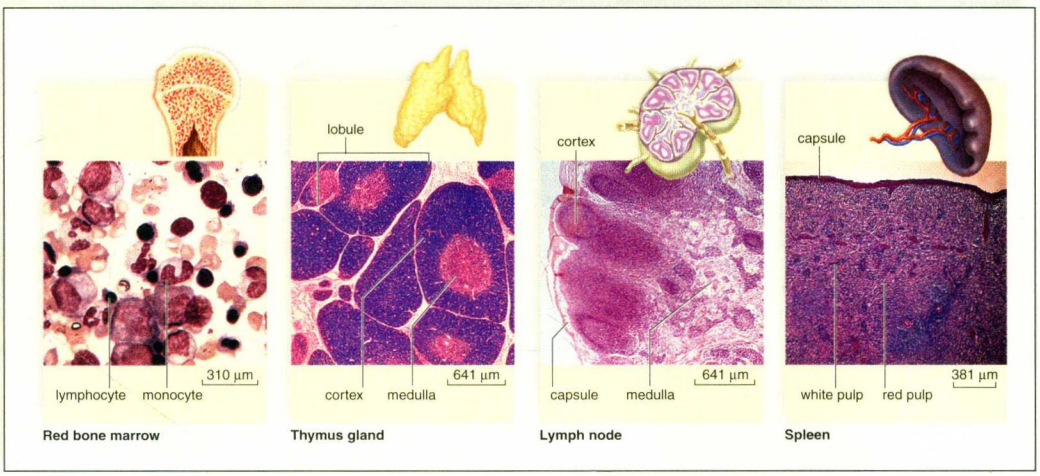
Homeostasis and Working Together Illustrations Because of their popular appeal, we have retained the homeostasis sections that include an illustration demonstrating how systems work together. These five sections make use of real-life situations to show how homeostasis is maintained in the body. As an example, see Section 6.6.

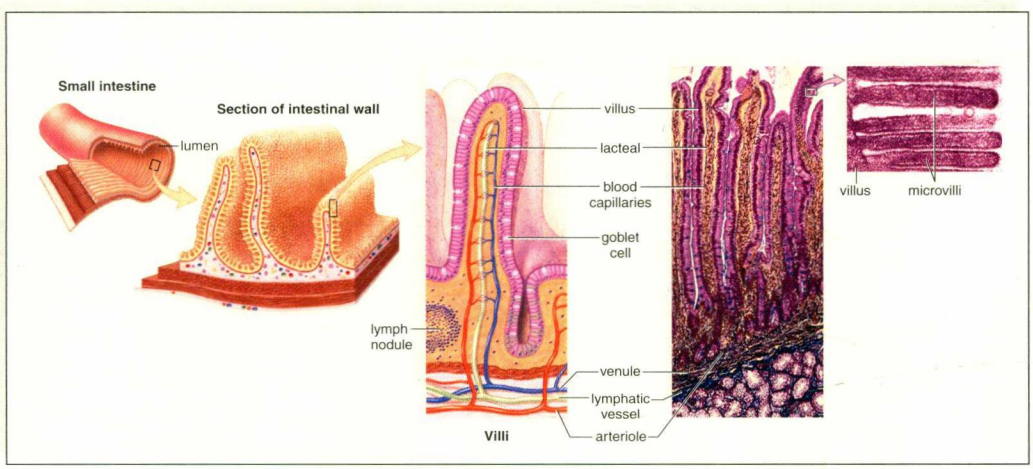
Vivid and Engaging Illustrations

The vivid and engaging illustrations in *Human Biology* bring the study of biology to life! The figures have been rendered to convey realistic detail and close coordination with the text discussions.

Combination Art

Drawings of structures are paired with micrographs to provide students with two perspectives: the explanatory clarity of line drawings and the realism of photos.



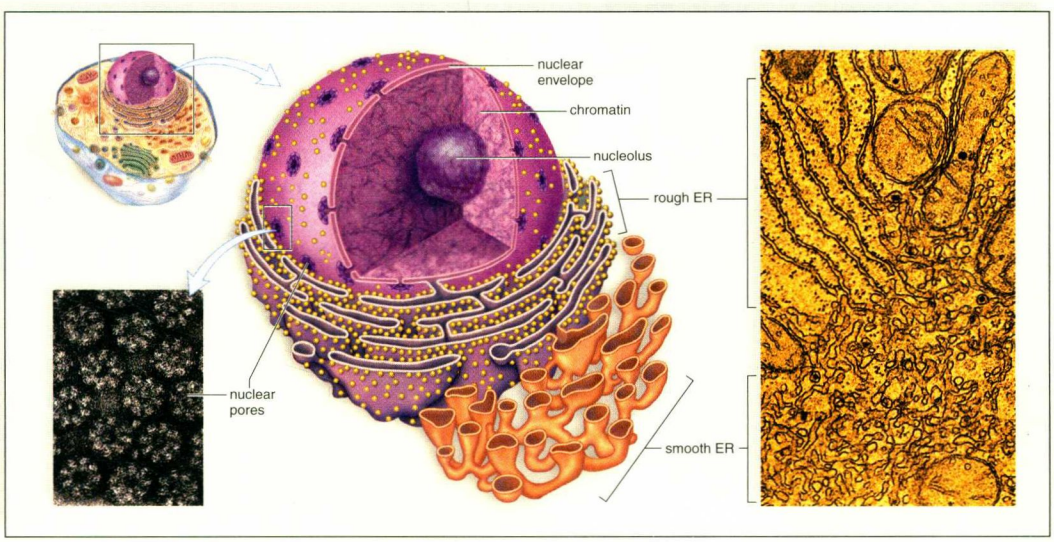


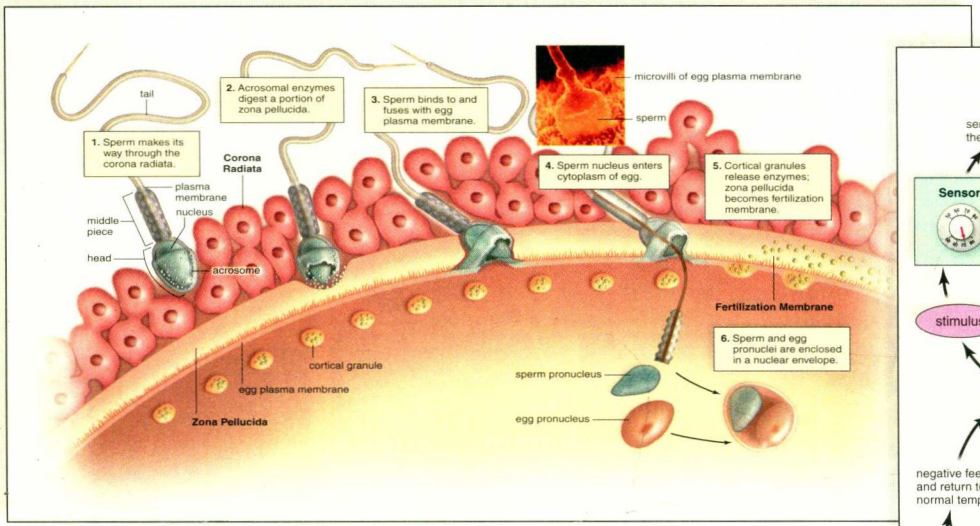
Multilevel Perspective

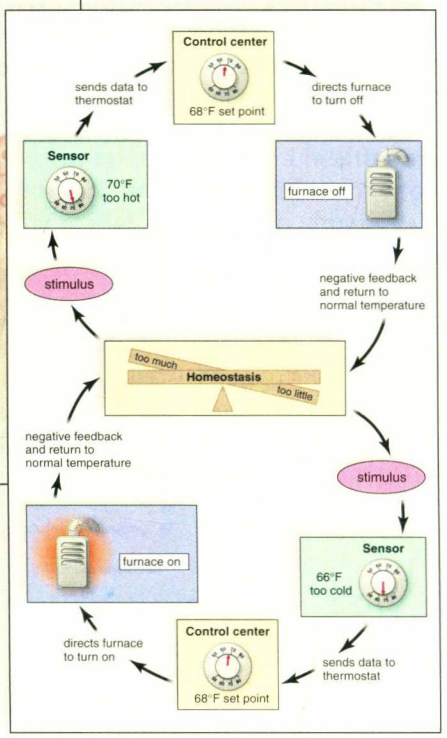
Such illustrations guide students from the more intuitive macroscopic level of learning to the functional foundations revealed through microscopic images.

Icons

Icons orient students to the whole structure or process by providing small drawings that help students visualize how a particular structure is part of a larger one.

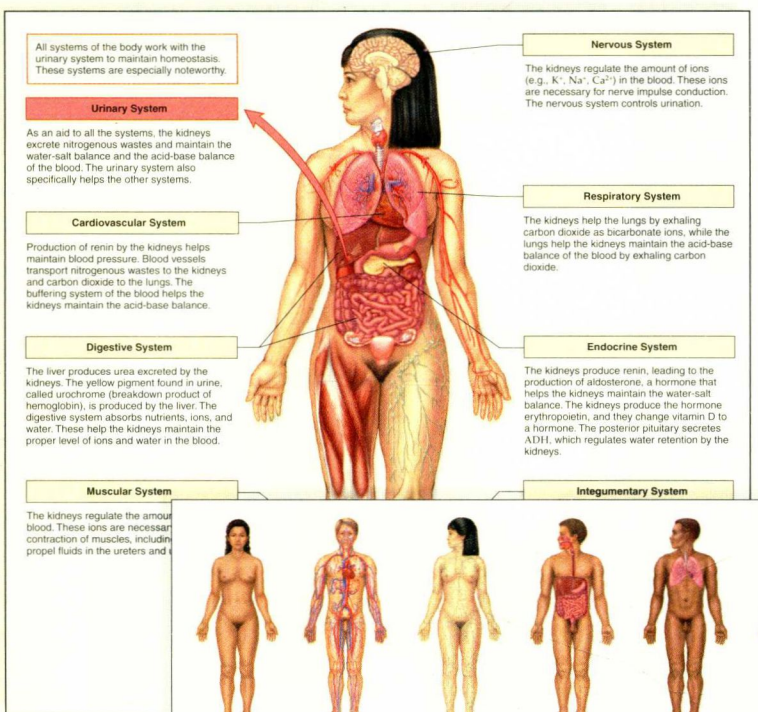


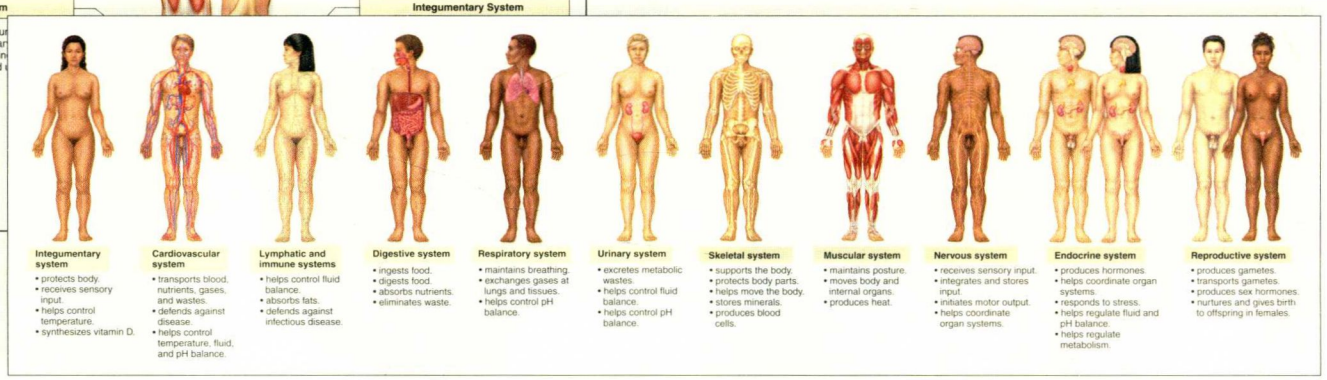




Process Figures

These figures break down processes into a series of smaller steps and organize them in an easy-to-follow format.





Human Systems Work Together

Working together illustrations use brief concise statements to tell students how various other systems help a featured system achieve homeostasis.

In this edition the working together illustrations have been integrated into homeostasis sections making a united whole. The homeostasis sections show how the systems achieve homeostasis despite real-life experiences that could alter the internal environment. For example, see page 269.

The Learning System

Proven pedagogical features that will facilitate your understanding of biology.

Chapter Concepts

The chapter outline contains a concise preview of the topics covered in each section.

Case Studies

New case studies bring human biology to life. Each story line continues throughout the chapter, and students will find themselves absorbed in each of the characters. *Critical Thinking* questions in the chapter end matter connect the case study with the chapter concepts.

Readings

Human Biology offers four types of boxed readings that put the chapter concepts in the context of modern-day issues:

- **Health Focus** readings review procedures and technology that can contribute to our well being.
- **Science Focus** readings describe how experimentation and observations have contributed to our knowledge about the living world.
- **Bioethical Focus** readings describe modern situations that call for value judgments and challenge students to develop a point of view.
- **Historical Focus** articles will allow the learner to enjoy human biology in a historical context.

Have You Ever Wondered . . .

This unique feature presents the types of spontaneous inquiries that students may have as they study the workings of the human body. Questions and answers can be serious or funny, but each will capture the student's attention.


CHAPTER 1

Exploring Life and Science

CASE STUDY INTRODUCTION

The upcoming exam for Microbiology 110 was supposed to be pretty tough. The study group agreed to meet at the nearby burger place to eat and study together. Shane and Katie were the first to arrive.They found a table big enough for the group that would be coming. Katie pulled napkins from the dispenser and wiped off the table before setting her books down. Then she squeezed a bit of antibacterial gel into her hands and rubbed them together vigorously. Shane had already thrown down his books and was in line placing his order for a burger and fries. Katie made her way to the counter and ordered a grilled chicken sandwich and a side salad. She wrinkled her nose and said to Shane, "I don't know how you eat so many French fries. Your arteries will be completly clogged soon!"

Shane shrugged. "Fries taste TONS better than that rabbit food you eat."

When Shane's order was ready, he carried his food to the drinks and condiments station. As he was adding ketchup to his fries, a couple of the fries fell off the table. He quickly snatched them up from the floor, and popped them into his mouth.

Katie reacted when she observed Shane's actions. "ICK! Shane, that is so disgusting! I can't believe you just ate food from the floor!

"Don't you know about the '5-second rule'?" retorted Shane. "The fries were on the floor for under five seconds, so they didn't have time to pick up any germs."

"If you say so," Katie sniffed. "I wouldn't eat anything after it touched the floor in here. Who knows when they last mopped the floor?"

"Well, your salad could have all kinds of germs in it, you know. It wasn't too long ago that the sale of spinach was banned because of some bacteria," Shane fired back.

Katie retorted, "Thanks a lot! You sure know how to ruin someone's appetite!"

CHAPTER CONCEPTS

1.1 The Characteristics of Life
The process of evolution accounts for the diversity of living things and why living things share the same seven characteristics of life.

1.2 Humans Are Related to Other Animals
Humans are classified as mammals in the animal kingdom. A highly developed brain, upright stance, creative language, and use of a variety of tools distinguishes us from other mammals. Our cultural heritage makes it difficult for us to see that preserving the biosphere is essential.

1.3 Science as a Process
Biologists use the scientific process when they study the natural world. A hypothesis is formulated and tested to arrive at a conclusion. Traditional methods give scientists added confidence in the conclusions of studies.

1.4 Making Sense of a Scientific Study
Data are more easily understood if results are presented in the form of a graph and they are accompanied by a standard error or the statistical significance.

1.5 Science and Social Responsibility
Scientific investigations and technology have always been affected by human values. Everyone has a responsibility to ensure that science and technology are used for the good of all.

1

Health Focus

Preventing Transmission of STDs

Uncircumcised males are more likely to become infected than circumcised males because vaginal

Sexual Activities Trans

Abstain from sexual interco monogamous (always t relationship with a partne

Refrain from multiple sex with someone who has have sex with two other sex with two people, and people who are relating i

Be aware that having relati user is risky because th AIDS and hepatitis B. Be already has another sexu more susceptible to an H

Avoid anal-rectal intercour inserted into the rectum) the risk of an HIV infectio thin, and infected CD4 T there. Also, the rectum is vessels, and insertion of t likely to cause tearing an entrance of HIV. The vagi to penetrate, but the lining thick at certain times of th T cells to enter.

Figure 16C Sexual a

Science Focus

Female Mosaics, Barr Bodies, and Breast Cancer

a corresponding gene on the Y chromosome. Thus, females have two copies of X genes, whereas males have only one. The body compensates for this extra dose of genetic

Most people are f patches of orang *mosaics*. A mosaic to form a whole Likewise, in gene cells have at least of genetic expres colors are due to hair cells of these If an orange-hair patch of orange gene is activated grow black patch you aware that hu

The nucleus arranged into a pair is maternal, somosomes in the each member of member. Sex chro are the last pair. males have one X is very small and mosome. Almost

Bioethical Focus

How Short Is Too Short?

Without treatment, child hormone (GH) exper growth, short stature begin puberty. Prior to the ad 1980s, treating these children pensive. The GH needed to treat from the cadaver pituitaries. Whi very successful, the use of cad Jacob (a neurological disease sin small number of treated individu

Thanks to biotechnology, ba size human GH (hGH). These bact inserted into their genetic inform then grown in laboratories and GH. Children with insufficient G and inexpensively with this GH. used to treat other disorders s ciency known as Turner syndro may even be possible to slow or hGH treatments.

There is some controversy s dren without hGH deficiency, fo Unfortunately, Americans are o children are often bullied and te data to suggest that shorter

Historical Focus

The Syphilis Research Scandal of Tuskegee University

Several sections of this chapter have covered the process of science, the way that legitimate research should be conducted, and the importance of informed consent when using human research subjects. As professionals, scientists have a responsibility to design moral and ethical research. Unfortunately, as with all professionals, not all sicentists are ethical. Documented cases of risky, life-threatening, and, in some cases, inhumane research on humans (often without the subject's consent or knowledge) blot scientific history. One of the most extreme examples of such "research" was that done by Dr. Josef Mengele, the handsome Nazi doctor called the "Angel of Death." Mengele tortured concentration camp prisoners in multiple horrible ways. Some were slowly frozen to death, other poisoned, still others bled to death—all to fulfill Mengele's obscene notion of scientific inquiry.

Regrettably, the history of research in the United States is also stained by misconduct. One notorious example of unethical research involving human subjects began in the United States in

arch was carried out by gators wished to study nsmitted bacterial dis- American males were d with African Ameri- as interest in determin- ion of syphilis.

an untreated syphilis r ulcers appear on the he bacteria associated who come into contact cally develops several se associated with the he disease shows up in sociated with the ner- nity are common, and ated pregnant women l syphilis in an infant retardation.

the Tuskegee Institute. ere enrolled, with 399 uninfected males. The pper farmers. None of tion in a research study.

Figure 1A Poorly educated African Americans were recruited for the Tuskegee project with promises of free medical care.

nor about available treatment options. The men were told that investigators were testing for and treating "bad blood." The phrase described a number of common illnesses, including anemia, that were widespread at the time. While they participated in the study, the men were offered medical exams, transportation to and from clinics, treatments for other ailments, food, and money for their burial expenses if necessary.

When the study first began, there were few available treatments for syphilis. Compounds containing mercury and arsenic were used, but all were toxic to the patient.

Originally, the study sought to determine if these toxic compounds helped, or if untreated individuals fared the same as those treated. The study was intended to last 6 months, but persisted for decades. Research continued on these men, even after penicillin became the accepted treatment for syphilis in 1947. Treatment with penicillin was never offered to the study's participants, even though it would have cured them of the disease.

Objections to the Tuskegee study began in the mid- 1960s. One critic deemed the project "bad science" because some men had been partially treated during the study. In July 1972, the Associated Press (AP) publicized the story of the syphilis project. The study was finally discontinued. A class-action lawsuit settlement covering medical and burial expenses for all living participants was reached in 1974, President Clinton offered a national apology to survivors and their families in 1997. Even now, there are some family members of the study's participants receiving benefits from that lawsuit.

Have You Ever Wondered . . .

How fast is a reflex?

A reflex is a built-in pathway that allows the body to react quickly to a response. One example, the knee jerk, or *patellar* reflex, is tested by tapping just below the knee cap. The lower leg will then involuntarily kick forward. The reaction is designed to protect the thigh muscle from excessive stretch. The knee-jerk reflex is an example of a simple stretch reflex. There is only one pathway required: the stretch sensation (caused by tapping the knee), to the spinal cord, to the leg muscle. The whole circuit is complete within milliseconds—or 1/1000th of a second!

Check Your Progress Boxes

Questions follow main sections of the text and help students assess their understanding of the material presented. Answers to these questions appear in Appendix B.

Check Your Progress 17.4

1. What chemical factors are responsible for the many physiological changes in a pregnant woman?
2. Maternal blood carbon dioxide levels fall by 20% during pregnancy. How does this benefit the fetus?
3. Describe the three stages of labor.

Summarizing the Concepts

A bulleted summary is organized according to the major sections in the chapter and includes art to helps students review the important topics and concepts.

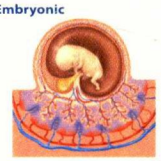
Summarizing the Concepts

17.1 Fertilization

The acrosome of a sperm releases enzymes that digest a pathway for the sperm through the zona pellucida. The sperm nucleus enters the egg and fuses with the egg nucleus.

17.2 Pre-Embryonic and Embryonic Development

- Cleavage, growth, morphogenesis, and differentiation are the processes of development.
- The extraembryonic membranes (chorion, allantois, yolk sac, and amnion) function in internal development.



17.3 Fetal Development

- At the end of the embryonic period, all organ systems are established, and there is a mature and functioning placenta. The umbilical arteries and umbilical vein take blood to and from the placenta, where exchanges take place.
- Exchanges supply the fetus with oxygen and nutrients and rid the fetus of carbon dioxide and wastes.
- The venous duct joins the umbilical vein to the inferior vena cava.
- The oval duct and arterial duct allow the blood to pass

- During stage 2, the child is born.
- During stage 3, the afterbirth is expelled.

17.5 Development After Birth

Development after birth consists of infancy, childhood, adolescence, and adulthood.

- Aging encompasses progressive changes from about age 20 on that contribute to an increased risk of infirmity, disease, and death.

Hypotheses of Aging

- Aging may have a genetic basis.
- Aging may be due to changes that affect the whole body

Understanding Key Terms

The boldface terms in the chapter are page referenced, and a matching exercise allows students to test their knowledge of the terms.

Understanding Key Terms

acrosome 356
birth control method 365
birth control pill 366
bulbourethral gland 353
cervix 358
chancre 373
chlamydia 372
circumcision 354
contraceptive 365
luteinizing hormone (LH) 356
male condom 367
menopause 362
menstruation 363
oogenesis 360
ovarian cycle 360
ovary 357
oviduct 357
ovulation 360
Pap test 358
penis 354
placenta 364
progesterone 362
prostate gland 353
scrotum 353
semen 353
seminal vesicle 353
seminiferous tubule 354
Sertoli cell 355
sperm 355
spermatogenesis 354
testes 353
testosterone 356
tubal ligation 367
urethra 353
uterine cycle 362
uterus 358
vagina 358
vas deferens 353
vasectomy 367
vulva 358
zygote 357

Testing Your Knowledge of the Concepts

Objective and art-based questions allow students to review material and prepare for tests. Answers to these questions appear in Appendix B.

Testing Your Knowledge of the Concepts

1. Describe how polyspermy is prevented during fertilization. (page 394)
2. Name the four embryonic membranes and give a human function for each one. (page 396)
3. Justify the division of development into pre-embryonic, embryonic, and fetal development. (pages 395–407)
4. What are the three primary germ layers, and what body me from each germ layer? (page 399)

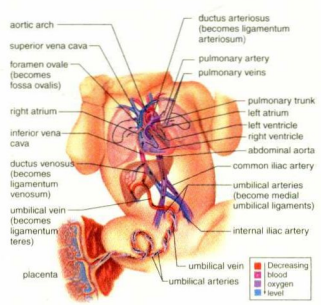
Thinking Critically About the Concepts

This set of questions encourages students to apply what they've just learned to the case study in the chapter.

Thinking Critically About the Concepts

Amber and Kent used a home pregnancy test to determine if she was pregnant. These tests detect the level of hCG (human chorionic gonadotropin; see page 398) in the urine. This hormone is released following implantation of the embryo into the uterus, usually around six days after fertilization. Some tests claim that they are sensitive enough to detect hCG on the date that menstruation is expected to begin. However, doctors recommend waiting until menstruation is one week late. If pregnant, a woman's level of hCG rises with each passing day, and testing is more likely to be accurate. However, even with a negative test result, the woman may still be pregnant if hCG levels are too low to be detected at the time of the first test. The test should be repeated later if menstruation doesn't begin. The home pregnancy tests contain a positive control. This is a visual sign (usually a line or a +) that appears if the test is working correctly. If this line does not appear, the test is not valid and must be repeated.

1. At home, pregnancy tests check for the presence of hCG in a female's urine. Where does hCG come from? Why is hCG found in a pregnant woman's urine?
2. A blood test at a doctor's office can also check for the presence of hCG in a female's blood.
   a. Why would you expect to find hCG circulating in a pregnant female's blood?
   b. hCG is a protein, so how does hCG affect its target cells?



Dedicated to providing high-quality and effective supplements for instructors and students, the following supplements were developed for *Human Biology.*

For Instructors

Laboratory Manual

The *Human Biology Laboratory Manual,* eleventh edition, is written by Dr. Sylvia Mader. With few exceptions, each chapter in the text has an accompanying laboratory exercise in the manual. Every laboratory has been written to help students learn the fundamental concepts of biology and the specific content of the chapter to which the lab relates and to gain a better understanding of the scientific method.
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Connect

Connect is a complete online tutorial, eletronic homework, and course management system designed for greater ease of use than any other system available. The program enables students to complete their homework online, as assigned by their instructor. Connect allows instructors to automatically grade and report easy-to-assign homework and quizzing, build their own assignments, track student progress, and share course materials with colleagues. Connect also provides instructors with the ability to create or edit questions from the question bank or import their own content. The fully integrated grade book can be downloaded to Excel, WebCT, or Blackboard.

Companion Website

The companion website contains the following resources for instructors:

- *Presentation Tools* Everything you need for outstanding presentation in one place! This easy-to-use table of assets include
  - **Enhanced image PowerPoints**—including every piece of art htat has been sized and cropped specifically for superior presentations as well as tables that you can edit. Also included are tables, photographs and unlabeled art pieces
  - **Animation PowerPoints**—Numerous full-color animations illustrating important processes are also provided. Harness the visual impact of concepts in motion by importing these files into classroom presentations or online course materials.
  - **Lecture PowerPoints** with animations fully embedded.
  - **Labeled and unlabeled JPEG images**—Full-color digital files of all illustrations that can be readily incorporated into presentations, exams, or custom-made classroom materials.
- *Presentation Center* This online digital library contains photos, artwork, animations, and other media types that can be used to create customized lectures, visually enhanced tests and quizzes, compelling course websites, or attractive printed support materials. All assets are copyrighted by McGraw-Hill Higher Education, but can be used by instructors for classroom purposes. The visual resources in this collection include:
  - **Art** Full-color digital files of all illustrations in the book can be readily incorporated into lecture presentations, exams, or custom-made classroom materials. In addition, all files are preinserted into PowerPoint slides for ease of lecture preparation.
  - **Photos** The photos collection contains digital files of photographs from the text, which can be reproduced for multiple classroom uses.
  - **Tables** Every table that appears in the text has been saved in electronic form.
  - **Animations** Numerous full-color animations illustrating important processes are also provided. Harness the visual impact of concepts in motion by importing these files into classroom presentations or online course materials.
- *Instructor's Manual* The instructor's manual contains learning objectives, extended lecture outlines, student activities, and classroom discussion topics.
- *Computerized Test Bank* A comprehensive bank of test questions is provided within a computerized test bank powered by McGraw-Hill's flexible electronic testing program "EZ Test Online." "EZ Test Online" allows you to create paper and online tests or quizzes in this easy-to-use program. A new tagging scheme allows you to sort questions by difficulty level, topic, and section. Imagine being able to create and access your test or quiz anywhere, at any time, without installing the testing software. Now, with "EZ Test Online," instructors can select questions from multiple McGraw-Hill test banks or author their own, and then either print the test for paper distribution or give it online.

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- Author/edit questions online using the 14 different question templates
- Export your tests for use in WebCT, Blackboard, PageOut, and Apple's iQuiz

Online Test Management

- Set availability dates and time limits for your quiz or test
- Assign points by question or question type with drop-down menu
- Provide immediate feedback to students or delay feedback until all finish the test

Online Scoring and Reporting

- Automated scoring for most of "EZ Test's" numerous question types
- Allows manual scoring for essay and other open-response questions
- Manual rescoring and feedback are also available

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- Flash tutorials for getting started on the support site
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Student Response System

Wireless technology brings interactivity into the classroom or lecture hall. Instructors and students receive immediate feedback through wireless response pads that are easy to use and engage students. This system can be used by instructors to take attendance, administer quizzes and tests, create a lecture with intermittent questions, manage lectures and student comprehension through the use of the grade book, and integrate interactivity into their PowerPoint presentations.

For Students

Companion Website

Students can readily access a variety of digital learning objects that include:

- Chapter-level quizzing with pretest and post test
- Bio Tutorial Animations with quizzing
- Vocabulary flashcards
- Virtual Labs
- Biology Prep, also available on the companion site, helps students to prepare for their upcoming coursework in biology. This website enables students to perform self assessments, conduct self study sessions with tutorials, and perform a post-assessment of their knowledge in the following areas: introductory biology skills, basic math, metric system, chemistry, and lab reports.

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Acknowledgments

A wonderful piece of poetry seems to me to be a fitting opening for my acknowledgments. "No man is an island, entire of itself. . . ." This idea certainly describes the effort required to create a fresh and innovative revision. A project such as this could never be completed without the work of a coordinated group. As always, the McGraw-Hill professionals guided this revision, assisting in all aspects. From beginning brainstorming sessions to completed text, this team supplied creativity, advice, and support whenever it was needed. Developmental Editor Lisa Bruflodt, Senior Project Manager April Southwood, Publisher Janice Roerig-Blong, and Executive Editor Michael Hackett collaborated to steer the book through the production process. Together, they have helped me to bring you a text and ancillaries that will serve your needs in every way.

Fresh, appealing new photos are a feature of this book, which students and professors alike will enjoy. Jo Johnson and Lori Hancock did a superb job of finding just the right photographs and micrographs. Marketing manager Tamara Maury directed the marketing team whose work is second to none.

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360° Development

McGraw-Hill's 360° Development Process is an ongoing, never-ending, market-oriented approach to building accurate and innovative print and digital products. It is dedicated to continual large-scale and incremental improvement driven by multiple customer feedback loops and checkpoints. This is initiated during the early planning stages of our new products and intensifies during the development and production stages, then begins again upon publication in anticipation of the next edition.

The process is designed to provide a broad, comprehensive spectrum of feedback for refinement and innovation of our learning tools, for both student and instructor. The 360° Development Process includes market research, content reviews, course- and product-specific symposia, accuracy checks, and art reviews. We appreciate the expertise of the many individuals involved in this process.

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Brief Contents

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