Shelby County Schools Science Vision

Shelby County Schools' vision of science education is to ensure that from early childhood to the end of the 12th grade, all students have heightened curiosity and an increased wonder of science; possess sufficient knowledge of science and engineering to engage in discussions; are able to learn and apply scientific and technological information in their everyday lives; and have the skills such as critical thinking, problem solving, and communication to enter careers of their choice, while having access to connections to science, engineering, and technology.

To achieve this, Shelby County Schools has employed The Tennessee Academic Standards for Science to craft meaningful curricula that is innovative and provide a myriad of learning opportunities that extend beyond mastery of basic scientific principles.

Introduction

In 2014, the Shelby County Schools Board of Education adopted a set of ambitious, yet attainable goals for school and student performance. The District is committed to these goals, as further described in our strategic plan, Destination 2025. In order to achieve these ambitious goals, we must collectively work to provide our students with high quality standards aligned instruction. The Tennessee Academic Standards for Science provide a common set of expectations for what students will know and be able to do at the end of each grade, can be located in the Tennessee Science Standards Reference. Tennessee Academic Standards for Science are rooted in the knowledge and skills that students need to succeed in post-secondary study or careers. While the academic standards establish desired learning outcomes, the curricula provides instructional planning designed to help students reach these outcomes. The curriculum maps contain components to ensure that instruction focuses students toward college and career readiness. Educators will use this guide and the standards as a roadmap for curriculum and instruction. The sequence of learning is strategically positioned so that necessary foundational skills are spiraled in order to facilitate student mastery of the standards.

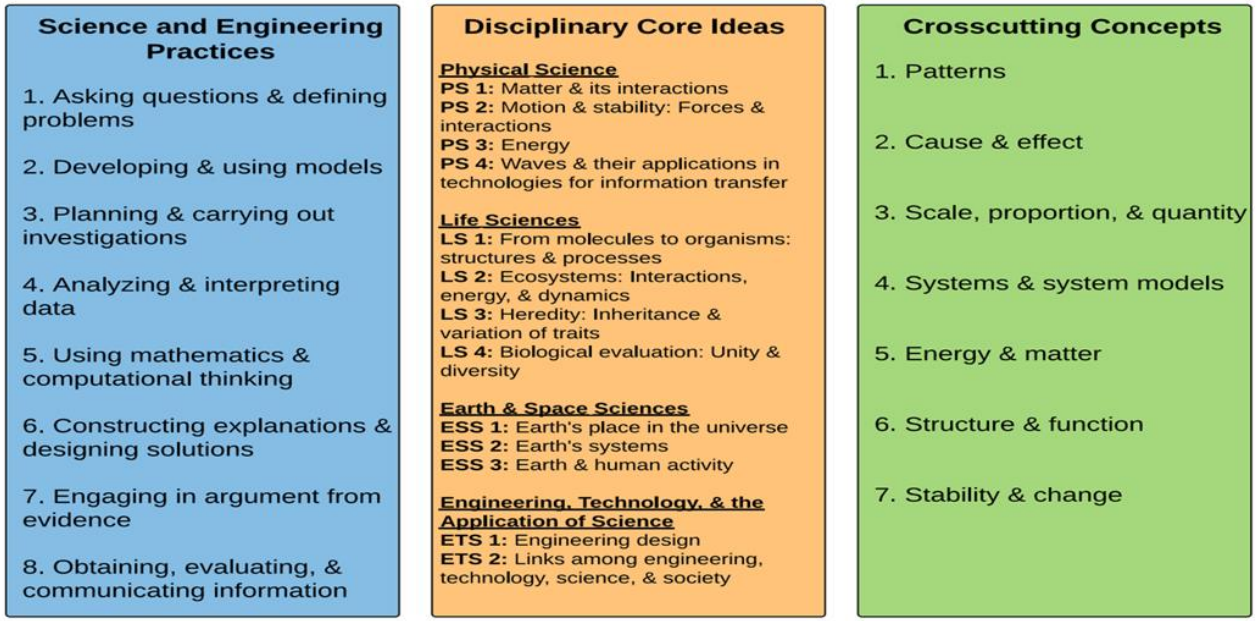
Our collective goal is to ensure our students graduate ready for college and career. Being College and Career Ready entails, many aspects of teaching and learning. We want our students to apply their scientific learning in the classroom and beyond. These valuable experiences include students being facilitators of their own learning through problem solving and thinking critically. The Science and Engineering Practices are valuable tools used by students to engage in understanding how scientific knowledge develops. These practices rest on important "processes and proficiencies" with longstanding importance in science education. The science maps contain components to ensure that instruction focuses students toward understanding how science and engineering can contribute to meeting many of the major challenges that confront society today. The maps are centered around five basic components: the Tennessee Academic Standards for Science, Science and Engineering Practices, Disciplinary Core Ideas, Crosscutting Concepts, and Phenomena.

The Tennessee Academic Standards for Science were developed using the National Research Council's 2012 publication, A Framework for K-12 Science Education as their foundation. The framework presents a new model for science instruction that is a stark contrast to what has come to be the norm in science classrooms. Thinking about science had become memorizing concepts and solving mathematical formulae. Practicing science had become prescribed lab situations with predetermined outcomes. The framework proposes a three-dimensional approach to science education that capitalizes on a child's natural curiosity. The Science Framework for K-12 Science Education provides the blueprint for developing the effective science practices. The *Framework* expresses a vision in science education that requires students to operate at the nexus of three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The *Framework* identified a small number of disciplinary core ideas that all students should learn with increasing depth and sophistication, from Kindergarten through grade twelve. Key to the vision expressed in the *Framework* is for students to learn these disciplinary core ideas in the context of science and engineering practices. The importance of combining Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas is stated in the *Framework* as follows:

Standards and performance expectations that are aligned to the framework must take into account that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content. (NRC Framework, 2012, p. 218)

To develop the skills and dispositions to use scientific and engineering practices needed to further their learning and to solve problems, students need to experience instruction in which they use multiple practices in developing a particular core idea and apply each practice in the context of multiple core ideas. We use the term "practices" instead of a term such as "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Students in grades K-12 should engage in all eight practices over each grade band**.** Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. There are seven crosscutting concepts that bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas and develop a coherent and scientifically based view of the world.

The map is meant to support effective planning and instruction to rigorous standards. It is *not* meant to replace teacher planning, prescribe pacing or instructional practice. In fact, our goal is not to merely "cover the curriculum," but rather to "uncover" it by developing students' deep understanding of the content and mastery of the standards. Teachers who are knowledgeable about and intentionally align the learning target (standards and objectives), topic, text(s), task, and needs (and assessment) of the learners are best-positioned to make decisions about how to support student learning toward such mastery. Teachers are therefore expected--with the support of their colleagues, coaches, leaders, and other support providers--to exercise their professional judgment aligned to our shared vision of effective instruction, the Teacher Effectiveness Measure (TEM) and related best practices. However, while the framework allows for flexibility and encourages each teacher/teacher team to make it their own, our expectations for student learning are non-negotiable. We must ensure all of our children have access to rigor—high-quality teaching and learning to grade level specific standards, including purposeful support of literacy and language learning across the content areas.



Learning Progression

At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain phenomena. Students can keep notebooks to record sequential observations and identify simple patterns. They are able to design and conduct investigations, analyze results, and communicate the results to others. Students will carry their curiosity, interest and enjoyment of the scientific world view, scientific inquiry, and the scientific enterprise into middle school.

At the end of the middle school science experience, students can discover relationships by making observations and by the systematic gathering of data. They can identify relevant evidence and valid arguments. Their focus has shifted from the general to the specific and from the simple to the complex. They use scientific information to make wise decision related to conservation of the natural world. They recognize that there are both negative and positive implications to new technologies.

As an SCS graduate, former students should be literate in science, understand key science ideas, aware that science and technology are interdependent human enterprises with strengths and limitations, familiar with the natural world and recognizes both its diversity and unity, and able to apply scientific knowledge and ways of thinking for individual and social purposes.

Structure of the Standards

- Grade Level/Course Overview: An overview that describes that specific content and themes for each grade level or high school course.
- Disciplinary Core Idea: Scientific and foundational ideas that permeate all grades and connect common themes that bridge scientific disciplines.
- Standard: Statements of what students can do to demonstrate knowledge of the conceptual understanding. Each performance indicator includes a specific science and engineering practice paired with the content knowledge and skills that students should demonstrate to meet the grade level or high school course standards.

Purpose of Science Curriculum Maps

This map is a guide to help teachers and their support providers (e.g., coaches, leaders) on their path to effective, college and career ready (CCR) aligned instruction and our pursuit of Destination 2025. It is a resource for organizing instruction around the Tennessee Academic Standards for Science, which define what to teach and what students need to learn at each grade level. The map is designed to reinforce the grade/course-specific standards and content (scope) and provides *suggested* sequencing, pacing, time frames, and aligned resources. Our hope is that by curating and organizing a variety of standards-aligned resources, teachers will be able to spend less time wondering what to teach and searching for quality materials (though they may both select from and/or supplement those included here) and have more time to plan, teach, assess, and reflect with colleagues to continuously improve practice and best meet the needs of their students.

The map is meant to support effective planning and instruction to rigorous standards. It is *not* meant to replace teacher planning, prescribe pacing or instructional practice. In fact, our goal is not to merely "cover the curriculum," but rather to "uncover" it by developing students' deep understanding of the content and mastery of the standards. Teachers who are knowledgeable about and intentionally align the learning target (standards and objectives), topic, text(s), task, and needs (and assessment) of the learners are best-positioned to make decisions about how to support student learning toward such mastery. Teachers are therefore expected--with the support of their colleagues, coaches, leaders, and other support providers--to exercise their professional judgment aligned to our shared vision of effective instruction, the Teacher Effectiveness Measure (TEM) and related best practices. However, while the framework allows for flexibility and encourages each teacher/teacher team to make it their own, our expectations for student learning are non-negotiable. We must ensure all of our children have access to rigor—high-quality teaching and learning to grade level specific standards, including purposeful support of literacy and language learning across the content areas.

SCS Human Anatomy & Physiology Curriculum Map

Unit 1 **Anatomical Orientation**	Unit 2 Protection, Support, and Movement	Unit 3 Nervous System	Unit 4 Endocrine System	Unit 5 Transport of Nutrients and Gases	Unit 6 Lymphatic System
3 Weeks	6 Weeks	6 Weeks	3 Weeks	7 Weeks	2 Weeks

UNIT 1: Anatomical Orientation [3 Weeks]

The Overarching Question(s) (*for the unit*)

- **How are structure and function related?**
- **What patterns of organization exist in the human body?**
- **Why are systems made up of small interdependent structures working together?**
- **How do organisms maintain a biological balance between their internal and external environments?**

DCI, Standards, Explanations, Misconceptions Length [7 days]	Learning Outcomes/Phenomena (Anchor, Driving)	imensional Instructional Approach (SEP's & CCC's)
DCI LS1: From Molecules to Organisms: Structures and Processes **Standard(s)** HAP.LS1.3 **Describe the organizational levels of the human body** and observe patterns in cell types and tissue types across organ systems. **focusing exclusively on the levels of organization portion of this standard.* HAP.LS1.4 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.	**Essential Questions** • What is the relationship between anatomical structure and physiological function? • How does organization contribute to the proper function of the human body? • How do location and direction contribute to anatomical functions? • Where and when are negative versus positive feedback loops necessary for maintaining homeostasis? **Learning Outcomes** • Model the levels of structural organization in a living organism. • Identify the body cavities and the main organs systems contained in each. • Use directional terms to describe anatomical structures.	**SEPSs** **Developing and using models** *Students can develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.* **Constructing Explanations** *Students can construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review).* **CCC's** **Structure and Function** *Students apply patterns in structure and function to unfamiliar phenomena.*

HAP.LS1.5 Explain homeostasis and describe how it is accomplished through feedback mechanisms that utilize receptors and effectors.

Explanation

Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. The body is organized into various parts with an increasing level of complexity. The body is divided up into distinct body cavities. The arrangement of organs in these cavities is significant in their function.

Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Outside that range (e.g., at a too high or too low external temperature, with too little food or water available), the organism cannot survive. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

Misconceptions

- Human organ systems are interrelated. Organ systems are essential for homeostatic maintenance. Organ systems' anatomies directly relate to physiology.
- The disruption of homeostatic mechanisms may lead to disease, and if severe enough, death.
- Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver

- Justify the claim that the importance of an organ system can be determined by the degree of protection the body cavity gives.
- Analyze situations and apply the proper anatomical terminology and orientation of parts and regions and apply them to real-life scenarios.
- Describe and illustrate evidence to demonstrate the role of both a positive and negative feedback mechanisms in maintaining homeostasis.
- Synthesize information from scientific sources to treat broken feedback systems.

Phenomenon

Diabetes: Type 1 and Type 2

An important example of negative feedback is the control of blood sugar. After a meal, the small intestine absorbs glucose from digested food. Blood glucose levels rise, insulin is produced by beta cells in the pancreas. Insulin triggers live, muscle, and fat tissue to absorb glucose, where it is stored. As glucose is absorbed, blood glucose levels fall. Once glucose levels drop below a threshold, there is no longer a sufficient stimulus for insulin release, and the beta cells stop releasing insulin.

Labor Contractions

A good example of positive feedback involves the amplification of labor contractions. The contractions are initiated as the baby moves into position, stretching the cervix beyond its normal position. After birth, the stretching stops and loop is interrupted.

Stability and Change

Students understand how feedback (negative or positive) can stabilize or destabilize a system.

the proper amount of blood within the circulatory system. **[Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]**		

Vocabulary

anatomy, physiology, directional terms, positional terms, movement terms, general locational terms, abdominopelvic regions and quadrants, body cavities

Curricular Materials

Textbook:
Applied Anatomy & Physiology 2nd Ed.: *A Case Study Approach; Brian R, Shmaefsky*
Ch. 1 Overview of The Body; pgs. 4 – 20

Applied Anatomy & Physiology 2nd Ed.: A Case Study Approach; Brian R, Shmaefsky
Ch. 3 Organization of The Body; Section on The Hum Physiological Environment; pgs. 70 – 84

EMC AA&P Workbook & Laboratory Manual:

- Ch. 1 Overview of the Body Workbook pgs. 1-7
- Laboratory Activity 1, pgs.8-9: Drawing the Abdominopelvic Regions and Quadrants
- Laboratory Activity 2, pgs. 11-14: Drawing the Body Cavities

Online Resources:
Homeostasis Video: https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-body-structure-and-homeostasis/v/homeostasis

Body System Poster Activity
http://www.haspi.org/uploads/6/5/2/9/65290513/01d_body_system_poster.pdf

Feedback Loops: Insulin and Glucagon

Body Systems Concept Map

WebAnatomy: Body Cavities 1
http://msjensen.cbs.umn.edu/webanatomy/intro_topics/intro_body_cavities_1_s.htm

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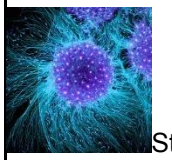
Unit 1 Anatomical Orientation	Unit 2 Protection, Support, and Movement	Unit 3 Nervous System	Unit 4 Endocrine System	Unit 5 Transport of Nutrients and Gases	Unit 6 Lymphatic System
3 Weeks	6 Weeks	6 Weeks	3 Weeks	7 Weeks	2 Weeks

UNIT 1: Anatomical Orientation [3 Weeks]

The Overarching Question(s)

- **How are structure and function related?**
- **What patterns of organization exist in the human body?**
- **Why are systems made up of small interdependent structures working together?**
- **How do organisms maintain a biological balance between their internal and external environments?**

DCI, Standards, Explanations, Misconceptions Length [8 days]	**Learning Outcomes/Phenomena (Anchor, Driving)**	**3-Dimensional Instructional Approach (SEP's & CCC's)**
DCI LS1: From Molecules to Organisms: Structures and Processes **Standard** HAP.LS1.3 Describe the organizational levels of the human body and **observe patterns in cell types and tissue types across organ systems.** **focusing on cell types and tissue types, in order to complete this standard.* ***In conjunction with*** HAP.LS1.11 Differentiate visceral, cardiac, and skeletal muscle tissues based on anatomical criteria and their physiological role in the movement of body parts and/or substances **Explanation** Systems of specialized cells within organisms help them perform the essential functions of life, which involve	**Essential Questions** • **Why is it important that groups of cells work together?** • **How does the specificity of a tissue affect the overall organ function in the human body?** **Learning Outcomes** • **Describe the function of each distinct tissue type.** • **Use a dissection model to identify the major tissue types.** • **Assess how tissues relate to their function using evidence.** • **Relate cellular metabolism and transport to homeostasis and cellular reproduction.**	**SEPs** **Developing and using models** *Students can develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.* **Constructing Explanations** *Students construct and revise an explanation based on valid and reliable evidence obtained from variety of sources.* **Engaging in Argument from Evidence** *Students critically evaluate evidence supporting and argument and create written or oral arguments which invoke*

chemical reactions that take place between different types of molecules, such as water, proteins, carbohydrates, lipids, and nucleic acids. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. The body is made up of for major, distinct tissue types that have specific functions: epithelial, connective, nervous, muscle. **Misconceptions** • Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments. • Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.	• **Connect the function of tissues to their use in a body system and analyze why that type of tissues is needed** **Phenomenon**  Stem Cells have the remarkable potential to develop into many different cell types and they have the remarkable potential to develop into many different cell types in the body during early life and growth. In addition, in many tissues they serve as a sort of internal repair system, dividing essentially without limit to replenish other cells as long as the person or animal is still alive. When a stem cell divides, each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell. body during early life and growth. In addition, in many tissues they serve as a sort of internal repair system, dividing essentially without limit to replenish other cells as long as the person or animal is still alive. When a stem cell divides, each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell.	*empirical evidence, scientific reasoning, and scientific explanations.* **CCC's** **Structure and Function** *Students apply patterns in structure and function to unfamiliar phenomena.* **Systems and System Models** *Students can use models to simulate systems and their interactions.*
Vocabulary		
connective tissue, contractile tissue, ectoderm, endoderm, epithelial tissue, mesoderm, muscle tissue, nervous tissue, stem cells		
Curricular Materials		

Textbook:
Applied Anatomy & Physiology 2nd Ed.: A Case Study Approach; Brian R, Shmaefsky
Ch. 3 Organization of The Body, Section on Tissues; pgs. 100-106

EMC AA&P Workbook & Laboratory Manual:

- Ch. 3 Organization of the Body, pgs. 29-31
- Laboratory Activity 1: Identifying Cell Structure and Function
- Laboratory Activity 2: Effects of Aspirin on Cell Function

Online Resources:
Stem Cell Case Study - Ethics Behind the Use and Study of Stem Cells
http://www.explorecuriocity.org/Portals/2/Symposia/Hamilton%20Site%20Pics/EthicsVignettes.pdf

Create Your Own Concept Map on Body Tissues
https://www.biologycorner.com/anatomy/tissues/tissue_concept.html

Connective Tissue Coloring

Types of Tissues Chart

Histology Virtual Lab – Answer Sheet for Lab: https://www.biologycorner.com/anatomy/tissues/histology_weblab.html

SCS Human Anatomy & Physiology Curriculum Map

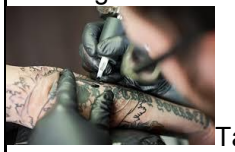
Unit 1 Anatomical Orientation	Unit 2 Protection, Support, and Movement	Unit 3 Nervous System	Unit 4 Endocrine System	Unit 5 Transport System	Unit 6 Lymphatic System
3 Weeks	6 Weeks	6 Weeks	3 Weeks	7 Weeks	2 Weeks

UNIT 2: Protection, Support, and Movement [6 Weeks]

The Overarching Question(s)

- **What structures are used to support and protect the body?**
- **What structures are used to allow movement in the body?**

DCI, Standards, Explanations, Misconceptions Length [10 days]	**Learning Outcomes/Phenomena (Anchor, Driving)**	**imensional Instructional Approach (SEP's & CCC's)**
DCI LS1. From Molecules to Organisms: Structures and Processes HAP.ETS2: Links Among Engineering, Technology, Science, and Society **Standard** HAP.LS1.7 **Diagram a cross-sectional image of skin layers identifying the microscopic components** and describe the life cycle of cells that maintain these layers. **focusing exclusively on the anatomy of the skin*. HAP.LS1.6 Describe the anatomical structures of the integumentary system and explain their role in the physiological processes of protection, temperature homeostasis, and sensation. HAP.LS1.7 Diagram a cross-sectional image of the skin layers identifying the microscopic components and **describe**	**Essential Questions** • How does the structure of the integumentary system and its functional role contribute to protecting the body and maintaining homeostasis? **Learning Outcomes** • Label the structures of the integumentary system. • Define the functions of the integumentary systems. • Compare the structure of the integumentary system to its functional role in protecting the body and maintaining homeostasis. • Connect the structures of the integumentary systems and apply functional concepts in how it protects the body and maintains homeostasis. **Phenomenon**	**SEP's** **Developing and Using Models** *Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system.* **CCC's** **Cause and Effect** *Students use cause an effect models at one scale to make predictions about the behavior of systems at different scales.* **Structure and Function** *Students apply patterns in structure and function to unfamiliar phenomena.* **Systems and System Models** *Students can use models to simulate systems and their interactions.*

the life cycle of cells that maintain these layers. **focusing on the life cycle of cells within the skin.* **Explanation** In multicellular organisms' individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. **Misconceptions** 1. ***Body piercings and tattoos are completely safe.*** Body modifications involve breaking the skin, and consequently, carry a risk of infection. People with tattoos are nine times more likely to be infected with the hepatitis C virus than are people without tattoos. The American Red Cross prevents people from donating blood for one year after they get a tattoo, body piercing, or acupuncture treatments. 2. Tattoos and body piercings involve breaking the skin and therefore carry a risk of infection. 3. There are health risks associated with body piercings and tattoos. Anyone considering undergoing these procedures should first research them, be aware of the health risks, find a provider who performs the procedure correctly, and use proper follow-up care.	Although you may not typically think of the skin as an organ, it is in fact made of tissues that work together as a single structure to perform unique and critical functions. The skin and its accessory structures make up the integumentary system, which provides the body with overall protection. The skin is made of multiple layers of cells and tissues, which are held to underlying structures by connective tissue. The deeper layer of skin is well vascularized (has numerous blood vessels). It also has numerous sensory, and autonomic and sympathetic nerve fibers ensuring communication to and from the brain.  Tattooing is as ancient as modern man. These decorative marks have been found in cavemen and mummies, spanning many different cultures worldwide. The first modern tattooing machine was modeled after Thomas Edison's engraving machine and ran on electricity. Today, over 60 million Americans have at least one tattoo – that means one out of every 5 people have gotten inked at some point in life. Today, as tattoos are not taboo anymore, we must focus on caring for them and understanding their impact on skin health. Tattoos and Skin Health: http://www.dermalinstitute.com/us/library/78_article_Tattoos_and_Skin_Health.htm	

Vocabulary
Integument, adipose tissue, areolar connective tissue, capillaries, dermal papilla, dermis, epidermis, fascia, fasciitis, hypodermis, keratin, keratocytes, Langerhans cells, melanin, stratum, stratum basale, stratum compactum, stratum corneum, subcutaneous layers Vocabulary from sections from the integumentary system, skin structures, skin appendages, functions of the integumentary system, pathology of the integumentary system, aging of the integumentary system

Curricular Materials
Textbook: *Applied Anatomy & Physiology 2nd Ed.: A Case Study Approach; Brian R, Shmaefsky* Ch. 4 The Skin and Its Parts; pgs. 128-151 **EMC AA&P Workbook & Laboratory Manual**: • Ch. 4 The Skin and Its Parts, pgs. 44-50 • Laboratory Activity 1: Histology of the Integumentary System • Laboratory Activity 2: Effectiveness of Sunscreen at Blocking Ultraviolet Light **Online Resources:** Blank Skin Labeling Diagram Homeostatic Skin Imbalance Writing Assignment *Students will describe four homeostatic imbalances that can occur in relation to the skin. Students will use evidence to describe in detail each problem along with the underlying cause of each imbalance.* Getting Comfortable in My Own Skin Activity *Students will investigate the integumentary system as well as discuss the art of tattoos and which layer of skin is inked when going under the needle.* Integumentary System Video

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UNIT 2: Protection, Support, and Movement [6 Weeks]

The Overarching Question(s)

- **What structures are used to support and protect the body?**
- **What structures are used to allow movement in the body?**

DCI, Standards, Explanations, Misconceptions Length [10 days]	Learning Outcomes/Phenomena (Anchor, Driving)	imensional Instructional Approach (SEP's & CCC's)
DCI LS1. From Molecules to Organisms: Structures and Processes HAP.ETS2: Links Among Engineering, Technology, Science, and Society **Standard** HAP.LS1.8 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. HAP.LS1.9 Diagram microscopic bone structures, identifying regions that participate in hematopoiesis and storage of minerals and fat.	**Essential Questions** • How does the skeletal structures provide support and protection for tissues, and functions together with the muscular system to make movements possible? **Learning Outcomes** • Label the structures of the skeletal system. • Describe an overview of the skeletal systems to include its functions, the axial and appendicular skeletons as well as types of bones and cartilage. • Explain why the skeletal systems is and organ system. • Identify which body parts make up the axial and appendicular skeletons. • Describe the structural and functional classifications of joints. **Phenomenon** The skeletal system forms the rigid internal framework of the body. It consists of the bones, cartilages, and ligaments. Bones support the weight of the body, allow for body movements, and	**SEPs** **Developing and using** models *Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system* **Constructing Explanations** **Obtaining, Evaluating, and Communication** Information **CCC's** **Systems and System Models** *Students design or define systems in order to evaluate a specific phenomenon or problem.* **Structure and Function** *Students apply patterns in structure and function to unfamiliar phenomena.*

HAP.LS1.10 Explain the process of bone formation, growth, and repair.

Explanation

The most apparent functions of the skeletal system are the gross functions—those visible by observation. Simply by looking at a person, you can see how the bones support, facilitate movement, and protect the human body. Just as the steel beams of a building provide a scaffold to support its weight, the bones and cartilage of the skeletal system compose the scaffold that supports the rest of the body. Bones also facilitate movement by serving as points of attachment for your muscles. While some bones only serve as a support for the muscles, others also transmit the forces produced when your muscles contract. From a mechanical point of view, bones act as levers and joints serve as fulcrums. Unless a muscle spans a joint and contracts, a bone is not going to move.

Misconceptions

- ***Joints bend or joints allow the body to move***. In actually it is muscle that allows the body to move.
- ***Cracking your knuckles, joints, and toes can lead to degenerative conditions like arthritis or mallet finger***. There is little evidence to support this idea.
- ***Bones are not living structures.*** Adolescents may have conflicting ideas about whether bones are living structures, depending upon the context of the situation they are considering. On the one hand, they may believe that bones are just hard things that hold the body up and have muscles attached to them. On the other hand, teenagers recognize that

protect internal organs. Cartilage provides flexible strength and support for body structures such as the thoracic cage, the external ear, and the trachea and larynx. At joints of the body, cartilage can also unite adjacent bones or provide cushioning between them. Ligaments are the strong connective tissue bands that hold the bones at a moveable joint together and serve to prevent excessive movements of the joint that would result in injury. Providing movement of the skeleton are the muscles of the body, which are firmly attached to the skeleton via connective tissue structures called tendons. As muscles contract, they pull on the bones to produce movements of the body. Thus, without a skeleton, you would not be able to stand, run, or even feed yourself!

Each bone of the body serves a particular function, and therefore bones vary in size, shape, and strength based on these functions. For example, the bones of the lower back and lower limb are thick and strong to support your body weight.

Joints are the location where bones come together. Many joints allow for movement between the bones. At these joints, the articulating surfaces of the adjacent bones can move smoothly against each other. However, the bones of other joints may be joined to each other by connective tissue or cartilage. These joints are designed for stability and provide for little or no movement. Importantly, joint stability and movement are related to each other. This means that stable joints allow for little or no mobility between the adjacent bones. Conversely, joints that provide the most movement between bones are the least stable. Understanding the relationship between joint structure and function will help to explain why particular types of joints are found in certain areas of the body.

The articulating surfaces of bones at stable types of joints, with little or no mobility, are strongly united to each other. For example, most of the joints of the skull are held together by fibrous connective tissue and do not allow for movement between the adjacent bones. This lack of mobility is important, because the skull bones serve to protect the brain. Similarly, other joints united by fibrous connective tissue allow for very

broken bones heal. Few students have an understanding of how their bones grow during development or recognize that the **bone marrow** is critical for production of both red and white blood cells. Even maintenance of bone structure is a dynamic process; the action of specialized cells called **osteoblasts** to form new bone is counterbalanced by other cells, **osteoclasts**, which break down bone through resorption. As people age, bone resorption predominates over bone formation. • ***Diseases like osteoporosis or arthritis affect only old people, so teenagers do not need to be concerned about them.*** Although osteoporosis, a disease in which bone density decreases, affects older individuals, scientists now realize that it is important for young people to take care of their bones because this can influence the onset of osteoporosis in later life. Exercise, including resistance and high-impact exercise, and good nutrition, including adequate **calcium** intake (1,300 milligrams per day for children ages 9 to 18), are important for optimal bone health.	little movement, which provides stability and weight-bearing support for the body. For example, the tibia and fibula of the leg are tightly united to give stability to the body when standing. At other joints, the bones are held together by cartilage, which permits limited movements between the bones. Thus, the joints of the vertebral column only allow for small movements between adjacent vertebrae, but when added together, these movements provide the flexibility that allows your body to twist, or bend to the front, back, or side. In contrast, at joints that allow for wide ranges of motion, the articulating surfaces of the bones are not directly united to each other. Instead, these surfaces are enclosed within a space filled with lubricating fluid, which allows the bones to move smoothly against each other. These joints provide greater mobility, but since the bones are free to move in relation to each other, the joint is less stable. Most of the joints between the bones of the appendicular skeleton are this freely moveable type of joint. These joints allow the muscles of the body to pull on a bone and thereby produce movement of that body region. Your ability to kick a soccer ball, pick up a fork, and dance the tango depend on mobility at these types of joints.	

Vocabulary

Bone, cartilage, endoskeleton, appendicular skeleton, articulation, axial skeleton, ligaments, lower appendages, tendon, upper appendages, osseous, alveolar bones, endochondral bones, flat bones, irregular bone, long bone, sesamoid bones, short bone, bone marrow, hyaline cartilage, compact bone, cancellous bone, red marrow, yellow marrow, bursa, bursitis, synovial fluid, cartilaginous join, fibrous joint

Curricular Materials

Textbook

Applied Anatomy & Physiology 2nd Ed.: A Case Study Approach; Brian R, Shmaefsky

Ch. 5 The Skeletal System; pgs. 162-201

SCS Human Anatomy & Physiology Curriculum Map

Unit 1 Anatomical Orientation	Unit 2 Protection, Support, and Movement	Unit 3 Nervous System	Unit 4 Endocrine System	Unit 5 Transport System	Unit 6 Lymphatic System
3 Weeks	6 Weeks	6 Weeks	3 Weeks	7 Weeks	2 Weeks

UNIT 2: Protection, Support, and Movement [6 Weeks]

The Overarching Question(s)

- **What structures are used to support and protect the body?**
- **What structures are used to allow movement in the body?**

DCI, Standards, Explanations, Misconceptions Length [days]	Learning Outcomes/Phenomena (Anchor, Driving)	imensional Instructional Approach (SEP's & CCC's)
DCI LS1. From Molecules to Organisms: Structures and Processes HAP.ETS2: Links Among Engineering, Technology, Science, and Society **Standard**	**Essential Questions** • **How does the skeletal structures provide support and protection for tissues, and function together with the muscular system to make movements possible?** • **How do the structure of muscles aid in its function?** • **How do diseases of the muscles disrupt the "normal" structure and function?** **Learning Outcomes**	**SEPs** **Asking Questions** **Developing and using models** *Students can test the predictive abilities of their models in a real-world setting and make comparisons of two models of the same process or system* **Constructing explanations**

HAP.LS1.12. Model the gross and microscopic anatomy of skeletal muscle and 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.
HAP.LS1.13 Model the anatomical connections between the skeletal system and muscular system and explain how they generate movement through antagonistic muscle groups.

Explanation

The most apparent functions of the skeletal system are the gross functions—those visible by observation. Simply by looking at a person, you can see how the bones support, facilitate movement, and protect the human body. Just as the steel beams of a building provide a scaffold to support its weight, the bones and cartilage of the skeletal system compose the scaffold that supports the rest of the body. Bones also facilitate movement by serving as points of attachment for your muscles. While some bones only serve as a support for the muscles, others also transmit the forces produced when your muscles contract. From a mechanical point of view, bones act as levers and joints serve as fulcrums. Unless a muscle spans a joint and contracts, a bone is not going to move.

Misconceptions

- ***Muscles are only used for voluntary physical actions like walking, running, or throwing.*** Skeletal muscles are probably most familiar to middle school students even though other types of muscles, cardiac and smooth, are essential for life functions. The heart muscle is composed of a different type of muscle cell (cardiac muscle cells) and beats to move blood throughout the body. Smooth muscle cells line blood vessels and the intestinal tract to help move blood or food through those passages. The tongue is made up of muscle

- **Label the structure of the muscular system.**
- **Define the function of the muscular system.**
- **Name the major parts of a skeletal muscle fiber and describe the functions of each.**
- **Explain how various types of muscular contractions produce body movements and help maintain posture.**
- **Compare the contraction mechanisms of skeletal, cardiac and smooth muscle fibers.**
- **Compare the structure of the muscular system in providing support and protection for tissues while making movement possible.**

Phenomenon

When most people think of muscles, they think of the muscles that are visible just under the skin, particularly of the limbs. These are skeletal muscles, so-named because most of them move the skeleton. But there are two other types of muscle in the body, with distinctly different jobs. Cardiac muscle, found in the heart, is concerned with pumping blood through the circulatory system. Smooth muscle is concerned with various involuntary movements, such as having one's hair stand on end when cold or frightened, or moving food through the digestive system. This chapter will examine the structure and function of these three types of muscles. Muscle is one of the four primary tissue types of the body, and the body contains three types of muscle tissue: skeletal muscle, cardiac muscle, and smooth muscle. All three muscle tissues have some properties in common; they all exhibit a quality called excitability as their plasma membranes can change their electrical states (from polarized to depolarized) and send an electrical wave called an action potential along the entire length of the membrane. While the nervous system can influence the excitability of cardiac and smooth muscle to some degree, skeletal muscle completely depends on signaling from the nervous system to work properly. On the other hand, both cardiac muscle and smooth muscle can respond to other stimuli, such as hormones and local stimuli.

Obtaining, Evaluating, and Communicating Information

CCCs

Patterns
Students recognize that different patterns for the same system may be present depending on the scale at which the system is analyzed.

Structure and Function
Students infer the function of a component of a system based on its shape and interactions with other components.

Stability and Change
Students provide examples and explanations for sudden and gradual changes.

cells that enable us to speak and is also an important part of the digestive system. • ***Your muscles turn to fat if you quit exercising.*** Misconception 2 is common not only among adolescents but also among adults and reflects a basic misunderstanding of how the body works. If a person stops exercising, his or her muscle cells may decrease in volume and become smaller. At the same time, a person may increase the volume of fat cells in his or her body. This concurrent change may give the impression that muscle is becoming fat, but this is not the case. Fat cells are different from muscle cells; muscle cells do not turn into fat.		

Vocabulary

ATPase, actin, action potential, aerobic respiration, atrophy, cardiac muscle, depolarize Fibrosis, glycolysis, graded muscle response, isotonic contraction, lactic acid, latent period, motor end-plate, motor unit, muscle tension, muscle tone, myoblast, Myofibril, myosin, neuromuscular junction (NMJ), neurotransmitter, oxygen debt, sarcolemma, sarcomere, sarcopenia, sarcoplasmic reticulum (SR), sarcoplasm, skeletal muscle, smooth muscle, synaptic cleft, thick filament, thin filament, tropomyosin, troponin, varicosity, visceral muscle, voltage-gated sodium channels

Curricular Materials

Textbook
Applied Anatomy & Physiology 2nd Ed.: A Case Study Approach; Brian R, Shmaefsky
Ch. 6 The Muscular System; pgs. 212-235