

Biology of Humans

Concepts, Applications, and Issues

Goodenough
McGuire
Wallace



Custom Edition for University of Massachusetts – Amherst

Biology *of* Humans

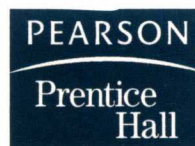
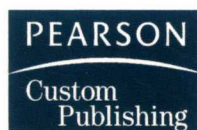
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Taken from:

Biology of Humans: Concepts, Applications, and Issues, Second Edition
by Judith Goodenough, Betty McGuire, and Robert A. Wallace



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To my students:

I hope that you will find human biology as exciting as I do. I believe that having a textbook will help you get more from the class. I also understand that textbooks are expensive and can be a financial burden. To make this text more affordable, I have created a custom book containing only the chapters that are most relevant to the course as I teach it. I have also pledged to the textbook annex that I will use this custom edition again in 2008, and so you will be able to sell it back to the textbook annex for half of the cost at the end of the semester.

To create the custom edition, we simply removed the chapters of interest and bound them together. Therefore, you may see an extra page before the start of a chapter or after the last page of the chapter. Ignore these extra pages.

I look forward to a great semester.

- Dr. Judy Goodenough

*In loving memory of Derick Goodenough
he was . . . cool
To Stephen, my husband,
best friend, personal hero,
and the funniest person I know
To Aimee and Heather, my daughters,
who fill me with love, wonder and amazement
To Betty Levrat, my mother,
an excellent role model
and endless source of support and encouragement
To "The Group," friends for more than thirty years,
who help me hold it all together
—J. G.*

*To Willy, Kate, and Owen Bemis,
and to Dora, James, and Cathy McGuire
—B. M.*

About the Authors



Judith Goodenough

Judith Goodenough

Judith received her B.S. from Wagner College (Staten Island, NY), and her doctorate from New York University. She has 30 years of teaching experience at the University of Massachusetts, Amherst, specializing in introductory level courses. The insights into student concerns and problems gained from more than 25 years of teaching Human Biology and 20 years of team-teaching *The Biology of Social Issues* have helped shape this book. In 1986, Judith was honored with a "Distinguished Teaching Award." In addition to teaching, she coordinates the introductory biology laboratories at UMass. Judith has written articles in peer-reviewed journals, contributed chapters to several introductory biology texts, and written numerous laboratory manuals. With the author team of McGuire and Wallace, she wrote *Perspectives on Animal Behavior*.



Betty McGuire

Betty McGuire

Betty received her B.S. in Biology from Pennsylvania State University, where she also played varsity basketball. She went on to receive an M.S. and Ph.D. in Zoology from the University of Massachusetts at Amherst, and then spent two happy years as a postdoctoral researcher at the University of Illinois, Champaign-Urbana. Her field and laboratory research emphasize the social behavior and reproduction of small mammals. She has published numerous research papers, co-authored the text *Perspectives on Animal Behavior* and several introductory biology study guides, and served as an Associate Editor for *Mammalian Species*, a publication of the American Society of Mammalogists. Betty taught Human Biology, Introductory Biology, Vertebrate Biology, and Animal Behavior at Smith College. She now teaches Mammalogy and *The Vertebrates: Structure, Function, and Evolution* at Cornell University.

Robert A. Wallace

The late Robert Wallace received a B.A. in Fine Art and Biology from Harding University, an M.A. in Muscle Histochemistry from Vanderbilt University, and a Ph.D. in Behavioral Ecology from the University of Texas at Austin. He subsequently taught at a number of colleges and universities in the United States and Europe, including the Richard Bland College of William and Mary, the University of Maryland-Overseas Division, Duke University, and the University of Florida. He is the author of seven previously published biology textbooks, including *Biology: The World of Life*, and two mass-market science books, *The Genesis Factor* and *How They Do It*, as well as numerous scientific articles on a variety of subjects. Robert was also a Fellow of the Explorers Club of New York and the Royal Geographical Society of London. He received the Orellana Medal from the government of Ecuador in recognition of his work with the medicinal plants of vanishing tribes in that country.

Humans are curious by nature. This book, intended for nonscience majors, was written to stimulate that natural curiosity, inspiring an appreciation for the intricacy of human biology and the place of humans in the ecosphere. Once awakened, however, curiosity demands satisfaction in the form of solid information. Toward this end, we provide students with a conceptual framework for understanding how their bodies work and for dealing with issues relevant to human health in the modern world. All along, we sustain the student's interest and curiosity by continuously illustrating the connections between biological concepts and issues of current social, ethical, and environmental concern. Our central belief is that the application of biological concepts to familiar experiences is the key to helping students see the excitement of science and its importance in their lives.

Strengths We Built On This edition builds on the strengths of clarity, liveliness, consistency, currency, and relevance that characterized the first edition. The writing is engaging, the explanations straightforward, and the pedagogical framework meticulously constructed. Great care has been taken to keep the level of coverage consistent throughout. All features—titles, outlines, headings, illustrations and legends, tables, vocabulary lists, summaries, questions, and so on—are designed to help students identify important facts and ideas, understand them, and appreciate why they matter.

As in the first edition, the text continually uses applications of scientific knowledge to engage students' interest, bring concepts to life, and illustrate the social relevance of human biology. This strategy is especially apparent in the seven Special Topics chapters (described shortly) and the dozens of Issues Boxes distributed throughout. Many discussions of applications have been added or enhanced. For example, the essay on asbestos in Chapter 3 now mentions the effects of asbestos contamination at Ground Zero on many of the surviving first responders from 9/11. As another example, Chapter 8a now has a discussion of the medical uses of marijuana. Newspaper headlines prompted the addition of five new essays: SOCIAL ISSUE *Scientific Misconduct* (Chapter 1); ENVIRONMENTAL ISSUE *Lead Poisoning* (Chapter 11); HEALTH ISSUE *The Fear That Vaccines Cause Autism* (Chapter 13); SOCIAL ISSUE *Bird Flu, Will It Become a Pandemic?* (Chapter 14); ENVIRONMENTAL ISSUE *Environmental Estrogens* (Chapter 17); and SOCIAL ISSUE *Forensic Science, DNA, and Personal Privacy* (Chapter 21).

Because students deserve information that is not only relevant but *current*, the text has been updated throughout. The chapter on Nutrition and Weight Control presents the new USDA food guide pyramid and recommendations for healthy living. The statistics on smoking, sexually transmitted diseases, and cancer are the latest available. The essays on health, social, and environmental issues have also been updated. Examples include the *Global Warming* essay in Chapter 23 and the discussion of shock wave lithotripsy in the essay on kidney stones in Chapter 16. (At the time of the first

edition, the lithotripsy procedure was deemed wonderful because surgery wasn't needed. However, in spring 2006, reports revealed that it appears to increase risk of diabetes and hypertension.)

Practical Goals and Special Features

The principal goal of this textbook is to give *a clear presentation* of the fundamental concepts of human anatomy, physiology, development, genetics, evolution, and ecology. The second goal is to *apply these concepts* in ways that will both interest and benefit the student. For example, the explanation of neurotransmitters is followed immediately by a discussion of the roles of neurotransmitters in Alzheimer's disease, depression, and Parkinson's disease. When students understand why a topic is relevant, they have a reason to want to learn about it. Thus, the chapters on organ systems explain how a healthy system functions, how that system might malfunction, steps to take to avoid a malfunction, and the ways in which medical science can help when systems are compromised or fail. Discussions of topics that students are likely to encounter in the media on an almost daily basis—smoking, contraception, STDs, cancer, antibiotic-resistant bacteria—help them see connections between classroom activities and the concerns of daily life. Connections between classroom topics and environmental issues help students develop a global perspective concerning questions they once thought of as being strictly personal.

Much of the information offered in the text is practical: What type of exercise is of greatest benefit to the heart? How can a person cope safely with insomnia? What can be done to protect against unwanted pregnancy and prevent the spread of sexually transmitted diseases? The body each of us is born with is a most intricate machine, but it does not come equipped with an owner's manual. In a sense, this book can be the student's owner's manual. Studying and applying the lessons to their individual lifestyles and health issues can help your students live longer, happier, and more productive lives.

The third goal is to help students *develop reasoning skills*, so they can make use of their newly acquired knowledge in situations they face in daily life. The “stop and think” and “what would you do” questions distributed within the chapters, as well as the “applying the concepts” questions at the end of each chapter are all written with this goal in mind. The fourth goal is to help students understand how the choices they make can *affect society and the planet, as well as their own quality of life*. Much of the material learned in human biology has a bearing on social and environmental issues that are important to us all. This text will help instructors heighten students' awareness of their impact on the biosphere and prepare students to be responsible citizens of their country and the world. Society is currently immersed in many pressing biological debates—concerning, for example, the cloning of human cells, stem cell research, genetically modified foods, gene therapy, organ

transplants, the definition of death, and the prevention and treatment of HIV infections—and students need the tools to understand these issues and make informed decisions about them.

Every aspect of the book is designed with these four goals in mind, but the following special features are particularly effective.

SPECIAL TOPIC CHAPTERS

The text contains seven Special Topic chapters: Chapter 8a, Drugs and the Mind; 13a, Infectious Disease; 14a, Smoking and Disease; 15a, Nutrition and Weight Control; 17a, Sexually Transmitted Diseases and AIDS; 19a, Stem Cells—the Body’s Repair Kit; and 21a, Cancer. Each of these short chapters builds on the “pure biology” presented in the immediately preceding chapter to cover issues likely to be of personal interest and therefore likely to motivate learning in students. The discussions they contain are more thoroughly developed than would be possible in a boxed essay. Even if you do not include these special topics in your reading assignments, we believe the issues are so pertinent to students that they will read the special chapters of their own volition, or at least refer to them occasionally as guides to a healthier lifestyle.

“STOP AND THINK” QUESTIONS

The “stop and think” questions scattered throughout each chapter are intended to promote active learning. They invite the student to pause in order to think about the information that was just presented and apply it to a new and interesting situation. These periodic checks allow the student to determine whether he or she has followed and understood the basic chapter content.

“WHAT WOULD YOU DO?” QUESTIONS

The “what would you do?” questions, which are also positioned throughout each chapter, challenge the student to form an opinion or to take a stand on a particular issue that society faces today, as well as to identify the criteria used in reaching that opinion or decision. These questions help students see the relevance of biology to real-life problems and foster the practice of thinking through such complicated issues as the fluoridation of water, routine screening for prostate cancer, the use of animal organs to save human lives, the export of pesticides to developing countries, and strategies for slowing the growth of human populations. When the subject of one of these questions is controversial, the text presents examples of arguments from both sides, as well as evidence in support of competing arguments. There frequently is no right answer to these questions. They simply demonstrate the broad implications of the topics discussed. Instructors may choose to use these questions to begin a classroom presentation, to stimulate in-class discussion, or as a way of sending students out of the classroom still thinking about the topic of the day’s lecture. Additional critical-thinking questions are provided on the Companion Website.

ISSUE ESSAYS

Three categories of boxed essays use the basic scientific content of the chapters to explore issues having broader impact on individual health, society, and the environment. Instructors might use these essays to arouse students’ interest in lecture topics or to provide

them with information needed for informed in-class discussions. **Health Issue** essays deal primarily with personal health topics. They provide current information on certain health problems that students, their families, or their friends might encounter. Examples of topics discussed in Health Issue essays are acne, osteoporosis, treatments for the common cold, and heartburn. These essays give students a better understanding of topics that commonly arise during visits to the doctor. The **Social Issue** essays explore ethical and social issues related to the topics in a chapter. For example, they explore questions concerning such subjects as anabolic steroids, gene testing, possible pandemic flu, and the use of primates in research. Finally, the **Environmental Issue** essays deal with ways in which human activities alter the environment or, conversely (sometimes simultaneously), ways in which the environment influences human health. Among the topics discussed in Environmental Issues essays are biodiversity, acid rain, noise pollution, and global warming.

ENTICING ILLUSTRATION PROGRAM

Users of the first edition—instructors and students alike—were unrestrainedly enthusiastic in praising the illustrations for their appeal and helpfulness. The visual program consists of simple but elegantly rendered illustrations that have been carefully designed for effective pedagogy. Their very beauty stimulates learning. This is particularly true of the many vibrant, three-dimensional anatomical figures, whose realistic style and appropriate depth and detail make them easy for students to interpret and use for review.

Within each category of illustrations—from molecular models to depictions of human tissues and organs—the figures are consistent in plan and style throughout the text. Numerous key figures pull concepts together to present the “big picture.” For example, the chapters on organ systems have figures that show both the anatomical structure and the function of all major components of the organ system. These figures, such as Figure 14.2, of the respiratory system, help keep students aware of the important relationship between structure and function. Pairing micrographs with drawings lends authority to the drawings, helps students interpret the micrographs, and in the end enhances the pedagogical value of both. Reference figures help students locate particular structures within the body. Figure 4.2, for instance, which illustrates types of connective tissue, not only pairs micrographs with drawings but also shows examples of where each type of connective tissue can be found. Many illustrations provide surrounding context for the anatomical structure being examined. For example, Figure 8.3, a sagittal section through the brain, shows the surrounding head, including facial features, to provide orientation and perspective. Flowcharts walk students through a process one step at a time, so they can follow the progress of a discussion visually after reading an explanation in the body of the text. Similarly, difficult concepts are reviewed using step-by-step figures that break the concepts down into simple components. Such figures help the student understand how events, processes, and ideas fit together. For example, Figure 18.2 guides the student through the process of early development, from ovulation to implantation. Liberal use of “voice balloons” makes all categories of illustrations easier to interpret and review.

Finally, color is used in the visual program as an effective means of organizing information. Where appropriate, color delineates the steps in a process. For example, in Figure 13.12, subtle differences in background shading distinguish different steps in the antibody-mediated immune response. In Figure 12.12, a depiction of the electrical activity of the heart, color indicates progression from one step in a heartbeat to the next.

Organization and Pedagogy

The text begins with a discussion of the chemistry of life, proceeds through cells, tissues, organs, and organ systems, and ends with discussions of genetics, populations, and ecosystems. As teachers ourselves, we understand the difficulty of covering all the topics in a human biology text in one semester. Instructors are inevitably forced to make difficult decisions concerning what to include and what to leave out. We also know that there are many equally valid ways of organizing the material. For this reason, the chapters in this text are written so as not to depend heavily on material covered in earlier chapters. The independence of each chapter allows the instructor to tailor the use of this text to his or her particular course. At the same time, cross-references are given where they may be helpful to direct students to relevant discussions in other chapters.

The pedagogical features that provide a consistent framework for every chapter have been designed not only to help students understand the information presented in their human biology course, but to help them study more effectively. Some of the most important of these elements are described below.

CHAPTER OUTLINES

Each chapter begins with an outline constructed from the chapter's two major levels of headings. Because it identifies the chapter's important concepts and the relationships between them, this feature provides a conceptual framework on which students can mentally organize new information as they read. It also serves as a meaningful review of chapter contents that students can use when studying for exams.

HEADINGS AND SUMMARIES

The two major levels of headings are worded as sentences stating the main point of the discussion that follows. Thus, students immediately see the big picture and therefore have an easier time focusing on the accompanying explanation. The "Highlighting the Concepts" sections that summarize each chapter are organized using the chapter's highest level of heading. Relevant page numbers are included in this summary to guide students back to the full text discussion of any topic they may wish to review.

KEY TERMS AND GLOSSARY

We have held the use of technical language to a minimum, because this text is intended for students who are not science majors. Important terms are set in bold type where they are formally introduced and are listed as key terms at the end of the chapter. New terms of lesser importance are set in italics. The Key Terms list also provides chapter page numbers indicating where each term is de-

fined. A Glossary at the end of the book contains definitions for all the key terms.

END-OF-CHAPTER QUESTIONS

The questions provided at the end of each chapter are designed in several formats to meet several purposes. Some, specifically the "Reviewing the Concepts," are intended simply as content review; others—particularly those under the heading "Applying the Concepts"—require critical thinking and challenge the students to apply what they have learned to new situations. Review questions that require a written answer are followed by the number of the page containing the relevant discussion. These questions encourage students to review and understand the relevant material instead of simply memorizing a few salient facts. Answers to the multiple-choice and fill-in-the-blank questions are provided in an appendix, as are hints for answering the "Applying the Concepts" questions. The hints, which help students identify the information needed to answer each question, are intended to guide students in their thinking process instead of simply providing a quick answer.

ICONS



WEB Tutorial icons displayed throughout the book direct the student to the text's Companion Website at www.prenhall.com/goodenough/. The Web tutorials employ animations and interactive exercises to teach processes and concepts that may be challenging for the student or that are difficult to understand from words and illustrations alone. Quizzes are offered to help students assess their understanding of a topic after viewing the animation or completing the exercise.



A second type of icon accompanies many of the tables in the text, identifying those tables as being presented for reference only. These icons, along with specific table titles, help students decide what material should be studied for exams and what material is provided primarily for reference or as a source of illustrative examples.

RELEVANT WEBSITES

The front inside text cover lists 160 relevant and useful Websites for students who want to explore certain topics in greater detail. Because the text discusses many health issues that students or their families and friends may be dealing with, the list of Websites includes resources that can provide support for people with various health problems, including cancer, drug and alcohol abuse, and smoking.

Supplements

Carefully designed packages of supplemental material for the student and instructor are available to further facilitate learning and teaching.

FOR INSTRUCTORS

Instructor Resource Center on CD/DVD This multiple-disc resource is designed to fully support individual teaching approaches and invigorate lectures has been upgraded with the highest-quality media assets available. Every figure, photo, and table in the

text has been enhanced for optimal projection results and is provided in a variety of JPEG and PowerPoint® options. A full set of Lectures that can be adapted to individual classroom needs is offered in PowerPoint as well. The array of animations on our IRC on CD/DVD is truly unparalleled. The more traditional set of 2-D animations created to support the text has been thoroughly revised and improved. In addition and for the first time, a set of 3-D animations and simulations from Prentice Hall's visually-stunning and scientifically precise "BLAST" series is also offered with this text. Both types of animations are pre-loaded into PowerPoint in PC and Macintosh versions.

Transparencies The set of transparencies consists of approximately 400 illustrations from the text on full-color acetates.

Instructors' Guide This manual contains material that will assist instructors in the preparation of lectures. Its contents include lecture outlines and hints, suggestions for classroom activities, answers to the end-of-chapter questions, and suggestions for assignments.

Test Item File The printed Test Item File contains over 1000 questions instructors can use to prepare exams. Types of questions include multiple choice, true/false, short answer, fill-in-the-blank, matching, and labeling.

TestGen EQ Computerized Testing Software The questions from the Test Item File are also available as part of the TestGen EQ Testing Software, a text-specific testing program that can be networked for administering tests. The program allows instructors to view and edit these test questions and also to add their own questions to create an unlimited variety of quizzes and tests.

FOR THE STUDENT:

Companion Website At www.prenhall.com/goodenough/, the Companion Website offers a wealth of student learning tools. Each chapter offers an *Online Study Guide* designed to help students gain focus with their limited study time. Study features include concise summaries with pop-up windows displaying key figures and tables, learning objectives, key term flashcards, interactive exercises, and interactive practice quizzes loaded with specific useful feedback. *Web Tutorials* use animation, interactivity, and quizzes to provide assistance with the most challenging and important concepts in each chapter. Icons alerting the student to the availability of specific tutorials have been included throughout the book. There is an access card for the Companion Website in the front of all new copies of the text. Students with used books can go to the web address above to find out about getting access to the Companion Website.

Student Study Guide (printed study aid) by Claudia Douglass, Central Michigan University The Student Study Guide is designed to help students master the topics and concepts covered in the textbook. The study guide contains several types of review questions, including multiple choice, fill-in-the-blank, critical thinking, matching, and labeling. It also includes study objectives, summaries, key terms, and student study tips.

Understanding Human Biology: Laboratory Exercises by Mimi Bres and Arnold Weisshaar, Prince George's Community College In both content and approach to learning, this lab manual is an appropriate ancillary to *Biology of Humans*. It emphasizes developing an understanding of the basic principles of human anatomy and physiology, genetics and evolutionary change, ecology, and the impact of human actions on the environment.

Acknowledgments

We are truly fortunate to be part of a team of dedicated and talented people. Gary Carlson, our executive editor, has enthusiastically supported us at every turn. He has been involved at almost every level, and the result is clear evidence of his effectiveness. Gary and Carol Trueheart, editor in chief of development, helped us develop a revision plan that built on the strengths of the first edition while selectively introducing new content and paring back needless detail. Our developmental editor, Moira Nelson, helped us implement that plan. She is one of the best in the business. She was a source of great ideas for new directions and always willing to help. During the academic year, most of our writing took place on week-ends. Moira always checked her email and quickly addressed any of our concerns—often including amusing quips that eased the stress.

Jane Loftus did an excellent job of copyediting the book: keeping our writing style, while improving accuracy and consistency.

We are especially pleased to work with Debra Wechsler as our production editor again on this edition, because of both her professional skills and her friendly personality. By helping us prioritize, she kept us to the schedule and still allowed us to meet the needs of our families. Throughout the project she was calm, patient, and helpful.

The art program was designed and developed by two medical illustrators: Jay McElroy from Prentice Hall with the help of Jack Haley of Imagineering, Inc. Their art development has created an accurate and pedagogically sound illustration program. We especially enjoyed working with Jay McElroy on art development. He was always responsive to questions and suggestions and somehow managed to keep a wonderful demeanor throughout this complex and demanding project. Imagineering Media Services skillfully rendered the art. Photo Researcher Yvonne Gerin persistently worked to find the best and most original photographs. Kenny Beck and Anne DeMarinis created an elegant design that highlights and effectively integrates the many graphic and pedagogical elements. Formatter, Joanne Del Ben, skillfully implemented the design.

Project manager, Crissy Dudonis, did a skillful job of coordinating development and production of the ancillary materials that accompany our text. She brought together lecture and study aids to create a supplemental package that is highly effective for instructors and students. Crissy also worked with Patrick Shriner, our excellent media editor, on the selection and development of media supplements.

We owe a great deal to our late friend and colleague, Bob Wallace. We are thankful for all he taught us. His wife, Jayne Wallace, provided information about medicines in the rain forest and has continued to support our efforts.

FROM JUDITH GOODENOUGH

I thank my family and friends who supported and encouraged me at every stage of this project. My husband, Steve, was a cheerleader and convinced me that I would complete this project. Without his witty quips, I would have lost my sanity. He reassures me that I'll always be his first wife. My daughters, Aimee and Heather, inspire me and continually remind me that the people you love should always come first. The willingness of my mother, Betty Levrat, to help in any way, allowed me to focus on writing.

Margaret Ludlam cheered me up and helped me cope when things got tense. Margaret's willingness to pick up the slack at UMass allowed me to take vacation days to work at home during the semester. Lee Estrin, one of "the group," dear friends who have always provided moral support and advice, was always willing to visit for an "I need a break weekend," even when I couldn't actually stop working completely.

FROM BETTY MCGUIRE

I thank my husband, Willy Bemis, for support and encouragement throughout this project, and my children, Kate and Owen, for (usually) waiting patiently for me to complete just one more sentence or paragraph. Dora, Jim, and Cathy McGuire were endlessly encouraging and understanding, as they have been throughout my life. Lowell Getz, my friend and research colleague, waited with good humor as one after another of our papers took a back seat to a book chapter.

We must thank the dozens of reviewers who so carefully read chapters. They were immensely helpful in shaping the book and in catching errors. Of course, any errors that remain are our responsibility, and we hope you will inform us if you find any.

Judith Goodenough
Betty McGuire

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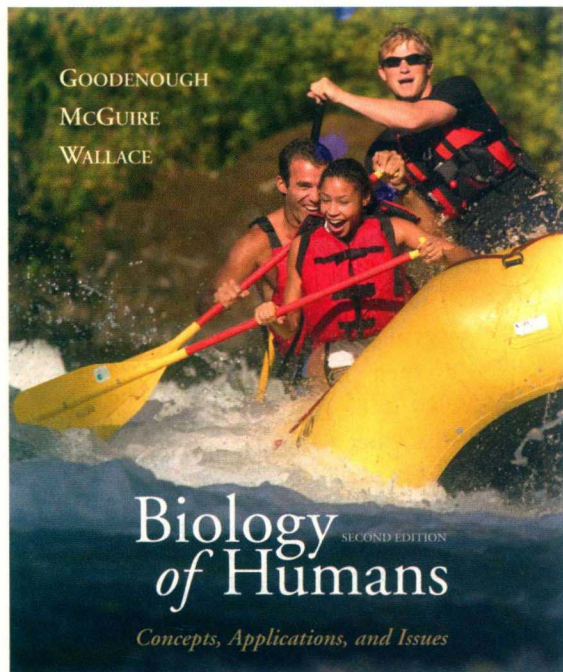
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BIOLOGY OF HUMANS: CONCEPTS, APPLICATIONS, AND ISSUES is designed to motivate students to learn basic biological concepts. It does this by providing more examples and applications to students' personal health, their environment, and society than any other book. It also equips students with tools for developing reasoning skills so the information they learn can be applied to life choices.

Biology is a visual science. For that reason graphics have been meticulously designed to help students learn biological concepts. Biology is not a native language for students. For that reason the chapters have been written, rewritten, read by hundreds of reviewers, and carefully developed so that concepts are clearly stated. The combination of exceptional writing and graphics gives students the opportunity to enter into and begin to understand the world of human biology.

Writing For Comprehension

- Accessible writing smoothly integrates just the right amount of detail with intriguing applications to keep students engaged
- Excellent metaphors and analogies abound to anchor concepts to what students already know
- Topic heads are written as declarative sentences to give students an overview and framework for review and understanding
- Occasionally a chapter ends with an *exploring further* box that makes connections between two or more chapters

Applications

- Seven SPECIAL TOPICS Chapters highlight important areas that warrant detailed explanation and exploration, but remain optional to instructors
- Interesting applications are woven into the text at every opportunity
- Contemporary, important issues are addressed in special boxes entitled *Health Issue*, *Social Issue*, and *Environmental Issue*
- Each chapter ends with questions focused on *Applying the Concepts*

Reasoning Skills

- Periodic interludes entitled *stop and think* and *what would you do?* ask the student to reflect and reason as well as to consider bioethical issues
- Most boxes end with provocative questions that invite students to ponder broader aspects of an issue
- *Applying the Concepts* questions invite critical thinking

Helping
Students
Understand
Human Biology

"The writing style is easy to read and understand. I do choose textbooks that are readable for the students, so this text is similar to others I have used in that respect. I think the students will be engaged and motivated. I like the neutral, factual presentation of the material without being judgmental or emotional about health issues."

—JANICE ITO,
LEEWARD COMMUNITY COLLEGE

There is some truth to the saying "You are what you eat." Rest assured, however, that no matter how many hamburgers you eat, you will never become one. Instead, the hamburger becomes *you*. The transformation is possible largely because of the activities of the digestive system. Like an assembly line in reverse, the digestive system takes the food we eat and breaks the complex organic molecules into their chemical subunits. The subunits are molecules small enough to be absorbed into the bloodstream and delivered to body cells. Food molecules ultimately meet one of two fates: they may be used to provide energy for daily activities or they may provide materials for growth and repair of the body. Imagine that you just ate a hamburger on a bun. The starch in the bun may fuel a jump for joy; the protein in the beef may be used to build muscle; and the fat may become myelin sheaths that insulate nerve fibers. Without the digestive system, this food would be useless to us, because it could never reach the cells of our body.

A simple experiment can demonstrate the effectiveness of venous valves. Allow your hand to hang by your side until the veins on the back of your hand become distended. Place two fingertips from the other hand at the end of one of the distended veins nearest to the knuckles. Then, leaving one fingertip pressed on the end of the vein, move the other toward the wrist, pressing firmly and squeezing the blood from the vein. Lift the fingertip near the knuckle and notice that blood immediately fills the vein. Repeat the procedure, but this time lift the fingertip near the wrist. You will see the vein remain flattened, because the valves prevent the backward flow of blood.

"The text is easy to read, and clearly defines new terms and concepts. It has distilled the chapter to the most relevant material without removing important details. The examples will be familiar to readers, and suggestions are given to relate concepts to known situations. This is very well done."

—MERRILEE ANDERSON,
MOUNT ALOYSIUS COLLEGE

"The writing style perfectly addresses the non-science student population nicely."

—KENNETH THOMAS,
NORTHERN ESSEX COMMUNITY COLLEGE

"I really enjoy the writing style. It is informative and accurate but casual.

It will engage the students. This style, in addition to the Special Topics sections and the wonderful companion website, is the main reason I switched to Goodenough et al."

—TAMATHA R. BARBEAU,
FRANCIS MARION UNIVERSITY

Contraction of skeletal muscle squeezes veins. Virtually every time a skeletal muscle contracts, it squeezes nearby veins. This pressure pushes blood past the valves toward the heart. The mechanism propelling the blood is not unlike the one that causes toothpaste to squirt out of the uncapped end of the tube regardless of where the tube is squeezed. When skeletal muscles relax, any blood that moves backward fills the valves. As the valves fill with blood, they extend further into the lumen of the vein, closing the vein and preventing the flow of blood from reversing direction (Figure 12.6b). Thus, the skeletal muscles are always squeezing the veins and driving blood toward the heart.

"The writing style of the Goodenough text has a very student-friendly tone...it is relaxed, easy to read, much like a conversation."

—LINDA McNALLY,
DAVIDSON COLLEGE

"Once again, I like the writing style of Goodenough et al.'s book. I feel that Drs. Goodenough, McGuire, and Wallace's extensive background and experience in teaching biology are reflected in their direct, concise style of presenting the material. Again, as mentioned previously, I have had numerous positive comments about how students like the textbook. These comments are really the first from non-majors students about their textbook and I never had such feedback from the previous and most recent textbooks used for our human biology course."

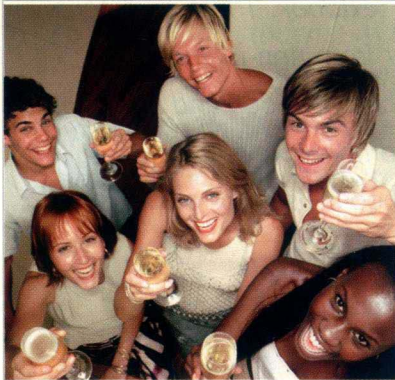
—ROBERT OKAZAKI,
WEBER STATE UNIVERSITY

Clear and
Engaging Writing
Motivates Students

8a

SPECIAL TOPIC

Drugs and the Mind



We may think of alcohol as adding to the festivity of an occasion, but in fact its effect on the brain is that of a depressant.

Psychoactive Drugs Alter Communication between Neurons

Drug Dependence Causes Continued Drug Use

Alcohol Depresses the Central Nervous System

- The rate of alcohol absorption depends on its concentration
- Alcohol is distributed to all body tissues
- The elimination of alcohol from the body cannot be increased
- Alcohol has many health-related effects

Marijuana's Psychoactive Ingredient Is THC

- Marijuana binds to THC receptors in the brain
- Long-term marijuana use has many effects on the body
- Legalization of medical marijuana is controversial

Stimulants Excite the Central Nervous System

- Cocaine augments the neurotransmitters dopamine and norepinephrine
- Amphetamines augment the neurotransmitters dopamine and norepinephrine

Hallucinogenic Drugs Alter Sensory Perception

Sedatives Depress the Central Nervous System

Opiates Reduce Pain

Maddie had decided to keep her wedding small and was excited to be planning it herself. Even so, she was beginning to feel overwhelmed by all the details. After weeks of long awake nights running through a long mental checklist of errands to run and decisions still to be made, she realized that what she needed more than anything was a decent night's sleep. Her doctor consented to prescribe a mild sedative that helped her get more rest and feel calm the days leading up to the celebration.

The wedding went as smoothly and happily as she had dreamed. But a few weeks later, when she was beginning to feel settled in her new life, Maddie stopped taking the sleeping pills and was distressed to find that her sleeplessness and anxiety flared up worse than ever. After she consulted her doctor. Apparently, her nervous system had developed a dependency on the drug, even in the limited period over which she had taken it. She and her doctor made a plan that included substituting the original sedative for a similar one and reducing her use of it until she could sleep without the drug. She didn't work, she might have to seek more

7 SPECIAL TOPIC CHAPTERS

focus on topics
of high student interest.

Circulation influences skin color in non-albinos, as well. When well-oxygenated blood flows through vessels in the dermis, the skin has a pinkish or reddish tint that is most easily seen in light-skinned people. Intense embarrassment can increase blood flow, causing the rosy color to heighten, particularly in the face and neck. This response, known as blushing, is impossible to stop. Other intense emotions may cause color to disappear temporarily from the skin. A sudden fright, for example, can cause a rapid drop in blood supply, making a person pale. Skin color may also change in response to changing levels of oxygen in the blood. Compared to well-oxygenated blood, which is bright red, poorly oxygenated blood is a much deeper red that gives the skin a bluish appearance. Poor oxygenation is why the lips appear blue in extremely cold conditions. When it is cold, your body shunts blood away from the skin to the body's core, which conserves heat and keeps vital organs warm. This shunting reduces the oxygen supply to the blood in the small vessels near the surface of the skin. The oxygen-poor blood seen through the thin skin of the lips makes them look blue. When you do not get enough sleep, the amount of oxygen in your blood may be slightly lower than usual, causing the color to darken. In some people, the darker color is visible through the thin skin under their eyes as dark circles.

exploring further . . .

In Chapter 19, we learned about the cell cycle. In Chapters 20 and 21, we learned about genes, their inheritance, and their regulation, and also considered how mutations affect gene functions. In Chapter 21a, we will use this information to understand cancer, a family of diseases in which mutations in genes that regulate the cell cycle cause a loss of control over cell division.

THESE BOXES connect
a chapter to preceding
and following chapters.

APPLICATIONS are woven
into the text more than
any other textbook.



SOCIAL ISSUE

The Ethics of Radiation Research on Humans

In the United States, between about 1945 and 1971, a number of people were exposed to radiation as part of research into its effects and uses (Figure 2.A). These people included terminally ill hospital patients, mentally delayed

patients, and scientists. Did their families understand the experiments? Did anyone explain the words, did the participants know what was being done to them, give their consent?

In one set of radiation experiments, the government's security concern was to fully inform study participants. In 1945 and 1947, 18 test subjects received injections of a substance that was not disclosed to them.

of such questions, terminally ill people are generally no longer used in research, except when the purpose is to test an experimental treatment for their illness.

The principle of informed consent was

able, although in others, informed consent was properly obtained. In 1974, the U.S. Department of Health, Education, and Welfare established regulations for all research with human subjects. However, it was not until 1991 that these requ-

ISSUE ESSAYS are designed to capture student attention and to get them to connect science to broader realms.



ENVIRONMENTAL ISSUE

Asbestos: The Deadly Miracle Material

During the first three-quarters of the twentieth century, over 30 million tons of asbestos were used for various purposes in the United States. About half a million people are estimated to have died as a result. What is asbestos? Why do we use it? And why do we sometimes die from it?

Asbestos is a fibrous silicate mineral, found in many forms in nature, that is strong, flexible, and resistant to heat and corrosion (Figure 3.A). Be-

cause of exposure to asbestos. It results from the dangerous interaction between asbestos and lysosomes. Apparently, cells responsible for cleaning the respiratory passages engulf small particles of asbestos inhaled into the lungs; lysosomes inside the cleaning cells then fuse with the vesicles containing the asbestos particles. Unfortunately, the lysosomal enzymes cannot break down the asbestos particles. Instead, the particles destabi-

lized, releasing fibers that are highly irritating and present in many buildings constructed before the ban went into effect. This point was made painfully clear when asbestos was detected in the debris and dust at the site where the World Trade Centers collapsed on September 11, 2001. Asbestos had been used as insulation in parts of the towers.

What can be done about the asbestos already present in our schools and workplaces? It is generally recommended and often required that

be removed by other means. The best method is best in sealing or re-



HEALTH ISSUE

Correcting Vision Problems

Although most people wear glasses to correct vision problems, almost 20 million Americans use contact lenses instead. The contact lens sits

on the cornea over a layer of tears. The outer surface of the lens is the corrective surface, and the inner surface fits snugly on the cornea.

There are two types of contact lenses. Rigid gas-permeable lenses are made of slightly flexible plastic. These lenses are tough and durable, but some people find that they irritate the eyes. Soft lenses are made of a more malleable plastic. Although soft lenses are gentler on the eyes, they become scratched and damaged more easily.

Contact lenses must be cleaned and disin-

fected frequently. frequent insertion and removal of lenses would reduce trauma to the cornea. However, a serious safety concern with contact lenses that are left in overnight or for extended periods of time is ulcerative keratitis, a condition in which the cells of the cornea may be rubbed away by the contact lens, sometimes leading to infection and scarring. If not promptly treated, ulcerative keratitis can lead to blindness. Another problem with leaving contact lenses in overnight seems to be a reduced oxygen supply to the cornea, which causes it to swell.

Many people who are tired of depending on glasses or contact lenses have opted to undergo laser eye surgery. This procedure is popu-

lar instead of in the entire cornea, eliminating some of the complications caused by the deeper corneal flaps. LASEK is used mostly for people who are poor candidates for LASIK because their corneas are thin or flat. In yet another procedure, photorefractive keratectomy (PRK), a surgeon uses short bursts of a laser beam to shave a microscopic layer of cells off the corneal surface and flatten it. A computer calculates and controls the laser exposure.

The shape of the cornea can also be altered using a surgical procedure that does not involve lasers. A surgeon can place corneal ring segments, two tiny crescent-shaped pieces of plastic, in the cornea to flatten it. This 15-minute

Rich in Applications and Connections