

NGSS OVERVIEW

BODY SYSTEMS

Performance Expectation MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Performance Expectation MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Performance Expectation MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (working towards, this PE is assessed in *From Cells to Organisms*)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
<p>1. View and Reflect: The Pellagra Story Students obtain and evaluate information from a short video segment and a text passage on the investigation of pellagra, a nutritional deficiency common in the early 1900s. They reflect on how scientists gather evidence about cause-and-effect relationships in the human body and are introduced to the concept of clinical trials. The issues associated with investigating and experimenting on humans provides a context for the exploration of the human body system as a system of interacting subsystems.</p>	MS-LS1.A	<p>Obtaining, Evaluating, and Communicating Information</p> <p>Engaging in Argument from Evidence</p> <p>Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence</p>	<p>Cause and Effect</p> <p>Connections to Nature of Science: Science Is a Human Endeavor</p>	<p>ELA/Literacy: RST.6-8.7 RST.6-8.9</p>
<p>2. Modeling: Parts of a Whole Students draw the organs of the human body based on their prior knowledge. They then use diagrams to create a three-dimensional clay model of some of the organs and structures in the human torso. The concepts of structure and function are introduced as students begin to think about how the organs can be grouped into body systems based on their function within the human body.</p>	MS-LS1.A	<p>Developing and Using Models</p> <p>Asking Questions and Defining Problems</p>	<p>Structure and Function</p> <p>Systems and System Models</p>	<p>ELA/Literacy RST.6-8.7</p>
<p>3. Investigation: What’s Happening Inside? Students group organs and structures into body systems based on their functions. They compare their initial ideas to information about human body systems and learn about the function of various systems. The idea that the human body is a system of interacting subsystems is formally introduced.</p>	MS-LS1.A	<p>Constructing Explanations and Designing Solutions</p>	<p>Structure and Function</p> <p>Systems and System Models</p>	<p>ELA/Literacy: SL.8.1</p>

BODY SYSTEMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
<p>4. Reading: Digestion: An Absorbing Tale Students integrate information from text and visual displays about the structure and function of the digestive system. They further develop the concept of interacting systems and how subsystems can be part of a larger complex system.</p>	MS-LS1.A	Constructing Explanations and Designing Solutions	Systems and System Models	ELA/Literacy: RST.6-8.4
<p>5. Modeling: Food Breakdown Students read two text passages about the composition and breakdown of food. After the first passage, they begin to develop a model to explain how organisms obtain matter and energy. After the next passage, they modify and elaborate their models to account for the new information provided.</p>	MS-LS1.A MS-LS1.C	Developing and Using Models Constructing Explanations and Designing Solutions	Energy and Matter	ELA/Literacy: RST.6-8.2 RST.6-8.9
<p>6. Laboratory: Observing Organisms In this laboratory, students begin to explore how sense receptors respond to stimuli in the blackworm (<i>Lumbriculus variegatus</i>). Students are introduced to the concept of immediate behavior being a response to stimuli. Students use what they have learned to predict blackworm behavior in response to specific application of stimuli.</p>	MS-LS1.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Cause and Effect	
<p>7. Laboratory: Can You Feel the Difference? In this laboratory, students investigate how the human nervous system and sensory receptors respond to stimuli that induce immediate behaviors. They are introduced to the idea that there are similar systems in different organisms.</p>	MS-LS1.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data Obtaining, Evaluating, and Communicating Information	Cause and Effect	
<p>8. Reading: Finding the Nerve In this reading, students deepen their understanding of the structure and function of the human nervous system. They learn about how information is transmitted and processed to result in behaviors or memories. They also learn more about how the nervous system works with other body systems to perform particular body functions. Students are formally assessed on Performance Expectation MS-LS1-8.</p>	MS-LS1.D	Obtaining, Evaluating, and Communicating Information	Systems and System Models Cause and Effect	ELA/Literacy: RST.6-8.4

BODY SYSTEMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
<p>9. Laboratory: Heartily Fit Students use mathematics and computational thinking as they conduct an investigation and analyze and interpret data on their own heart and respiratory rates before and after exercise. The investigation stimulates a discussion of the interactions between human body systems—specifically the circulatory and respiratory systems—in order to meet the body’s need for more oxygen during exercise.</p>	MS-LS1.A	Analyzing and Interpreting Data Using Mathematics and Computational Thinking	Systems and System Models Stability and Change	Mathematics: 6.SP.B.4 ELA/Literacy: RST.6-8.3
<p>10. Laboratory: Gas Exchange Students conduct an investigation to identify the presence of carbon dioxide in exhaled breath. The function of the respiratory system in excreting carbon dioxide waste is highlighted. This activity is building towards an understanding of human body systems and subsystems from the level of the cell to the complete system, and to the interacting roles of these systems in providing nutrients and oxygen and removing carbon dioxide wastes from the cells throughout the body.</p>	MS-LS1.A MS-PS3.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Systems and System Models	ELA/Literacy: RST.6-8.3
<p>11. Reading: Interacting Systems In this activity, students obtain more information about the circulatory and respiratory systems, which they investigated in the previous two activities. They read about the structure and function of each of these systems and how they interact at the system, organ, tissue, and cellular levels of organization. They construct an explanation for how each level of organization contributes to circulatory function. This helps them to prepare for the argument they will develop in the next activity.</p>	MS-LS1.A	Constructing Explanations and Designing Solutions Connections to Nature of Science: Scientific Knowledge is Based on Empirical Evidence	Systems and System Models Structure and Function Scale, Proportion, and Quantity	ELA/Literacy: RST.6-8.2
<p>12. Modeling: The Circulation Game Students use what they have learned from the activities and readings in this unit to develop a whole-class model of the interactions of the circulatory, respiratory, and digestive systems. This activity provides an opportunity to formally assess MS-LS1-3.</p>	MS-LS1.A	Developing and Using Models Engaging in Argument from Evidence Constructing Explanations and Designing Solutions	Systems and System Models Structure and Function	ELA/Literacy: WHST.6-8.1 WHST.6-8.2

BODY SYSTEMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
<p>13. Investigation: Testing Medicines: A Clinical Trial In this investigation, students analyze and interpret data about a simulated clinical trial of a headache medicine. They use the evidence from their analysis to engage in an argument about the potential use of this medicine. They begin to think about how body system interactions may need to be considered when developing new medicines for human use.</p>	MS-LS1.A	Engaging in Argument from Evidence Analyzing and Interpreting Data	Cause and Effect Systems and System Models Connections to Nature of Science: Science Is a Human Endeavor	ELA/Literacy: RST.6-8.3 WHST.6-8.1
<p>14. Talking It Over: Evaluating Clinical Trials In this activity, students analyze and interpret data from a fictional headache medicine clinical trial to develop an argument for which of three medicines should be further developed and tested. Students consider how body system interactions play a role in the side effects of the medications and what that might mean for future possible use of the medicines.</p>	MS-LS1.A	Engaging in Argument from Evidence Analyzing and Interpreting Data	Cause and Effect Systems and System Models Connections to Nature of Science: Science Is a Human Endeavor	ELA/Literacy: WHST.6-8.1 WHST.6-8.9

PHENOMENA, DRIVING QUESTIONS AND SEPUP STORYLINE

BODY SYSTEMS

BODY SYSTEMS

Unit Issue: How interactions between body systems can be affected by disease, medications, and other factors.

Anchoring Phenomenon: How body systems function and interact in a healthy person and when a person is sick. An example is the interaction of the circulatory and respiratory systems during exercise. Students generate and answer questions such as: How do systems in the human body function? How do they interact? How can a problem in one system affect another system or systems?

Investigative Phenomenon	Driving Questions	Guiding Questions	Activities	PE	Storyline
Medicines can treat diseases but can have unintended consequences.	How do scientists ensure that a medication to treat a health condition works and is safe?	How do scientists investigate and gather evidence about the human body? (Activity 1)	1 (13, 14)	MS-LS1-3 MS-LS1-8	Students learn about the challenge of pellagra and the methods scientists use to investigate and treat/cure medical conditions.
The human body is a system made up of subsystems, including organ systems, organs, cells, and tissues.	What are the systems in the human body, and what are they composed of?	What do you know about structures, such as organs, in the human body? (Activity 2) How do structures in the human body interact to perform a specific function? (Activity 3)	2, 3	MS-LS1-3	The human body has different systems with different functions. Body systems are composed of organs, which are composed of tissues, which are composed of cells.
Each body system has specific structures and functions.	What does each body system contribute to the overall function of the body?	How does your digestive system function and interact with other systems in your body? (Activity 4) How does food provide energy and matter for organisms? (Activity 5) What can your observations tell you about how an organism's nervous system will respond to stimuli? (Activity 6) How does your brain gather and synthesize information from sensory receptors in your skin? (Activity 7) How does your body gather and synthesize information to respond to stimuli? (Activity 8)	4, 5, 6, 7, 8	MS-LS1-3 MS-LS1-8	Each specific body system connects to other body systems. Stimuli can affect behavior of organisms. Nervous systems gather and synthesize information differently. Nervous system responses can affect other body systems.

PHENOMENA, DRIVING QUESTIONS AND SEPUP STORYLINE

BODY SYSTEMS (continued)

Investigative Phenomenon	Driving Questions	Guiding Questions	Activities	PE	Storyline
<p>Changes in one body system can cause changes in another body system.</p>	<p>How do different body systems interact with and affect one another?</p>	<p>How do your body systems respond to exercise? (Activity 9)</p> <p>How much carbon dioxide is in your exhaled breath before and after you exercise? (Activity 10)</p> <p>How do systems in your body work together to keep you healthy? (Activity 11)</p> <p>How do oxygen, nutrients, and wastes move into, within, and out of your body? (Activity 12)</p>	<p>9, 10, 11, 12</p>	<p>MS-LS1-3 MS-LS1-8</p>	<p>Systems interact.</p> <p>Interactions between systems affect both systems.</p> <p>Structures and functions of systems facilitate interactions.</p> <p>Problems in one system can cause problems in another system.</p>
<p>Medicines can treat diseases but can have unintended consequences.</p>	<p>How do scientists ensure that a medication to treat a health condition works and is safe?</p>	<p>How are medicines tested during a clinical trial? (Activity 13)</p> <p>How can data be used to determine the best medicine to research and test? (Activity 14)</p>	<p>(1) 13, 14</p>	<p>MS-LS1-3 MS-LS1-8</p>	<p>Students learn more about the methods scientists use to investigate and treat/cure medical conditions. Cycles back to Activity 1.</p> <p>Students investigate data about effects of a medicine on several systems in human body. Cycles back to Activity 1.</p>

NGSS CORRELATIONS

BODY SYSTEMS

Crosscutting Concepts		Activity number
Cause and Effect	Cause and effect relationships may be used to predict phenomena in natural or designed systems.	1, 6, 7, 8, 13, 14
Energy and Matter	Matter is conserved because atoms are conserved in physical and chemical processes.	5
	Within a natural system, the transfer of energy drives the motion and/or cycling of matter.	5
	The transfer of energy can be tracked as energy flows through a designed or natural system.	5
Scale, Proportion, and Quantity	The observed function of natural and designed systems may change with scale.	11
Stability and Change	Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.	9
Structure and Function	Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.	2, 3, 4, 11, 12
Systems and System Models	Systems may interact with other systems and be a part of larger complex systems.	4, 8, 9, 10, 11, 12, 13, 14
	Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.	2, 3
	Models are limited in that they only represent certain aspects of the system under study.	12
Connections to the Nature of Science	Scientists and engineers are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	1, 13, 14
Science and Engineering Practices		Activity number
Analyzing and Interpreting Data	Analyze and interpret data to determine similarities and differences in findings.	13, 14
	Analyze and interpret data to provide evidence for phenomena.	6, 7, 9, 10
	Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).	7

NGSS CORRELATIONS

BODY SYSTEMS (continued)

Science and Engineering Practices		Activity number
Asking Questions and Defining Problems	Ask questions to identify and clarify evidence of an argument.	2
	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	2
Constructing Explanations and Designing Solutions	Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.	3, 4, 5
	Apply scientific ideas to construct an explanation for real world phenomena, examples, or events.	4, 11, 12
Developing and Using Models	Develop a model to predict and/or describe phenomena.	2
	Develop a model to describe unobservable mechanisms.	5, 12
	Evaluate limitations of a model for a proposed object or tool.	12
Engaging in Argument from Evidence	Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.	1, 4, 12, 13, 14
Obtaining, Evaluating, and Communicating Information	Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.	1
	Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	7, 8
Planning and Carrying Out Investigations	Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.	7
	Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.	10
	Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.	6, 10

NGSS CORRELATIONS

BODY SYSTEMS (continued)

Science and Engineering Practices		Activity number
Using Mathematics and Computational Thinking	Use mathematical representations to describe and/or support scientific conclusions and design solutions.	9
Connections to the Nature of Science	Scientific knowledge is based on logical and conceptual connections between evidence and explanations.	1, 11
Structure and Function (LS1.A)	All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).	5
	In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.	1, 2, 3, 4, 9, 10, 11, 12, 13, 14
Disciplinary Core Ideas		Activity number
Organization for Matter and Energy Flow in Organisms (LS1.C)	Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.	5
Information Processing (LS1.D)	Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.	6, 7, 8
Energy in Chemical Processes and Everyday Life (PS3.D)	Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.	10
Performance Expectations		Activity number
From Molecules to Organisms: Structures and Processes (LS1)	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (MS-LS1-3)	12
	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. (MS-LS1-8)	8

COMMON CORE STATE STANDARDS: CONNECTIONS AND CORRELATIONS

BODY SYSTEMS

Making Connections in ELA

As with all SEPUP instructional materials, this unit introduces multiple opportunities for students to engage in a range of ELA practices and skills that are important grade-specific goals of the common core state standards and are also essential to the sensemaking students are doing throughout the unit. Specifically, in activities 1, 4, 8 and 11, students obtain and evaluate key textual and visual information from readings and multimedia about gathering data in clinical trials and the interactions between different body systems (RST.6-8.2; RST.6-8.4; RST.6-8.7; RST.6-8.9). They use this information to construct explanations about the functions within and between systems. In addition, students also engage in hands-on investigations and experiments in activities 9, 10 and 13, following a multi-step procedure (RST.6-8.3) to further develop their sensemaking and making predictions and interpreting data about body system interactions. In activity 3, students also engage in collaborative discussions (SL8.1) to develop collective understanding of body systems. The unit culminates with students documenting and sharing their collective sensemaking (WHST.6-8.2) in activity 12 and drawing on evidence gathered from the unit’s readings and investigations (WHST.6-8.9) to write text that supports their argumentation (WHST.6-8.1) in a simulated clinical trial for medicines in activities 13 and 14. Specific literacy strategies are embedded throughout the unit to support student development of particular ELA skills and practices. In addition, appendix E in the Student Book contains optional resources to support reading, writing and oral communication.

Common Core State Standards – English Language Arts		Activity number
Reading in Science and Technical Subjects (RST)	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (RST.6-8.2)	5, 11
	Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)	9, 10, 13
	Determine the meaning of symbols, Key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. (RST.6-8.4)	4, 8
	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (RST.6-8.7)	1, 2
	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (RST.6-8.9)	1, 5
Speaking and Listening (SL)	Engage effectively in a range of collaborative discussions (e.g., one-on-one, in groups, teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others’ ideas and expressing their own clearly. (SL8.1)	3

Common Core State Standards – English Language Arts		Activity number
Writing in History/ Social Studies, Science, and Technological Subjects (WHST)	Write arguments focused on discipline-specific content. (WHST.6-8.1)	12, 13, 14
	Write informative/explanatory texts to examine and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (WHST.6-8.2)	12
	Draw evidence from informational texts to support analysis, reflection, and research. (WHST.6-8.9)	14

Making Connections in Mathematics

This unit introduces an opportunity for students to engage in an important grade-specific statistics and probability concept of the common core state standards. Specifically, in activity 9 of this unit, students collect, analyze and interpret data about their own heart to make sense of how body systems - specifically the circulatory and respiratory systems - affect each other and how body systems interact and work together. The activity engages students in the use of statistical plots to support the analysis and interpretation of their data (6.SP.B.4). An optional student sheet entitled “Scatterplot and Line Graphing Checklist” is provided in Appendix C: Science Skills in the Student Book for students who need additional support.

Common Core State Standards – Mathematics		Activity number
Statistics and Probability (SP)	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (6.SP.B.4)	9