HUMAN ANATOMY AND PHYSIOLOGY: COURSE OVERVIEW

The academic standards for high school Human Anatomy and Physiology are built on the foundation provided by Biology I (a prerequisite course) and are research-based, supported by the National Research Council's *Framework for K-12 Science Education*. Human Anatomy and Physiology provides students with the opportunity to focus on a particular aspect of life science in more detail while continuing to provide knowledge that is rooted in the same crosscutting concepts and practices utilized throughout all of the sciences. The academic standards for Human Anatomy and Physiology are focused on an in depth analysis of the human organ systems and how they function to support life.

The major disciplinary core ideas utilized for Human Anatomy and Physiology include:

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Human body organization to accomplish life
Integumentary system
Skeletal system
Muscular system
Cardiovascular system
Immune and lymphatic systems
Digestive system
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Artificial organ design considerations</td></tr>
<tr><td>Ecosystems: Interactions, Energy, and Dynamics</td><td>Links Among Engineering, Technology, Science, and Society
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Although science is a body of knowledge consisting of theories that explain data, science is also a set of practices that use analysis and argumentation to establish, extend, and refine knowledge. The science and engineering practices are used as a means to learn science by doing science. These practices are not intended to be a sequence of steps nor are they intended to be taught as a separate, introductory unit for the course. By combining content knowledge with skill, students discover how scientific knowledge is acquired and applied to solve problems or advance scientific knowledge further. In addition, there are seven crosscutting concepts that are fundamental to the nature of science and thus stretch across all science disciplines. The Human Anatomy and Physiology standards have been constructed by explicitly

integrating practices and crosscutting concepts, iteratively and in combination, within each core idea to provide students with a well-rounded education in science.

Special attention has been given to mathematics and literacy through the use of the science and engineering practices described above. Students are required to use mathematics in the collection, presentation, and analysis of data, and computational thinking is employed for complex data sets and simulation models. Students are also required to obtain information from reliable sources, evaluate information, and construct evidence-based arguments. The importance of STEM integration has been stressed by including a set of stand-alone disciplinary core ideas under Engineering, Technology, and Applications of Science, as well as being integrated throughout other major disciplinary core ideas.

Tennessee's state mathematics standards are integrated throughout the Human Anatomy and Physiology standards that incorporate data measurements and/or analysis. Literacy standards are integrated throughout as well when informational texts are used to gather information on anatomical structures and functions and/or when oral or written explanations are provided for how structures support physiological mechanisms. STEM applications are incorporated throughout the life science core ideas, in addition to the ETS core ideas, when data collected with technology and/or technology applications are used to support and explain observations.

The skills and content knowledge emphasized in the following Human Anatomy and Physiology standards are intended to provide a deep appreciation for normal and abnormal human structures and functions that support life. In addition, they should provide opportunities to practice science, promoting the development of critical consumers of scientific information.

HUMAN ANATOMY AND PHYSIOLOGY: ACADEMIC STANDARDS

HAP.LS1: From Molecules to Organisms: Structures and Processes

Core Idea: The human body is organized to accomplish life processes.

1) Investigate the organization of the human body in relation to its ability to accomplish life functions and construct an explanation for the relationship between anatomy and physiology.

2) Differentiate the major organ systems of the human body by their anatomy and physiology and engage in argument about defined boundaries due to their functional connectivity.

3) Describe the organizational levels of the human body and observe patterns in cell types and tissue types across organ systems.

4) Use a human model to differentiate the major body cavities and organs located within them. Describe the model using proper anatomical and directional terminology for body regions, planes, and cavities.

5) Explain homeostasis and describe how it is accomplished through feedback mechanisms that utilize receptors and effectors.

Core Idea: The Integumentary system provides protection, temperature homeostasis, and sensation

6) Describe the anatomical structures of the integumentary system and explain their role in the physiological processes of protection, temperature homeostasis, and sensation.

7) Diagram a cross-sectional image of skin layers identifying the microscopic components and describe the life cycle of cells that maintain these layers.

Core Idea: The Skeletal system provides support, protection, movement, storage, and hematopoiesis.

8) Identify major bones within the axial and appendicular divisions, describing their physiological roles in creating a body scaffold, internal organ protection, and anchor points for skeletal muscles participating in movement.

9) Diagram microscopic bone structures, identifying regions that participate in hematopoiesis and storage of minerals and fat.

10) Explain the processes of bone formation, growth, and repair.

Core Idea: Muscular systems provide movement and temperature homeostasis.

11) Differentiate visceral, cardiac, and skeletal muscle tissues based on anatomical criteria and their physiological role in the movement of body parts and/or substances.

12) Model the gross and microscopic anatomy of skeletal muscle and a muscle fiber and use the model to identify and explain the roles of subcellular structures that participate in the events of muscle fiber contraction and heat generation.

13) Model the anatomical connections between the skeletal system and muscular system and explain how they generate movement through antagonistic muscle groups.

Core Idea: The Cardiovascular system provides transport of materials for homeostatic control and protection throughout the body.

14) Describe, in terms of structure and function, the systemic and pulmonary paths of the cardiovascular system.

15) Prepare and/or use a model of a human heart to explain systole and diastole and the heart's internal and external control mechanisms involved in producing the heartbeat.

16) Explain blood pressure in terms of systole and diastole. Describe the factors affecting blood pressure and blood pressure's role in homeostasis.

17) Examine the structure (molecular and cellular) of blood constituents and describe their function.

18) Explain how the anatomy of the respiratory system functions to provide oxygen and carbon dioxide transport mechanisms between the lungs and the circulatory system, considering capillary structures, red blood cell structures, diffusion, and affinity.

19) Explain the relationship between the integumentary, muscular, and circulatory systems in temperature homeostasis.

Core Idea: The Immune and Lymphatic systems provide protection and lipid transport.

20) Describe the relationship between the structure and function of the lymphatic system.

21) Differentiate between innate and adaptive immunity, identifying immune cells that play a role in each.

22) Analyze ABO and Rh blood groups as a basis for blood transfusion and infant incompatibility reactions.

23) Diagram the progression of lipid transport from the digestive system, through the lymphatic system, and into the cardiovascular circulation.

Core Idea: The Digestive system provides for absorption of raw materials that build and fuel the body's cells.

24) Model the sequential organization of the alimentary canal and its accessory organs in order to describe the physiological role of each.

25) Analyze gastrointestinal wall histology and explain the anatomical architecture that supports efficient absorption and transport of molecules into cardiovascular or lymphatic circulation.

26) Investigate the actions of major digestive enzymes and hormones and identify their sources.

27) Describe the role of the hepatic portal system in coupling the digestive and cardiovascular systems.

Core Idea: The Urinary system provides for waste excretion, osmotic homeostasis, electrolyte homeostasis, and pH homeostasis.

28) Model the sequential organization of the male and female urinary tracts in order to describe the physiological role of blood filtration and waste excretion from the body.

29) Identify the parts of a nephron and describe how they assist in homeostatic mechanisms through urine formation.

Core Idea: The Endocrine system, through hormones, regulates the functions of organs to support life processes.

30) Using a model, name and locate the major endocrine glands and identify additional organ tissues in the human body that produce hormones. Describe the hormones produced and their physiological effects on other body targets.

31) Describe the relationship between receptors and ligands and differentiate between steroid and nonsteroid hormones as ligands.

32) Explain, using examples, the mechanism of negative feedback in hormonal production and control.

Core Idea: The Nervous system, in response to stimuli, coordinates functions of other body systems to support life processes.

33) Anatomically distinguish between the central nervous system and the peripheral nervous system. Explain how their structures and locations are related to their physiological roles.

34) Model the cellular and subcellular structures of neurons and explain the molecular neurophysiology of membrane potentials and the conduction of information through synaptic transmission.

35) Identify and describe the types of sensory receptors found in the human body.

36) Compare and contrast the structures and functions of the somatic nervous system and the autonomic nervous system.

37) Model the major parts of the brain and spinal cord, relating each part to its source of sensory information and/or its primary target of regulation.

38) Explain the structures, functions, and limitations of the human sensory systems (senses): hearing, balance/proprioception, sight, touch, smell, and taste.

Core Idea: The Reproductive systems ensure the continuity of species through gametogenesis, fertilization, and embryogenesis.

39) Identify and describe the organs of the human male and female reproductive systems that provide the physiological functions of gametogenesis, fertilization, and embryogenesis.

40) Examine the microscopic structures of the human egg and sperm and explain how their structures relate to their functions.

41) Based on the secretion of hormones, identify the endocrine tissues of the reproductive system and describe their roles in regulation of secondary sex characteristics, the female menstrual cycle, pregnancy, fetal development, and parturition.

42) Trace the major events of human development from fertilization to birth, with a focus on the development of organs and functional organ systems.

HAP.ETS2: Links Among Engineering, Technology, Science, and Society

1) Research system disorders to communicate information on the known facts about the disorders and identify technology that has been developed to diagnose and/or treat the disorders.