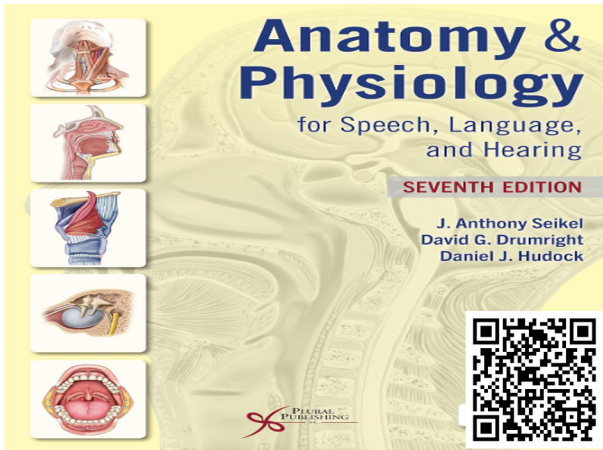


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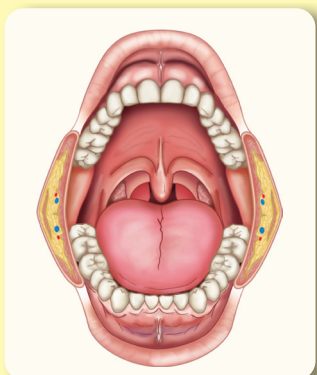
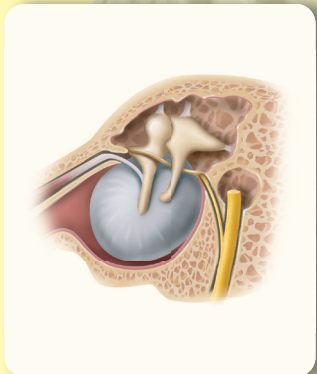
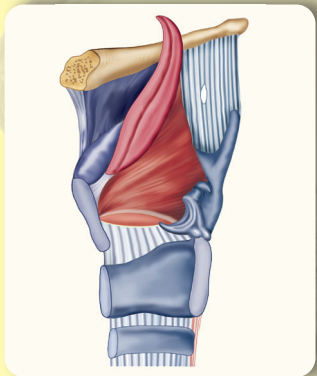
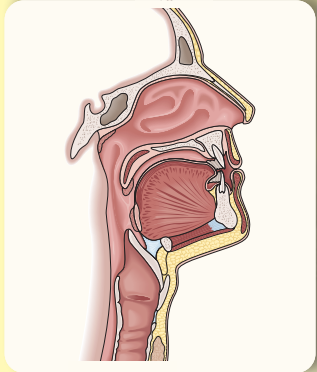
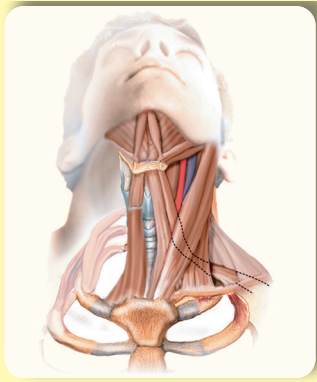
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Anatomy & Physiology

for Speech, Language,
and Hearing

SEVENTH EDITION

J. Anthony Seikel
David G. Drumright
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Preface

Anatomy & Physiology for Speech, Language, and Hearing, Seventh Edition, provides a sequential tour of the anatomy and physiology associated with speech, language, and hearing. Those of us studying Speech and Hearing Sciences are in the enviable position of being at the center of one of the most important facets of being human: Communication. In this text, our aspiration is for the content to be both accessible and applicable to your careers in our professions. Even as you read this material, know that your future clients are counting on the knowledge that you are gaining. What you study now becomes the heart of your practice later. We want this material to be relevant to you, the clinician.

This text is designed to serve the upper division undergraduate or graduate student in the fields of speech-language pathology and audiology, and it is our hope that it will serve you as a reference for your professional life as well. We aspire for it to be a learning tool and resource for both the developing and the accomplished clinician. We, the authors of this text, are first and foremost teachers ourselves. We are committed to the students within our professions and to the instructors who have made it their life work to teach them. Every revision of the text has both student and instructor in mind as we try to meet your needs in the rapidly changing professions of Audiology and Speech-Language Pathology.

Learning is not a spectator sport. Our goal is to make the text and its ancillary materials as useful to 21st-century students as possible. This new edition not only provides students with great interactive study tools in the revised ANAQUEST study software but also makes available a wealth of student and instructor resources to facilitate learning. We moved a great deal of the activities online, reflecting the dominant method for using them by students. We want you to be the best clinician and scientist you can be and sincerely hope that these materials move you along the path of your chosen career.

Organization

The text is organized around the five “classic” systems of speech and hearing: the respiratory, phonatory, articulatory/resonatory, nervous, and auditory systems. The respiratory system (involving the lungs) provides the “energy source” for speech, whereas the phonatory system (involving the larynx) provides voicing. The articulatory/resonatory system modifies the acoustic source provided by voicing (or other gestures) to produce the sounds we acknowledge as speech. The articulatory system is responsible for the mastication (chewing) and deglutition (swallowing) function, an increasingly important area within the field of speech-language pathology. The nervous system lets us control musculature, receive information, and make sense of the information. Finally, the auditory mechanism processes speech and nonspeech acoustic signals received by the listener who is trying to make sense of their world. We included information about prenatal and postnatal development of these systems as well as changes that occur through aging.

There are few areas of study where the potential for overwhelming detail is greater than in the disciplines of anatomy and physiology. Our desire with this text and the accompanying software lessons is to provide a stable foundation upon

See the beginning of the textbook for instructions on how to access the *PluralPlus* companion website.

which detail may be learned. In the text, we provide you with an introductory section that sets the stage for the detail to follow, and we bring you back to a more global picture with summaries. We also provide derivations of words to help you remember technical terms.

New to the Seventh Edition

This new edition of *Anatomy & Physiology for Speech, Language, and Hearing* includes many exciting enhancements:

- revised and updated physiology of swallowing includes discussion of postnatal development and aging effects of the swallowing mechanism and function
- brief discussion of the basics of genetics and trait transmission
- overview of prenatal development as it relates to the mechanisms of speech and hearing
- presentation of prenatal and postnatal development for each of the systems of speech and hearing as well as the effects of aging on each system
- content on the effects of pathology on communication, included within each of the physical systems of communication
- addition of clinical cases in neurophysiology and hearing as well as additional study and test questions
- updated lessons and images in ANAQUEST

*J. Anthony Seikel
David G. Drumright
Daniel J. Hudock*

About the Authors

J. Anthony (Tony) Seikel, PhD, is emeritus faculty at Idaho State University, where he taught graduate and undergraduate coursework in neuroanatomy and neuropathology over the course of his career in Communication Sciences and Disorders. He is coauthor of numerous chapters, books, and research publications in the fields of speech-language pathology and audiology. His current research is examining the relationship between orofacial myofunctional disorders and oropharyngeal dysphagia. Dr. Seikel is also coauthor of *Neuroanatomy & Neurophysiology for Speech and Hearing Sciences*, also published by Plural Publishing.

David G. Drumright, BS, grew up in Oklahoma and Kansas, taught electronics at DeVry for several years, then spent 20 years as a technician in acoustics and speech research. He developed many programs and devices for analysis and instruction in acoustics and speech/hearing. He has been semiretired since 2002, working on graphics and programming for courseware. He is also coauthor of *Neuroanatomy & Neurophysiology for Speech and Hearing Sciences*, published by Plural Publishing.

Daniel J. Hudock, PhD, CCC-SLP, is an associate professor of Communication Sciences and Disorders at Idaho State University who has taught courses on anatomy and physiology of the speech and hearing mechanisms and speech and hearing science for over a decade. He has published more than 30 articles and has given over 100 presentations. In his TEDx Talk (<https://bit.ly/2oAYeKC>) titled “Please Let Me Finish My Sentence,” he presents his experience living with a stutter. Dr. Hudock is also the founding director of the Northwest Center for Fluency Disorders that offers an intensive interprofessional stuttering clinic with speech-language pathologists collaborating with counselors and clinical psychologists through an Acceptance and Commitment Therapy (ACT) informed framework in the treatment of adolescent and adult stuttering, which is his main area of research.

Acknowledgments

We are deeply indebted to our friends at Plural Publishing who have worked so hard to make this seventh edition happen. Angie Singh, Valerie Johns, and Elisa Andersen have tremendous energy and a wonderful calming effect on authors, even as our deadlines loom. We are indebted to them and appreciate their continued support in this revision process.

We would like to acknowledge the effort that reviewers put into their examination of our material and hope we have done justice to their work. Reviewers are the unsung heroes of textbook preparation. They put in long and often tedious hours, examining our work with an unflinching eye, providing us with the critically important view of the instructor. The deadlines that they faced in reviewing the material for this seventh edition were daunting, and yet they persevered. We are very deeply indebted to them for their careful review and willingness to call our attention to areas that needed correction, refinement, and improvement. We also are grateful for their keen insight and discernment and hope that we have in some measure answered their suggestions. This textbook is written, quite literally, on their shoulders.

We also wish to acknowledge all those who, over the course of the past few years, have given us corrections and suggestions for improving this edition of the text. Samantha Smith provided us with keen insight into the changing face of animal research ethics, and Megan-Brette Hamilton and her colleagues at the American Speech-Language-Hearing Association's Office for Multicultural Affairs were a wonderful resource for updating the language of text relative to sex and gender. We appreciate the keen eyes of Meghan Wendelken, Jenny Iwarsson, and Katie Huang, all of whom found text errors, some of which dated to the first edition. Dianna Evers gave me great insight into oromyofunctional disorders, and our friend and colleague Kostas Konstantopoulos provided us with inspiration and additional cases for the text. There were many other sharp-eyed professors and students who led us to text corrections for this edition, and we are grateful for all of that input. We are extremely grateful for the talented artwork of Tatiana Gandlin whose art now graces this book.

To you, our students, please realize that your future clients support your present intentions and also will serve as your inspiration as you move through life. As speech-language pathologists and audiologists, we must acknowledge the tremendous debt we owe to the great researchers and teachers who have formed the profession, our colleagues with whom we consult and work, and, always, our clients, who have taught us more than any book could.

As authors, we must also acknowledge the source of our inspiration. We have been actively involved in teaching students in speech-language pathology and audiology for some time, and not a semester goes by that we do not realize how very dedicated our students are. There is something special about our field that attracts not just the brightest but the most compassionate. You, students, keep us as teachers alive and vital. Thank you.

Introduction to the Learner

We continue to be impressed with the complexity and beauty of the systems of human communication. Humans use an extremely complex system for communication, requiring extraordinary coordination and control of an intensely interconnected sensorimotor system. It is our heartfelt desire that the study of the physical system will lead you to an appreciation of the importance of your future work as a speech-language pathologist or audiologist.

We also know that the intensity of your study will work to the benefit of your future clients and that the knowledge you gain through your effort will be applied throughout your career. We appreciate the fact that the study of anatomy is challenging, but we also recognize that the effort you put forth now will provide you with the background for work with the medical community.

A deep understanding of the structure and function of the human body is critical to the individual who is charged with the diagnosis and treatment of speech, language, and hearing disorders. As beginning clinicians, you are already aware of the awesome responsibility you bear in clinical management. It is our firm belief that knowledge of the human body and how it works will provide you with the background you need to make informed and wise decisions. We welcome you on your journey into the world of anatomy.

Using This Textbook and Online Resources

Textbook

The text offers the following features to enhance your learning and comprehension:

- Learning Outcomes** provide a guide on how to navigate the depth and breadth of the chapter content.
- Margin Notes** identify important terminology, root words, and definitions that are highlighted in color throughout each chapter. Other important terms are boldfaced in text to indicate that the definition can be found in the Glossary at the end of the book. Use these terms to study and prepare for tests and quizzes. Additionally, callouts in the margin indicate corresponding ANAQUEST lessons and video labs.
- Clinical Notes** relate a topic directly to clinical experience to emphasize the importance of anatomy in your clinical practice. Gain insight into your chosen profession by using the topics discussed for research papers, to facilitate in-class discussion, and to complete homework assignments.
- Illustrations and Graphs** provide visual examples of the anatomy, processes, and body systems discussed. Refer to the figures as you read the text to enhance your understanding of the specific idea or anatomical component being discussed. When reviewing for quizzes and tests, refer back to the figures for an important visual recap of the topics discussed.
- Photographs** provide a real-life look at the body parts and functions you are studying. Use these images as reference for accuracy in describing body systems, parts, and processes. Allow yourself to be amazed by the intricacies of human anatomy.
- Tables** highlight the various components, functions, structures, and pathologies of anatomical concepts related to what you might encounter in actual practice. Use these tables for quick reference to study and learn to relate your new anatomical knowledge to clinical experience. **Muscle Tables** describe the origin, course, insertion, innervation, and function of key muscles and muscle groups. Use these tables to stay organized and keep track of the numerous muscles studied in the chapters.

Anatomy of Phonation 4

LEARNER OUTCOMES

1. Expressively define, and receptively identify on graphic image the pharynx, nasopharynx, and larynx, including the functional units of the pharynx, epiglottis, aryepiglottic folds, vocal ligament, vocal folds, and glottis.
2. Discuss the biological functions of the larynx and trachea.
3. Discuss the relationship among the cartilages, ligaments, and muscles of the larynx.
4. Identify each of the laryngeal cartilages and ligaments of the larynx, as well as the vocal folds and its landmarks from graphic image.
5. Receptively identify the level and directional specialization of the larynx of the vocal fold.
6. Identify the cartilage, landmarks, and structures of the larynx through description or visual image.
7. Describe the location of structures and spaces of the larynx.
8. Describe the movements and articulation of the cartilages, including the functional units of the larynx.
9. Define the intrinsic laryngeal musculature origin, insertion, course, function, and innervation, as well as identify on a graphic image.
10. Receptively identify from an image and description the functions of the aryepiglottic and thyroepiglottic muscles.
11. Identify the origin, insertion, course, function, and innervation of the inferior and superior laryngeal muscles, and receptively identify the muscles on graphic image.

There is a great deal of detail in the anatomy of the pharynx, larynx, and trachea, and you should follow the path of your instructor when reading this content.

ANAQUEST LESSON

Lesson 1: All of the parts

Student communication uses both vocal and non-vocal sounds, and this chapter is concerned with the critical distinction. As you remember, speech sounds are produced within the oral cavity, and the vocal folds are the source of energy for speech. Remember from Chapter 3 that we entered as respiratory there would be no voice.

The vocal folds are made up of five layers of tissue, with the deepest layer being muscle. The space between the vocal folds is termed the **glottis** for times the airway passes between the vocal folds, they may be made to vibrate, thus creating a rasping vibration. This is the mechanical movement of the vocal folds vibrating and stop. Because of a **glottis**, you should be able to produce a sound that is greater than expected. In the larynx, the superior surface is marked by a superior articular face, which may vary the **pedicle**. The inferior surface contains an inferior articular face. In the subpedicle, the inferior surface contains an inferior articular face. The part of the superior foramina above the level of the vocal folds, these foramina are. The part of the superior foramina above the level of the vocal folds, these foramina are. The part of the superior foramina above the level of the vocal folds, these foramina are.

Figure 3-7 shows the course of the vocal folds through the larynx. You can see the vocal folds in the larynx.

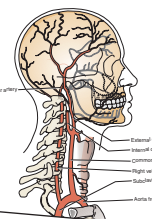


Figure 3-7 COURSE OF VIBRATING STRINGS THROUGH THE LARYNX

Figure 3-8 COURSE OF VIBRATING STRINGS THROUGH THE LARYNX

Table 3-1: Bones of the Face and Cranial Skeleton

Bones of the Face	Bones of the Cranial Skeleton
Mandible	Frontal bone
Maxilla	Sphenoid bone
Nasal bone	Parietal bone
Palatine bone and nasal concha	Temporal bone
Zygomatic bone	Occipital bone
Lacrimal bone	Basilar part of occipital condyle
Mental bone	Clavicle
	Scapula



• **“To Summarize” Sections** provide a succinct listing of the major topics covered in a chapter or chapter section. These summaries provide a helpful recap of the general areas where you should focus your time while reviewing for examinations.

• **Chapter Summaries** provide precise reviews of content. The summary is offset from the running text to make it easily identifiable for quick review.

• A **Bibliography** with a comprehensive list of references at the end of each chapter offers great sources to start your research for a paper or class project.

• A **Glossary** lists all key terms found throughout the text.

Online Resources

The text is supported by a suite of supplementary resources on a **PluralPlus companion website**. The site is divided into two areas: one housing materials for the instructor and the other just for students.

ANAQUEST

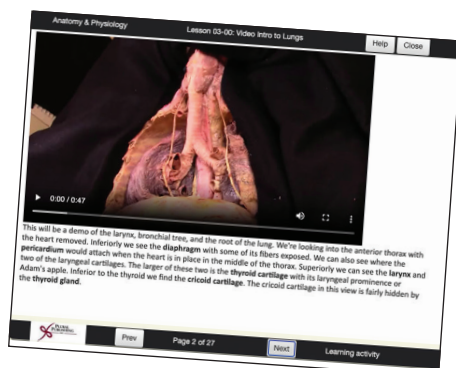
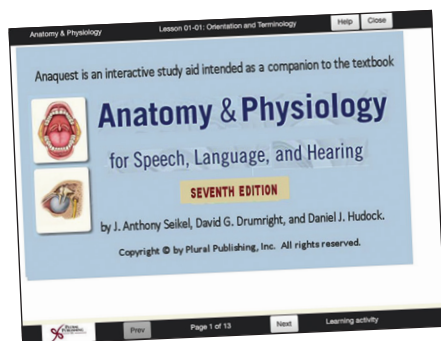
The innovative software program, **ANAQUEST**, is available in two different versions: one for instructors to import into their Learning Management Systems (LMS) for exams, and another web-based version for student study. ANAQUEST features interactive **lessons**, **images**, **animations**, and **videos**.

For the Instructor

The instructor area of the PluralPlus companion website contains a variety of tools to help instructors successfully prepare lectures and teach within this subject area. This comprehensive package provides something for all instructors, from those teaching anatomy and physiology for the first time to seasoned instructors who want something new. The resources include the following:

- *PowerPoint slides* for each chapter
- a *test bank* with over 1,000 questions and answers
- *class activities* and *labs*
- a sample *syllabus*
- *videos*
- a version of *ANAQUEST* importable to the leading LMSs
- access to the student section of the companion website

See the inside front cover of the book on how to gain instructor access to the website.



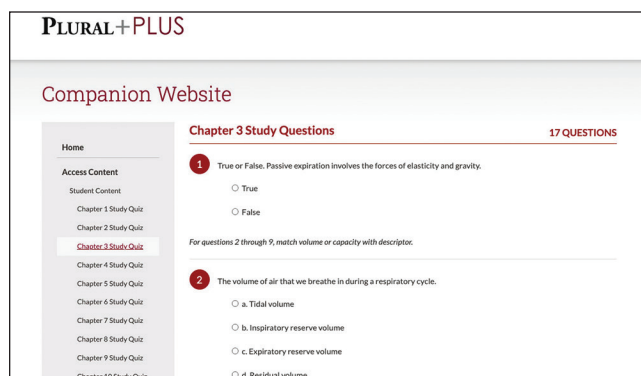
For the Student

To further help students master complex material, the student area of the Plural-Plus companion website includes the following:

- interactive *study quizzes* for each chapter
- *videos*
- downloadable *appendices*
- a student web-version of the *ANAQUEST* study software

The ANAQUEST software is keyed to the text, reinforcing identification of the structures presented during lecture and, more importantly, illustrating the function of those structures. The lessons and videos are self-paced, with frequent quizzes. Spending two or three half-hour sessions per week will be a great refresher while preparing for exams.

See the inside front cover of the book for the website URL and your access code.



The authors dedicate this text to the researchers in speech and hearing science and in allied fields who continue to examine how we, as humans, function. We continue to be amazed at both the ingenuity and diligence with which researchers in our field approach their task. Their work forms the basis for all we do as authors. We also dedicate this text to the clients we have known and interacted with who give us so much inspiration. Their courage, commitment, and humor has sustained us for many years. Finally, we dedicate this text to the students who are taking our place in the clinical world and to the teachers who are helping them do that. We have spoken with numerous people outside of our fields who say that our students are, indeed, special. You have tremendous compassion and strength of will, and it is wonderful to see you become the clinicians of the future.

Students-in-training will get to know clients we have known over our years of practice who have inspired us with their courage and wisdom. We also dedicate this text to the students and faculty in speech and hearing who do the work of helping people with communication and swallowing difficulties. We have been blessed with our associations with you for many decades, and we know that audiologists and speech-language pathologists are compassionate and generous people who dedicate their lives to improving the well-being of others in what we, the authors, consider the most important aspect of life: communication. We thank you, the faculty and students of our fields, for your dedication.

—*JAS, DGD, and DJH*

I also dedicate this text to my sweetie for life, Paula, who has lived with my angst over textbook creations and revisions since the first edition of this text. Revisions are fraught with deadline pressures that strain every other aspect of a person's life, but she has never complained about my need to plow forward on a task that seems to have no end. She is a wonderful sounding-board for problems, and an irreplaceable resource for editing. We have a very "yin and yang" relationship: My writing is wordy and often imprecise, and hers is precise, pithy, and lean. Blessedly, we come to some middle-way when we work together, and I quite literally could not go forward without her.

—*Tony Seikel*

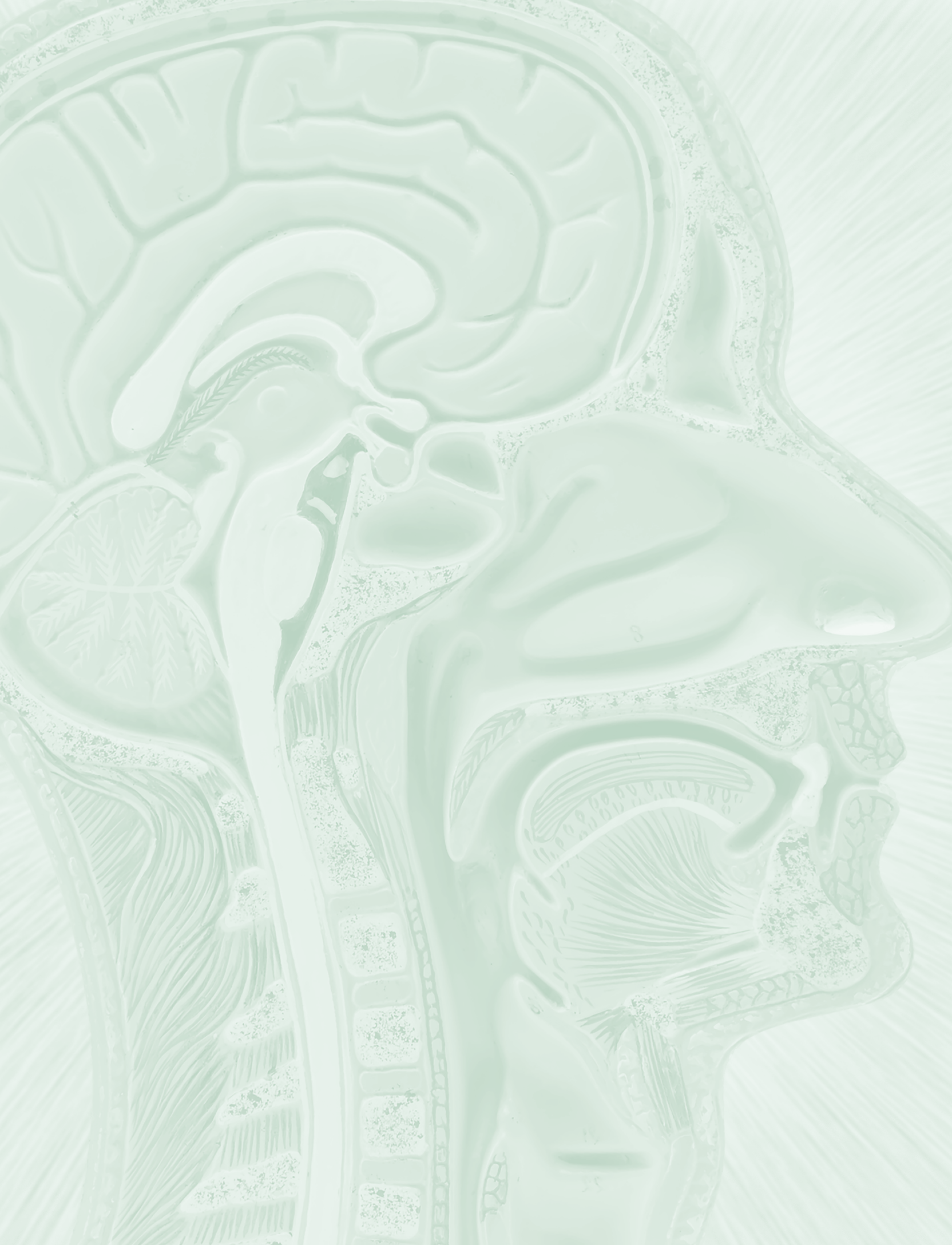
I also dedicate the accompanying software to Professor Merle Phillips, who taught me something about audiology and a lot about life.

—*David Drumright*

I wish to dedicate my contributions to the text to the first author, "Tony," who has been a beloved colleague, mentor, and dear friend over the past several years. Tony's passion for the field, colleagues, teaching, and students knows no bounds as he has tirelessly and compassionately given of himself for the betterment of others.

I would also like to acknowledge the many speech-language pathologists, teachers, professors, students, friends, and family who have supported me along the way. There are no words that can fully express my gratitude and appreciation for the kindness and support shown to me. Thank you.

—*Dan Hudock*



Basic Elements of Anatomy

1

LEARNING OBJECTIVES

The learner will be able to:

1. Define and demonstrate an understanding of the terminology of anatomy and physiology as it relates to the body, its position in space, and movement of its parts.
2. Demonstrate receptive knowledge of the subspecializations of anatomy and physiology.
3. Identify the four basic tissue types, and define their general function in the body.
4. Receptively differentiate the derivatives, and functions of those derivatives, of epithelial tissue, connective tissue, muscular tissue, and nervous tissue.
5. Receptively identify joint types of the skeleton.
6. Discuss muscle function as it relates to exertion of force on the skeletal structures.
7. Differentiate fascia, ligaments, and tendons.
8. Define the systems of the body and how they relate to the systems of communication.
9. Describe the basic function of the central and peripheral nervous systems.
10. Relate the name, number, and general function of each cranial nerve, the name and general function of lobes of the cerebellum, lobes of the cerebral cortex, and structures of the brainstem.
11. Relate the difference among autosomal dominant, autosomal recessive, and sex-linked inheritance, and between genotype and phenotype.
12. Define the times that indicate the embryonic and fetal stages of development.
13. Receptively differentiate general structures that arise from endoderm, ectoderm, and mesoderm in development.
14. Receptively differentiate the structures of the face, head, and neck that arise from each pharyngeal arch.

There is a great deal of detail in this introductory information, and you should follow the guidance of your instructor when studying this content.

You are entering into a study of the human body that has a long and rich tradition. We are fortunate to have myriad instruments and techniques at our avail for this study, but it has not always been so. You will likely struggle with arcane terminology that seems confusing and strange, and yet if you look closely, you will see what the early anatomists first saw. The amygdala of the brain is a small almond-shaped structure, and *amygdala* means “almond.” *Lentiform* literally means “lens-shaped,” and the lentiform nucleus is just that. The fact that the terminology remains in our lexicon indicates the accuracy with which our academic ancestors studied their field, despite extraordinarily limited resources.

This chapter provides you with some basic elements to prepare you for your study of the anatomy and physiology of speech, language, and hearing. We provide a broad picture of the field of anatomy and then introduce you to the basic tissues that make up the human body. Tissues combine to form structures, and those structures combine to form systems. This chapter sets the stage for your understanding of the new and foreign anatomical terminologies.

ANAQUEST LESSON 

anatomy dissection: Gr, anatome

dissection: L., dissecare, the process of cutting up

physiology: Gr., physis, nature; logos, study; function of an organism

applied anatomy or **clinical anatomy:** application of anatomical study for the diagnosis and treatment of disease, particularly as it relates to surgical procedures

descriptive anatomy or **systemic anatomy:** anatomical specialty involving the description of individual parts of the body without reference to disease conditions

gross anatomy: study of the body and its parts as visible without the aid of microscopy

microscopic anatomy: study of the structure of the body by means of microscopy

surface anatomy or **superficial anatomy:** study of the body and its surface markings as related to underlying structures

developmental anatomy: study of anatomy with reference to growth and development from conception to adulthood

pathological anatomy: study of parts of the body with respect to the pathological entity

comparative anatomy: study of homologous structures of different animals

electrophysiological techniques: those techniques that measure the electrical activity of single cells or groups of cells, including muscle and nervous system tissues

evoked auditory potential: electrical activity of the brain that is directly associated with hearing an auditory stimulus, an example of this is an auditory brainstem response

Anatomy and Physiology

Anatomy refers to the study of the *structure* of an organism. **Physiology** is the study of the *function* of the living organism and its parts, as well as the chemical processes involved. **Applied anatomy** (also known as **clinical anatomy**) involves the application of anatomical study for the diagnosis and treatment of disease and surgical procedures. **Descriptive anatomy** (also known as **systemic anatomy**) is a description of individual parts of the body without reference to disease conditions, viewing the body as a composite of systems that function together. **Gross anatomy** studies structures that are visible without a microscope, while **microscopic anatomy** examines structures not visible to the unaided eye. **Surface anatomy** (also known as **superficial anatomy**) studies the form and structure of the surface of the body, especially with reference to the organs beneath the surface (Gilroy et al., 2012; Gray & Standring, 2008; Rohen et al., 2011; Tank & Grant, 2012). **Developmental anatomy** deals with the development of the organism from conception (Moore et al., 2020).

When your study examines disease conditions or structural abnormalities, you have entered the domain of **pathological anatomy**. When we make comparisons across species boundaries, we are engaged in **comparative anatomy**. Examination of physiological processes may entail the use of a range of methods, from simply measuring forces exerted by muscles to highly refined **electrophysiological techniques** that measure electrical activity of single cells or groups of cells, including muscle and nervous system tissues. For example, audiologists are particularly interested in procedures that measure the electrical activity of the brain caused by auditory stimuli (**evoked auditory potentials**). We rely heavily on descriptive anatomy to guide our understanding of the physical mechanisms of speech and to aid our discussion of its physiology (e.g., Duffy, 2019). Study of pathological anatomy occurs naturally as you enter your clinical process because many of the

Teratogen

A **teratogen** or teratogenic agent is anything causing teratogenesis, the development of a severely malformed fetus. For an agent to be teratogenic, its effect must occur during prenatal development. Because the development of the fetus involves the proliferation and differentiation of tissues, the timing of the teratogen is particularly critical. The heart undergoes its most critical period of development from the third week to the eighth, while the critical period for the palate begins around the fifth week and ends around the 12th week. The critical period for neural development stretches from the third week until birth. These critical periods for development mark the points at which the developing human is most susceptible to insult. An agent destined to have an effect on the development of an organ or system will have its greatest impact during that critical period.

Many teratogens have been identified, including organic mercury (which causes cerebral palsy, cognitive impairment, blindness, cerebral atrophy, and seizures), heroin and morphine (causing neonatal convulsions, tremors, and death), alcohol (fetal alcohol syndrome, cognitive impairment, microcephaly, joint anomalies, and maxillary anomalies), and tobacco (growth restriction), to name just a few.

acquired conditions speech-language pathologists or audiologists work with arise from pathological changes in structure.

We need to call on knowledge from related fields to support your study of anatomy and physiology. **Cytology** is the discipline that examines structure and function of cells; **histology** is the microscopic study of cells and tissues. **Osteology** studies the structure and function of bones, while **myology** examines muscle form and function. **Arthrology** studies the joints uniting bones, and **angiology** is the study of blood vessels and the lymphatic system. **Neurology** is the study of diseases of the nervous system.

✓ To summarize:

- **Anatomy** is the study of the structure of an organism; **physiology** is the study of function.
- **Descriptive anatomy** relates the individual parts of the body to functional systems.
- **Pathological anatomy** refers to changes in structure as they relate to disease.
- **Gross** and **microscopic anatomy** refer to levels of visibility of structures under study.
- **Developmental anatomy** examines growth and development of an organism.
- **Cytology** and **histology** study cells and tissues, respectively. **Myology** examines muscle form and function.
- **Arthrology** refers to the study of the joint system for bones, while **osteology** is the study of form and function of bones.
- **Neurology** refers to the study of diseases of the nervous system.

cytology: Gr., kytos, cell; logos, study

histology: Gr., histos, web, tissue; logos, study

osteology: Gr., osteon, bone; logos, study

myology: Gr., mys, muscle; logos, study

arthrology: Gr., arthron, joint; logos, study

angiology: Gr., angio, blood vessels; logos, study

neurology: Gr., neuron, sinew, nerve; logos, study

Terminology of Anatomy

Terminology allows us to communicate relevant information concerning the location and orientation of various body parts and organs, so clarity of terminology is of the utmost importance in the study of anatomy. Terminology also links us to the historic roots of this field of study. To the budding scholar of Latin or Greek, learning the terms of anatomy is an exciting reminder of our linguistic history. To the rest of us, the terms we are about to discuss may be less easily digested but are nonetheless important.

As you prepare for your study of anatomy, please realize that this body of knowledge is extremely hierarchical. *What you learn today will be the basis for what you learn tomorrow.* Not only are the terms the bedrock for understanding anatomical structures but mastery of their usage will let you gain the maximum benefit from new material presented.

Terms of Orientation

In the **anatomical position**, the body is erect, and the palms, arms, and hands face forward, as shown in Figure 1–1A. Terms of direction assume this position. The body and brain (and many other structures) are seen to have axes (plural of axis), or midlines from which other structures arise. The **axial skeleton** is the head and trunk, with the spinal column being the axis, while the **appendicular**

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