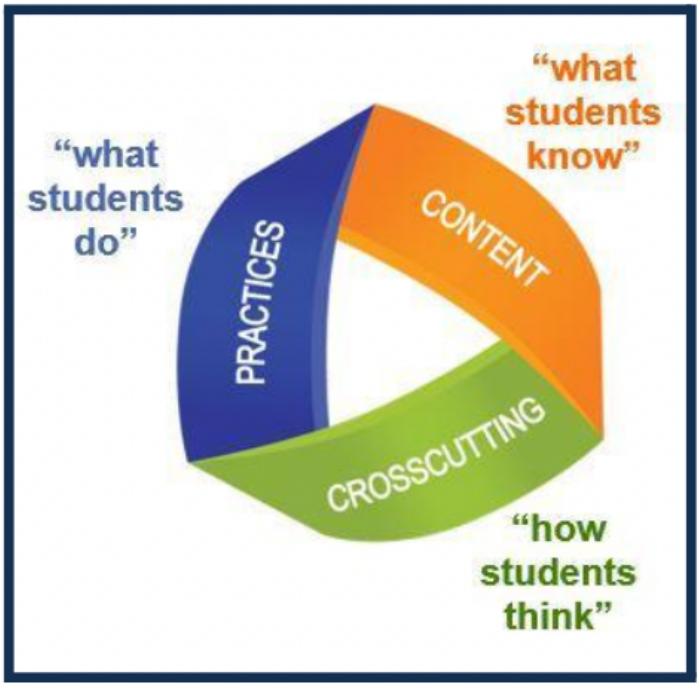
Ledyard Public Schools

Ledyard High School

NGSS Science Curriculum

Anatomy and Physiology



Approved by Instructional Council on May 10, 2023

Course Title	Anatomy & Physiology
Department and Curriculum Writing Team Members	**Science** Elizabeth Chivers
Course Overview	This course is an intensive introduction to human anatomy and physiology, including the parts and the functioning of the human body. It is recommended for students planning for careers in medical (STEM) or bioscience and emphasizes laboratory experiences. The lab experiences involve various dissections that are an integral part of the course and are required. High motivation is needed for success. This course is open to students in grades 11 and 12.
Length of Course	☑ Full year ☐ Semester
Type of Course	☐ Humanities Required Credit ☐ STEM Required Credit ☐ Humanities Elective Credit ☑ STEM Elective Credit ☐ PE/Health Required Credit ☐ Other
Grade Level	☐ 9 ☐ 10 ☑ 11 ☑ 12
Prerequisites	None
Ledyard High School Vision of the Graduate	Ledyard High School is a learning community dedicated to the cultivation of skills essential for our students' success in a rapidly-evolving society. At Ledyard High School, we believe our graduates should demonstrate the following: ☑ Collaboration - Colonel Graduates will demonstrate an ability to work effectively with others, sharing ideas, acknowledging one another's strengths, and collaborating to produce presentations, projects, performances, or events. ☑ Communication- Colonel Graduates will demonstrate an ability to communicate information clearly and effectively through a variety of media, including written, oral, visual, musical, and/or video productions. ☑ Problem-Solving- Colonel Graduates will demonstrate an ability to solve problems of varying complexity across a variety of content areas. ☑ Critical Thinking - Colonel Graduates will demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas. ☑ Perseverance - Colonel Graduates will demonstrate perseverance in academic and extracurricular settings by working through and past obstacles in pursuit of goals. ☑ Creativity - Colonel Graduates will demonstrate creativity through their participation in fine arts courses as well as through their inventive approaches to learning activities in a variety of settings.
VOG Portfolio Component	No Requirement - Student Option

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District Philosophy

Ledyard's vision for K-12 inquiry based science is to engage students in scientific and engineering practices as they apply crosscutting concepts to deepen their understanding of the core ideas in these fields.

A New Vision for Science Education

Implications of the Vision of the Framework for K-12 Science Education and the Next Generation Science Standards

SCIENCE EDUCATION WILL INVOLVE LESS:	SCIENCE EDUCATION WILL INVOLVE MORE:
Rote memorization of facts and terminology.	Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.
Learning of ideas disconnected from questions about phenomena.	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned.
Teachers providing information to the whole class.	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance.
Teachers posing questions with only one right answer.	Students discussing open-ended questions that focus on the strength of the evidence used to generate claims.
Students reading textbooks and answering questions at the end of the chapter.	Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information.
Pre-planned outcome for "cookbook" laboratories or hands-on activities.	Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas.
Worksheets.	Student writing of journals, reports, posters, and media presentations that explain and argue.
Oversimplification of activities for students who are perceived to be less able to do science and engineering	Provision of supports so that all students can engage in sophisticated science and engineering practices

Source: National Research Council. (2015). *Guide to Implementing the Next Generation Science Standards* (pp. 8-9). Washington, DC: National Academies Press.
http://www.nap.edu/catalog/18802/guide-to-implementing-the-next-generation-science-standards

Three Dimensions of the *Next Generation Science Standards*: Practices of Science and Engineering:

Scientific and Engineering Practices Matrix - SEP (appendix F)

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.

Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

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Three Dimensions of the *Next Generation Science Standards*: Disciplinary Core Ideas:

Disciplinary Core Ideas Matrix - DCI (appendix E)			
Physical Science	**Life Science**	**Earth and Space Science**	**Engineering, Technology, and the Application of Science**
PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

Three Dimensions of the *Next Generation Science Standards*: Crosscutting Concepts:

Crosscutting Concepts Matrix - CCC (appendix G)		
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. **Cause and Effect: Mechanism and Explanation** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.	**Scale, Proportion, and Quantity** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. **Systems and System Models** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.	**Energy and Matter: Flows, Cycles, and Conservation** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. **Structure and Function** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and Change** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

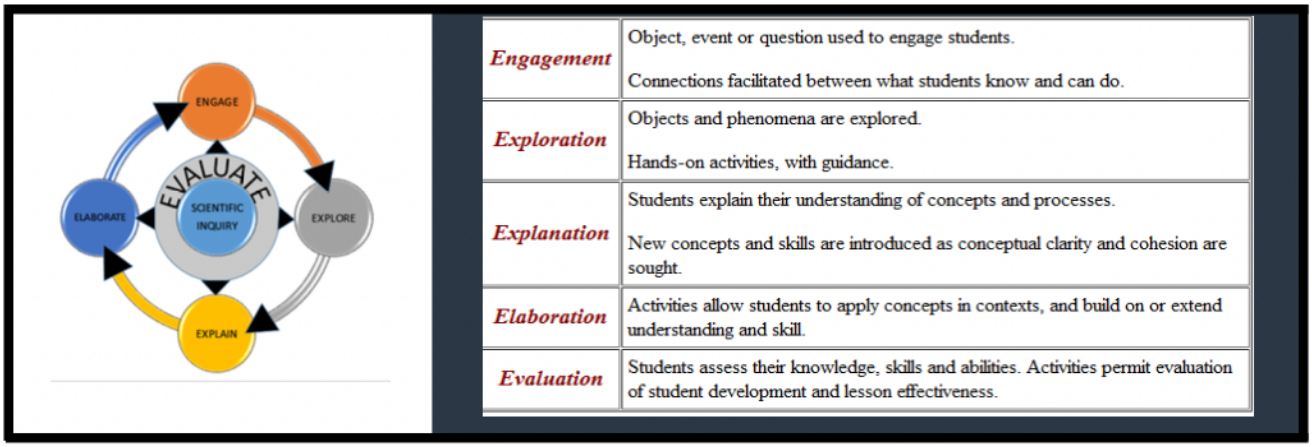
Connections to the Nature of Science

Nature of Science Practices	Nature of Science Crosscutting Concepts
These understandings about the nature of science are closely associated with the science and engineering practices, and are found in that section of the foundation box on a standards page. More information about the Connections to Engineering, Technology and Applications of Science can be found in Appendix H.	These understandings about the nature of science are closely associated with the crosscutting concepts, and are found in that section of the foundation box on a standards page. More information about the Connections to Engineering, Technology and Applications of Science can be found in Appendix H.
Scientific Investigations Use a Variety of Methods	Science is a Way of Knowing
Science Knowledge is Based on Empirical Evidence	Scientific Knowledge Assumes and Order and Consistency in Natural Systems
Scientific Knowledge is Open to Revision in Light of New Evidence	Science is a Human Endeavor
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena.	Science Addresses Questions About the Natural and Material World

How does Ledyard Define Inquiry?

Inquiry is defined as a way of seeking information, knowledge, or truth through questioning. Inquiry is a way for a learner to acquire new information and data and turn it into useful knowledge. Inquiry involves asking good questions and developing robust investigations from them. Inquiry also involves considering possible solutions and consequences. A third component of inquiry is separating evidence based claims from common opinion, and communicating claims with others, and acting upon these claims when appropriate. Questions lead to gathering information through research, study, experimentation, observation, or interviews. During this time, the original question may be revised, a line of research refined, or an entirely new path may be pursued. As more information is gathered, it becomes possible to make connections and allows individuals to construct their own understanding to form new knowledge. Sharing this knowledge with others develops the relevance of the learning for both the student and a greater community. Sharing is followed by reflection and potentially more questions, bringing the inquiry process full circle.

Inquiry 5 Science Teaching Model



Engagement	Object, event or question used to engage students. Connections facilitated between what students know and can do.
Exploration	Objects and phenomena are explored. Hands-on activities, with guidance.
Explanation	Students explain their understanding of concepts and processes. New concepts and skills are introduced as conceptual clarity and cohesion are sought.
Elaboration	Activities allow students to apply concepts in contexts, and build on or extend understanding and skill.
Evaluation	Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.

Course Overview
This course is an intensive introduction to human anatomy and physiology, including the parts and the functioning of the human body. It is recommended for students planning for careers in medical (STEM) or bioscience and emphasizes laboratory experiences. The lab experiences involve various dissections that are an integral part of the course and are required. High motivation is needed for success. This course is open to students in grades 11 and 12.

Grade Level: 11-12	Timeline: 7-8 classes
Unit Title: The Body as a Whole	
Essential Question(s):	● What is the internal and external organization of the body? ● What are the relationships between cells, tissues and organs?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)**	
Crosscutting Concepts: ● **Structure and Function: Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem (HS-LS1-1)** ● **Systems and System Models: Models can be used to simulate systems and interactions within and between systems at different scales (HS-LS1-2)** ● **Stability and Change: Feedback (negative or positive) can stabilize or destabilize a system (HS-LS1-3)**	
Science and Engineering Practices: ● **Developing and Using Models: Use a model based on evidence to illustrate the relationships between systems or between components of a system (HS-LS1-2)**	
Content & Vocabulary:	● Form (anatomy) determines function (physiology) ● The body's organization ranges from atoms to the entire organism ● Anatomical terms describe body directions, regions, and planes ● Many internal organs lie in membrane-lined body cavities ● Epithelial tissue covers body surfaces, lines cavities, and forms glands ● Connective tissue is the most abundant and widely distributed tissue in the body ● Muscle tissue is responsible for body movement ● Nervous tissue is a specialized tissue of the nervous system
Suggested Activities:	● Use models and diagrams, 3-D and virtual, to identify major anatomical regions, terms, planes, body cavities and system relationships ● Microscope lab to identify, label, and describe various tissue types ● Use virtual models to correlate tissue anatomy to physiology
Suggested Assessments:	● Anatomical terminology assessment ● Histology assessment ● Microscope lab practical

Grade Level: 11-12	Timeline: 5-6 classes
Unit Title: The Integumentary System	
Essential Question(s):	● What is the anatomy and physiology of the skin? ● What happens when parts of the skin malfunction?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)**	
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Content & Vocabulary:	● The epidermis is a multilayered keratinized stratified squamous epithelium ● The dermis consists of papillary and reticular layers ● Melanin, carotene, and hemoglobin determine skin color ● Hair and nails are modifications of the epidermis ● Sweat glands and oil glands contribute to homeostasis
Suggested Activities:	● Use 3-D and virtual models of skin to illustrate layers and strata ● Skin lab investigating blood supply, neural receptors and glands of the integument ● Research and present disorders of the integumentary system ● Skin mammal dissection
Suggested Assessments:	● Integumentary system assessment ● Dissection Virtual Lab practical

Grade Level: 11-12	Timeline: 14-16 classes
Unit Title: The Skeletal & Muscular Systems	
Essential Question(s):	● What are the major muscle groups and their functions? ● What are the major bones and tissues of the skeletal system and their functions? ● How do the skeletal and muscular systems work together?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)**	
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Content & Vocabulary:	● Hyaline, elastic, and fibrocartilage help form the skeleton ● The gross structure of all bones consists of spongy and compact bone ● The axial skeleton consists of multiple skull bones along with the vertebral column and thoracic cage ● The appendicular skeleton consists of bones of the upper and lower limbs along with bones of the pectoral and pelvic girdles ● Five joint types articulate the skeleton and allow movement ● Skeletal muscle fibers contain structural, contractile and regulatory proteins that each play roles in the sliding filament model of muscle contraction ● Skeletal muscles are named for their origin, insertion, structure and action

Suggested Activities:	● Use sectioned animal long bones to identify types and locations of bony tissues and marrows ● Use diagrams and models - 3-D skeleton, animal bones, virtual pictures - to identify bone locations and markings of the skeleton ● Joints identification and movements lab ● Use diagrams and models, 3-D and virtual, to identify major muscles of the body ● Skeletal and muscle mammal dissection
Suggested Assessments:	● Skeletal system assessment ● Muscular system assessment ● Dissection Virtual Lab practical

Grade Level: 11-12	Timeline: 18-20 classes
Unit Title: The Nervous & Endocrine Systems	
Essential Question(s):	● How does the body receive and send messages? ● How does the central and peripheral nervous system respond to internal and external stimuli? ● How are external and internal stimuli processed into and throughout the nervous system? ● How are chemical responses vital for control of body functions and homeostasis?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)**	
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Content & Vocabulary:	● Neurons are the structural unit of the nervous system ● Action potentials use ion concentration differences to transmit signals in the body ● The central nervous system consists of the brain and spinal cord ● The brain's cerebral hemispheres consists of gray cortex and white matter ● The diencephalon includes the thalamus, hypothalamus, and epithalamus ● The brainstem consists of the midbrain, pons, and medulla oblongata ● The spinal cord is a reflex center and conduction pathway ● The peripheral nervous system consists of the autonomic - sympathetic and parasympathetic

	divisions ● Each of the sense organs - eyes, ears, nose, and tongue - receive stimuli and transmit them to the central nervous system ● The endocrine system consists of glands release hormones to aid the nervous system in control of the body
Suggested Activities:	● Testing reflexes lab ● Neural circuits activity ● Research activity: What is the status of research on the repair of nervous tissue in the CNS ● Use diagrams and models, 3-D and virtual, to identify brain and spinal cord parts ● Mammal brain and spinal cord dissection ● Senses lab - vision, smell and hearing ● Use diagrams and models, 3-D and virtual, to identify eye, ear, nose and tongue parts ● Mammal eye dissection ● Use diagrams and models, 3-D and virtual, to identify major endocrine glands of the body ● Mammal endocrine glands dissection
Suggested Assessments:	● Nervous system assessment ● Endocrine system assessment ● Dissection Virtual Lab practicals

Grade Level: 11-12	Timeline: 9-11 classes
Unit Title: The Cardiovascular System	
Essential Question(s):	● What are the components of blood and how does this fluid support homeostasis? ● What are the structures of the heart and vascular system and how does each contribute to the circulation of blood?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)**	
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Content & Vocabulary:	● Blood consists of plasma and formed elements ● Erythrocytes play a crucial role in oxygen transport ● Leukocytes defend the body ● Platelets stop bleeding and help prevent blood loss ● Blood types are based on ABO and Rh groups ● The heart has four chambers and pumps blood through the pulmonary and systemic circuits ● Heart valves make blood flow in one direction ● Pacemaker cells trigger action potentials throughout the heart detectable in and ECG ● The cardiac cycle describes the mechanical events associated with blood flow through

	the heart ● Arteries carry blood away from the heart under pressure ● Veins return blood to the heart ● Capillaries are exchange vessels
Suggested Activities:	● Microscope blood cell lab ● Identifying blood types lab ● Use diagrams and models, 3-D and virtual, to identify heart internal chambers and valves and external blood vessels ● Research activity: Investigate the options for heart valve replacements and pacemakers ● Heartbeat and pulse lab ● Blood pressure lab ● Mammal heart and blood vessel dissection
Suggested Assessments:	● Cardiovascular system assessment ● Dissection Virtual Lab practical

Grade Level: 11-12	Timeline: 7-9 classes
Unit Title: The Digestive System	
Essential Question(s):	● How does the digestive system process food into nutrients that can be used by the body? ● What are the locations and major functions of the structures of the digestive system?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)** ● **HS-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 (HS-LS1-7)**	
Crosscutting Concepts: ● **Structure and Function: Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem (HS-LS1-1)** ● **Systems and System Models: Models can be used to simulate systems and interactions within and between systems at different scales (HS-LS1-2)** ● **Stability and Change: Feedback (negative or positive) can stabilize or destabilize a system (HS-LS1-3)**	
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Content & Vocabulary:	● Carbohydrates, lipids, and proteins supply energy and are used as building blocks ● Metabolism is the sum of all biochemical reactions of the body ● Digestion hydrolyzes food into nutrients that are absorbed into the bloodstream ● The mouth contains glands and accessory organs that contribute to digestion ● The pharynx and stomach move food from the mouth to the stomach ● The stomach stores food and begins protein digestion ● The liver and gallbladder secrete bile ● The pancreas secretes digestive enzymes ● The small and large intestine are absorptive tubes

Suggested Activities:	● Use diagrams and models, 3-D and virtual, to identify each structure of the digestive system ● Digestive enzymes lab ● Research activity: Gastric bypass and bariatric surgeries ● Mammal digestive system dissection
Suggested Assessments:	● Digestive system assessment ● Dissection Virtual Lab practical

Grade Level: 11-12	Timeline: 7-8 classes
Unit Title: The Respiratory & Urinary Systems	
Essential Question(s):	● How does the respiratory system process oxygen and carbon dioxide for the body? ● How are excess and waste solute levels of the blood maintained by the kidneys? ● What are the locations of and major functions of the structures of the respiratory and urinary systems?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)** ● **HS-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 (HS-LS1-7)**	
Crosscutting Concepts: ● **Structure and Function: Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem (HS-LS1-1)** ● **Systems and System Models: Models can be used to simulate systems and interactions within and between systems at different scales (HS-LS1-2)** ● **Stability and Change: Feedback (negative or positive) can stabilize or destabilize a system (HS-LS1-3)**	
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Content & Vocabulary:	● The upper respiratory system warms, humidifies, and filters air ● The lower respiratory system consists of conducting and respiratory zone structures ● Each multi-lobed lung occupies its own pleural cavity ● Volume changes cause pressure changes, which cause air to move ● Ventilation can be assessed by measuring respiratory volumes, capacities, and flow rates ● Gases exchange by diffusion among the blood, lungs, and tissues ● Nephrons are the functional unit of the kidneys ● Filtration, absorption, and secretion are the key processes of urine formation

	● Renal function is evaluated by analyzing blood and urine ● The ureters, bladder and urethra transport, store, and eliminate urine
Suggested Activities:	● Measuring lung capacities and volumes lab ● Carbon dioxide production lab ● Use diagrams and models, 3-D and virtual, to identify each structure of the respiratory system ● Mammal respiratory system dissection ● Urinalysis lab ● Use diagrams and models, 3-D and virtual, to identify each structure of the urinary system ● Mammal kidney dissection
Suggested Assessments:	● Respiratory system assessment ● Urinary system assessment ● Dissection Virtual Lab practical

Grade Level: 11-12	Timeline: 6-7 classes
Unit Title: The Lymphatic & Immune System	
Essential Question(s):	● What are the parts of the lymphatic system and what are their functions? ● What are the body's responses that prevent and protect the body from infection, harm and diseases?
Standards: ● **HS-LS1.A: Structure and Function.** ○ **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)** ○ **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 (HS-LS1-2)** ○ **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 (HS-LS1-3)** ● **HS-LS1.B: Growth and Development of Organisms.** ○ **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)**	
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Science and Engineering Practices: ● **Developing and Using Models: Use a model based on evidence to illustrate the relationships between systems or between components of a system (HS-LS1-2)** ● **Asking Questions and Defining Problems: Ask questions that arise from examining models or a theory to clarify relationships** ● **Analyzing and Interpreting Data: Apply concepts of statistics and probability to scientific and engineering questions and problems**	
Content & Vocabulary:	● The lymphatic system includes lymphatic vessels, lymph, and lymph nodes ● Lymph nodes filter lymph and house lymphocytes ● The spleen removes pathogens and aged red blood cells ● Surface barriers act as the first line of defense against infection ● The inflammatory process is the body internal second line of defense against infection ● B and T lymphocytes are cells of the adaptive immune response ● Humoral immunity creates antibodies the target extracellular antigens ● Cellular immunity consists of T lymphocytes that attack cellular targets
Suggested Activities:	● Simulating the spread of disease activity ● Coagulation response in blood types activity ● Research activity: Immunosuppressants and transplantation ● Use diagrams and models, 3-D and virtual, to identify lymphatic structures

	• Mammal lymphatic organs dissection
Suggested Assessments:	• Lymphatic and immune systems assessment • Dissection Virtual Lab practical

Unit Title: The Reproductive System

Essential Question(s):	● What is the structure and function of the parts of the male and female reproductive systems?

Standards:

- **HS-LS1.A: Structure and Function.**
  - **Systems of specialized cells within organisms help them perform the essential functions of life (HS-LS1-1)**
  - **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 (HS-LS1-2)**
  - **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 (HS-LS1-3)**
- **HS-LS1.B: Growth and Development of Organisms.**
  - **Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissue and organs that work together to meet the needs of the whole organism (HS-LS1-4)**
- **HS-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 (HS-LS1-7)**

Crosscutting Concepts:

- **Structure and Function: Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem (HS-LS1-1)**
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Science and Engineering Practices:

- **Developing and Using Models: Use a model based on evidence to illustrate the relationships between systems or between components of a system (HS-LS1-2)**
- **Asking Questions and Defining Problems: Ask questions that arise from examining models or a theory to clarify relationships**

Suggested Content & Vocabulary:	● The male reproductive systems consists of the testes, penis and accessory glands ● Spermatogenesis is the sequence of events that leads to formation of sperm ● The female reproductive system consists of ovaries, the uterine tubes, uterus and vagina ● Oogenesis is the sequence of events that leads to the formation of ova ● Fertilization is the joining of sperm and egg chromosomes to form a zygote ● Embryonic events include tissue differentiation which is followed by rapid growth of the fetus
Suggested Activities:	● Use diagrams and models, 3-D and virtual, to identify male and female reproductive structures ● Mammal reproductive organs dissection
Suggested Assessments:	● Reproductive system assessment ● Dissection Virtual Lab practical