Chariho Regional School District - Science Curriculum
September, 2016

HUMAN ANATOMY AND PHYSIOLOGY CURRICULUM

Unit 1: Organization of the Human Body and Introduction to Medical Terminology

OVERVIEW

Summary

Students will be introduced to the general organization of the body's cavities and systems. They will review levels of organization, from atom to organism. Students will learn the planes, regions, and directional terminology to assist in the navigation of technical reading as well as to access and perform dissections within a lab. Students will also learn about homeostasis in the body and the result of a lack of homeostasis which is disease.

Content to Be Learned

- Levels of organization within the human body.
- Medical and anatomical terminology.
    - Regions.
    - Planes.
    - Directional terms.
    - Cavities.
    - Membranes.
- Homeostasis and feedback mechanisms.
    - Positive and Negative feedback.
- Overview of body systems and introduction to disease and disorders.

Practices

- Constructing and revising an explanation based on valid and reliable evidence.
- Planning and carrying out investigations.
- Developing and using models.

Crosscutting Concepts

- Stability and change.
- Systems and system models.

Essential Questions

- What mechanisms regulate homeostasis?
- How is the body designed to support efficient functions of all systems?

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: 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 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • 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.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas*. Integrated and reprinted with permission from the National Academy of Sciences.

Students who demonstrate understanding can:

HS-LS1-3. **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. *Connections to Nature of Science* **Scientific Investigations Use a Variety of Methods** • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.	**LS1.A: Structure and 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. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -

WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*

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Unit 2: Biochemistry and Cytology

OVERVIEW

Summary

Students will review the chemistry of biomolecules including carbohydrates, proteins, nucleic acids, and lipids. They will learn the importance of water in the body and a review of water's properties and how it creates an ideal medium to maintain homeostasis for living systems. Students will review concepts from Biology including eukaryotic and prokaryotic cells, organelle structures and functions, cell division, and DNA and protein synthesis, and cellular respiration. The focus in the section will be on specialization of cells and the link between their functions and the organelles they contain.

Content to Be Learned

- Functions and characteristics of biomolecules.
- Role of water in the body and properties of water.
- Chemical reactions that provide energy for the body.
- Review the structure and function of DNA and its role in protein synthesis.
- Understand the purpose for and products of mitosis.
- Structure and function of cellular organelles and structures.
- Specialization of cells.
- Cellular membrane and transport mechanisms.
- Carbon, hydrogen and oxygen from sugar molecules combine with other elements to form amino acids and other carbon-based molecules.
- In systems, molecules are either broken down into their atomic components or rebuilt into new molecules.

Practices

- Developing and using models.
- Constructing explanations and designing solutions.
- Asking questions and defining problems.

Crosscutting Concepts

- Structures and functions.
- Energy and matter flow.
- Systems and system models.

Essential Questions

- How do eukaryotic cells become specialized to create the tissues of the body?
- How are organic molecules broken down and rebuilt in the body?
- What happens to the human body when water is a limiting factor? How does this connect to homeostasis?

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-6. **Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [*Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**LS1.C: Organization for Matter and Energy Flow in Organisms** • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Connections to other DCIs in this grade-band:
HS.PS1.B

Articulation of DCIs across grade-bands:
MS.PS1.A ; MS.PS1.B ; MS.PS3.D ; MS.LS1.C ; MS.ESS2.E

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-6)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6)

WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6)

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Students who demonstrate understanding can:

HS-LS1-7. **Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [*Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.C: Organization for Matter and Energy Flow in Organisms** • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.	**Energy and Matter** • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Connections to other DCIs in this grade-band:
HS.PS1.B ; HS.PS2.B ; HS.PS3.B

Articulation of DCIs across grade-bands:
MS.PS1.B ; MS.PS3.D ; MS.LS1.C ; MS.LS2.B

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-7)*

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Students who demonstrate understanding can:

HS-LS3-1. **Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** [*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from examining models or a theory to clarify relationships.	**LS1.A: Structure and Function** • 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. *(secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)* **LS3.A: Inheritance of Traits** • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS3.A ; **MS.LS3.B**

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-LS3-1)*

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. *(HS-LS3-1)*

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Students who demonstrate understanding can:

HS-LS1-4. **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** [*Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.B: Growth and Development of Organisms** • 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.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A ; **MS.LS1.B** ; **MS.LS3.A**

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-4)*
Mathematics -
MP.4 Model with mathematics. *(HS-LS1-4)*
HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *(HS-LS1-4)*
HSF-BF.A.1 Write a function that describes a relationship between two quantities. *(HS-LS1-4)*

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Unit 3: Protection

OVERVIEW

Summary

This unit focuses on the structures that protect the body from the environment and infection. This covers specific and nonspecific defense across the Integumentary and Lymphatic systems. Students will study the structures and functions of these systems from histology to macroscopic observations and learn the mechanisms of differentiating leukocytes in the body. Students will explore the organization of these systems as well as common diseases and disorders that impact their function. Other trends observed in this unit will include the impacts of the aging process and the interdependence between systems.

Content to Be Learned

- Histology with a focus on protection (Stratified squamous, Pseudostratified ciliated columnar, dense irregular connective tissue, adipose tissue, lymphatic tissue, reticular tissue, hematopoietic tissue).
- Layers of the integument.
- Hair and nail structure and function.

- Effects of radiation in cancer and mutations.
- Aging and disease as it impacts homeostasis in the integumentary structures.
- Structures and functions of Lymphatic system.
- Barriers to infection.
- Inflammatory response.
- Antigens and antibody interactions.
- Immunity (nonspecific, specific, and acquired).
- Aging and disease as it impacts homeostasis in the lymphatic system.

Practices

- Developing and using models.
- Constructing explanations and designing solutions.

Crosscutting Concepts

- Structure and function.
- Systems and system models.
- Stability and change.

Essential Questions

- In what ways does the body create specific and nonspecific barriers to infectious agents?
- How is the skin structured to support the function of protection for the human body?
- How are the integumentary and lymphatic systems interdependent?
- How are the lymphatic and integumentary systems impacted by the aging process or disease?

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: 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 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.*]

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Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • 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.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

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Students who demonstrate understanding can:

HS-LS1-3. **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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Planning and Carrying Out Investigations Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.	**LS1.A: Structure and 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. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*

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Unit 4: Structure and Support

OVERVIEW

Summary

In this unit, students will study the structures and functions of the Skeletal and Muscular systems. Students will learn the skeletal and articular structures that create movement in our bodies. They will learn about how the shape of the surfaces of bones help to define the types of actions they perform. Students will also study various muscle groups in both the human and fetal pig. They will compare the anatomies of quadrupeds to bipeds and look at how these muscles work with the skeleton to create the various movements of the body. At the microscopic level, students will observe the histologies of the three types of muscle as well as bone and cartilage. This will assist students in creating understanding of structure and functional relationships at the cellular level. Applications from the field of physical and occupational therapy are brought in to explain the importance of range of motion and various therapies to support movement.

Content to Be Learned

- Histology: Focus on structure and support (bone, cartilage, dense regular connective tissue, skeletal muscle).
- Bones of the skeleton.
- Anatomy of long bones (layers of compact bone; cancellous bone; periosteum).
- Ossification process.
- Articular surfaces and joint classification.
- Movements.
- Skeletal muscle anatomy.
- Physiology of muscle contraction.
- Integration of muscle and connective tissues.
- Aging and disease as it relates to the maintenance of homeostasis in the skeletal and muscular systems.

Practices

- Developing and using models.
- Planning and carrying out investigations.
- Constructing explanations and designing solutions.

Crosscutting Concepts

- Structure and function.
- Stability and change.
- Cause and effect.

Essential Questions

- In what ways are the skeletal and muscular systems interdependent?
- How does disease and the aging process impact the skeletal and muscular systems?
- How are the structures of muscles and bones in alignment with their specific functions in movement?
- How does cartilage, bone, and fibrous connective tissue work to support articulations?
- How can physical therapy support improved movement in an injured body?
- What technologies exist to support human movement?

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: 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 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.*]

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Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

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Students who demonstrate understanding can:

HS-LS1-3. **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]

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Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*

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Unit 5: Control and Reproduction

OVERVIEW

Summary

Students will learn the various branches of the Nervous System. We will study the structures and functions of various types of neurons and support cells. Students will learn about the various areas and centers of the cerebrum and their functions. Students will understand the physiology of transmission in neurons and the cellular mechanisms that allow neurons to conduct action potentials. We will also discuss the interdependence of this system with the muscular system. This unit will also explore homeostatic regulation by the Endocrine system and Reproductive systems. Students will learn all anatomy, hormones, target tissues, and effects of hormones on their targets. Students will think through case studies to explain and help diagnose diseases that impact endocrine glands. Students will also learn about development regulated by the

Reproductive system. We will learn the chemistry of puberty and talk about the physiology of sexual function.

Content to Be Learned

- Histology: Focus on conduction (multipolar neurons, motor neurons, and motor end plates).
- Anatomy of the nervous system.
- General functions of the nervous system.
- Compare and contrast the anatomical subdivisions of the nervous system.
- Myelin sheath role.
- Reflex response.
- Difference between neuroglia and neuron.
- Summarize the events of synaptic transmission.
- Physiology of action potential.
- Name the major regions of the brain and describe their functions.
- Identify and describe the ventricles of the brain.
- Identify and describe the structures that protect and support the brain.
- Identify structures that make up the limbic system.
- Identify the anatomical structure that form the thalamus and hypothalamus and explain their functions.
- Distinguish among motor, sensory, and association areas of the cerebral cortex.
- Distinguish between somatic and autonomic nervous response.
- Discuss the impacts of some neurological diseases on the normal function of this system.
- Identify the impacts of the aging process on the nervous systems.
- Describe the chemical classes of hormones and explain how hormones control their targets.
- Describe the relationships between the anterior and posterior pituitary and the hypothalamus.
- Analyze symptoms of endocrine diseases to hypothesize the target gland.
- Locate and discuss functions of major endocrine glands.
- Discuss the impacts of some endocrine diseases on the normal function of this system.
- Identify the impacts of the aging process on the endocrine system.
- Identify structures and functions of the male and female reproductive structures.
- Compare oogenesis and spermatogenesis.
- Describe the histological features of the testes and ovaries.
- Discuss the development of male and female reproductive structures.

Practices

- Developing and using models.
- Planning and carrying out investigations.
- Constructing explanations and designing solutions.

Crosscutting Concepts

- Cause and effect.
- Structure and function.

- Systems and system models.
- Patterns.

Essential Questions

- How do the Nervous and Endocrine systems communicate with other systems of the body?
- What is the difference in the length of influence of the Nervous system versus the Endocrine system?
- What is the difference between a reflex response and a cerebral response?
- How does the Nervous system use feedback systems to control the body?
- How does the Endocrine system use feedback systems to control the body?
- How can one gland impact another in the Endocrine system?
- How do steroid and peptide hormones compare?
- How do oogenesis and spermatogenesis compare?
- Are the functions of male and female reproductive systems different?
- How does development of male and female differ?
- How does the endocrine help regulate growth?

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: 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 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • 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.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas*. Integrated and reprinted with permission from the National Academy of Sciences.

Students who demonstrate understanding can:

HS-LS1-3. **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. - - - - - - - - - - - - - - - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.	**LS1.A: Structure and 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. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Unit 6: Transport

OVERVIEW

Summary

Beginning with the blood, students will learn about the circulatory, respiratory, digestive, and urinary systems. The focus will remain on the relationship between form and function within organs and structures with ties to histology. Students will study these systems in homeostasis and will learn about their interdependent relationships with each other and with the blood. Students will also explore the effects of the aging process on the transport systems as well as common diseases that impact each system.

Content to Be Learned

- Histology: Focus on transport (blood, cardiac and smooth muscle, epithelial tissues).
- Identify the anatomy of the blood.
- Explain the general functions of the blood.
- Describe the process of hemostasis.
- Identify ABO blood groupings and describe the process of agglutination.
- Compare erythrocytes, thrombocytes, and leukocytes.
- Identify and describe the anatomy of the heart, arteries, veins, and capillaries.
- Describe the cardiac cycle.
- Explain how aging impacts the circulatory system.
- Explain how disease impacts the circulatory system.
- Describe an ECG read out.
- Identify and describe the anatomy of the respiratory system.
- Discuss the functions of the respiratory system.
- Explain the role of the muscles in respiration.
- Compare internal and external respiration.
- Discuss how pollution and smoking can damage the respiratory membranes.
- Explain the effects of aging and disease on the respiratory system.
- Identify and describe the anatomy of the alimentary canal.
- Describe the histology of the alimentary canal and connect to functions.
- Identify the accessory structures in digestion and their secretions.
- Compare chemical and mechanical digestion.
- Discuss how macromolecules are broken down and rearranged.
- Discuss the interdependence of the circulatory system and the digestive system.
- Explain the impact of aging and disease on the digestive system.
- Identify and describe the anatomy of the urinary system.
- Explain the histology of the kidney and nephron and how this connects to function.
- Explain urine formation (filtration, reabsorption, and secretion).
- Discuss the interdependence of the urinary and circulatory systems.
- Explain the role of ADH.
- Explain how aging impacts the urinary system.
- Use urinalysis to diagnose a patient based on chemical and microbiological observations.

Practices

- Developing and using models.
- Planning and carrying out investigations.
- Constructing explanations and designing solutions.

Crosscutting Concepts

- Cause and effect.
- Structure and function.
- Systems and system models.
- Patterns.

Essential Questions

- What structural components do all transport systems share?
- How are the transport systems linked through the blood?
- What common patterns can be seen in how aging impacts transport systems?
- How can the blood and urine be used as diagnostic tools for the human body?
- How does disease impact homeostasis in each transport system?
- How do the histologies of structures give clues to the physiology of the organ?

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: 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 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.*]

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Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

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Students who demonstrate understanding can:

HS-LS1-3. **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]

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Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*

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Students who demonstrate understanding can:

HS-LS1-6. **Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [*Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**LS1.C: Organization for Matter and Energy Flow in Organisms** • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Connections to other DCIs in this grade-band:
HS.PS1.B

Articulation of DCIs across grade-bands:
MS.PS1.A ; MS.PS1.B ; MS.PS3.D ; MS.LS1.C ; MS.ESS2.E

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-6)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6)

WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6)

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