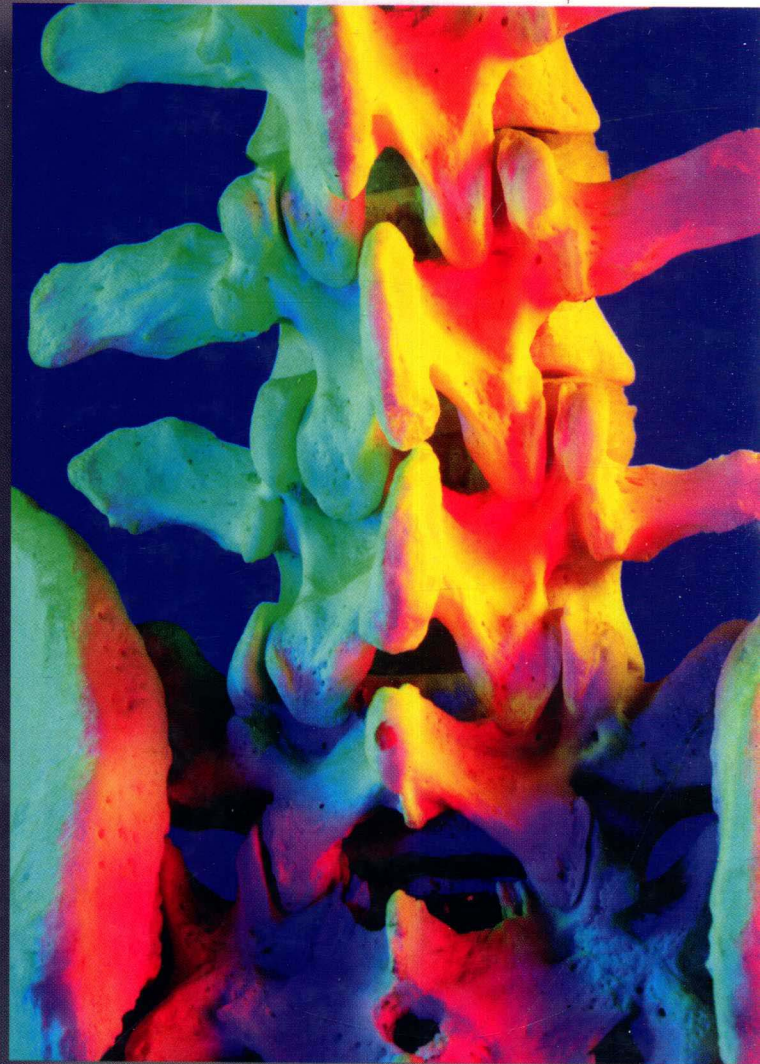


Essentials of Anatomy and Physiology



Seeley Stephens Tate

Third Edition

Essentials of Anatomy and Physiology

Third Edition

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Idaho State University

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ESSENTIALS OF ANATOMY AND PHYSIOLOGY, THIRD EDITION

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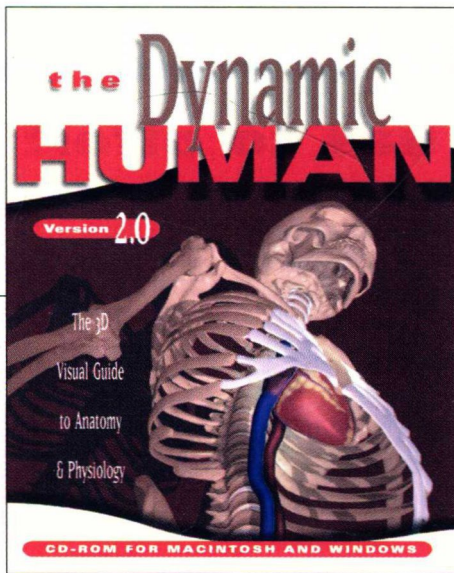
Prefixes, Suffixes, And Combining Forms

The ability to break down medical terms into separate components or to recognize a complete word depends on mastery of the combining forms (roots or stems) and the prefixes and suffixes that alter or modify the meaning and usage of the combining form. The combining forms are usually derived from Latin or Greek nouns, verbs, or adjectives. Prefixes are placed before the combining form, and suffixes are added after.

Term	Meaning	Example
a-	Without, lack of	Aphasia (lack of speech)
ab-	Away from	Abductor (leading away from)
-able	Capable	Viable (capable of living)
acou-	Hearing	Acoustics (science of sound)
acr-	Extremity	Acromegaly (large extremities)
ad-	To, toward, near to	Adrenal (near the kidney)
adeno-	Gland	Adenoma (glandular tumor)
-al	Expressing relationship	Neural (referring to nerves)
-algia	Pain	Gastralgia (stomach pain)
an-	Without, lack of	Anaerobic (without oxygen)
ana-	Up, back, again	Anatomy (a cutting up)
angio-	Vessel	Angiography (radiography of blood vessels)
ante-	Before, forward	Antecubital (before elbow)
anti-	Against, reversed	Antiperistalsis (reversed peristalsis)
arthr-	Joint	Arthritis (inflammation of a joint)
-ary	Associated with	Urinary (associated with urine)
-asis	Condition, state of	Homeostasis (state of staying the same)
auto-	Self	Autolysis (self breakdown)
bi-	Twice, double	Bicuspid (two cusps)
bio-	Live	Biology (study of living)
-blast-	Bud, germ	Fibroblast (fiber - producing cell)
brady-	Slow	Bradycardia (slow heart rate)
-c	Expressing relationship	Cardiac (referring to heart)
carcin-	Cancer	Carcinogenic (causing cancer)
cardio-	Heart	Cardiopathy (heart disease)
cata-	Down, according to	Catabolism (breaking down)
cephal-	Head	Cephalic (toward the head)
-cele	Hollow	Blastocele (hollow cavity inside a blastocyst)
cerebro-	Brain	Cerebrospinal (referring to brain and spinal cord)
chol-	Bile	Acholic (without bile)
cholecyst-	Gallbladder	Cholecystokinin (hormone that causes the gallbladder to contract)
chondr-	Cartilage	Chondrocyte (cartilage cell)
-cide	Kill	Bactericide (agent that kills bacteria)
circum-	Around, about	Circumduction (circular movement)
-clast-	Smash, break	Osteoclast (cell that breaks down bone)
co-	With, together	Coenzyme (molecule that functions with an enzyme)
com-	With, together	Commissure (coming together)
con-	With, together	Convergence (to incline together)
contra-	Against, opposite	Contralateral (opposite side)
crypto-	Hidden	Cryptorchidism (undescended or hidden testes)

Term	Meaning	Example
cysto-	Bladder or sac	Cystocele (hernia of a bladder)
-cyte	Cell	Erythrocyte (red blood cell)
cyto-	Cell	Cytoskeleton (supportive fibers inside a cell)
de-	Away from	Dehydrate (remove water)
derm-	Skin	Dermatology (study of the skin)
di-	Two	Diploid (two sets of chromosomes)
dia-	Through, apart, across	Diapedesis (ooze through)
dis-	Reversal, apart from	Dissect (cut apart)
-duct-	Draw	Abduct (lead away from)
-dynia	Pain	Mastodynia (breast pain)
dys-	Difficult, bad	Dysmentia (bad mind)
e-	Out, away from	Eviscerate (take out viscera)
ec-	Out from	Ectopic (out of place)
ecto-	On outer side	Ectoderm (outer skin)
-ectomy	Cut out	Appendectomy (cut out the appendix)
-edem-	Swell	Myoedema (swelling of a muscle)
em-	In	Empyema (pus in)
-emia	Blood	Anemia (deficiency of blood)
en-	In	Encephalon (in the brain)
endo-	Within	Endometrium (within the uterus)
entero-	Intestine	Enteritis (inflammation of the intestine)
epi-	Upon, on	Epidermis (on the skin)
erythro-	Red	Erythrocyte (red blood cell)
eu-	Well, good	Euphoria (well-being)
ex-	Out, away from	Exhalation (breathe out)
exo-	Outside, on outer side	Exogenous (originating outside)
extra-	Outside	Extracellular (outside the cell)
-ferent	Carry	Afferent (carrying to the central nervous system)
-form	Expressing resemblance	Fusiform (resembling a fusion)
gastro-	Stomach	Gastrodynia (stomach ache)
-genesis	Produce, origin	Pathogenesis (origin of disease)
gloss-	Tongue	Hypoglossal (under the tongue)
glyco-	Sugar, sweet	Glycolysis (breakdown of sugar)
-gram	A drawing	Myogram (drawing of a muscle contraction)
-graph	Instrument that records	Myograph (instrument for measuring muscle contraction)
hem-	Blood	Hemolysis (breakdown of blood)
hemi-	Half	Hemiplegia (paralysis of half of the body)
hepato-	Liver	Hepatitis (inflammation of the liver)
hetero-	Different, other	Heterozygous (different genes for a trait)
hist-	Tissue	Histology (study of tissues)
homeo-	Same	Homeostasis (state of staying the same)
hydro-	Wet, water	Hydrocephalus (fluid within the head)
hyper-	Over, above, excessive	Hypertrophy (overgrowth)
hypo-	Under, below, deficient	Hypotension (low blood pressure)
-ia	Expressing condition	Neuralgia (pain in nerve)
-iatr-	Treat, cure	Pediatrics (treatment of children)
-id	Expressing condition	Flaccid (state of being weak)
im-	Not	Impermeable (not permeable)
in-	In, into	Injection (forcing fluid into)
infra-	Below	Infraorbital (below the eye)
inter-	Between	Intercostal (between the ribs)

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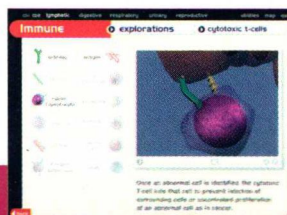
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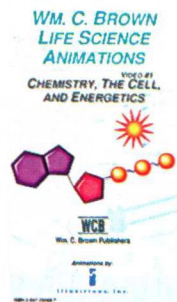


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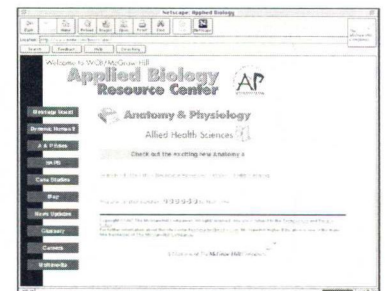
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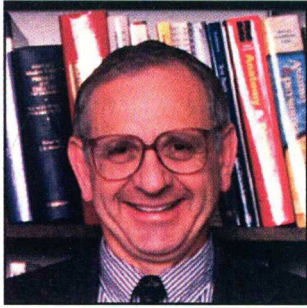
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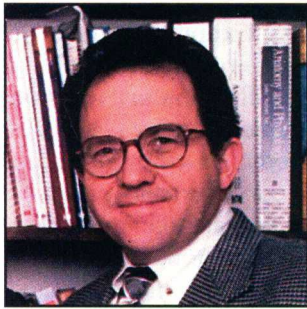
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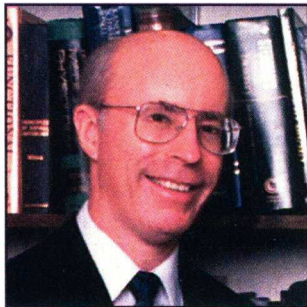
Rod R. Seeley Professor of Physiology, Idaho State University

With a B.S. in zoology from Idaho State University and an M.S. and Ph.D. in zoology from Utah State University, Rod Seeley has built a solid reputation as a widely published author of journal and feature articles, a popular public lecturer, and an award-winning instructor. Very much involved in the methods and mechanisms that help students learn, he contributes to this text his teaching expertise and proven ability to communicate effectively in any medium.



Trent D. Stephens Professor of Anatomy and Embryology, Idaho State University

An award-winning educator, Trent Stephens teaches human anatomy, neuroanatomy, and embryology. His skill as a biological illustrator has greatly influenced every illustration in this text. With B.S. and M.S. degrees in zoology from Brigham Young University and a Ph.D. in anatomy from the University of Pennsylvania, Trent Stephens has also published numerous scientific papers and books. His students continually rate him highly on their evaluations—you will too!



Philip Tate Instructor of Anatomy and Physiology, Phoenix College

From the community college to the private 4-year college, Phil Tate has taught anatomy and physiology to all levels of students: nursing and allied health, physical education, and biology majors. At San Diego State University, Phil earned B.S. degrees in both mathematics and zoology and a M.S. in ecology. He earned his doctorate in biological education from Idaho State University.



Preface

Human anatomy and physiology courses present exciting and tremendous challenges to both students and teachers. The acquisition of basic anatomical and physiological facts is essential to the study of anatomy and physiology, but it is also important for students to develop the ability to solve practical, real-life problems related to the knowledge they have acquired. It is impossible to memorize all of the body's responses to all possible situations. Students who have accumulated background knowledge and who are prepared to reason effectively are better able to anticipate responses to new situations and are better prepared to be effective citizens and health care professionals. In addition, it is not possible for students to learn all of the details of anatomy and physiology that are known. Selecting the most important information to provide a solid understanding of anatomy and physiology and to prepare students to solve problems effectively are major challenges for teachers and for authors.

We have written each edition of *Essentials of Anatomy and Physiology* with the same major intention: to help students learn basic anatomy and physiology. We chose to present the major concepts that provide a current understanding of the subject. We present the information in a readable form that seeks to explain in such a way that concepts may be truly understood rather than simply memorized. In parallel with the written explanations of structures and functions are illustrations that reinforce the concepts and explanations.

When teaching beginning students, it is important not to obscure the “big picture” with an overwhelming deluge of detail. It is important to provide enough pieces of information to allow the students to solve basic problems. It is our goal to present, in the text and illustrations, basic content at an appropriate level and in a way that supports the development of problem-solving skills that emphasize the practical application of concepts in anatomy and physiology to real-life situations.

Essentials of Anatomy and Physiology is unique in its approach to the development of problem-solving skills. The third edition provides the teacher with a great deal of flexibility and assistance. It can be used very successfully to focus on content and in learning the vocabulary of anatomy and physiology. The third edition can also provide a gentle introduction to problem-solving techniques that can be emphasized to a greater extent as students progress through the course. The problem-solving strategies can also be used to illustrate how knowledge of anatomy and physiology is relevant to real-life situations.

Themes

We have chosen to emphasize the following two major themes throughout this text: the **relationship between structure and function** and **homeostasis**.

Just as the structure of a hammer makes it well-suited for the function of pounding nails, the structure of specific cells, tissues, and organs within the body allows them to perform their specific functions effectively. For example, muscle cells contain proteins that make contraction possible, and bone cells surround themselves with a mineralized matrix that provides strength and support. Knowledge of structure and function relationships makes it easier to understand anatomy and physiology and greatly enhances one's appreciation for the subject.

Homeostasis, the maintenance of an internal environment within an acceptably narrow range of values, is necessary for the survival of the human body. An emphasis in this book is on how mechanisms operate to maintain homeostasis. Because failure of these mechanisms also illustrates how they work, examples of pathological conditions that result in dysfunction, disease, and possibly death are presented. Changes in response to increased physical exercise or aging are also included to illustrate how these mechanisms work. Consideration of pathology, exercise, and aging adds relevance and interest, makes the material more meaningful, and enhances the background of the people who plan to pursue areas related to health. The two themes—the relationship between structure and function, and homeostasis—combined with the book's solid problem-solving orientation and numerous clinical and other related examples, make this text unique among anatomy and physiology texts at this level.

General Features

The following four general features, taken together, distinguish *Essentials of Anatomy and Physiology* from other texts:

1. The systematic presentation of content is designed to be consistent with the problem-solving approach of the text. Explanations are based on a conceptual framework that allows students to tie together individual pieces of information. Simple facts are presented first, and explanations are developed in a logical sequence that are thorough enough to support

the problem-solving emphasis of the book. Students are not confronted with problems without adequate information to solve them.

2. We offer balanced coverage of anatomy and physiology. Some texts emphasize anatomy at the expense of physiology coverage. Health professionals return to school for further training, mainly because they need a better understanding of physiology. Other texts do not adequately integrate anatomy with physiology and fail to help students understand how structures carry out functions. This text provides a solid foundation in anatomy as well as a balanced coverage of physiology.
3. Problem-solving is encouraged by the addition of relevant contextual examples. Clinical information should not be an end in itself. In some texts, mere clinical descriptions or medical terminology represent a significant portion of the material. Some texts also provide lists of pathologies with brief explanations. This text provides clinical examples to promote interest and demonstrate relevance, but clinical information is used primarily to illustrate the application of basic knowledge. The ability to apply information is a skill that will always be an asset for students, even after knowledge learned today is no longer current. We encourage students using *Essentials of Anatomy and Physiology* to apply the knowledge they have gained through problem-solving to their professional and private lives.
4. Questions that require the solution of practical problems are included in a systematic fashion. At best, some anatomy and physiology texts include a few “thought” questions that, for the most part, involve a restatement or a summary of content. Yet once students understand the material well enough to state it in their own words, it only seems logical for them to proceed to the next step—that is, to apply the knowledge to hypothetical situations. This text features two sets of problem-solving questions in every chapter. Predict questions and Develop Your Reasoning Skills questions provide students with an opportunity and challenge because we believe the simple assumption that practice in solving problems greatly enhances problem-solving skills.

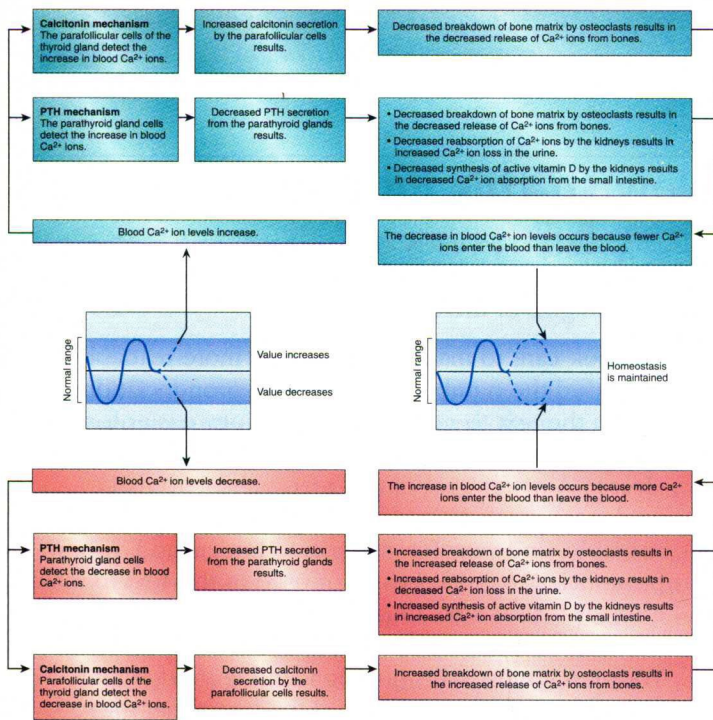
This text helps to develop problem-solving skills in several ways. First, all the information necessary to solve a problem is presented at a level that is sufficiently simple to avoid unnecessary confusion. Second, the opportunity to practice problem-solving is made available through Predict questions embedded within the chapter materials, and the Develop Your Reasoning Skills questions found at the end of each chapter. Third, answers and explanations for the Predict questions are included at the end of each chapter. Explanations for Develop Your Reasoning Skills questions are presented in the Instructor's Manual. The explanations illustrate the methods used to solve problems and provide a model for the development of problem-solving skills. When students are exposed to the reasoning used to correctly solve a problem, they are more likely to be able to successfully apply that reasoning to future problems. The acquisition of problem-solving skills is necessary for a

complete understanding of anatomy and physiology; it is fun; and it makes it possible for the student to deal with the many problems that occur as part of professional and everyday life.

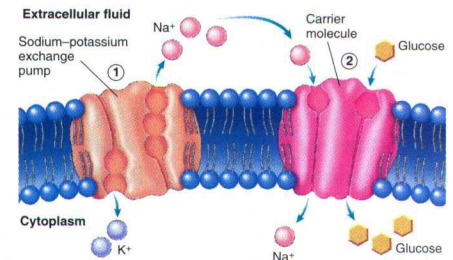
New to this Edition

It is impossible to list every change that has taken place in the third edition of *Essentials of Anatomy and Physiology*, but the major highlights of the revision are:

1. We took care to make the text even more readable, increased the number of terms with pronunciations within the text to make the terminology easier for students, and refined explanations to make them even clearer. A major goal of this revision was to make explanations of structures and functions current, readable, and easy for students to understand. A new pronunciation guide has been used in this text to make it easier for students to pronounce words.
2. We have increased the number of Predict and Develop Your Reasoning Skills questions in the third edition. The questions have been reviewed to ensure that they address topics current and consistent with the concepts emphasized in the text. We have continued the emphasis on providing problem-solving practice for students, and are confident that students who are encouraged to answer these questions will dramatically improve their problem-solving skills.
3. Throughout the text, there is an increased emphasis on clinically-related information to enhance relevancy and to illustrate normal anatomy and physiology. In all cases, the emphasis is helping students understand basic anatomical and physiological principles, but the clinical orientations emphasize the importance of these principles. This creates relevancy for many students in a way that helps them learn the information and motivates them to remember more. Clinically-related information appears in the text in the form of Did You Know?, Clinical Foci, Predict questions, Develop Your Reasoning Skills questions, and tables where appropriate.
4. Homeostasis figures (on the following page) are a major new addition to assist students in understanding regulatory mechanisms, which are often difficult for them. The homeostasis figures provide a visual means of understanding the concept of homeostasis, which is the maintenance of an internal environment within an acceptably narrow range of values. The emphasis in this book is on how mechanisms operate to maintain homeostasis. Because understanding how these mechanisms fail also illustrates how they work, pathological conditions that result in dysfunction, disease, and possibly death are also presented. Changes in response to increased physical exercise or aging also illustrate how these mechanisms work. Consideration of pathology, exercise, and aging adds relevance and interest, makes the material more meaningful, and enhances the background of the people who plan to pursue areas related to health.



1. A sodium-potassium exchange pump maintains a concentration of sodium ions that is higher outside the cell than inside.
2. The sodium ions diffuse back into the cell by facilitated diffusion, assisted by a carrier molecule that also facilitates the diffusion of glucose. The diffusing sodium ions provide energy that can be used to move glucose against its concentration gradient.



trigger specific mechanisms that function to cause the deviations to be reversed. A new section describing the characteristics of life has been added.

We have added a description of homeostatic mechanisms using the concepts of receptors, control centers, and effectors. In addition, the concepts of variation around a set point producing a normal range of values are introduced. New illustrations of negative and positive feedback and the introduction of the homeostasis illustrations used throughout the remainder of the text have been added. **Chapter 2:** The chemistry chapter has been rewritten to be consistent with the presentations found in modern introductory chemistry texts, including a discussion of the differences between molecules and compounds, the formation of covalent and ionic bonds, and the effect of dissociation on molecules, covalent compounds, and ionic compounds. A new section was added on energy and chemical reactions and the significance of ATP production and breakdown within cells. **Chapter 3:** The sections on transport processes, receptors and membrane channels are rewritten to be consistent with current data and made to be consistent with descriptions in the other chapters of the book.

Chapter 4: The organization of the tissue illustrations has been changed. We have improved the transition from macroscopic to microscopic structure and established a convenient and consistent labeling organization to make patterns easy to recognize. **Chapter 5:** A new chapter-opening description summarizes the functions of the integumentary system. This format is used in the other chapters that introduce systems. There is an improved discussion and illustration of the transfer of melanin from melanocytes to other cells in the epidermis. A System Pathology essay on burns has been added to the end of the chapter. **Chapter 6:** A new figure has been added to improve the presentation of bone repair. Insets have been added to figures to help students appreciate the orientation of individual bones in the whole skeleton. A System Pathology essay on osteoporosis has been added at the end of the chapter. **Chapter 7:** Labels on muscle figures and tables have been reorganized to make cross-referencing the information in tables and figures easier. A System Pathology essay on muscular dystrophy has been added at the end of the chapter. **Chapter 8:** New figures have been added to provide a clear representation of resting membrane potentials and action potentials. New figures representing the functional characteristics of the cerebellum have been

5. Many new illustrations have been added to the book to emphasize an attractive and clear visual presentation of both anatomy and physiology. There is continued emphasis in this revision to achieve coordinated, attractive, and full-color illustrations throughout the text, and to design the illustrations to be easily understood, aesthetically pleasing, and informative. Where appropriate, text has been placed directly into the figure to produce a strong conceptual presentation of concepts or processes embedded in the figure. These figures are designed to help students learn physiological processes easily. The labels for the illustrations in the book have been changed to fit a new format. The purpose is to make the illustrations better organized to help students find structures more easily.
6. Each chapter that addresses an organ system ends with a Systems Pathology essay. The essay presents a pathology that affects the system presented in the chapter. The essay is used to emphasize the functional characteristics of the system and interactions with other body systems. Students are presented with examples of how a pathology that affects a single system results in manifestations that involve several other systems of the body. The manifestations are explained so students can understand the mechanisms involved.
7. Revisions of several chapters have resulted in improved presentations. **Chapter 1:** We introduce a new presentation of homeostasis and negative feedback in the form of homeostasis figures. We use homeostasis figures throughout the text to illustrate negative feedback mechanisms that function to maintain homeostasis. These figures appear in a form that allows students to systematically follow how deviations from a set point

added. A System Pathology essay on stroke has been added at the end of the chapter. **Chapter 9:** New figures have been added to illustrate the optic radiations. **Chapter 10:** A new section has been included to present simple models of how chemical signals, such as hormones, interact with receptors at either the membrane or within the cell, to produce a response. Homeostasis figures have been added to summarize how hormones regulate functions so that homeostasis is maintained. A System Pathology essay on hyperthyroidism has been added to the end of the chapter. **Chapter 11:** A new section on the functions of blood has been added. Revised discussion on platelet plug formation and an introduction to integrins is included. A new discussion of disseminated intravascular coagulation is included. **Chapters 12 and 13:** Figures in these chapters have been revised to improve consistency in style and to illustrate the location of the heart in the thoracic cavity, the layers of the heart and blood vessels, and the anatomy of blood vessels. Homeostasis figures have been added to present a simple and clear explanation of heart and blood pressure regulation. A System Pathology essay has been added on myocardial infarctions. **Chapter 14:** A revised discussion and new illustrations of antigen recognition, helper T-cell proliferation, and the activation of B cells have been added. A new overview illustration of the relationships between innate, antibody-mediated, and cell-mediated immunity was included. A new section on immunotherapy was added. A new System Pathology essay on systemic lupus erythematosus has been added to the end of the chapter. **Chapter 15:** A new introduction summarizing the functions of the respiratory system has been added. A revised discussion and new illustrations of the tracheobronchial tree have been included. A new section on the lymphatic supply of the respiratory system has been added. A revised discussion and new illustrations of the mechanics of breathing and the pressure changes that cause air flow in the lungs have been included. A revised and expanded presentation of the neural control of respiration that is consistent with modern concepts of respiratory control has been included. A revised discussion of the effects of exercise on respiration and a new section on respiratory adaptations to exercise has been included. A new System Pathology essay on asthma has been added at the end of the chapter. **Chapter 16:** Figures have been changed to create a more consistent art style. A new section, with figures, on digestion, absorption, and transport has been added. A System Pathology essay has been added on diarrhea. **Chapter 17:** We added a new section on the role of enzymes in regulating metabolism. We revised the discussion on and created new illustrations of anaerobic and aerobic respiration, the electron-transport chain, and lipid and protein metabolism. We introduce a new section and illustration of the absorptive and postabsorptive state. We present a new illustration of heat exchange and a new homeostasis illustration

depicting temperature regulation. **Chapter 18:** New figures have been added to clearly illustrate the nephron and its functions. Homeostasis figures have been added to illustrate the role of the kidney in maintaining homeostasis, as well as the means by which water and electrolytes are regulated. A System Pathology essay on kidney failure has been added. **Chapter 19:** Figures have been changed to make clear the structural and functional characteristics of reproductive structures. A System Pathology essay on benign uterine tumors has been added. **Chapter 20:** Figures have been changed to create a more consistent art style. The genetics section has been rewritten and expanded.

Learning Aids



As the amount of information in a textbook increases, it becomes more and more difficult for students to organize the material in their minds, determine the main points, and evaluate the progress of their learning. Above all, the text must be an effective teaching tool. Because each student may learn best in a different way, a variety of teaching and learning aids is provided.

1. **Chapter Objectives.** Each chapter begins with a series of learning objectives. The objectives are not a detailed cataloging of everything to be learned in the chapter; rather, they emphasize the important facts, topics, and concepts to be covered. The chapter objectives are a conceptual framework to which additional materials will be added as the chapter is read in detail.
2. **Key Terms.** All key terms in the chapter are listed and defined on the chapter opening page. Within the chapter, these terms are set in boldface for student identification. The terms are also included in the glossary at the end of the book.
3. **Vocabulary Aids.** Learning anatomy and physiology is, in many ways, like learning a new language. Basic terminology must be mastered to communicate effectively. In cases where it is instructionally valuable, the derivation or origin of key words is given. In their original language, words are often descriptive, and knowing the original meaning can often enhance understanding and make it easier to remember the definition of the word. Common prefixes, suffixes, and combining forms of many biological terms appear on the inside of the front and back covers of the text and provide additional information on the derivation of words. When the pronunciation of a word is complex, a pronunciation guide is included. Simply being able to pronounce a word correctly is often the key to remembering it. The glossary, which collects the most important terms into one location for easy reference, also has a pronunciation guide.
4. **Did You Know?.** The Did You Know? boxes are designed to provide relevant and interesting examples to enhance the background of students who plan to pursue areas related to health. Other examples related to sports

Did You Know?

A small population of "stem cells" in the brain that can divide and form new neurons has been discovered. Although mature neurons do not form additional neurons, it may be possible to treat brain injuries by developing treatments that stimulate these "stem cells." Also, chemicals called growth factors have been identified that may stimulate stem cells and make injured neurons recover more rapidly.

medicine or everyday experiences are included when they reinforce basic concepts. The Did You Know? essays appear right after concepts are presented, and in so doing, the relevance of the concepts is immediately apparent, helping the student to better appreciate and understand them.

5. **Clinical Focus Boxes.** These boxed essays are expanded versions of the Did You Know? boxes that permit a more detailed or complete coverage of a topic. Subjects covered include pathologies, current research, sports medicine, exercise physiology, pharmacology and clinical applications. They are designed to not only illustrate the chapter content but also stimulate interest.
6. **Predict Questions.** Did You Know? essays (see example above) or Clinical Focus boxes can illustrate how a concept works, but a Predict question requires application of a concept. When reading a text, it is very easy to become a passive learner; everything seems very clear to passive learners until they attempt to use the information. The Predict questions convert the passive learner into an active learner who must use new information to solve a problem. The answer to this kind of question is not a mere restatement of a fact, but rather a prediction and analysis of the data, the synthesis of an experiment, or the evaluation and weighing of important variables of a problem. For example, "Given a stimulus, predict how a system will respond." Or, "Given a clinical condition, explain why the observed symptoms occurred." Answers are given for the Predict questions at the end of each chapter. Not only are possible answers given for the questions, but explanations are provided that demonstrate the process of problem-solving.
7. **Tables.** The book contains many tables that have several uses. They provide more specific information than that included in the text discussion, allowing the text to concentrate on the general or main points of a topic. The tables also summarize some aspects of the chapter's content, providing a convenient way to find information quickly. Often, a table is designed to accompany an illustration, so a written description and a visual presentation are combined to communicate information more effectively.
8. **Homeostasis Figures.** Homeostasis is illustrated using these figures, which provide a summary of the functions of a system and the means by which that system regulates a parameter within a narrow range of values. Homeostasis is a major theme of this text, and the homeostasis figures reinforce that theme effectively.
9. **System Pathology.** These new boxes added to each system chapter represent a modified case study. Their goal is to show how each body system is influenced by the condition described in the case study. A Predict question follows each System Pathology essay.
10. **Chapter Summary.** As the student reads the chapter, details may obscure the overall picture. The chapter summary is an outline that briefly states the important facts and concepts and provides a perspective of the "big picture."
11. **Content Review Questions.** The Content Review questions are another method used in this text to transform the passive learner into an active learner. The questions systematically cover the content and require students to summarize and restate the content in their own words.
12. **Develop Your Reasoning Skills Questions.** Following mastery of the Content questions and therefore chapter content, the Develop Your Reasoning Skills questions require the application of content to new situations. These are not essay questions that involve the restatement or summarization of chapter content. Instead, they provide additional practice in problem-solving and promote the development and acquisition of problem-solving skills.
13. **Multimedia Tie-ins.** *The Dynamic Human Version 2.0* CD-ROM is correlated to many figures. A Dynamic Human icon  appears in appropriate figure legends. The WCB/McGraw-Hill *Life Science Animations* videotape series is correlated to many figures, as is the new *Life Science Animations 3D* videotape. Videotape icons  appear in relevant figure legends. A complete listing of these correlations appears at the end of this preface.
14. **Appendices.** Appendix A is a table of measurements that helps the student relate the metric system to the more familiar English system when determining the size or weight of a structure. Appendix B contains tables of routine clinical test results along with normal values of clinical significance. Reference to this appendix provides students with the homeostatic values of many common subtonics in the blood and urine. Also, the importance of laboratory testing in the diagnosis and/or treatment of illnesses becomes readily apparent to students. Appendix C helps the student understand the shorthand of scientific notation. Appendix D defines various methods for reporting the concentration of solutions and explains the rationale behind how various solutions are described. Appendix E explains the concept of pH and how it is measured.

Supplemental Materials

1. **Student Study Guide** (0-697-39484-0). Written by James Kennedy and Philip Tate, this Study Guide builds on the same teaching goals as the main text. Students are encouraged to use their recall and synthesis skills to

- complete the Study Guide objectives, which mirror and supplement the text objectives.
2. **Laboratory Manual** (0-697-39485-9). Written by Kevin Patton of St. Charles Community College, this manual divides the material typically covered in anatomy and physiology labs into 42 subunits. Selection of the subunits and the sequence of their use permits the design of a laboratory course that is integrated with the emphasis and sequence of the lecture material. Basic content is introduced first, and gradually more complex activities are developed. This laboratory manual also contains boxed hints, safety alerts, separate lab reports, and coloring exercises.
 3. **Instructor's Manual for the Laboratory Manual** (0-07-029446-1). This manual provides all answers to the lab report questions, suggestions on how to use various exercises, materials lists, helpful hints, reagent recipes, and more.
 4. **Instructor's Manual and Test Item File** (0-697-39482-4). The Instructor's Manual was written by James Kennedy of Phoenix College. It suggests ways to organize the material and is keyed to relevant transparencies, boxed essays, illustrations, and lab exercises. Answers to the Develop Your Reasoning Skills questions are included in this manual. The Test Item File, also written by James Kennedy, has been carefully designed to complement the text as well as the study guide.
 5. **MicroTest III**, available in Windows (0-697-39489-1) and Macintosh (0-697-39490-5). A computerized test generator for use with the text allows for quick creation of tests based on questions from the test item file and requires no programming experience.
 6. **Transparencies** (0-697-739486-7). A set of 200 full-color acetate transparencies. The figures that appear were chosen by the authors to be the most useful in lecture presentations.
 7. **WCB/McGraw-Hill Visual Resource Library** (0-697-39936-2). A CD-ROM containing all of the book's line art, with an easy-to-use interface program enabling the user to quickly move among the images, show or hide labels, and create a multimedia presentation.
 8. **A World Wide Web Home Page** exists for *Essentials of Anatomy and Physiology* by Seeley/Stephens/Tate. The address is <http://www.mhhe.com/biosci/abio/>. The site contains instructor and student resources, links to relevant anatomy and physiology sites, and information about appropriate WCB/McGraw-Hill multimedia products.
 9. **The Dynamic Human Version 2.0** CD-ROM (0-697-38935-9) illustrates the important relationships between anatomical structures and their functions in the human body. Realistic computer visualization and three-dimensional visualizations are the premier features of this CD-ROM. The CD-ROM is usable on both Macintosh and Windows '95 computers. Various figures throughout this text are correlated to modules of *The Dynamic Human*. See the end of the preface for a detailed listing of figures.
 10. **The Dynamic Human Videodisc** (0-697-38937-5) contains all the animations (200+) from the first *Dynamic Human* CD-ROM. A barcode directory is also available.
 11. **WCB Life Science Animations Videotape Series** is a series of five videotapes containing fifty-three animations that cover many of the key physiological processes. Another videotape containing similar animations is also available, entitled *Physiological Concepts of Life Science*. Various figures throughout this text are correlated to animations from the *Life Science Animations*. See the end of the preface for a detailed listing of figures. Tape 1: Chemistry, The Cell, Energetics (0-697-25068-7) Tape 2: Cell Division, Heredity, Genetics, Reproduction and Development (0-697-25069-5) Tape 3: Animal Biology I (0-697-25070-9) Tape 4: Animal Biology II (0-697-25071-7) Tape 5: Plant Biology, Evolution, and Ecology (0-697-26600-1) Tape 6: Physiological Concepts of Life Science (0-697-21512-1)
 12. **Life Science Animations 3D** Videotape (0-07-29065-2). Featuring 42 animations of key biological processes, this tape contains 3D animations and is fully narrated. Various figures throughout this text are correlated to video animations. See the end of the preface for a detailed listing of figures.
 13. **Explorations in Human Biology** CD-ROM (0-697-37906-X IBM, 0-697-37907-8 Mac) consists of sixteen interactive modules that stress human physiology. Students can actively investigate vital processes as they explore each module, which is filled with color, sound, and movement. The CD-ROM is available for use with Macintosh and IBM Windows computers.
 14. **Explorations in Cell Biology, and Genetics** CD-ROM (0-697-37908-6) contains interactive concepts related to key topics covered in an anatomy and physiology course. The CD-ROM can be used by an instructor in lecture and/or placed in a lab or resource center for students and is available for use with Macintosh and IBM Windows computers.
 15. **Life Science Living Lexicon** CD-ROM (0-697-37993-0) 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, featuring quizzing and note-taking capabilities.
 16. **The Virtual Physiology Lab** CD-ROM (0-697-37994-9) contains ten dry labs of the most common and important physiology experiments.
 17. **Anatomy and Physiology Videodisc** (0-697-27716-X) is a four-sided videodisc containing more than thirty animations of physiological processes, as well as line art and micrographs. A barcode directory is also available.
 18. **WCB Anatomy and Physiology Video Series** consists of the following:
 - Internal Organs and the Circulatory System of the Cat (0-697-13922-0);
 - Blood Cell Counting, Identification, & Grouping (0-697-11629-8);

- Introduction to the Human Cadaver and Prosection (0-697-11177-6); and
 - Introduction to Cat Dissection: Musculature (0-697-11630-1).
19. **Laboratory Atlas of Anatomy and Physiology**, second edition (0-697-39480-8) by Eder et al., is a full-color atlas containing histology, human skeletal anatomy, human muscular anatomy, dissections, and reference tables.
 20. **Study Cards for Anatomy and Physiology** (0-697-26447-5) by Van De Graaff et al. is a boxed set of (300) 3-by-5 inch cards. It serves as a well-organized and illustrated synopsis of the structure and function of the human body. The Study Cards offer a quick and effective way for students to review human anatomy and physiology.
 21. **Coloring Review Guide to Anatomy and Physiology** (0-697-17109-4) by Robert and Judith Stone emphasizes learning through the process of color association. The Coloring Guide provides a thorough review of anatomical and physiological concepts.
 22. **Atlas of the Skeletal Muscles** (0-697-13790-2) by Robert and Judith Stone is a guide to the structure and function of human skeletal muscles. The illustrations help students locate muscles and understand their actions.
 23. **Case Histories in Human Physiology 3rd** edition, by Van Wynsberghe and Cooley (Internet-based: <http://www.mhhe.com/biosci/ap/vanwyn>) stimulates analytical thinking through case studies and problem solving; includes an instructor's answer key.
 24. **Survey of Infectious and Parasitic Diseases** (0-697-27535-3) by Kent M. Van De Graaff is a black-and-white booklet that presents the essential information on 100 of the most common and clinically significant diseases.

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Dynamic Human Correlations

Chapter 1

- 1.6 Human Body/Explorations/Anatomical Orientation/Directional Terminology
- 1.7 Human Body/Explorations/Anatomical Orientation/Planes
Human Body/Explorations/Visible Human
- 1.8 Human Body/Explorations/Anatomical Orientation/Planes

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- 3.1 Human Body/Anatomy/Cell Components
- 3.2 Human Body/Anatomy/Cell Components
- 3.3 Human Body/Anatomy/Cell Components
- 3.5 Human Body/Anatomy/Cell Components
- 3.6 Human Body/Anatomy/Cell Components
- 3.7 Human Body/Anatomy/Cell Components
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- 3.22 Human Body/Explorations/Cell Cycle

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Cardiovascular System/Histology/Elastic Artery
Cardiovascular System/Histology/Vasculature
- 4.2 Human Body/Histology
- 4.5 Human Body/Histology
Skeletal System/Histology
- 4.6 Muscular System/Histology
- 4.7 Nervous System/Histology/Spinal Neurons
- 4.11 Lymphatic System/Clinical Concepts/Inflammation

Chapter 6

- 6.2 Skeletal System/Explorations/Cross-Section of a Long Bone
- 6.3 Skeletal System/Histology/Compact Bone
- 6.4 Skeletal System/Histology/Spongy Bone
- 6.9 Skeletal System/Anatomy/Gross Anatomy
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- 6.13 Skeletal System/Anatomy/Gross Anatomy
- 6.14 Skeletal System/Anatomy/Gross Anatomy
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Skeletal System/Clinical Concepts/MRI of Knee
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- 7.5 Muscular System/Explorations/Neuromuscular Junction
- Muscular System/Histology/Neuromuscular Junction
- 7.6 Muscular System/Explorations/Sliding Filament Theory
- 7.12 Muscular System/Anatomy/Body Regions
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- 7.18 Muscular System/Anatomy/Body Regions
- 7.19 Muscular System/Anatomy/Body Regions
- 7.20 Muscular System/Anatomy/Body Regions
- 7.21 Muscular System/Anatomy/Body Regions
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- 8.27 Nervous System/Explorations/Motor and Sensory Pathways
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- 10.11 Endocrine System/Explorations/Hypothalamo-Pituitary Thyroid Axis
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- 11.10 Lymphatic System/Clinical Concepts/Blood Type
- 11.11 Lymphatic System/Clinical Concepts/Blood Type

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