SIXTH EDITION

VAN DE GRAAFF

HUMAN ANATOMY

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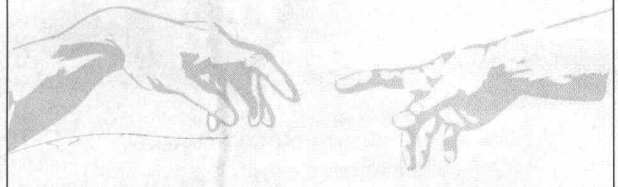

SIXTH EDITION

Kent M. Van De Graaff
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Prefixes and Suffixes in Anatomical and Medical Terminology

Element	Definition and Example
a-	absent, deficient, lack of: *atrophy*
ab-	off, away from: *abduct*
abdomin-	relating to the abdomen: *abdominal*
-able	capable of: *viable*
ac-	toward, to: *actin*
acou-	hear: *acoustic*
ad-	toward, to: *adduct*
af-	movement toward a central point: *afferent artery*
alb-	white: *corpus albicans*
-algia	pain: *neuralgia*
ambi-	both: *ambidextrous*
angi-	pertaining to the vessels: *angiology*
ante-	before, in front of: *antebrachium*
anti-	against: *anticoagulant*
aque-	water: *aqueous*
arch-	beginning, origin: *archenteron*
arthr-	joint: *arthritis*
-asis	condition or state of: *homeostasis*
aud-	hearing, sound: *auditory*
auto-	self: *autolysis*
bi-	two: *bipedal*
bio-	life: *biopsy*
blast-	generative or germ bud: *blastocyst*
brachi-	arm: *brachialis*
brachy-	short: *brachydont*
brady-	slow: *bradycardia*
bucc-	cheek: *buccal cavity*
cac-	bad, ill: *cachexia*
calc-	stone: *calculus*
capit-	head: *capitis*
carcin-	cancer: *carcinogenic*
cardi-	heart: *cardiac*
cata-	lower, under, against: *catabolism*
caud-	tail: *cauda equina*
cephal-	head: *cephalic*
cerebro-	brain: *cerebrospinal fluid*
chol-	bile: *cholic*
chondr-	cartilage: *chondrocyte*
chrom-	color: *chromocyte*
-cide	destroy: *germicide*
circum-	around: *circumduct*
co-	together: *copulation*
coel-	hollow cavity: *coelom*
-coele	swelling, an enlarged space or cavity: *blastocoele*
con-	with, together: *congenital*
contra-	against, opposite: *contraception*
corn-	denoting hardness: *cornified*
corp-	body: *corpus*
crypt-	hidden: *cryptorchidism*
cyan-	blue: *cyanosis*
cyst-	sac or bladder: *cystoscope*
cyto-	cell: *cytology*
de-	down, from: *descent*
derm-	skin: *dermatology*
di-	two: *diarthrotic*
dipl-	double: *diploid*
dis-	apart, away from: *disarticulate*
duct-	lead, conduct: *ductus deferens*
dur-	hard: *dura matter*
dys-	bad, difficult, painful: *dysentery*
e-	out, from: *eccrine*
ec-	outside, outer, external: *ectoderm*

Element	Definition and Example
-ectomy	surgical removal: *tonsillectomy*
ede-	swelling: *edema*
-emia	pertaining to a condition of the blood: *lipemia*
en-	within: *endoderm*
enter-	intestine: *enteritis*
epi-	upon, over: *epidermis*
erythro-	red: *erythrocyte*
ex-	out of: *excise*
exo-	outside: *exocrine*
extra-	outside of, beyond, in addition: *extracellular*
fasci-	band: *fascia*
febr-	fever: *febrile*
-ferent	bear, carry: *efferent*
fiss-	split: *fissure*
for-	opening: *foramen*
-form	shape: *fusiform*
gastro-	relating to the stomach: *gastrointestinal*
-gen	an agent that produces or originates: *pathogen*
-genic	produced from, producing: *carcinogenic*
gloss-	tongue: *glossopharyngeal*
glyco-	sugar: *glycosuria*
-gram	a record, recording: *electroencephalogram*
gran-	grain, particle: *granulosa cells*
-graph	instrument for recording: *electrocardiograph*
gravi-	heavy: *gravid*
gyn-	female sex: *gynecology*
haplo-	simple or single: *haploid*
hem(at)-	blood: *hematology*
hemi-	half: *hemiplagia*
hepat-	liver: *hepatic portal*
hetero-	other, different: *heterosexual*
histo-	web, tissue: *histology*
holo-	whole, entire: *holocrine*
homo-	same, alike: *homologous*
hydro-	water: *hydrocoel*
hyper-	beyond, above, excessive: *hypertension*
hypo-	under, below: *hypoglycemia*
-ia	abnormal state or condition: *hypoglycemia*
-iatrics	medical specialties: *pediatrics*
idio-	self, separate, distinct: *idiopathic*
ilio-	ilium: *iliosacroal*
infra-	beneath: *infraspinatus*
inter-	among, between: *interosseous*
intra-	inside, within: *intracellular*
-ion	process: *acromion*
-ism	condition or state: *dimorphism*
iso-	equal, like: *isotonic*
-itis	inflammation: *meningitis*
labi-	lip: *labium majus*
lacri-	tears: *lacrimal apparatus*
later-	side: *lateral*
leuk-	white: *leukocyte*
lip-	fat: *lipid*
-logy	science of: *morphology*
-lysis	solution, dissolve: *hemolysis*
macro-	large, great: *macrophage*
mal-	bad, abnormal, disorder: *malignant*
medi-	middle: *medial*
mega-	great, large: *megakaryocyte*
meso-	middle or moderate: *mesoderm*
meta-	after, beyond: *metatarsal*
micro-	small: *microtome*

Prefixes and Suffixes in Anatomi ology

Element	Definition and Example
mito-	thread: *mitochondrion*
mono-	alone, one, single: *monocyte*
morph-	form, shape: *morphology*
multi-	many, much: *multinuclear*
myo-	muscle: *myology*
narc-	numbness, stupor: *narcotic*
necro-	corpse, dead: *necrosis*
neo-	new, young: *neonatal*
nephr-	kidney: *nephritis*
neuro-	nerve: *neurolemma*
noto-	back: *notochord*
ob-	against, toward, in front of: *obturator*
oc-	against: *occlusion*
-oid	resembling, likeness: *sigmoid*
oligo-	few, small: *oligodendrocyte*
-oma	tumor: *lymphoma*
oo-	egg: *oocyte*
or-	mouth: *oral*
orchi-	testis: *orchiectomy*
ortho-	straight, normal: *orthopnea*
-ory	pertaining to: *sensory*
-ose	full of: *adipose*
osteo-	bone: *osteoblast*
oto-	ear: *otolith*
ovo-	egg: *ovum*
par-	give birth to, bear: *parturition*
para-	near, beyond, beside: *paranasal*
path-	disease, that which undergoes sickness: *pathology*
-pathy	abnormality, disease: *neutropathy*
ped-	children: *pediatrician*
pen-	need, lack: *penicillin*
-penia	deficiency: *thrombocytopenia*
per-	through: *percutaneous*
peri-	near, around: *pericardium*
phag-	to eat: *phagocyte*
-phil	have an affinity for: *neutrophil*
phleb-	vein: *phlebitis*
-phobia	abnormal fear, dread: *hydrophobia*
-plasty	reconstruction of: *rhinoplasty*
platy-	flat, side: *platysma*
-plegia	stroke, paralysis: *paraplegia*
-pnea	to breathe: *apnea*
pneumo(n)-	lung: *pneumonia*
pod-	foot: *podiatry*
-poiesis	formation of: *hemopoiesis*
poly-	many, much: *polyploid*
post-	after, behind: *postnatal*
pre-	before in time or place: *prenatal*
pro-	before in time or place: *prophase*

Element	Definition and Example
proct-	anus: *proctology*
pseudo-	false: *pseudostratified*
psycho-	mental: *psychology*
pyo-	pus: *pyorrhea*
quad-	fourfold: *quadriceps femoris*
re-	back, again: *repolarization*
rect-	straight: *rectus abdominis*
ren-	kidney: *renal*
rete-	network: *rete testis*
retro-	backward, behind: *retroperitoneal*
rhin-	nose: *rhinitis*
-rrhagia	excessive flow: *menorrhagia*
-rrhea	flow or discharge: *diarrhea*
sanguin-	blood: *sanguineous*
sarc-	flesh: *sarcoma*
-scope	instrument for examining a part: *stethoscope*
-sect	cut: *dissect*
semi-	half: *semilunar*
-sis	process or action: *dialysis*
steno-	narrow: *stenosis*
-stomy	surgical opening: *tracheostomy*
sub-	under, beneath, below: *subcutaneous*
super-	above, beyond, upper: *superficial*
supra-	above, over: *suprarenal*
syn- (sym-)	together, joined, with: *synapse*
tachy-	swift, rapid: *tachycardia*
tele-	far: *telencephalon*
tens-	stretch: *tensor tympani*
tetra-	four: *tetrad*
therm-	heat: *thermogram*
thorac-	chest: *thoracic cavity*
thrombo-	lump, clot: *thrombocyte*
-tomy	cut: *appendectomy*
tox-	poison: *toxemia*
tract-	draw, drag: *traction*
trans-	across, over: *transfuse*
tri-	three: *trigone*
trich-	hair: *trichology*
-trophy	a state relating to nutrition: *hypertrophy*
-tropic	turning toward, changing: *gonadotropic*
ultra-	beyond, excess: *ultrasonic*
uni-	one: *unicellular*
-uria	urine: *polyuria*
uro-	urine, urinary organs or tract: *uroscope*
vas-	vessel: *vasoconstriction*
viscer-	organ: *visceral*
vit-	life: *vitamin*
zoo-	animal: *zoology*
zygo-	union, join: *zygote*

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About the Author

Kent M. Van De Graaff received his Ph.D. in zoology from Northern Arizona State University. For nearly three decades, he has been a teacher and researcher of anatomy and physiology at the University of Minnesota, Brigham Young University, and Weber State University. A prolific writer, Kent has authored and co-authored a wealth of learning materials, including atlases, manuals, and guides. As an educator, he has been honored many times with awards of excellence for teaching, student advisement, and academic service.

Kent is the father of six children. Three of his sons are physicians, another is a public administrator, and a fifth son is a premedical student. His daughter has a bachelor's degree in zoology and will be attending graduate school with the intent of eventually teaching human anatomy and physiology. Outside the classroom, he enjoys jogging and painting wildlife.

This text is dedicated to my six children and to the memory of their wonderful mother.

Preface

Human Anatomy was written to serve as a foundation and resource for students pursuing health-related careers in fields such as medicine, dentistry, nursing, physician assistant, podiatry, optometry, chiropractic, medical technology, physical therapy, athletic training, massage therapy, and other health-related professions. Created to accompany the one-semester human anatomy course, this text presents a basic introduction to human anatomy for students enrolled in medical, allied-health, and physical education programs, or for those majoring in biological science. The focus of *Human Anatomy* is to provide applicable knowledge of the structure of the human body and foundation information for understanding physiology, cell biology, developmental biology, histology, and genetics. Practical information is presented in this text that will enable students to apply pertinent facts to the real-world situations they might encounter in their chosen profession.

Many changes have been made in the sixth edition of *Human Anatomy* to provide students with a high-quality text for their course of study. Because human anatomy is such a visual science, many refinements and additions have been made in a continuing effort to provide an effective art program. Many new illustrations, radiographs, and photographs (including images of cadaver dissections) make this text even more useful. Strengthening clinical aspects of the text has been another major focus in the sixth edition. Additional Clinical Practicums have been added at the ends of the chapters throughout the text. These case studies and their accompanying images test student knowledge and demonstrate the application of anatomical information in a clinical setting. A final task in creating the sixth edition of *Human Anatomy* has been to revise the content for currentness and accuracy. In keeping with the pace of research, updated information is presented on the history of current human genome research, the structure of DNA and RNA, protein synthesis, utilization of stem cells from red bone marrow and fetal tissue, and the classification of hair. The comprehensive nature of the sixth edition of this text and its current clinical information enable it to be used as a valuable reference resource regarding the structure, function, development, senescence, and possible dysfunctions of the human body.

OBJECTIVES

In preparing and updating a text and its ancillaries (website, laboratory manual, instructor's manual, test bank, and so forth), it is essential to consider both the needs of the student and the needs of the instructor. A well-written and inviting text is at the heart of an effective educational package. With this in mind, the following objectives were formulated for the sixth edition of *Human Anatomy:*

- To provide a text that is inviting and attractive—a text that is readable and informative with accurate, up-to-date information of practical concern. *Human Anatomy* aims to entice readers to study the material and thereby enhance their appreciation of life through a better understanding of the structure, function, and magnificence of their own bodies.
- To provide a conceptual framework of learning through the use of concise concept statements, learning objectives, and chapter review questions.
- To express the beauty of the body through spectacular art that is anatomically accurate. Anatomy is a visual science where exactness is essential. The numerous high-quality illustrations prepared expressly for this edition augment the acclaimed art program of the previous editions.
- To stimulate student interest in anatomy and related subjects through a series of thematic commentaries, highlighted by topic icons.
- To provide a systematic, balanced presentation of anatomical concepts at the developmental, cellular, histological, clinical, and gross anatomy levels.
- To build students' technical vocabularies to the point where they feel comfortable with basic medical terminology, enabling them to become conversant with health-care providers and understand current medical literature.
- To encourage proper care of the body in order to enjoy a healthier, more productive life, and to provide a foundation of knowledge students can share to help enrich the lives of others.
- To acquaint students with the history of anatomy, from its primitive beginnings to recent advances in the field. Only with the realization of how long it took to build up knowledge that is now taken for granted—and with what difficulty—can students appreciate the science of anatomy in its proper proportion.

TEXT ORGANIZATION

The 22 chapters in this text are grouped into seven units that are identified by colored tabs on the outside page margins.

Unit 1: Historical Perspective In this unit, the stage is set for studying human anatomy by providing a historical perspective

on how this science has developed over the centuries. Anatomy is an exciting and dynamic science that remains vital as it continues to broaden its scope. It is hoped that this unit will make the reader feel a part of the heritage of human anatomy.

Unit 2: Terminology, Organization, and the Human Organism In this unit, the anatomical characteristics that define humans as a distinct species are described. The various levels of organization of the human body are also described, and the basic terminology necessary for understanding the structure and functioning of the body is introduced.

Unit 3: Microscopic Structure of the Body The microscopic aspect of body organization is considered at the cellular and histological levels in this unit. Cellular chemistry is emphasized as an integral aspect of learning about how the body functions.

Unit 4: Support and Movement Support, protection, and movement of the human body are the themes of this unit. The integumentary system provides the body with external support and protection, and the skeletal system provides internal support and protection for certain organs of the body. Movement is possible at the joints of the skeleton as the associated skeletal muscles are contracted. Surface anatomy and regional anatomy are given detailed coverage in chapter 10 of this unit. Atlas-quality photographs of dissections of human cadavers are included in this chapter.

Unit 5: Integration and Coordination This unit includes chapters on the nervous system, endocrine system, and sensory organs. The concepts identified and discussed in these chapters are concerned with the integration and coordination of body functions and the perception of environmental stimuli.

Unit 6: Maintenance of the Body In this unit, the structure and function of the circulatory, respiratory, digestive, and urinary systems are discussed as they contribute in their individual ways to the overall functioning and general welfare of the organism. All of these systems work together in maintaining a stable internal environment in which the cells of the body can thrive on a day-to-day basis.

Unit 7: Reproduction and Development The male and female reproductive systems are described in this unit, and the continuance of the human species through sexual reproduction is discussed. Unit 7 provides an overview of the entire sequence of human life, including prenatal development and postnatal growth, development, and aging. Basic concepts of genetics and inheritance are also explained.

LEARNING AIDS

Each of the 22 chapters of this text incorporates numerous pedagogical devices that organize and underscore the practicality of the material, clarify important concepts, help assess student learning, and stimulate students' natural curiosity about the human body. In short, these aids make the study of human anatomy more effective and enjoyable.

Chapter Introductions

The beginning page of each chapter contains an outline of the chapter contents and a Clinical Case Study pertaining to the subject matter of the chapter. Each case study is elucidated with a related photograph. These hypothetical situations underscore the clinical relevance of anatomical knowledge and entice students to watch for information contained within the chapter that may be needed to answer the case study questions. The solution to the case study is presented at the end of the chapter, following the last major section.

Understanding Anatomical Terminology

Each technical term is set off in boldface or italic type, and is often followed by a phonetic pronunciation in parentheses, at the point where it first appears and is defined in the narrative. The roots of each term can be identified by referring to the glossary of prefixes and suffixes found on the inside of the front cover. In addition, the derivations of many terms are provided in footnotes at the bottom of the page on which the term is introduced. If students know how a term was derived, and if they can pronounce the term correctly, the term becomes more meaningful and is easier to remember.

Chapter Sections

Each chapter is divided into several major sections, each of which is prefaced by a concept statement and a list of learning objectives. A concept statement is a succinct expression of the main idea, or organizing principle, of the information contained in a chapter section. The learning objectives indicate the level of competency needed to understand the concept thoroughly and be able to apply it in practical situations. The narrative that follows discusses the concept in detail, with reference to the objectives. Knowledge Check questions at the end of each chapter section test student understanding of the concept and mastery of the learning objectives.

Commentaries and Clinical Information

Set off from the text narrative are short paragraphs highlighted by accompanying topic icons. This interesting information is relevant to the discussion that precedes it, but more important, it demonstrates how basic scientific knowledge is applied. The five icons represent the following topic categories:

Clinical information is indicated by a stethoscope. The information contained in these commentaries provides examples of the applied medical nature of the information featured in the topic discussion.

Aging information is indicated by an hourglass. The information contained in these commentaries is relevant to normal aging and indicates how senescence (aging) of body organs impacts body function.

Developmental information of practical importance is indicated by a human embryo. Knowledge of pertinent developmental anatomy contributes to understanding how congenital problems develop and impact body structure and function.

Homeostasis information is indicated by a gear mechanism. The information called out by this icon is relevant to the body processes that maintain a state of dynamic equilibrium. These commentaries point out that a disruption of homeostasis frequently accompanies most diseases.

Academic interest commentaries discuss topics that are relevant to human anatomy that are quite simply of factual interest.

In addition to the in-text commentaries, selected developmental disorders, aging, clinical procedures, and diseases or dysfunctions of specific organ systems are described in Clinical Considerations sections that appear at the end of most chapters. Photographs of pathological conditions accompany many of these discussions.

Developmental Expositions

In each body system chapter, a discussion of prenatal development follows the presentation on gross anatomy. Each of these discussions includes exhibits and explanations of the morphogenic events involved in the development of a body system. Placement near the related text discussion ensures that the anatomical terminology needed to understand the embryonic structures has been introduced.

Clinical Practicums

These focused clinical scenarios present a patient history and supporting diagnostic image—such as a radiograph, ultrasound, or photograph—followed by a series of questions. Students are challenged to evaluate the clinical findings, explain the origin of symptoms, diagnose the patient, recommend treatment, etc. Each body system chapter contains one or two Clinical Practicums, placed before the chapter summary. Detailed answers to the Clinical Practicum questions are provided in Appendix B.

Chapter Summaries

A summary, in outline form, at the end of each chapter reinforces the learning experience. These comprehensive summaries serve as a valuable tool in helping students prepare for examinations.

Review Activities

Following each chapter summary, sets of objective, essay, and critical thinking questions give students the opportunity to measure the depth of their understanding and learning. The critical thinking questions have been updated and expanded in the sixth edition to further challenge students to use the chapter information in novel ways toward the solution of practical problems. The correct responses to the objective questions are provided in Appendix A. Each answer is explained, so students can effectively use the review activities to broaden their understanding of the subject matter.

Illustrations and Tables

Because anatomy is a descriptive science, great care has been taken to continuously enhance the photographs and illustrations in *Human Anatomy*. A hallmark feature of the previous editions of this text has been the quality art program. In keeping with the objective of forever improving and refining the art program, over 150 full-color illustrations were substantially revised or rendered entirely new for the sixth edition. Each illustration has been checked and rechecked for conceptual clarity and precision of the artwork, labels, and captions. Color-coding is used in certain art sequences as a technique to aid learning. For example, the bones of the skull in chapter 6 are color-coded so that each bone can be readily identified in the many renderings included in the chapter. These illustrations represent a collaborative effort between author and illustrator, often involving dissection of cadavers to ensure accuracy. Illustrations are combined with photographs whenever possible to enhance visualization of anatomical structures. Light and scanning electron micrographs are used throughout the text to present a true picture of anatomy from the cellular and histological levels. Surface anatomy and cadaver dissection images help students understand the juxtaposition of anatomical structures and help convey the intangible anatomical characteristics that can be fully appreciated only when seen in a human speci-

men. Many of the cadaver dissection photographs have been modified or replaced with new, high-quality images shot expressly for the sixth edition. All of the figures are integrated with the text narrative to maximize student learning.

Numerous tables throughout the text summarize information and clarify complex data. Many tables have been enhanced with the addition of illustrations to communicate information in the most effective manner. Like the figures, all of the tables are referenced in the text narrative and placed as close to the reference as possible to spare students the trouble of flipping through pages.

Appendixes, Glossary, and Index

Appendixes A and B provide answers and explanations for the objective questions at the end of each chapter and for the questions that accompany the Clinical Practicum boxes. The glossary provides definitions for the important technical terms used in the text. Phonetic pronunciations are included for most of the terms, and an easy-to-use pronunciation guide appears at the beginning of the glossary. Synonyms, including eponymous terms, are indicated, and for some terms antonyms are given as well.

TEACHING AND LEARNING SUPPLEMENTS

There is much more to *Human Anatomy* than this book. Numerous study and teaching aids round out the complete package. Students can order supplemental study materials by contacting the McGraw-Hill Customer Service Department at 800-338-3987. Instructors can obtain teaching aids by calling the Customer Service Department or by contacting your McGraw-Hill sales representative.

Online Learning Center

The Online Learning Center (OLC) at www.mhhe.com/vdg offers an extensive array of learning and teaching tools. This website includes chapter-specific quizzes and web links, clinical applications, interactive activities, art labeling exercises, case studies, and more. Teaching resources at the instructor site include image and animations libraries, PowerPoint lecture presentations, technology resources, and the online Instructor's Manual for *Human Anatomy*. In addition, the OLC provides online access to the following premium interactive products:

Essential Study Partner for Anatomy and Physiology is a complete, interactive student study tool packed with hundreds of animations and more than 800 learning activities. Interactive diagrams and quizzes make learning core concepts stimulating and fun.

adam Online Anatomy is a comprehensive database of detailed anatomical images that allows users to point, click, and identify more than 20,000 anatomical structures within fully dissectible male and female bodies in anterior, lateral, medial, and posterior views. Exhaustively reviewed by panels of leading anatomists, adam Online Anatomy is recognized as the standard anatomical database in computer-based medical education worldwide.

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The Faculty Club gives new and experienced instructors access to a variety of resources to help increase their effectiveness in lecture, discover groups of instructors with similar interests, and find information on teaching techniques and pedagogy. A comprehensive search feature allows instructors to search for information using a variety of criteria.

The Student Center allows students the opportunity to search BioCourse for information specific to the course area they are studying, or by using specific topics or keywords. Information is also available for many aspects of student life, including tips for studying and test taking, surviving the first year of college, and job and internship searches.

BioLabs helps laboratory instructors, who often face a special set of challenges. BioLabs addresses those challenges by providing laboratory instructors and coordinators with a source for basic information on suppliers, best practices, professional organizations, and lab exchanges.

Briefing Room is where to go for current news in the life sciences. News feeds from *The New York Times*, links to prominent journals, commentaries from popular McGraw-Hill authors, and XanEdu journal search service are just a few of the resources you will find here.

The Quad utilizes a powerful indexing and searching tool to provide the user with a guided review of specific course content. Information is available from a variety of McGraw-Hill sources, including textbook material, Essential Study Partner modules, Online Learning Centers, and images from Visual Resource Libraries.

R&D Center is the opportunity to see what new textbooks, animations, and simulations McGraw-Hill is working on and to send McGraw-Hill your feedback. You can also learn about other opportunities to review as well as submit ideas for new projects.

Laboratory Manual to accompany Human Anatomy, Sixth Edition

Kent Van De Graaff has authored a comprehensive laboratory manual specifically designed to accompany *Human Anatomy*, sixth edition. This laboratory manual emphasizes learning anatomical structures through visual observation, palpation, and knowledge of the functional relationship of one body system to another. It focuses primarily on the human organism, but also contains cat dissections and selected organ dissections. Closely integrated with the *Human Anatomy* text, the companion lab manual utilizes a well-rounded pedagogical system that helps students organize the background information and materials needed to complete each lab exercise. Coloring and labeling activities placed throughout the chapters reinforce recognition of anatomical structures, and laboratory reports at the end of each chapter encourage students to synthesize concepts covered in both lab and lecture.

Instructor's Manual for the Laboratory Manual

This online manual is housed within the instructor Online Learning Center. It provides answers to the lab report questions, as well as overviews on how to present each laboratory exercise, materials lists, and additional topics for discussion.

Transparencies

This set of transparency acetates includes 200 full-color illustrations from the text that have been chosen for their value in reinforcing lecture presentations.

Visual Resource Library

Accessed through the instructor site at the Online Learning Center and also available on CD-ROM, the Visual Resource Library contains labeled and unlabeled versions of the key illustrations and photos from the book, as well as all tables. You can quickly preview images and incorporate them into PowerPoint or other presentation programs to create your own multimedia presentations. You can also remove and replace labels to suit your own preferences in terminology or level of detail.

Instructor's Manual

Accessed via the Online Learning Center, the instructor's manual by Jeffrey S. Prince, M.D. and Karianne N. Prince provides instructional support in the use of the textbook. It includes teaching strategies, discussion and demonstration ideas for lectures, and suggestions for laboratory exercises. This manual also includes a listing of transparencies and multimedia resources that correlate with each text chapter and provides answers to the Knowledge Check, Essay, and Critical Thinking questions that appear in the text.

Test Item File

The Test Item File contains fill-in-the-blank, multiple choice, and true/false questions specifically designed to complement each chapter of the text. Instructors using WebCT, Blackboard, or PageOut can access the Test Item File online.

MicroTest

MicroTest is a computerized test generator that is free upon request to qualified adopters. The test generator contains the complete Test Item File on CD-ROM. MicroTest requires no programming experience and is designed to work on both Windows and Macintosh platforms.

PageOut®

PageOut is McGraw-Hill's exclusive tool for creating your own website for your anatomy course. It requires no knowledge of coding. Simply type your course information into the templates provided. PageOut is hosted by McGraw-Hill.

In addition to the materials specifically designed to accompany *Human Anatomy*, McGraw-Hill offers the following supplemental resources to enrich the study and instruction of anatomy and physiology.

Regional Human Anatomy: A Laboratory Workbook For Use With Models and Prosections by Frederick E. Grine, State University of New York—Stony Brook. Organized with a regional approach to human anatomy, this workbook utilizes coloring and labeling activities to simplify the learning of anatomy. Brief text descriptions of key anatomical structures are grouped with detailed illustrations that can be colored and labeled to reinforce the material presented. Critical thinking questions encourage students to think about how anatomical structures work together, and boxed clinical insights highlight facts of interest to students pursuing health-related professions.

Anatomy and Physiology Laboratory Manual-Fetal Pig by Terry R. Martin, Kishwaukee College. Provides excellent full-color photos of the dissected fetal pig with corresponding labeled art. It includes World Wide Web activities for many chapters.

Web-Based Cat Dissection Review for Human Anatomy and Physiology by John Waters, Pennsylvania State University. This online multimedia program contains vivid, high-quality labeled cat dissection photographs. The program helps students easily identify and review the corresponding structures and functions between the cat and the human body.

Dynamic Human, Version 2.0. A set of two interactive CD-ROMs that cover each body system and demonstrate clinical concepts, histology, and physiology with animated three-dimensional and other images.

Interactive Histology CD-ROM by Bruce Wingerd and Paul Paolini, San Diego State University. This CD contains 135 full-color, high-resolution light micrograph images and 35 scanning electron micrograph images of selected tissue sections typically studied in anatomy and physiology. Each image has labels that can be clicked on or off, has full explanatory legends, offers views at two magnifications, and has links to study questions. The CD also has a glossary with pronunciation guides.

Life Science Animation VRL 2.0 contains over 200 animations of major biological concepts and processes, such as the sliding filament mechanism, active transport, genetic transcription and translation, and other topics that may be difficult for students to visualize.

Life Science Animations 3D Videotape contains 42 key biological processes that are narrated and animated in vibrant full color with dynamic three-dimensional graphics.

Life Science Animations (LSA) videotape series contains 53 animations on five VHS videocassettes: Chemistry, the Cell, and Energetics; Cell Division, Heredity, Genetics, Reproduction, and Development; Animal Biology No. 1; Animal Biology No. 2; and Plant Biology, Evolution, and Ecology. Another available videotape is Physiological Concepts of Life Science.

Atlas to Human Anatomy by Dennis Strete, McLennan Community College, and Christopher H. Creek. This atlas takes a systems approach with references to regional anatomy, thereby making it a great complement to your regular course structure, as well as to your laboratory.

Atlas of the Skeletal Muscles, third edition, by Robert and Judith Stone, Suffolk County Community College. This atlas is a guide to the structure and function of human skeletal muscles. The illustrations help students locate muscles and understand their actions.

Laboratory Atlas of Anatomy and Physiology, third edition, by Eder et al. This full-color atlas contains histology, human skeletal anatomy, human muscular anatomy, dissections, and reference tables.

Coloring Guide to Anatomy and Physiology by Robert and Judith Stone, Suffolk County Community College. This guide emphasizes learning through the process of color association. The *Coloring Guide* provides a thorough review of anatomical and physiological concepts.

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Preparing a new edition of a text is a formidable task that involves a number of colleagues, students, and publishing professionals. And in the case of this text, even family members were involved. My sincere gratitude is extended to faculty and students who have used previous editions of this text and have taken the time to suggest ways to improve it. They are indeed thinking of others who will be using the text in the future, and at the same time, ensuring a future for the text.

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The visual appeal and accuracy provided by quality photographs and illustrations are essential in an anatomy text. I have enjoyed my years of professional interaction with Christopher Creek, the talented artist who rendered many of the illustrations in the previous editions and a number of new ones for this edition. His anatomical art is engaging and realistic. Dr. Gary M. Watts, Department of Radiology at the Utah Valley Regional Medical Center, provided many of the radiographic images used in the previous editions of this text and some new ones for this edition. Thanks are also extended to Don Kincaid and Rebecca Gray of Ohio State University, who dissected and photographed the new cadaver images for this edition.

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McGraw-Hill dutifully assembled a panel of competent anatomists to review the previous text and the new manuscript as it was being developed for the sixth edition. These professionals aided my work immeasurably, and I am especially grateful for their frank criticism, comments, and reassurance.

Marion Alexander
University of Manitoba

Frank Baker
Golden West College

Leann Blem
Virginia Commonwealth University

Carolyn W. Burroughs
Bossier Parish Community College

Russ Cagle
Willamette University

Paul V. Cupp, Jr.
Eastern Kentucky University

Brian Curry
Grand Valley State University

Shirley Dillaman
Penn State–Shenango

Cathryn R. Dooly
Ball State University

Ruth E. Ebeling
Biola University

Charles A. Ferguson
University of Colorado at Denver

David K. Ferris
University of South Carolina–Spartanburg

Allan Forsman
East Tennessee State University

Carl D. Frailey
Johnson County Community College

Glenn A. Gorelick
Citrus College

Douglas J. Gould
University of Kentucky Chandler Medical Center

Melanie Gouzoules
University of North Carolina–Greensboro

Phyllis C. Hirsch
East Los Angeles College

Bert H. Jacobson
Oklahoma State University

Glenn E. Kietzmann
Wayne State College

Dennis Landin
Louisiana State University

Bryan G. Miller
Eastern Illinois University

Virginia L. Naples
Northern Illinois University

Daniel R. Olson
Northern Illinois University

Scott Pedersen
South Dakota State University

Russell L. Peterson
Indiana University of Pennsylvania

Larry A. Reichard
Maple Woods Community College

Alexander Sandra
University of Iowa

David J. Saxon
Morehead State University

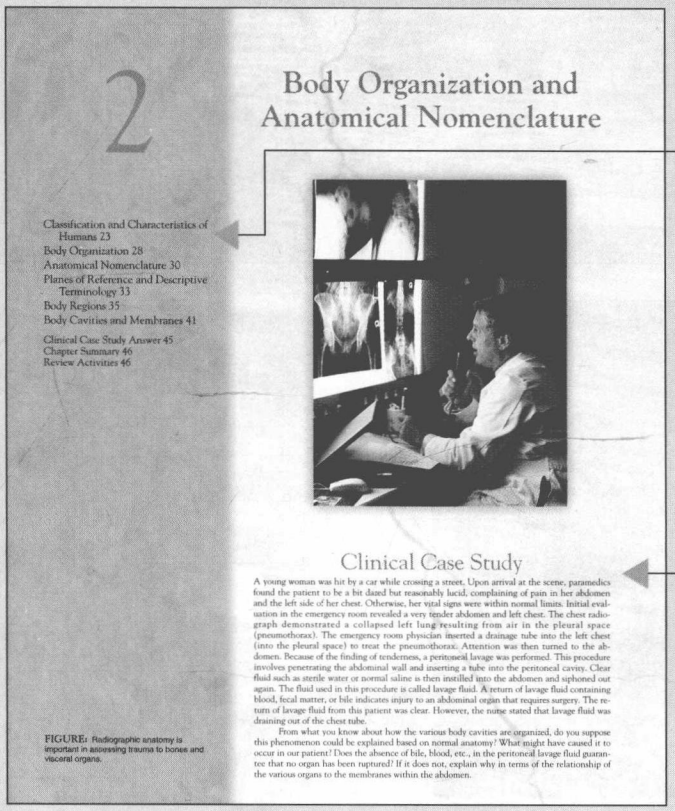
Stephen P. Schiffer
Georgetown University Medical Center

Leeann Sticker
Northwestern State University of Louisiana

R. Brent Thomas
University of South Carolina–Spartanburg

Judy A. Williams
Southeastern Oklahoma State University

Visual Guide



2

Body Organization and Anatomical Nomenclature

FIGURE: Radiographic anatomy is important in assessing trauma to bones and visceral organs.

Clinical Case Study

A young woman was hit by a car while crossing a street. Upon arrival at the scene, paramedics found the patient to be a bit dazed but reasonably lucid, complaining of pain in her abdomen and the left side of her chest. Otherwise, her vital signs were within normal limits. Initial evaluation in the emergency room revealed a very tender abdomen and left chest. The chest radiograph demonstrated a collapsed left lung resulting from air in the pleural space (pneumothorax). The emergency room physician inserted a drainage tube into the left chest (into the pleural space) to treat the pneumothorax. Attention was then turned to the abdomen. Because of the finding of tenderness, a peritoneal lavage was performed. This procedure involves penetrating the abdominal wall and inserting a tube into the peritoneal cavity. Clear fluid such as sterile water or normal saline is then instilled into the abdomen and siphoned out again. The fluid used in this procedure is called lavage fluid. A return of lavage fluid containing blood, fecal matter, or bile indicates injury to an abdominal organ that requires surgery. The return of lavage fluid from this patient was clear. However, the nurse stated that lavage fluid was draining out of the chest tube.

From what you know about how the various body cavities are organized, do you suppose this phenomenon could be explained based on normal anatomy? What might have caused it to occur in our patient? Does the absence of bile, blood, etc., in the peritoneal lavage fluid guarantee that no organ has been ruptured? If it does not, explain why in terms of the relationship of the various organs to the membranes within the abdomen.

Chapter Outline

A page-referenced preview of major topics is included on the opening page of each chapter, allowing you to see at a glance what the upcoming chapter covers.

Clinical Case Study

A hypothetical medical situation sets the stage for the chapter by underscoring the clinical relevance of the chapter content. As you read the chapter, watch for the background information needed to solve the case study, then check your answer against the solution given at the end of the chapter.

Concept Statement

A carefully worded expression of the main idea, or organizing principle, of the information contained in a chapter section gives you a quick overview of the material that will follow.

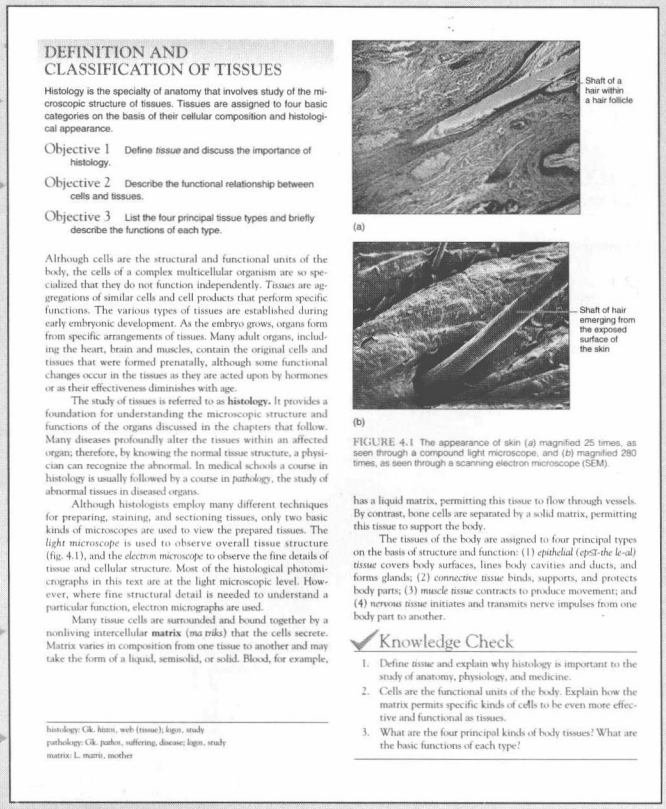
Learning Objectives

Each chapter section begins with a set of learning objectives that indicate the level of competency you should attain in order to thoroughly understand the concept and apply it in practical situations.

Vocabulary Aids

New terms appear in boldface print as they are introduced and immediately defined in context. Definitions and phonetic pronunciations for boldfaced terms are gathered in the glossary at the end of the book.

The Greek or Latin derivations of many terms are provided in footnotes at the bottom of the page on which the term first appears.



DEFINITION AND CLASSIFICATION OF TISSUES

Histology is the specialty of anatomy that involves study of the microscopic structure of tissues. Tissues are assigned to four basic categories on the basis of their cellular composition and histological appearance.

Objective 1 Define *tissue* and discuss the importance of histology.

Objective 2 Describe the functional relationship between cells and tissues.

Objective 3 List the four principal tissue types and briefly describe the functions of each type.

Although cells are the structural and functional units of the body, the cells of a complex multicellular organism are so specialized that they do not function independently. *Tissues* are aggregations of similar cells and cell products that perform specific functions. The various types of tissues are established during early embryonic development. As the embryo grows, organs form from specific arrangements of tissues. Many adult organs, including the heart, brain and muscles, contain the original cells and tissues that were formed prenatally, although some functional changes occur in the tissues as they are acted upon by hormones or as their effectiveness diminishes with age.

The study of tissues is referred to as **histology.** It provides a foundation for understanding the microscopic structure and functions of the organs discussed in the chapters that follow. Many diseases profoundly alter the tissues within an affected organ; therefore, by knowing the normal tissue structure, a physician can recognize the abnormal. In medical schools a course in histology is usually followed by a course in *pathology*, the study of abnormal tissues in diseased organs.

Although histologists employ many different techniques for preparing, staining, and sectioning tissues, only two basic kinds of microscopes are used to view the prepared tissues. The *light microscope* is used to observe overall tissue structure (fig. 4.1), and the *electron microscope* to observe the fine details of tissue and cellular structure. Most of the histological photomicrographs in this text are at the light microscopic level. However, where fine structural detail is needed to understand a particular function, electron micrographs are used.

Many tissue cells are surrounded and bound together by a nonliving intercellular **matrix** (ma′triks) that the cells secrete. Matrix varies in composition from one tissue to another and may take the form of a liquid, semisolid, or solid. Blood, for example, has a liquid matrix, permitting this tissue to flow through vessels. By contrast, bone cells are separated by a solid matrix, permitting this tissue to support the body.

The tissues of the body are assigned to four principal types on the basis of structure and function: (1) *epithelial* (*ep*″*i*-*thē*′*le-al*) *tissue* covers body surfaces, lines body cavities and ducts, and forms glands; (2) *connective* tissue binds, supports, and protects body parts; (3) *muscle tissue* contracts to produce movement; and (4) *nervous tissue* initiates and transmits nerve impulses from one body part to another.

histology: Gk. *histos*, web (tissue); *logos*, study
pathology: Gk. *pathos*, suffering, disease; *logos*, study
matrix: L. *matrix*, mother

Shaft of a hair within a hair follicle

(a)

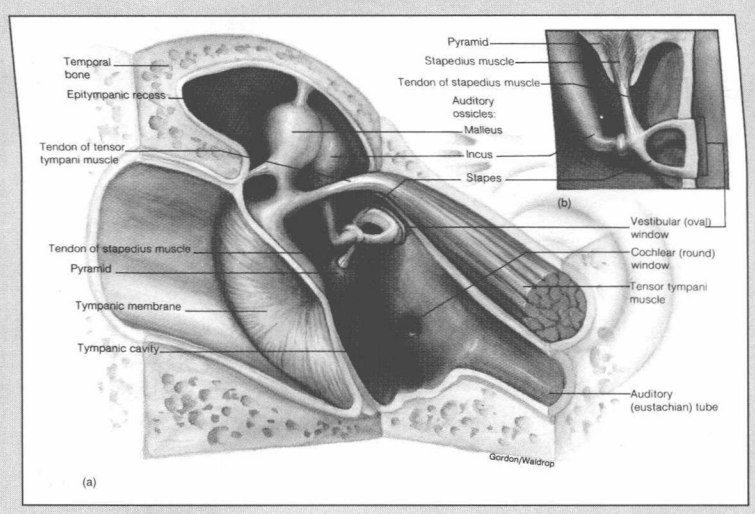
Shaft of hair emerging from the exposed surface of the skin

(b)

FIGURE 4.1 The appearance of skin (*a*) magnified 25 times, as seen through a compound light microscope, and (*b*) magnified 280 times, as seen through a scanning electron microscope (SEM).

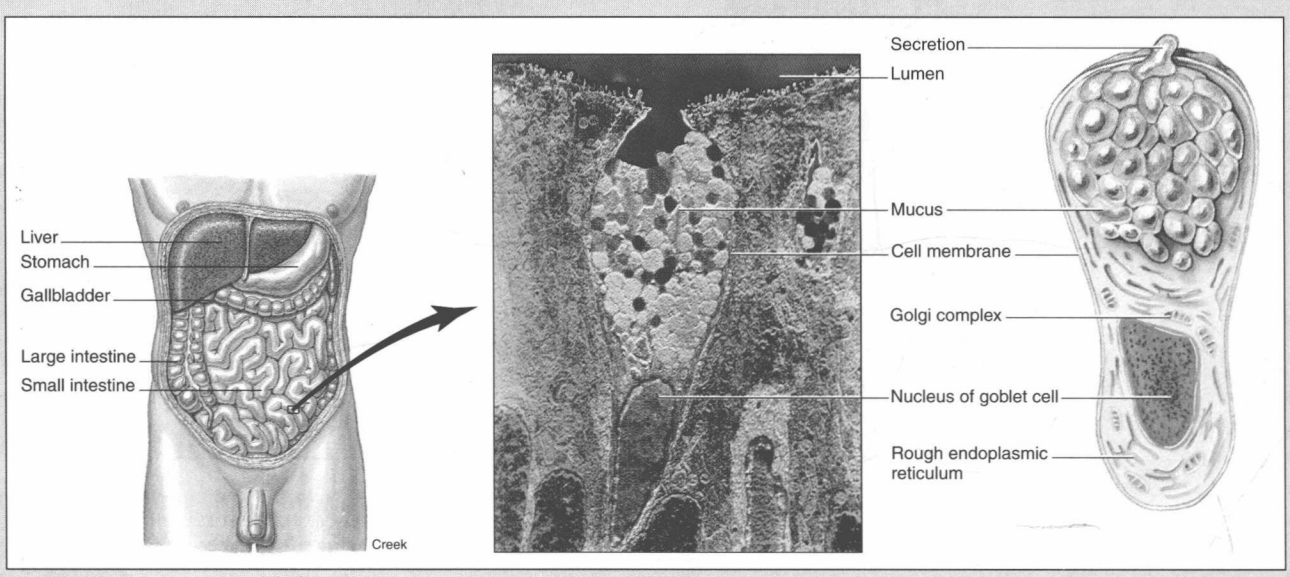
Knowledge Check

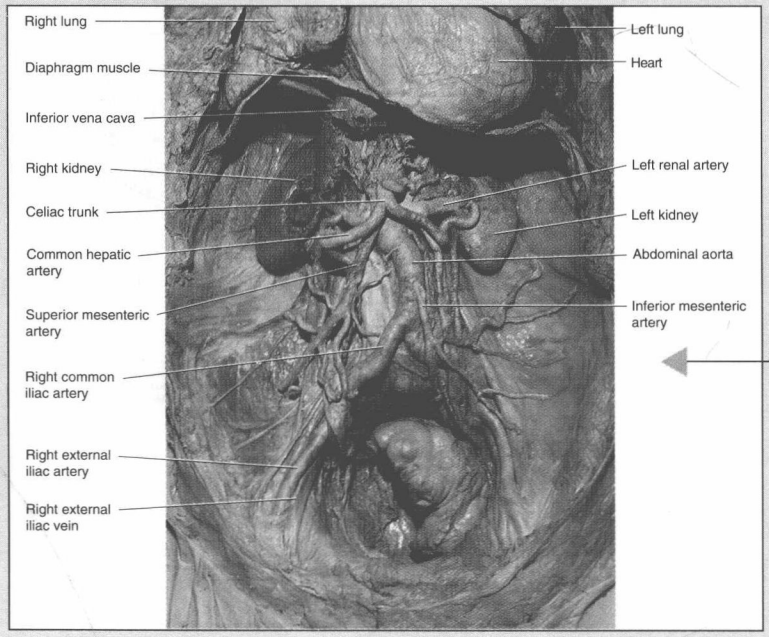
1. Define *tissue* and explain why histology is important to the study of anatomy, physiology, and medicine.
2. Cells are the functional units of the body. Explain how the matrix permits specific kinds of cells to be even more effective and functional as tissues.
3. What are the four principal kinds of body tissues? What are the basic functions of each type?



Beautifully Rendered Full-Color Art

Carefully prepared, accurate illustrations are a hallmark of this text. Human anatomy is a visual science, and realistic art is essential. Vibrant four-color illustrations are often paired with photographs, reinforcing the detail conveyed in the drawings with direct comparisons of actual structures.





Atlas-Quality Cadaver Images

Precisely labeled photographs of dissected human cadavers provide detailed views of human anatomy that allow students concrete visualization of anatomical structures and their position relative to other parts of the body.