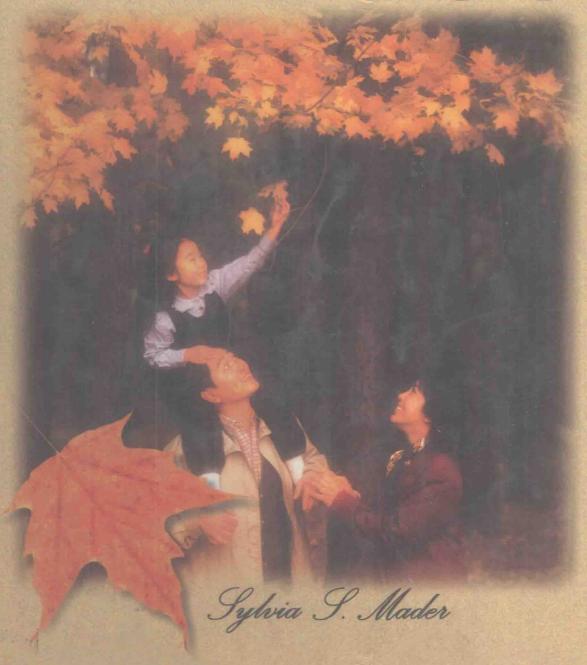
# B I O L O G Y







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# **Preface**

Human Biology is suitable for use in one-semester biology courses that emphasize human physiology and the role that humans play in the biosphere. All students should leave college with a firm grasp of how their bodies normally function and how the human population can become more fully integrated into the biosphere. This knowledge can be applied daily and helps assure our continued survival as individuals and as a species. The application of biological principles to practical human concerns is now widely accepted as a suitable approach to the study of biology because it fulfills a great need. Human beings are frequently called upon to make decisions about their bodies and their environment. Wise decisions require adequate knowledge.

In this edition, as in previous editions, each chapter presents the topic clearly, simply, and distinctly so that students will feel capable of achieving an adult level of understanding. Detailed, high-level scientific data and terminology are not included because I believe that true knowledge consists of working concepts rather than technical facility. Students and instructors alike will find the text stimulating and a pleasure to read and study, especially since the illustration program is outstanding and there are many spectacular four-color illustrations that integrate art with micrographs.

# **Concepts Are Stressed**

In this edition, the major topics are numbered, and the concepts listed on the chapter's opening page are grouped according to these topics. This numbering system, which is used in the text material and in the summaries, allows instructors to assign just certain portions of the chapter. It also allows students to study the chapter in terms of the concepts presented.

# **Applications Are Made**

Educational theory tells us that students are most interested in knowledge of immediate practical application. This text is consistent with and remains true to this approach.

Each chapter now begins with a short story that applies chapter material to real-life situations. The readings stress applications and so does the running text material.

At the end of the chapter, certain Applying Your Knowledge questions ask students to relate the concepts of the chapter to events that occur in their own lives. Others are concerned with a bioethical issue. The issue is discussed at some length, and then questions are asked that can be used as a basis for class discussion.

# **Illustration Program**

Many illustrations use both a micrograph and drawing along with boxed statements that emphasize key concepts, thereby increasing student comprehension. Common leaders and labels allow students to accurately relate the micrograph and the drawing.

In this edition, illustrations are even more closely correlated with the text material. Every illustration is on the same or the facing page to its reference to aid learning and studying.

# **Working Together Boxes**

A theme for this edition is how systems work together to achieve homeostasis. Working Together boxes appear at the end of the systems chapters. These illustrations describe how each organ system works with the other systems to achieve its many functions, which are discussed throughout the chapter.

# Readings

Two main concerns of this edition (health and ecology) are carried through the book by Health Focus and Ecology Focus readings. The Health Focus readings are designed to help students cope with a common health problem. The Ecology Focus readings draw attention to a particular environmental problem. The readings emphasize the concepts of the chapter and tie biological principles to practical human concerns.

New to this edition, a bioethical issue is described in detail at the end of each chapter, and questions are provided for class discussion.

# New and Modified Chapters

All chapters have been modified or rewritten to improve the presentation. The following changes are of special interest.

Part Three, Movement and Support, is new to this edition and contains chapters 10 (Skeletal System) and 11 (Muscular System), which are both completely new chapters.

The chapters dealing with genetics and biotechnology have been extensively revised to include the latest research, techniques, and information. The AIDS supplement was completely rewritten.

Chapter 22 (Evolution) was rewritten to better present basic principles, the origin of life, and to update the human evolution section.

# **Technology Aids Pedagogy**

Many technology aids are available for use with Human Biology.

#### For the Student

The Mader Home Page on the World Wide Web provides additional exercises to aid learning and resources that expand on the text's content and applications. The Applying Technology section in each chapter reminds students to visit the site and explore the many activities.

Interactive CD-ROMs bring biology to life. New to this edition, *The Dynamic Human* CD-ROM offers three-dimensional visuals that facilitate an understanding of human anatomy and physiology. *Explorations in Human Biology* has 16 modules, and each one allows students to study a particular high-interest biological topic. *Explorations in Cell* 

Biology and Genetics provides 17 exciting interactive activities. The Life Science Animations include 53 additional topics that can be studied in a visually appealing way. Numerous other aids are available, and all of these are listed on the Technology page (see page xviii of the Preface).

#### For the Instructor

The Extended Lecture Outline software makes the contents of the book available in a way that facilitates lecture preparation, and the Visual Resource Library on CD-ROM makes the text illustrations available for classroom use.

To help with the mechanics of teaching, there is testing software, which is the computerized version of the *Test Item File*; the computerized test bank is available in Windows and Macintosh formats.

# NEW TO THIS EDITION

- Major topics are numbered on the chapter opening page, throughout the chapter, and in the summary of the chapter. Each illustration is on the same or facing page as its reference.
- ► Chapter opening stories now introduce the chapter in an appealing way that emphasize the relevancy of the topics to be studied.
- A bioethical issue is explained in detail, with questions for class discussion, at the end of each chapter. Health Focus and Ecology Focus readings occur in nearly every chapter.
- ▶ Working Together boxes appear at the end of the systems chapters. These illustrations describe how each organ system works with the other systems to achieve its many functions, which are discussed throughout the chapter. Each system can also be studied by using *The Dynamic Human* CD-ROM. For further explanation regarding this CD-ROM, see the Technology section on p. xviii.
- ▶ Part Three, Movement and Support, is new and contains chapters 10 (Skeletal System) and 11 (Muscular System), which are both completely new chapters. The AIDS supplement was updated, as

- were the genetics chapters. Chapter 22 (Evolution) was rewritten to better explain the principles and to update the section on human evolution.
- ▶ Technology aids are described and assigned a level of difficulty at the end of each chapter. New to this edition, *The Dynamic Human* CD-ROM is an interactive three-dimensional visual guide to human anatomy and physiology. *Explorations in Human Biology* and *Explorations in Cell Biology and Genetics* CD-ROMs offer exciting new ways to understand biological concepts. The *Life Science Animations* videotapes allow students to see processes in motion.
- Explore the Mader Home Page for even more information:
  - http://www.mhhe.com/sciencemath/biology/mader/
- Appendix G, Internet Guide, provides instructions for reaching the Mader Home Page.

#### Aids to the Reader

*Human Biology* includes a number of aids that have helped students study biology successfully and enjoyably.

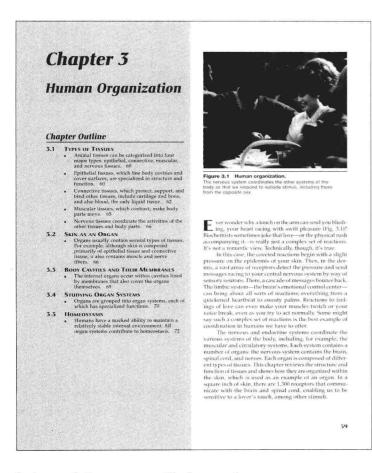
#### Part Introduction

An introduction for each part highlights the central ideas of that part and specifically tells the student how the topics within each part contribute to biological knowledge.

# **Chapter Concepts**

Each chapter begins with a list of concepts that organizes the content of the chapter into a few meaningful sentences. The concepts provide a framework for the content of the chapter.

Note that the concepts are grouped under the major headings and are page-referenced for student study.



# **Internal Summary Statements**

Internal summaries are highlighted to illustrate the chapter's key concepts. These appear at the ends of major sections and help students focus their study efforts on the basics.

Humans belong to the world of living things and are vertebrates. They have modified existing ecosystems to the point that they must now be seriously concerned about the continued existence of the biosphere.

#### Readings

Two types of readings are included in the text. The Health Focus readings give practical information concerning some particular topic of interest, such as how to do a breast exam for cancer, when not to give blood, and proper nutrition for healthy living. The Ecology Focus readings draw attention to some particular environmental problem, such as the need to preserve tropical rain forests, the relationship between ozone holes and skin cancer, and the possible ecological effects of biotechnology. The Instructor's Manual explains how to use the readings in the classroom.

New to this edition, a bioethical issue is described in detail at the end of each chapter, and questions are provided for class discussion.



# Working Together Boxes

These boxes, which appear at the end of the systems chapters, describe how each system works with other organ



systems to achieve its many functions, which are discussed in the chapter.

#### Illustrations and Tables

The illustrations and tables in *Human Biology* are consistent with multicultural educational goals. There are many integrative illustrations that include both a micrograph and a drawing combined with information formerly found in tables. Often it is easier to understand a given process by studying a drawing, especially when it is carefully coordinated with the text as in *Human Biology*.

#### **Chapter Summaries**

The summary is organized according to the major sections of the chapter. The sections are numbered as on the chapter opening page and in the chapter. The summary helps students review the important concepts and topics discussed in each chapter.

# **Selected Key Terms**

Key terms are boldfaced in the chapter, defined in context, and also appear in the end-of-text glossary. Especially significant key terms appear in the selected key term list at the close of the chapter. Here each term is accompanied by a definition and a phonetic spelling, if needed.

# **Chapter Questions**

The chapter questions allow students to test their ability to fulfill the study objectives.

Studying the Concepts These questions, which are page-referenced and organized according to the major sections of the chapter, review the chapter.

#### Applying Your Knowledge to the concepts and a bioethical issue In this section,

three or four questions ask students to relate the concepts they have learned to matters of practical concern. A bioethical issue is described in a nonbiased manner, and then questions appropriate for class discussion are presented.

**Testing Your Knowledge** These objective questions allow students to test their ability to answer recall-based questions. At least one question requires that students label a diagram or fill in a table. Answers to Applying Your Knowledge questions and Testing Your Knowledge questions appear in Appendix A.

# **Further Readings**

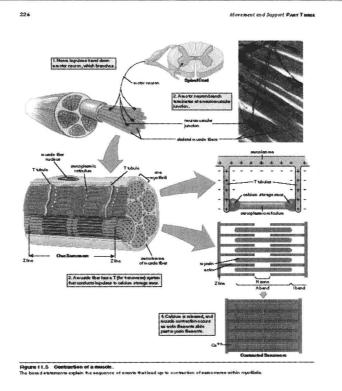
The list of readings at the end of each part suggests references that can be used for further study of the topics covered in the chapters of that part. The references listed in the section were carefully chosen for readability and accessibility. New to this edition, references are followed by a short description and an indication of their level of rigor.

# **Appendices and Glossary**

The appendices contain optional information. Appendix A is the Answer Key for the Applying Your Knowledge to the concepts and Testing Your Knowledge questions; Appendix B is a new presentation of the metric system; Appendix

C is an expanded table of chemical elements; Appendix D reviews most of the drugs of abuse; and Appendix E gives pertinent information about the most frequent types of cancer. Appendix F is a new reference that defines acronyms given throughout the text; and Appendix G is a new appendix that gives information on accessing the Internet in general, and the Mader Home Page specifically.

The glossary defines all the boldfaced terms in the text. These terms are the ones most necessary for making the study of biology successful. Terms that are difficult to pronounce have a phonetic breakdown.





# TECHNOLOGY

everal new state-of-the-art technology products are available that are correlated to this textbook. These useful and enticing supplements can assist you in teaching and can improve student learning.

#### **EXPLORING THE INTERNET**

http://www.mhhe.com/sciencemath/biology/mader/

The Mader Home Page allows students and teachers from all over the world to communicate. *Human Biology* has a complete text-specific site developed exclusively for users of the fifth edition. By visiting this site, students can access additional study aids, explore links to other relevant biology sites, catch up on current information, and pursue other activities. Appendix G in the text provides directions for accessing the Mader Home Page.

#### THE INTERNET PRIMER

by Fritz J. Erickson & John A. Vonk

This short, concise primer shows students and instructors how to access and use the Internet. The guide provides enough information to get started by describing the most critical elements of using the Internet.

#### THE DYNAMIC HUMAN CD-ROM

This guide to anatomy and physiology interactively illustrates the complex relationships between anatomical structures and their functions in the human body. Realistic, three-dimensional visuals are the premier feature of this exciting learning tool. The program covers each body system, demonstrating to the viewer the anatomy, physiology, histology, and clinical applications of each system as described in the Applying Technology section at the end of each chapter.

# EXPLORATIONS IN HUMAN BIOLOGY CD-ROM; EXPLORATIONS IN CELL BIOLOGY AND GENETICS CD-ROM

These interactive CDs, by Dr. George B. Johnson, feature fascinating topics in biology. *Explorations in Human Biology* and *Explorations in Cell Biology and Genetics* have 33 different modules that allow students to study a high-interest biological topic in an interactive way. In this edition of *Human Biology*, the Explorations that correlate to the chapter are briefly described in the Applying Technology section, which appears at the end of each chapter.

#### LIFE SCIENCE ANIMATIONS VIDEOTAPES

Fifty-three animations of key physiological processes are available on videotapes. The animations bring visual movement to biological processes that are difficult to understand on the text page. In this edition of *Human Biology*, the videotapes are correlated to the chapters and are briefly described in the Applying Technology section, which appears at the end of each chapter.

#### **BIOSOURCE VIDEODISC**

BioSource Videodisc, by Wm. C. Brown Publishers and Sandpiper Multimedia, Inc., features 20 minutes of animations and nearly 10,000 full-color illustrations and photos, many from leading WCB/McGraw-Hill biology textbooks.

#### **BIOETHICS FORUMS VIDEODISC**

Bioethics Forums is an interactive program that explores societal dilemmas arising from recent breakthroughs in biology, genetics, and biomedical technology. The scenarios are fictional, but the underlying science and social issues are real. Bioethics Forums encourages students to explore the science behind decisions as well as the processes of ethical reasoning and decision-making.

#### VISUAL RESOURCE LIBRARY

Our electronic art image bank is a CD-ROM that contains hundreds of biological images from *Human Biology*, fifth edition. The CD-ROM contains an easy-to-use program that enables you to quickly view images and import the images into PowerPoint to create your own multimedia presentations. Also included are several video clips featuring key animated biological processes.

#### **HEALTHQUEST CD-ROM**

HealthQuest CD-ROM is an interactive CD-ROM designed to help students address the behavioral aspects of personal health and wellness. HealthQuest allows users to assess their current health and wellness status, determine their health risks and relative life expectancy, explore options and make decisions to improve the behaviors that impact their health.

# VIRTUAL PHYSIOLOGY LABORATORY CD-ROM

Virtual Physiology Lab CD-ROM features ten simulations of the most common and important animal-based experiments ordinarily performed in the physiology component of your laboratory. This revolutionary program allows users to repeat laboratory experiments until they adeptly master the principles involved. The program contains video, audio, and text to clarify complex physiological functions.

#### THE SECRET OF LIFE VIDEO MODULES

WGBH, Boston and BBC-TV

WGBH has produced eight 15-minute video modules that illuminate the biological universe with unique stories and animation. Each module concludes with a series of stimulating questions for class discussion.

#### THE SECRET OF LIFE VIDEODISC

WGBH, Boston

A two-sided videodisc will be available as a companion to *Human Biology*, fifth edition. Topic coverage includes biotechnology, human reproduction, portraits of modern science and research, and human genetics.

Our CD-ROM products may be packaged with the text at a cost-savings. Contact your WCB/McGraw-Hill sales representative for details.

# *TECHNOLOGY*

he fifth edition of *Human Biology* has three technology learning tools that are correlated to the chapters. The Applying Technology section at the end of the chapter describes those that are appropriate to that chapter.

The Dynamic Human is an interactive CD-ROM with three-dimensional visuals demonstrating the anatomy, physiology, histology, along with clinical applications, of each body system.



Explorations in Human Biology and Explorations in Cell Biology and Genetics are interactive CD-ROMs consisting of 33 different modules that cover key topics in biology.





Life Science Animations is a set of five videotapes containing 53 animations of

processes integral to the study of biology.

#### **Chapter 1 Chemistry of Life**

Life Science Animations 1, 11 (Tape 1)

#### **Chapter 2 Cell Structure and Function**

Explorations in Cell Biology & Genetics 2, 3, 6, 8 Life Science Animations 2, 3, 4, 5, 6, 7, 11 (Tape 1)

# **Chapter 3 Human Organization**

The Dynamic Human, Anatomical Orientation

# **Chapter 4 Digestive System and Nutrition**

The Dynamic Human, Digestive System Explorations in Human Biology 3, 7 Life Science Animations 33, 34, 35, 36 (Tapes 3 and 4)

# **Chapter 5 Composition and Function of Blood**

The Dynamic Human, Lymphatic System Life Science Animations 37 (Tape 4) Explorations in Human Biology 12

# **Chapter 6 Cardiovascular System**

The Dynamic Human, Cardiovascular System Life Science Animations 32, 37, 38 (Tapes 3 and 4)

# **Chapter 7 Lymphatic System and Immunity**

The Dynamic Human, Lymphatic System Explorations in Human Biology 12 Life Science Animations 41, 42, 43, 44 (Tape 4)

# **Chapter 8 Respiratory System**

The Dynamic Human, Respiratory System Explorations in Human Biology 3, 6

# **Chapter 9 Urinary System and Excretion**

The Dynamic Human, Urinary System

# **Chapter 10 Skeletal System**

The Dynamic Human, Skeletal System

# **Chapter 11 Muscular System**

The Dynamic Human, Muscular System Life Science Animations 29, 30, 31 (Tape 3) Explorations in Human Biology 4, 9

#### **Chapter 12 Nervous System**

The Dynamic Human, Nervous System Explorations in Human Biology 8, 9 Life Science Animations 22, 23, 24, 25 (Tape 3)

#### **Chapter 13 Senses**

Explorations in Cell Biology & Genetics 4 Explorations in Human Biology 11 Life Science Animations 28 (Tape 3)

# **Chapter 14 Endocrine System**

The Dynamic Human, Endocrine System Explorations in Human Biology 11 Life Science Animations 28 (Tape 3)

# **Chapter 15 Reproductive System**

The Dynamic Human, Reproductive System

# **Chapter 16 Sexually Transmitted Diseases**

Explorations in Human Biology 13

# **Chapter 17 Development and Aging**

Explorations in Human Biology 3, 15 Life Science Animations 21, 39 (Tapes 2 and 4)

# **Chapter 18 Chromosomal Inheritance**

Explorations in Cell Biology & Genetics 10

# **Chapter 19 Genes and Medical Genetics**

Explorations in Cell Biology & Genetics 12, 13 Explorations in Human Biology 1

# Chapter 20 DNA and Biotechnology

Explorations in Cell Biology & Genetics 14, 16, 17 Life Science Animations 15, 16, 17 (Tape 2)

# Chapter 21 Cancer

Explorations in Cell Biology & Genetics 5 Explorations in Human Biology 3, 6

#### Chapter 23 Ecosystems

Life Science Animations 51, 52 (Tape 5)

# **Chapter 24 Population Concerns**

Explorations in Human Biology 16

# More Teaching and Learning Aids Transparencies

A set of 200 full color transparency acetates accompanies the text. These acetates contain key illustrations from the text.

#### Instructor's Manual/Test Item File

The *Instructor's Manual/Test Item File*, prepared by Jennifer Carr Burtwistle, is designed to assist instructors as they plan and prepare for classes using *Human Biology*. The first part of the *Instructor's Manual* pertains to the text chapters and the second part is the Test Item File.

Each chapter in the manual begins with a list of objectives, and the questions in the Test Item File are sequenced according to these objectives. Instructors can decide which objectives are best suited to their particular course and then easily locate the appropriate test questions.

The *Instructor's Manual* contains both an extended lecture outline and a general discussion, which together review in detail the contents of the text chapter. The technology section lists videos and computer software items that are available from outside sources and also those that are available from WCB/McGraw-Hill. The student activities section includes some activities that are based on technology accompanying this text. Additional Applying Your Knowledge Questions, with answers, are given in the *Instructor's Manual*.

The Test Item File for each chapter contains approximately 60 objective test questions and several essay questions. Some questions require more thought than others, and the questions are coded as to level of difficulty. These same questions are found in the computerized version of the Test Item File.

#### Visuals Testbank

This testbank contains black-and-white versions of 200 illustrations. The labels are deleted and copies can be run off for student quizzing or practice.

# **Study Guide**

Jennifer Carr Burtwistle prepared the *Study Guide* that accompanies the text. Each text chapter has a corresponding *Study Guide* chapter that includes a listing of objectives, study questions, and a chapter test. Answers to the study questions and the chapter tests are provided to give students immediate feedback.

The objectives in the *Study Guide* are the same as those in the *Instructor's Manual*, and the practice test questions in the *Study Guide* are sequenced according to these objectives. Instructors who make their choice of objectives known to the students can thereby direct student learning in an efficient manner. Instructors and students who make use of the *Study Guide* should find that student performance increases dramatically.

#### **Laboratory Manual**

The author has also written the *Laboratory Manual* to accompany *Human Biology*. With few exceptions, each chapter in the text has an accompanying laboratory exercise in the manual (some chapters have more than one accompanying exercise). In this way, instructors are better able to emphasize particular portions of the curriculum if they wish. The 19 laboratory sessions in the manual are designed to further help students appreciate the scientific method and to learn the fundamental concepts of biology and the specific content of each chapter. All exercises have been tested for student interest, preparation time, and feasibility.

#### **Laboratory Resource Guide**

More extensive information regarding preparation is found in the *Laboratory Resource Guide*. The guide includes suggested sources for materials and supplies, directions for making up solutions and otherwise setting up the laboratory, expected results for the exercises, and suggested answers to all questions in the laboratory manual. It is free to all adopters of the laboratory manual.

# Micrograph Slides

This ancillary provides 35mm slides of many photomicrographs and all electron micrographs in the text.

# From WCB/McGraw-Hill

# How to Study Science, 2nd Edition

by Fred Drewes, Suffolk County Community College

This excellent new workbook offers students helpful suggestions for meeting the considerable challenges of a college science course. It offers tips on how to take notes, how to get the most out of laboratories, and how to overcome science anxiety. The book's unique design helps students develop critical thinking skills while facilitating careful note taking. (ISBN 0-697-15905-1)

# A Life Science Living Lexicon

by William N. Marchuk, Red Deer College

This portable, inexpensive reference helps introductory-level students quickly master the vocabulary of the life sciences. Not a dictionary, it carefully explains the rules of word construction and derivation, in addition to giving complete definitions of all important terms. (ISBN 0-697-12133-X)

# **Biology Study Cards**

by Kent Van De Graaff, R. Ward Rhees, and Christopher H. Creek, Brigham Young University

This boxed set of 300 two-sided study cards provides a quick yet thorough visual synopsis of all key biological terms and concepts in the general biology curriculum. Each card features a masterful illustration, pronunciation guide, definition, and description in context. (ISBN 0–697–03069–5)

# **Virtual Biology Laboratory CD-ROM**

by John Beneski and Jack Waber, West Chester University This CD-ROM is designed primarily for nonscience major students. The exercises (10 modules) are designed to expose students to the types of tools used by biologists, allow students to perform experiments without the use of wet lab setups, and support and illustrate topics and concepts from a traditional biology course. (ISBN 0-697-33427-9)

# **Life Science Living Lexicon CD-ROM**

by William N. Marchuk, Red Deer College

A Life Science Living Lexicon CD-ROM contains a comprehensive collection of life science terms, including definitions of their roots, prefixes, and suffixes as well as audio pronunciations and illustrations. The Lexicon is student-interactive, providing quizzing and notetaking capabilities. It contains 4,500 terms, which can be broken down for study into the following categories: anatomy and physiology, botany, cell and molecular biology, genetics, ecology and evolution, and zoology.

# **Critical Thinking Case Study Workbook**

by Robert Allen

This ancillary includes 34 critical thinking case studies that are designed to immerse students in the "process of science" and challenge them to solve problems in the same way biologists do. The case studies are divided into three levels of difficulty (introductory, intermediate, and advanced) to afford instructors greater choice and flexibility. An answer key accompanies this workbook. (ISBN 0-697-34250-6)

#### The AIDS Booklet

by Frank D. Cox

This booklet describes how AIDS and related diseases are commonly spread so that readers can protect themselves and their friends against this debilitating and deadly disease. This booklet is updated quarterly to give readers the most current information. Also visit the Mader Home Page for additional AIDS material. (ISBN 0-697-26261-8)

# **Chemistry for Biology**

by Carolyn Chapman

This workbook is a self-paced introduction or review of the basic principles of chemistry that are most useful in other areas of science. (ISBN 0-697-24121-1)

# **Biology Startup**

by Myles Robinson and Kathleen Pace, Grays Harbor College Biology Startup is a five-disk Macintosh tutorial that helps nonmajors master challenging biological concepts such as basic chemistry, photosynthesis, and cellular respiration. This program can be a valuable addition to a resource center and is especially helpful as a refresher or for students who need additional assistance to succeed in an introductory biology course.

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The personnel at WCB/McGraw-Hill have always lent their talents to the success of *Human Biology*. My editor, Michael Lange, directed the efforts of all. Connie Haakinson, my developmental editor, served as a liaison between the editor, me, and many other people. She met each new challenge in a prompt and most professional way.

The production team worked diligently toward the success of this edition. Margaret Horn was the project manager; Lori Hancock, the photo coordinator; and Wayne Harms, the designer. My thanks to each of them for a job well done!

#### The Reviewers

Many instructors have contributed not only to this edition of *Human Biology*, but also to previous editions. I am extremely thankful to each one, for they have all worked diligently to remain true to our calling and provide a product that will be the most useful to our students.

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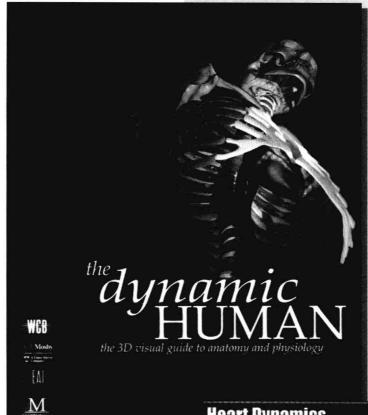
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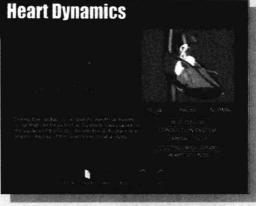


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# **Brief Contents**

Introduction		Part 5	
A	Human Perspective 1	Human Reproduction 311	
Part	1	15 Reproductive System 311	
Human Organization 13		16 Sexually Transmitted Diseases 333	
1	Chemistry of Life 13	AIDS Supplement 349	
2	Cell Structure and Function 39	17 Development and Aging 357	
3	Human Organization 59	Part 6	
Part 2		Human Genetics 379	
		18 Chromosomal Inheritance 379	
Maint	enance of the Body 79	19 Genes and Medical Genetics 397	
4	Digestive System and Nutrition 79	20 DNA and Biotechnology 415	
5	Composition and Function of Blood 107	21 Cancer 437	
6	Cardiovascular System 123	Part 7	
7	Lymphatic System and Immunity 141	Human Evolution and Ecology 455	
8	Respiratory System 163	22 Evolution 455	
9	Urinary System and Excretion 183	23 Ecosystems 469	
Part	3	24 Population Concerns 489	
		•	
	ment and Support 203	Appendices	
10		A Answer Key A-1	
11	Muscular System 221	B Metric System A–8	
Part	4	C Table of Chemical Elements A–9	
		D Drugs of Abuse A-10	
Integration and Coordination in Humans 241		E Selected Types of Cancer A–12	
		F Acronyms A–17	
12	,	G Internet Guide A–19	
13			
14	Endocrine System 287	Glossary G-1	
		Credits C-1	
		Index 1–1	
		IIIIIEX I— I	