

Inv	Inv Title	Part	Part Summary	Sessions	Content	NGSS Standards Addressed	Disciplinary Core Ideas (Framework)	Crosscutting Concepts	Scientific and Engineering Practices (SP / EP)							
									Asking questions (SP) / Defining problems (EP)	Developing and using models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and comp. thinking	Constructing explanations (SP) / Designing solutions (EP)	Engaging in argument from evidence	Obtaining, evaluating, and communicating information
1	Systems Connections	1	Human Body Structural Levels Students are presented with a patient who has symptoms that could lead to a number of diagnoses. They determine a course of learning that begins with confirming the levels of complexity in a multicellular organism.	1	<ul style="list-style-type: none"> Multicellular organisms are complex systems composed of organ systems, which are made of organs, which are made of tissues, which are made of cells. Cells are made of cell structures, which are made of molecules, which are made of atoms. 	<p>MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. (Foundational)</p> <p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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). (MS-LS1-1) 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. (MS-LS1-3) 	<p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> The observed function of natural and designed systems may change with scale. Phenomena that can be observed at one scale may not be observable at another scale. 	SP						SP	SP
1	Systems Connections	2	Systems Research Students continue their research to determine a diagnosis by focusing on human organ systems. They learn about how one organ system interacts with other organ systems in the body to support life processes. They pool their learning with the rest of the class. They conclude by making a tentative diagnosis of the patient, arguing their case to other students. They learn additional information that allows them to make a conclusive diagnosis.	4	<ul style="list-style-type: none"> Multicellular organisms are made of organ systems, which are made of organs, which are made of tissues, which are made of cells. Cells are made of cell structures, which are made of molecules, which are made of atoms. The human body is a system of interacting subsystems. 	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. (MS-LS1-3) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems <p>Structure and Function</p> <ul style="list-style-type: none"> 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. <p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems 				SP		SP	SP	SP
2	Supporting the Cells	1	Food and Oxygen Students participate in an exercise activity to think about how the cells in the human body get oxygen and energy (food). They watch video clips and manipulate an online activity to add detail to their ideas. They construct a model to illustrate the pathways that oxygen and energy (food) take from the external environment to a muscle cell in the leg.	3	<ul style="list-style-type: none"> The human body is a system of interacting subsystems. The respiratory system supplies oxygen and the digestive system supplies energy (food) to the cells in the body. The circulatory system carries food and oxygen to the cells in the body and carries waste products to the excretory/respiratory systems for disposal. 	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. (MS-LS1-3) <p>LS1.C: Organization for Matter and Energy Flow in Organisms</p> <ul style="list-style-type: none"> 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. (MS-LS1-7) 	<p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. 		SP				SP		SP
2	Supporting the Cells	2	Aerobic Cellular Respiration Students model the substances and steps in aerobic cellular respiration. They summarize the entire process, demonstrating how substances get to the cells, what happens at the cells, and how substances depart from the cells to be removed from the body.	4	<ul style="list-style-type: none"> The human body is a system of interacting subsystems. The respiratory system supplies oxygen and the digestive system supplies energy (food) to the cells in the body. The circulatory system carries food and oxygen to the cells in the body and carries waste products to the excretory/respiratory systems for disposal. Aerobic cellular respiration is the process by which energy stored in food molecules is converted into usable energy for cell. 	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p> <p>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.</p>	<p>LS1.C: Organization for Matter and Energy Flow in Organisms</p> <ul style="list-style-type: none"> 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. (MS-LS1-7) <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> Cellular respiration in plants and animals involve 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. (secondary to MS-LS1-7) 	<p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> The observed function of natural and designed systems may change with scale. Phenomena that can be observed at one scale may not be observable at another scale. <p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural system, the transfer of energy drives the motion and/or cycling of matter. The transfer of energy can be tracked as energy flow through a natural system. 		SP				SP		SP

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3	The Nervous System	1	Interacting with the Environment Students think about how humans sense the environment around them and then turn their attention to the sense of touch. They compare touch sensitivity between fingertips and knuckles to learn about pressure receptors and receptive fields.	2	<ul style="list-style-type: none"> Sensory receptors respond to an array of mechanical, chemical, and electromagnetic stimuli. 	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p> <p>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.</p>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. (MS-LS1-3) <p>LS1.D: Information processing</p> <ul style="list-style-type: none"> 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. (MS-LS1-8) 	<p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> The observed function of natural and designed systems may change with scale. Phenomena that can be observed at one scale may not be observable at another scale. <p>Structure and Function</p> <ul style="list-style-type: none"> 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. 		SP	SP	SP		SP	SP	SP
3	The Nervous System	2	Sending a Message Students consider the stimulus/response phenomenon. They develop a model to explain how messages are transmitted along neurons and across synapses, to and from the brain.	3	<ul style="list-style-type: none"> Sensory information is transmitted electrically to the brain along neural pathways for processing and response. 	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p> <p>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.</p>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. (MS-LS1-3) <p>LS1.D: Information processing</p> <ul style="list-style-type: none"> 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. (MS-LS1-8) 	<p>Cause and effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. <p>Structure and Function</p> <ul style="list-style-type: none"> 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. 		SP		SP		SP	SP	SP
3	The Nervous System	3	Other Senses Students explore the sense of smell by identifying scents, and the sense of sight by testing reaction time. They read about chemical receptors and photoreceptors and consider how their eyes are designed to interpret electromagnetic information.	3	<ul style="list-style-type: none"> Sensory receptors respond to an array of mechanical, chemical, and electromagnetic stimuli. Sensory information is transmitted electrically to the brain along neural pathways for processing and response. 	<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p> <p>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.</p>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. (MS-LS1-3) <p>LS1.D: Information processing</p> <ul style="list-style-type: none"> 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. (MS-LS1-8) 	<p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems 				SP		SP		SP
3	The Nervous System	4	Learning and Memory Students use mirror drawing to explore the connection between hand-eye coordination, learning, and memory. They use various combinations of sensory input to memorize lists of objects. They look for patterns to determine strategies for improving short-term memory.	6	<ul style="list-style-type: none"> Neural pathways change and grow as information is acquired and stored as memories. 	<p>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.</p>	<p>LS1.D: Information processing</p> <ul style="list-style-type: none"> 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. (MS-LS1-8) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns in rates of change and other numerical relationships can provide information about natural and human-designed systems. Patterns can be used to identify cause-and-effect relationships. 				SP		SP		SP