

Human Anatomy and Physiology

Human Anatomy and Physiology addresses the structure and function of human body systems from the cellular level to the organism level in an approach that complements the natural curiosity of high school students. The standards are designed to help students apply their conceptual understanding of the human body to make well-informed, evidence-based decisions by obtaining and critically evaluating new and changing information from the scientific research community.

Human Anatomy and Physiology incorporates safe laboratory investigations allowing students actively to explore the structure and functions of the human body. Students are encouraged to apply evidence-based reasoning to investigate how organs and systems interact to maintain homeostasis. Hands-on experiences in the lab spark curiosity and build interest in learning how the human body works. Laboratory experiences are especially valuable for students interested in health-related science, technology, engineering, and mathematics (STEM) careers.

Embedded in the content standards are the disciplinary core ideas of the Engineering, Technology, and Applications of Science (ETS) domain, which require students to use design strategies in conjunction with knowledge and understanding of science and technology to solve practical problems. Engineering standards are denoted with a gear icon ⚙️. Through participation in the engineering design process, students will use tools and materials to model a body system.

Although disorders of the human body are not included in the standards, the exploration of disorders can be an extension of learning anatomy and physiology.

Students should use correct scientific and anatomical terminology including directional terms, regions, planes, and cavities when organs and systems are discussed.

Each content standard completes the stem “*Students will...*”

From Molecules to Organisms: Structures and Processes		
Tissues	1. Obtain, evaluate, and communicate information to explain how differences in cellular structure (mitochondria, cytoskeletal structure, endoplasmic reticulum, cell membrane) lead to differences in the function and organization of the four tissue types (epithelial, connective, muscular, and nervous).	Structure and Function

Integumentary System	<p>2. Obtain, evaluate, and communicate information to describe how the structures of the integumentary system and its accessory organs contribute to its function. <i>Examples: how the layers of the skin contribute to homeostasis, the role of glands in thermoregulation and in hydration of skin and mucous membranes, the protective functions of hair and nails</i></p>	
	<p>a. Construct an explanation of the relationships between the integumentary system and other organ systems, including the body's mechanisms for maintaining homeostasis. <i>Examples: Explain how changes in vessel diameter and evaporation of water over the skin contribute to thermoregulation (cardiovascular). Explain how sweat is used to excrete nitrogenous waste from the blood (cardiovascular). Explain how the skin and mucous membranes create a barrier against infection (immune system).</i></p>	Stability and Change
Skeletal System	<p>3. Develop and use a model to illustrate how the structures of the skeletal system contribute to its function. <i>Examples: Create a diagram or 3D model to illustrate bone shape, joint types, and bones in the appendicular and axial skeletons. Use models to illustrate the role of the skeletal system in movements around joints, support of a body structure, and protection of soft tissues.</i></p> <p>a. Obtain, evaluate, and communicate information describing the growth and development of the skeletal system.</p>	Structure and Function
	<p>b. Construct an explanation of the relationships between the skeletal system and other organ systems, including the body's mechanisms for maintaining homeostasis. <i>Examples: Explain the role of spongy bone in hematopoiesis (cardiovascular system) and leukopoiesis (immune system). Explain how the storage of minerals in bone contributes to homeostasis.</i></p>	Stability and Change

Muscular System	<p>4. ⚙️ Develop and build a three-dimensional model to illustrate the structures of the muscular system, including muscle locations, origins, and insertions, and explain their roles in movement and support. <i>Example: Design and build a model of a lever to illustrate the relationship between bones and muscles and explain their roles in body movement and support.</i></p>	Structure and Function
	<p>a. Model the cellular physiology of skeletal muscle, including how the cell functions in muscle contraction and relaxation. <i>Example: Use straws and paper to create a model of a sarcomere to illustrate how the fibers move during contraction and relaxation.</i></p>	Systems and System Models
	<p>b. Obtain, evaluate, and communicate information to explain muscle fatigue and tone in terms of muscle cell physiology.</p>	Structure and Function
Nervous System	<p>5. Obtain, evaluate, and communicate information explaining the relationship between the structures and functions of the central nervous system and the peripheral nervous system.</p>	
	<p>a. Use a model to illustrate the role of action potentials in neural transmission. Clarification: Discussions of sodium-potassium pumps and ion channels are not required.</p>	Systems and System Models
	<p>b. Construct an explanation of the role of reflex arcs, the central nervous system, and special senses in the response to stimuli to maintain homeostasis and guide behavior. <i>Example: smelling a strong odor initiating a sneeze response using a reflex arc; pupil diameter changing in relation to the amount of light entering the eye</i> Clarification: Discussion of the anatomy and physiology of the sensory organs is not required.</p>	Stability and Change

	<p>c. Construct an explanation of the role of neurotransmitters in the functions and behavior of the nervous system. Clarification: Discussion of classes of neurotransmitters is not required.</p>	Structure and Function
	<p>d. Obtain, evaluate, and summarize scientific findings regarding the biological origin of emotions and memories in distinct regions of the brain. <i>Examples: the role of the frontal lobe in emotional regulation, the regulation of fear response by the amygdala</i></p>	
Endocrine System	<p>6. Construct an explanation of how the interdependence of the nervous and endocrine systems maintains homeostasis.</p> <p>a. Obtain, evaluate, and communicate information explaining how hormones secreted by endocrine glands help the body maintain homeostasis through negative and positive feedback loops. <i>Examples: the role of insulin and glucagon in maintaining glucose levels, the role of parathyroid hormone and calcitonin in maintaining calcium levels</i></p> <p>b. Obtain, evaluate, and communicate information describing the role of endocrine axes involving the thyroid and gonads in controlling growth, development, metabolism, and reproduction.</p>	Stability and Change
Immune System	<p>7. Obtain, evaluate, and communicate information describing the structure of lymph nodes and primary cells of the immune system (neutrophils, lymphocytes, monocytes, macrophages, eosinophils, and basophils) and explaining their role in inflammation and the body's defense.</p>	Structure and Function
	<p>a. Obtain, evaluate, and communicate information explaining how vaccines work to stimulate immunity in the human body.</p>	Cause and Effect
	<p>b. Construct an explanation of how the lymphatic system interacts with the immune and circulatory systems.</p>	Systems and System Models

Cardiovascular System	8. Obtain, evaluate, and communicate information explaining how the structures of the cardiovascular system are related to its functions.	Structure and Function
	a. Create a model to show how a pressure gradient moves blood through the circulatory system. <i>Example: Apply pressure to water in a closed system to generate circulation.</i>	Systems and System Models
	b. Carry out an investigation exploring the link between blood pressure and heart rate and include the role of baroreceptors and chemoreceptors in the explanation of results.	Cause and Effect
	c. Construct an explanation of the cardiovascular system's relationships with other organ systems, including the body's mechanisms for maintaining homeostasis. <i>Examples: Explain how the nervous system exerts control over cardiovascular function. Explain the role of respiratory gases in cardiovascular function. Explain the filtration of blood to form urine.</i>	Stability and Change
Respiratory System	9. Obtain, evaluate, and communicate information to explain the relationship between the structures and functions of the respiratory system.	Structure and Function
	a. Construct an explanation of how the circulatory system works with respiration to transport respiratory gases. b. Use a model to illustrate how pressure gradients move air into and out of the lungs. <i>Example: Use balloons in a closed system to illustrate the role of negative and positive pressures in airflow in the lungs.</i>	Systems and System Models
	c. Construct an explanation of the respiratory system's relationships with other organ systems, including the body's mechanisms for maintaining homeostasis. <i>Examples: Explain how the musculo-skeletal system works to move air. Explain that the waste product of cellular digestion (CO₂) is removed by the lungs and controls respiratory rate. Explain the role of the cardiovascular system in the movement of respiratory gases.</i>	Stability and Change

Digestive System	10. Obtain, evaluate, and communicate information explaining the relationship between the structures and functions of the digestive system, including absorption and chemical and mechanical digestion. a. Construct an explanation of the roles of accessory organs (salivary glands, pancreas, and liver) in digestion.	Structure and Function
	b. Construct an explanation of the relationships between the digestive system and other organ systems, including the body's mechanisms for maintaining homeostasis. <i>Examples: Explain how the products of chemical digestion are used in other systems. Explain how waste products from the digestive system are removed by the respiratory and excretory systems. Explain the importance of the immune system in maintaining digestive system health.</i>	Stability and Change
Excretory System	11. Use a model to illustrate the microanatomy of excretory structures and describe their functions. Clarification: Discussion of microanatomy of the nephron and the steps of urine formation not required.	Systems and System Models
	a. Construct an explanation of how the excretory system maintains homeostasis, including blood pressure and pH. <i>Example: Explain that urine formation decreases blood volume and can decrease blood pressure.</i>	Stability and Change
Reproductive System	12. Use models to compare and contrast the internal and external structures of the female and male reproductive systems and their production of gametes. Clarification: Meiosis, fertilization, and embryonic development do not need to be included in this discussion.	Systems and System Models
	a. Construct an explanation of how the endocrine system influences the growth, development, and functions of the reproductive systems in males and females, including the mechanisms of hormonal birth control.	Cause and Effect