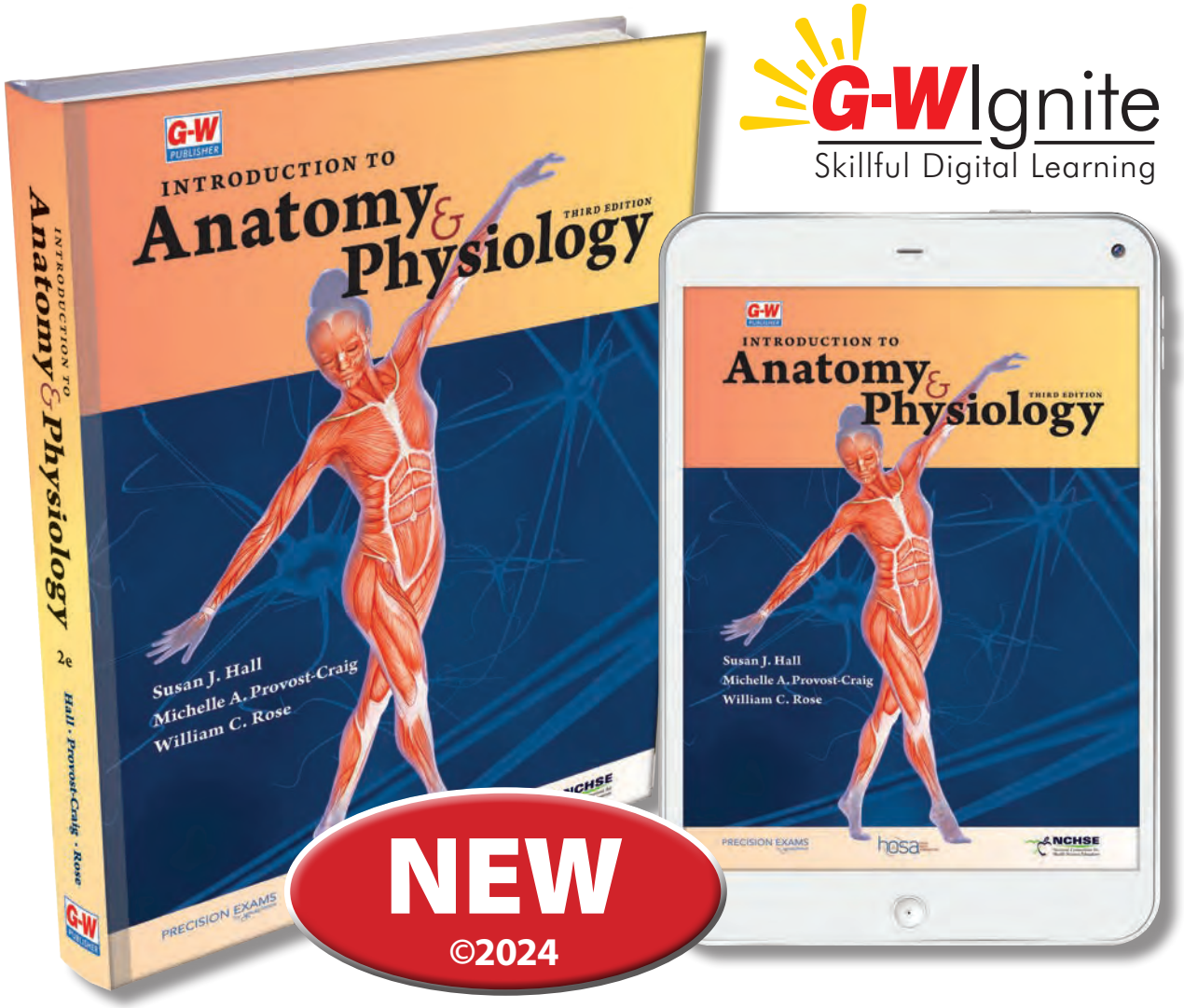
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Support Any Health Science Career Pathway with Anatomy & Physiology Curriculum Built for High School Students

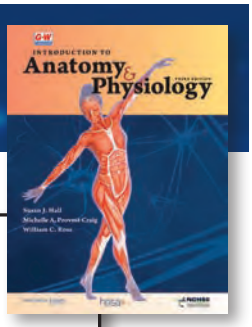


G-W Ignite
Skillful Digital Learning

- Updated to NCHSE National Health Science Standards for Human Structure, Function, and Disease A and B exams
- Now aligned to NGSS standards
- Clinical Case Studies and NEW HOSA Event Prep activities help students apply knowledge to real-world scenarios and CTSO competitions.
- Highly structured chapters help keep students on track as they navigate each body system with accessible content written for high school courses.
- Text is broken up by frequent self-assessment and easy-to-read tables about diseases, disorders, and trauma, and includes hundreds of high-quality medical drawings and images.

NCHSE National Consortium for Health Science Education

hosa future health professionals



About the Authors

Susan J. Hall is a Professor Emerita in the Department of Kinesiology and Applied Physiology at the University of Delaware. She is a fellow of the American College of Sports Medicine and the AAHPERD Research Consortium, and she has served as President of the Biomechanics Academy of AAHPERD, President of the AAHPERD Research Consortium, and Vice President of the American College of Sports Medicine. She has been teaching at the college level for more than 30 years and served for many years as a department chair and deputy dean.

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New to this Edition

The third edition of ***Introduction to Anatomy & Physiology*** features updates in medical knowledge, scientific technology, and terminology, including advances in mental health and the emergence of COVID-19.

Content Updates:

- Updated to align with the **National Consortium for Health Science Education Standards** for two, stackable certificates—Human Structure, Function, and Disease A and B
- **Information on COVID-19**, including its pathology, spread, and impact on health
- **Additional content** on artificial tissues, muscle disorders, sense of touch, and the impact of Rh factor on the universal donor and universal recipient definitions
- **NEW HOSA Event Prep activities** in each chapter support the skills portion of HOSA competitive events

hosa future health professionals

Let's Look Inside the Student Edition

Learning Outcomes
list key concepts students will learn in each chapter and help direct reading.

LESSON 10.1

The Functions and Composition of Blood

Before You Read

Try to answer the following questions before you read this lesson.

- What substances does blood transport?
- How does blood protect the body from infection?

Learning Outcomes

10.1-1 Identify the functions of blood in the human body.

10.1-2 Describe the physical properties of blood.

10.1-3 Explain the components of blood and their functions, including red blood cells, white blood cells, and platelets.

Key Terms

buffy coat
carbaminohemoglobin
coagulation
diapedesis
erythrocytes
erythropoiesis
erythropoietin
fibrin
formed elements
hematocrit
hematopoiesis
hemoglobin
hemolysis
hemostasis
leukocytes
oxyhemoglobin
plasma
platelet plug
platelets

Every day, your body undergoes so many changes that it would be hard to quantify them. Even with all of these changes, however, the body maintains homeostasis through many dynamic regulatory systems. Blood is one of the body's regulatory and transport systems. Blood plays a vital role in gas exchange; body temperature maintenance; and acid-base, fluid, and electrolyte balance.

10.1-1 The Functions of Blood

The blood is responsible for providing transportation, regulation, and protection throughout the body. It plays a key role in gas exchange, which, as explained in Chapter 9, involves supplying oxygen and other nutrients to cells, while also removing carbon dioxide and other waste produc
carries waste to the kidneys and carb
the lungs, where both the waste and c
are eliminated from the body.

Blood also protects the body agai
and regulates body temperature by di
toward the skin and lungs. In additio
and amino acids transported in the b
maintain the body's pH at healthy lev
7.35 and 7.45. **Figure 10.1** summariz
that blood plays in maintaining home

Check Your Understan

1. The functions of blood can be div
what three major categories? Give
examples for each category.
2. What is a healthy pH for the hum

10.1-2 Physical Propertie of Blood

Blood is a sticky, thick fluid that makes up roughly 8% of total body weight. Both men and

Functions of the Blood

Transports	oxygen and carbon dioxide
	waste products of metabolism (urea and lactic acid)
	hormones
	enzymes
	nutrients (glucose, fats, amino acids, vitamins, and minerals)
	blood cells (white and red)
	plasma proteins (fibrinogen, albumin, globulin)
Regulates	body temperature
	acid-base balance (pH)
	fluid and electrolyte balance
Protects	white blood cells protect against infection
	antibodies detect foreign material
	clotting factors prevent excessive bleeding

Figure 10.1 *Goodheart-Willcox Publisher*

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Contents

1. Foundations of Human Anatomy & Physiology
2. Cells and Tissues
3. Membranes and the Integumentary System
4. The Skeletal System
5. The Muscular System
6. The Nervous System
7. The Special Senses
8. The Endocrine System
9. The Respiratory System
10. The Blood
11. The Cardiovascular System
12. The Lymphatic and Immune Systems
13. Nutrition and the Digestive System
14. The Urinary System
15. The Male and Female Reproductive Systems

Appendix A: Metric-English Conversion Factors

Appendix B: Basic Mathematical Operations

Appendix C: Anatomy and Physiology Word Elements

Appendix D: Common Medical Abbreviations

Preview: High quality medical illustrations help students recognize and locate anatomical structures in each body system.

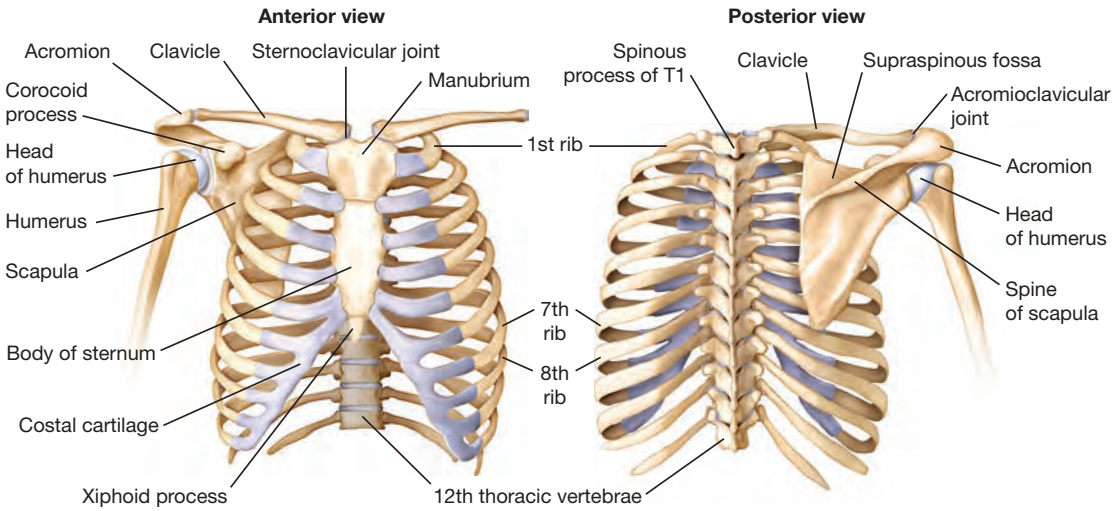


Figure 4.17 Anterior and posterior views of the pectoral girdle, ribs, and humerus.

able to glide against the glenoid fossa, in addition to rotating. As a result, the glenohumeral joint allows motion in more directions than any other joint in the body.

The glenohumeral joint, along with the bones and joints of the pectoral girdle, are referred to as the *shoulder complex*. Together these joints provide the significant range of motion present in a healthy shoulder. This large degree of mobility, however, comes at the cost of instability: the shoulder is one of the most frequently dislocated joints in the human body. **Figure 4.19** summarizes the joints of the shoulder complex.

The Arm

The single bone of the upper arm is the humerus (**Figure 4.20**). The humerus is a large, strong bone, second in size only to the major bone of the

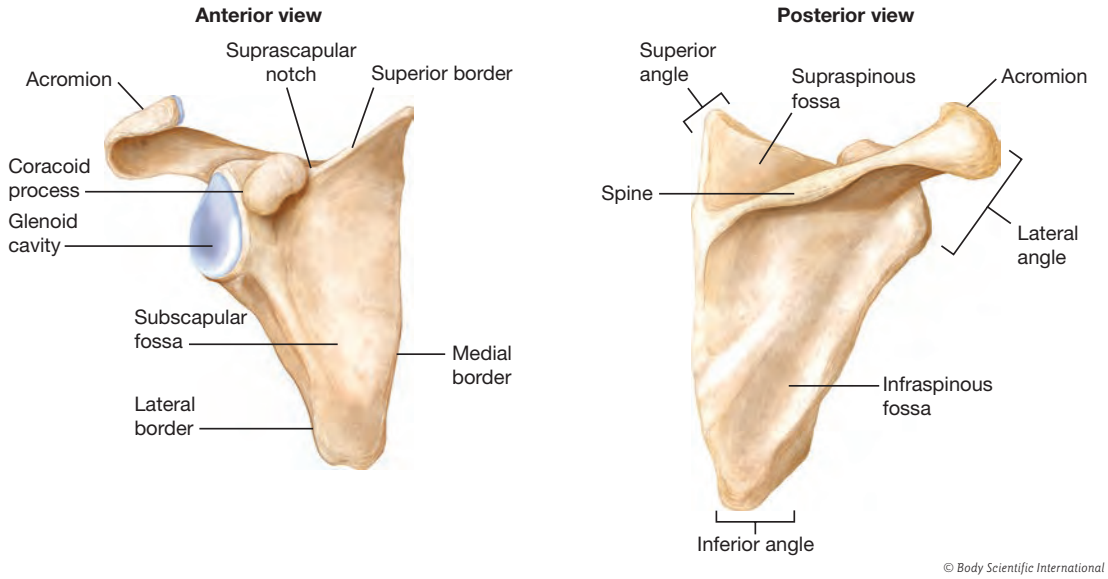


Figure 4.18 Anterior and posterior views of the scapula.

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Preview: Integrated with CTSO & Industry-Recognized Credential Prep

NEW HOSA Event Prep icons identify activities specifically crafted to help students practice for competitive events and were reviewed by national HOSA.

HOSA Event Prep

Did you know that medical terminology is used in all health science professions? Healthcare professionals have to understand the terminology used so they can accurately diagnose and treat their patients. Most terminology comes from word parts, including prefixes, word roots, and suffixes. That means if you know the definition of the word parts, you can define the word. Descriptive terminology describes locations, positions, and directions relative to the body. Knowing body planes, regions, quadrants, and directional terms is crucial when you are assessing a patient and their symptoms.

You can also use these skills in one of the largest HOSA events, called *Medical Terminology*. Go to the HOSA website at https://hosa.org/guidelines/ to find out more about this event. What is involved in this event? Is it a written or practical (skills assessment) event, or both? How might you best prepare for this event?

As you read the information in this chapter, keep HOSA's *Medical Terminology* event in mind, and pay special attention to the related information in this chapter. If you decide you want to participate in this event, check with your HOSA advisor for more information about guidelines and procedures.

Communicating about Anatomy & Physiology EVENT PREP

1. **Speaking and Listening** Work ing in small groups, create a poster that clearly illustrates the anatomical planes and directional movements of the human body. Have a volunteer briefly stand before the class as a "visual aid" to help you accurately capture and represent anatomical position and directional relationships.

Lab Investigations EVENT PREP

1. Working in groups of two or three students, create a three-dimensional anatomical man and label your creation using the terms that you have learned in this chapter. If you created a poster in the "Communicating" activity above, use it as a guide as you label your "anatomy man."

Preview: Career features highlight related careers for each body system.

CAREER CORNER

Anatomy & Physiology at Work

The respiratory system is a vital body system that delivers life-sustaining oxygen to body tissues and removes harmful carbon dioxide.

A number of careers are dedicated to the study of the respiratory system, the health and maintenance of its components, and the diagnosis and treatment of respiratory disorders and diseases. Two of these careers are respiratory therapist and pharmacy technician.

Respiratory Therapist

A respiratory therapist (RT) is a healthcare professional who, under the supervision of a physician, cares for people with respiratory disorders. RTs also provide emergency care for people who have breathing problems resulting from heart attack, stroke, near-drowning, or other circumstances (**Figure 9.24**).

RTs perform diagnostic tests on patients, including pulmonary function tests, static lung volume measurements, cardiopulmonary exercise testing, and arterial blood gas tests. RTs also treat patients with poor pulmonary health. They control patients' supplemental oxygen levels and provide respiratory muscle training. In addition, RTs educate patients about effective ways to minimize symptoms and manage their pulmonary disease.



Akira Kaelyn/Shutterstock.com

Figure 9.24 A respiratory therapist assists her patient with a breathing exercise.

RTs administer drug treatments to patients, including nebulizer therapy treatments. A nebulizer is a machine that turns liquid medication into a mist, which is breathed directly into the lungs.

To become a respiratory therapist, you need an associate's degree or a bachelor's degree in respiratory therapy from an accredited institution. You must also pass a national certification exam and meet the licensing requirements of your state. Most hospitals hire registered respiratory therapists (RRTs) who have passed the Registered Respiratory Therapist exam.

The demand for respiratory therapists is expected to increase by more than 25% in the next 10 years. Much of the growth in this field, and in other healthcare-related careers, is due to the aging of a large segment of the population called *baby boomers*. Baby boomers are people who were born in the decades after World War II, when the birth rate in the United States increased dramatically. The baby boomers are now moving into old age, a time when many people develop health problems, including respiratory system disorders.

Pharmacy Technician

A pharmacy technician assists licensed pharmacists in dispensing prescription medications. They work in hospitals and in retail pharmacies (**Figure 9.25**).

Because pharmacy technicians interact frequently with patients or customers, they must have excellent interpersonal, or "people," skills. After receiving a prescription from a customer, the pharmacy technician may need to request additional information from the customer or a physician in order to provide the correct medication. Prescriptions also come into the pharmacy electronically from physician offices, so pharmacy technicians must have a working knowledge of computers and electronic document handling.

Pharmacy technicians must be very attentive to detail. Dispensing the wrong medication or the wrong dosage (amount) to a customer or patient

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Figure 9.25 A pharmacy technician works under the direct supervision of a licensed pharmacist.

can cause illness or even death. After reading a prescription, the pharmacy technician retrieves the correct medication from the shelves. Under the supervision of a pharmacist, the pharmacy technician counts out the correct number of tablets or capsules, measures the prescribed amount of a liquid, or mixes substances to produce the drug. Pharmacy technicians who work in healthcare facilities may also dispense intravenous (IV) medications.

After prescriptions have been packaged and labeled, a pharmacist checks them. The pharmacy technician then dispenses the medications to customers and takes payment. Pharmacy technicians may also create and maintain medical profiles of their customers or patients, prepare and submit health insurance forms, and manage the pharmacy inventory.

Pharmacy technicians must possess a high school diploma or its equivalent. Some pharmacy technicians receive on-the-job training; others attend a certificate program at a vocational school or community college. Certification for pharmacy technicians is offered by the National Pharmacy Technician Certification Board and the National Healthcare Association. To find out the certification requirements for your state, check the website of your state pharmacy board.

The job outlook for pharmacy technicians is promising. As people age, they often need more prescription medications. A shortage in the number of licensed pharmacists has also created a demand for pharmacy technicians.

Planning for a Health-Related Career

Do some research on the career of a respiratory therapist or a pharmacy technician. You may choose instead to research a profession from the list of related career options. Using the internet or resources at your local library, find answers to the following questions:

1. What are the main tasks and responsibilities of a person employed in the career that you chose to research?
2. What is the outlook for this career? Are workers in demand, or are jobs dwindling? For complete information, consult the current edition of the *Occupational Outlook Handbook,* published by the US Department of Labor. This handbook is available online or at your local library.
3. What special skills or talents are required? For example, do you enjoy research? Do you enjoy communicating with other people?
4. What personality traits do you think are necessary for success in the career that you have chosen to research? For example, are you meticulous and accurate? Pharmacy technicians must have these traits.
5. Does the work involve a great deal of routine, or are the day-to-day responsibilities varied?
6. Does the career require long hours, or is it a standard, "9-to-5" job?
7. What is the salary range for this job?
8. What do you think you would like about this career? Is there anything about it that you might dislike?

Related Career Options

- Athletic trainer
- Medical assistant
- Medical records and health information specialist
- Occupational therapist
- Pharmacist
- Physical therapist
- Registered nurse

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Preview: Updated with current research related to each body system.

What Research Tells Us

...about Exercise-Induced Asthma

Asthma attacks triggered by exercise are called *exercise-induced bronchospasms (EIBs)*, or *exercise-induced asthma*. Exercise-induced asthma is not uncommon. Many people who exercise regularly have asthma, even professional athletes. Hundreds of athletes successfully compete at the Olympic Games despite having asthma.

Researchers investigated the incidence of EIBs among members of the US Olympic Winter Sports teams. The athletes tested for EIBs included members of seven different teams: biathlon, cross-country skiing, figure skating, ice hockey, Nordic combined events, long-track speed skating, and short-track speed skating.

All the athletes in the study were tested for EIBs during actual or simulated competition. The overall incidence of EIBs was 23%. This percentage included nearly half of the cross-country skiing team as well as winners of gold, silver, and bronze medals. This study demonstrated that athletes can compete at the international level—even winning an Olympic gold medal—despite having exercise-induced asthma.

Taking It Further

1. Research the career of a famous athlete with asthma. What challenges did asthma cause for the athlete? How did he or she cope with the disease? Present your findings in an oral report to the class.
2. If you were a coach and a member of your team showed symptoms of exercise-induced asthma, what advice would you give him or her for

Reading is broken into manageable chunks integrated with frequent opportunities to check for comprehension.

Treatments for asthma include limiting exposure to irritants that can trigger an asthma attack and using prescription medications such as bronchodilators, anti-inflammatory drugs, and inhaled steroids (**Figure 9.21**). These medications work by relaxing the muscles of the bronchi and expanding the airways.

Currently more than 25 million people in the United States have asthma, with an incidence of about 8% of all adults and children. According to the CDC's 2016 prevalence data, African-Americans and Puerto Ricans have the highest rates among minority populations, with rates of 11.6 and 14.3 percent respectively. This respiratory disease can be fatal;



xavier gallego morel/Shutterstock.com

Figure 9.21 A mother helps her child use an asthma inhaler with a spacer. The spacer allows more of the medicine to get into the child's lungs.

it kills more than 3
United States, the c
treatments and lost prod
amount to roughly $56 billion e

Check Your Understanding

1. What percentage of people in the United States has asthma?
2. What are some treatments for asthma?

9.3-5 Obstructive Sleep Apnea

Sleep apnea affects more than 12 million Americans, and many of them go undiagnosed because the primary symptom happens during sleep. There are many forms of sleep apnea. This discussion relates to the most common form: obstructive sleep apnea. OSA is usually characterized by loud snoring with intermittent partial or complete obstruction of the upper airway. It occurs when an individual's tongue falls against the soft palate and the soft palate and the uvula fall back against the throat, obstructing the airway, which results in **hypoxia** (too little oxygen).

Sleep apnea is diagnosed when an individual stops breathing for 10 seconds or longer for a minimum of five times per hour while sleeping. Many individuals experience moderate to severe OSA,

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Preview: End-of-Lesson content includes a summary of newly learned terms, as well as application activities and hands-on labs tied to lesson learning outcomes.

external respiration the process by which gas exchange occurs between the alveoli in the lungs and the pulmonary blood

forced expiratory volume in one second (FEV_1) the amount of air that a person can expire in one second

forced expiratory volume in one second/forced vital capacity (FEV_1/FVC) the overall expiratory power of the lungs

functional residual capacity (FRC) the amount of air that remains in the lungs after a normal expiration; ERV + RV

Hering-Breuer reflex an involuntary impulse triggered by stretch receptors in the bronchioles and alveoli that halts inspiration and initiates exhalation

inspiration the process by which air flows into the lungs; inhalation

inspiratory reserve volume (IRV) the amount of air that can be inhaled immediately after a normal inhalation

internal respiration the process of gas exchange between the tissues and arterial blood

mechanoreceptors chemical receptor cells that detect muscle contraction and force generation during exercise; they quickly increase respiration rates when exercise begins

peripheral chemoreceptors sensory receptor cells located in the aortic arch and carotid arteries that are sensitive to changes in blood oxygen level

pulmonary ventilation the process of continuously moving air in and out of the lungs

residual volume (RV) the volume of air that never leaves the lungs, even after the most forceful expiration

respiration the process by which the lungs provide oxygen to body tissues and dispose of carbon dioxide; breathing

respiratory gas transport the process by which oxygen and carbon dioxide are transported to and from the lungs and tissues

tidal volume (TV) the amount of air inhaled in a normal breath

total lung capacity (TLC) a combination of the vital capacity plus the residual volume; IRV + TV + ERV + RV

vital capacity (VC) the total amount of air that can be forcibly expired from the lungs after a maximum inspiration

Know and Understand

1. What are the four key tasks the cardiopulmonary system works to accomplish? (LO 9.2-1)
2. Describe the mechanics of a cough. (LO 9.2-1)
3. How does posture affect your breathing rate? (LO 9.2-2)
4. Where are the neural centers for breathing located? (LO 9.2-2)
5. What instruments are used to measure static and dynamic lung volume? (LO 9.2-3)

Analyze and Apply

1. Explain Boyle's law and how it relates to breathing. (LO 9.2-1)
2. What are stretch receptors, and what role do they play in the Hering-Breuer reflex? (LO 9.2-2)
3. Imagine that you are a pediatrician. A frantic mother visits you in your office with her newborn son. The mother expresses concern that her baby's breathing rate is too high. She tells you that the baby takes many more breaths each minute than his older brother. After testing the baby's respiratory rate, you discover that it falls in the normal range for newborns. How do you explain this to the mother? (LO 9.2-2)
4. Using the information shown in Figure 9.11, when do you think the baby will take its first breath of air? (LO 9.2-3)

IN THE LAB

1. Compare respiratory rates as related to lung age. Begin with a partner in the classroom and practice counting each other's respiration for a full minute. Remember, one respiration equals one inhalation and one exhalation. Then, outside the classroom, obtain permission to count the respirations of an infant, toddler, middle school student, adult, and senior citizen. Graph your results. When you return to class, compare your graph to that of other students. (LO 9.2-2)
2. You can determine lung capacity with a balloon, ruler, pencil, and graph paper.

   Take several deep breaths and then exhale as much air as possible into the balloon. Measure and record the diameter of the balloon, labeling it *vital capacity*. Repeat three times, and then calculate your average vital capacity.

   Exhale normally. Before inhaling again, quickly put the balloon to your lips and exhale into the balloon. Measure the diameter of the balloon as before, and record this measurement as the *expiratory reserve*. Repeat three times and calculate your average expiratory reserve.

   Take a normal breath, and as you exhale normally, put the balloon to your lips. Measure the diameter of the balloon as before, recording the measurement as *tidal volume*. Repeat three more times, then calculate your average tidal volume.

   Make a bar graph that compares your three average lung volume measurements. Compare your results with those of your classmates. (LO 9.2-3)

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Preview: Body systems content includes pathophysiology with clinical case studies.

LESSON 9.3

Respiratory Disorders and Diseases

Before You Read

Try to answer the following questions before you read this lesson.

- How common is the "common cold"?
- What is the leading cause of chronic obstructive pulmonary disease?

Learning Outcomes

9.3-1 Identify common illnesses of the upper respiratory tract.

9.3-2 Differentiate among lower respiratory tract illnesses.

9.3-3 Identify the most common forms of chronic obstructive pulmonary disease and describe strategies for symptom management.

9.3-4 Describe potential causes for asthma attacks and how to avoid asthma triggers.

9.3-5 Explain the effects of obstructive sleep apnea.

9.3-6 Understand the causes, symptoms, and treatments associated with other common respiratory disorders and diseases.

Key Terms

acute bronchitis
asthma
bronchospasms
chronic bronchitis
chronic obstructive pulmonary disease (COPD)
emphysema
hyperventilation
hypoxia
influenza
laryngitis
nasopharyngitis
pharyngitis
pneumonia
sinusitis
tonsillitis
tuberculosis (TB)

CLINICAL CASE STUDY

Demetrius was a straight-A student, and he was determined to keep it that way because had had his sights set on career as a physical therapist. On Wednesday, he felt a little fatigued but otherwise fine, so he was surprised when he woke up Thursday feeling horrible. He had a fever, chills, headache, was coughing a lot and his whole body ached. Despite wanting to attend school to maintain his grades, Demetrius knew he had to stay home. As you read this section, try to determine which of the following conditions Demetrius most likely has.

A. Nasopharyngitis
B. Laryngitis
C. Sinusitis
D. Influenza

It is likely that you have had a "common cold" several times in your life—after all, it is called the *common* cold for a reason! In fact, you have probably had the flu, have a friend with asthma, or know someone whose tonsils have been removed. But do you know how to prevent the cold or flu? Do you know what causes your friend's asthma attacks?

This lesson discusses the causes and symptoms of several respiratory disorders, along with treatment options. You may be surprised to learn that some of these disorders cannot be cured, yet others can be prevented by behavior as simple as washing your hands.

9.3-1 Upper Respiratory Tract Illnesses

Upper respiratory tract illnesses, or URIs, are the most common acute respiratory illnesses. As explained in Lesson 9.1, the upper respiratory tract includes the nose, nasal cavity, sinuses, pharynx, and larynx. Infection and inflammation of the upper respiratory tract can lead to a variety of illnesses, including:

- **nasopharyngitis** (nay-zoh-fair-in-JIGH-tis): the common cold
- **pharyngitis** (fair-in-JIGH-tis): inflammation of the pharynx, or throat
- **sinusitis** (sigh-nyoos-IGH-tis): inflammation of the sinuses
- **laryngitis** (lair-in-JIGH-tis): inflammation of the larynx, or *voice box*
- **tonsillitis** (tahn-si-LIGH-tis): inflammation of the tonsils

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Preview: Easy-to-read tables summarize common pathophysiology and offer a flexible method to quickly introduce disorders and diseases for one-semester courses.

Figure 9.13 lists the causes and symptoms of upper respiratory tract illnesses. The chart also provides recommended treatments for these illnesses.

Avoiding URIs

Most people get between two and four colds (nasopharyngitis) each year. Typical symptoms of a cold come on gradually and include a runny or stuffy nose with a sore throat. Sometimes you may feel little fatigued or have a slight cough, but rarely does a common cold develop into a more serious health problem. Treatment is just rest, drinking plenty of fluids and, if needed, taking over-the-counter medication to relieve nasal congestion or discharge and a sore throat. According to the Cleveland Clinic, there are 12 million medical visits for pharyngitis and 20 billion cases of bacterial sinusitis each year.

Upper Respiratory Tract Illnesses

	Etiology	Prevention	Pathology	Diagnosis	Treatment
Pharyngitis	infection from common cold or flu virus; bacterium such as group A streptococcus (strep throat)	wash hands with soap and hot water often; use alcohol-based hand sanitizer if you cannot wash your hands; cover your mouth and nose with a tissue when sneezing, or sneeze into your sleeve	sore, scratchy throat; fever; headache; swollen lymph nodes	self-diagnosis, physical exam, throat swab to test for strep, if suspected	gargle with saline solution; drink warm fluids; suck on freezer pops or throat lozenges; over-the-counter pain relievers and antibiotics if strep is diagnosed
Sinusitis	caused by bacteria, viruses, or fungi	same as pharyngitis	sinus pain; nasal stuffiness and discharge; headache; fever; sore throat; postnasal drip; fatigue	self-diagnosis; if serious, nasal/sinus cultures, imaging, nasal endoscopy, allergy testing	drink fluids; apply warm, moist cloth to face; use humidifier, nasal saline spray; see a doctor about severe/chronic symptoms
Laryngitis	viral infections such as common cold of flu, bacterial infections, allergies, or inhaled irritants	same as pharyngitis	sore throat; hoarseness; loss of voice; fever, dry cough, swollen glands	self-diagnosis; see physician if it persists more than 2 weeks, or if you cough up blood, have a temperature over 103°F, or have trouble breathing	rest your voice; use a humidifier, decongestants, or pain relievers as necessary
Tonsillitis	viral or bacterial infection; streptococcus A is the most common bacterial infection	same as pharyngitis	red, swollen tonsils; white/yellow patches on tonsils; difficult, painful swallowing; bad breath; swollen neck glands	physical exam; throat swab for strep; rarely, blood test	gargle with saline solution; drink warm fluids such as tea with honey; over-the-counter pain medications (no aspirin for those under 21 years of age); antibiotic, if strep is diagnosed; surgery
Influenza (both upper and lower respiratory infection)	viral infection	proper hand washing, annual flu shot, avoid smoking; strengthen immune system through diet, exercise, and adequate sleep	quick onset of fever, headache, nasal congestion, alternating chills/sweats, dry cough, fatigue, aching muscles	medical exam; rapid influenza diagnostic test	antiviral medication, bed rest, plenty of fluids, over-the-counter pain relievers

Figure 9.13

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Preview: Life Span Development features help students understand how each body system changes over the life span from infancy to older adulthood.

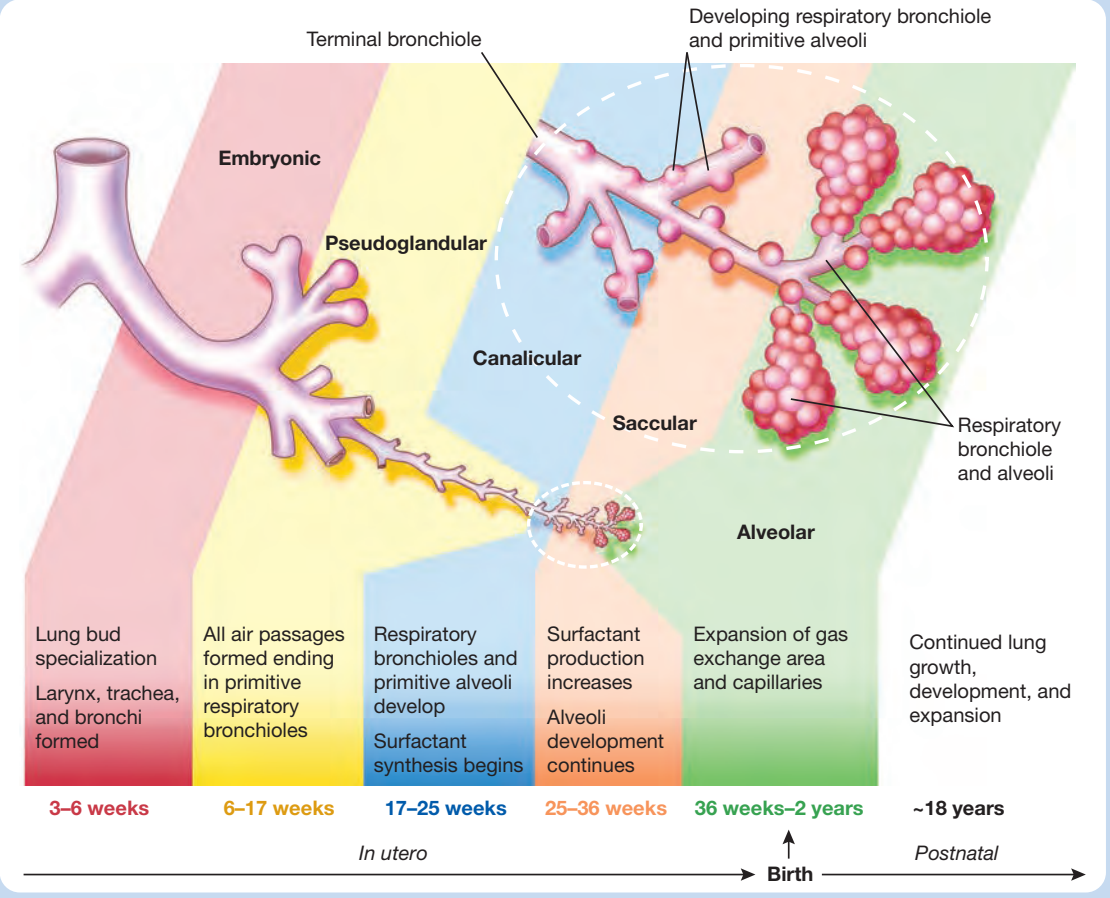
LIFE SPAN DEVELOPMENT: *The Respiratory System*

Before an infant takes its first breath of air, the respiratory system undergoes dramatic and amazing changes within the mother's uterus. While in the uterus, the fetus receives all oxygen and nutrients from the mother's blood, and carbon dioxide and other waste products are removed through the mother's umbilical blood. Fetal lungs develop in five stages (**Figure 9.11**). An explanation of the lung structures that develop in utero is shown in **Figure 9.12**. Following these dramatic changes, alveoli will increase in size and blood supply, and the lungs will continue to develop until the chest wall finishes growing in size at adulthood.

Generally speaking, lung capacity peaks in the mid-twenties, then gradually declines until approximately age 55 to 60 years, when the lung tissue becomes less elastic, the respiratory muscles weaken, and the chest wall becomes stiffer. All of these factors decrease lung capacity and the ability to ventilate the lung. In fact, by the age of 70, lung capacity is reduced by approximately 30 percent. These physical changes, combined decreased ciliary activity, a weakened immune system, and diminished gas exchange, make older individuals more susceptible to respiratory tract illnesses, pneumonia, influenza, and lung diseases.

Life Span Review

1. How are waste products removed from a developing fetus?
2. Why are older people more susceptible to respiratory tract illness than younger people?



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Figure 9.11 The stages of fetal lung development.

(continued)

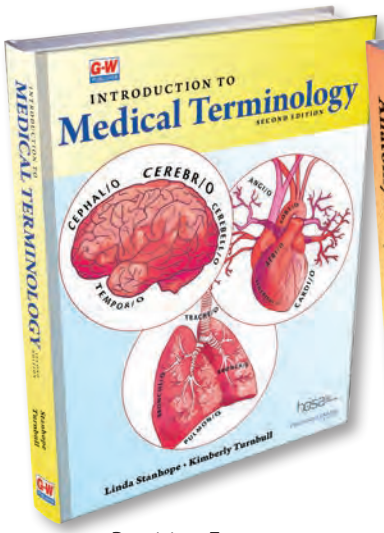
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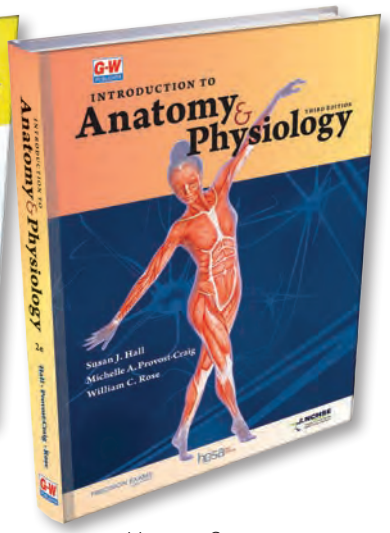
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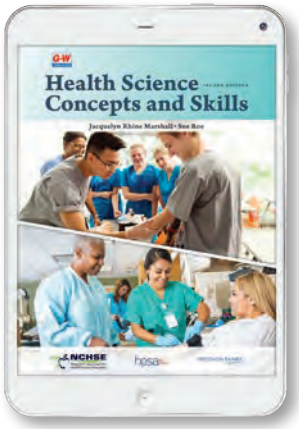
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