NGSS OVERVIEW

FROM CELLS TO ORGANISMS

Performance Expectation 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.

Performance Expectation MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Performance Expectation MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

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.

This unit also builds toward more complete understanding of concepts related to MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. MS-LS1-3 is assessed in the Body Systems unit of *Issues and Life Science*.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Investigation: Disease Outbreak** Students participate in a model of the spread of infectious disease. They analyze data from the model to identify patterns, and then use the patterns supported by the data to determine the cause of the spread of the infectious disease. The problem of diagnosing and treating an infectious disease provides a context for the exploration of cell structure and function that follows.	MS-LS1.A	Analyzing and Interpreting Data Using Mathematics and Computational Thinking Constructing Explanations and Designing Solutions	Patterns Cause and Effect Scale, Proportion, and Quantity Connections to Nature of Science	ELA/Literacy: RST 6-8.3 Mathematics: MP.2 6.SB.B.5
2. **View and Reflect: An Invisible Organism** A video segment introduces the idea that there are some living organisms that cannot be seen without the use of tools such as microscopes. Students consider the role of evidence in developing scientific explanations about the role of microbes in spreading infectious diseases. Over the course of the next few activities, the concept that these microscopic organisms are alive and made of a single cell is developed.	MS-LS1.A	Engaging in Argument from Evidence	Cause and Effect Scale, Proportion, and Quantity Connections to Engineering, Technology, and Applications of Science Connections to Nature of Science	ELA/Literacy: RST.6-8.9

FROM CELLS TO ORGANISMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
3. **Laboratory: Evidence of Microscopic Organisms** Students use microscopes to conduct an investigation that will provide evidence of microscopic living organisms. They begin to observe the pattern that living things are made of cells. They also experience the usefulness of microscope technology in investigating biological structures at scales too small to be observed by the human eye.	MS-LS1.A	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Scale, Proportion, and Quantity Structure and Function Connections to Engineering, Technology, and Applications of Science Connections to Nature of Science	ELA/Literacy: RST.6-8.3
4. **Reading: The History of Cell Theory** Students read about the relationship between the development of the cell theory and the germ theory of disease. The idea that all living things are made of cells in introduced. The role that advances in microscope technology played in furthering scientific knowledge is highlighted.	MS-LS1.A	Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	Scale, Proportion, and Quantity Structure and Function Connections to Engineering, Technology, and Applications of Science Connections to Nature of Science	ELA/Literacy: RST.6-8.9 WHST.6-8.9
5. **Laboratory: Cells Alive!** Students explore the idea that both unicellular and multicellular organisms are living. Students carry out and interpret investigations to obtain evidence of cellular respiration by yeast. This concept of how cells obtain and use matter and energy from food is developed and then revisited in later activities.	MS-LS1.A MS-LS1.C MS-PS3.D	Analyzing and Interpreting Data Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Developing and Using Models	Energy and Matter	ELA/Literacy: RST.6-8.3 Mathematics: MP.2
6. **Reading: Parts of a Cell** A reading on cells emphasizes the complementary nature of structure and function. Students learn that cells of all organisms have similar structures (e.g., the cell membrane), and these structures function similarly in each organism.	MS-LS1.A	Obtaining, Evaluating, and Communicating Information Developing and Using Models Constructing Explanations and Designing Solutions	Scale, Proportion, and Quantity Structure and Function Systems and System Models	ELA/Literacy: RST.6-8.7 RST.6-8.9 WHST.6-8.9 Mathematics: MP.2

FROM CELLS TO ORGANISMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
7. **Investigation: Investigating the Cell Membrane** The role of the cell membrane within a cell is further investigated as students construct a simple cell model. They use the model to investigate how the cell membrane acts as a boundary that controls what enters and leaves the cell.	MS-LS1.A	Planning and Carrying Out Investigations Analyzing and Interpreting Data Developing and Using Models Connections to Nature of Science	Scale, Proportion, and Quantity Structure and Function	ELA/Literacy: RST.6-8.3 WHST.6-8.2 Mathematics: MP.2 6.SP.B.5
8. **Modeling: Modeling Cell Structure and Function** An interactive computer animation helps review the ways that parts of a cell contribute to its function and compares plant and animal cell structures and functions. Students use the knowledge gained over the last few activities to develop and use a model to describe the function of a cell as a whole and ways that parts of cells contribute to the function. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-2.	MS-LS1.A	Developing and Using Models Obtaining, Evaluating, and Communicating Information	Scale, Proportion, and Quantity Structure and Function Systems and System Models	ELA/Literacy: RST.6-8.7 WHST.6-8.2 SL.8.5
9. **Laboratory: Observing Multicellular Organisms** Students use microscopes to further their investigations of the cellular nature of life. They gather additional evidence that living things are made of one or many cells and that cells of different organisms share certain structural components (e.g., the cell membrane). These structures function similarly in different organisms.	MS-LS1.A	Planning and Carrying Out Investigations Analyzing and Interpreting Data Constructing Explanations and Designing Solutions	Scale, Proportion, and Quantity Structure and Function Connections to Engineering, Technology, and Applications of Science Connections to Nature of Science	ELA/Literacy: RST.6-8.3
10. **Reading: Cells, Tissues, and Organs** Students recognize levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms. They compare the types of cells found in living things and begin to develop the idea that the body is a system of interacting subsystems composed of cells. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-1.	MS-LS1.A	Obtaining, Evaluating, and Communicating Information Constructing Explanations and Designing Solutions Engaging in Argument from Evidence	Scale, Proportion, and Quantity Structure and Function Systems and System Models	ELA/Literacy: RST.6-8.9 WHST.6-8.9 Mathematics: MP.2

FROM CELLS TO ORGANISMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
11. **Modeling: Energy and Matter in Cells** Students read a series of three text passages about the composition of food, breakdown of food, and use of food for matter and energy. After the first passage, they begin to develop a model to explain how organisms obtain matter and energy. After each additional passage, they modify and elaborate their models to account for the new information provided. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-7. The activity also addresses conservation of matter from the perspective of reuse of matter, without going to the atomic level.	MS-LS1.A MS-LS1.C MS-PS3.D	Developing and Using Models Constructing Explanations and Designing Solutions Connections to Nature of Science	Energy and Matter	ELA/Literacy: RST.6-8.2 RST.6-8.9
12. **Laboratory: The Cells of Plants** Students investigate plant-specific cellular structures through microscopy. By comparing photosynthetic and nonphotosynthetic cells, they will identify structures required for photosynthesis. Students will also explore the structure–function relationship between plant-specific structures and photosynthesis.	MS-LS1.A MS-LS1.C MS-PS3.D	Constructing Explanations and Designing Solutions	Energy and Matter Structure and Function	ELA/Literacy: RST.6-8.3
13. **Laboratory: A Plant's Source of Energy** Students plan and carry out investigations to collect evidence that plants produce and break down sugars. Students investigate the role of carbon dioxide and light in photosynthesis. Experimental results should lead students to an understanding of how matter (carbon) cycles through a plant. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-6.	MS-LS1.C MS-PS3.D	Analyzing and Interpreting Data Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions	Energy and Matter	ELA/Literacy: RST.6-8.3

FROM CELLS TO ORGANISMS (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
14. **View and Reflect: Fighting Disease** Students explore how knowledge about cell structure and function has helped scientists develop drugs that treat diseases caused by unicellular organisms. A video segment on the discovery of antibiotics to treat infectious disease highlights how scientists formulate and test their explanations using observations and experiments.	MS-LS1.A	Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	Scale, Proportion, and Quantity Cause and Effect Connections to Engineering, Technology, and Applications of Science Connections to Nature of Science	ELA/Literacy: RST.6-8.7 RST.6-8.9
15. **Investigation: Disease Detectives** Students analyze data to develop hypotheses for the infectious agent causing a disease outbreak. Slides of cultures from patients allow them to support or confirm their hypotheses. The activity concludes with students explaining how an understanding of cells and infectious agents can help medical professionals with the diagnosis and treatment of diseases.	MS-LS1.A	Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Connections to Nature of Science	Cause and Effect	ELA/Literacy: RST.6-8.2 WHST.6-8.1 Mathematics: MP.2

FROM CELLS TO ORGANISMS

Unit Issue: Public health, preventing the spread and the treatment of infectious diseases.

Anchoring Phenomenon: Organisms as different as humans, plants, and many of the microorganisms that make people sick are all made of cells. Examples include cells from various animal tissues like blood cells, plant cells, protozoa, and bacteria, including specific microorganisms that cause certain infectious diseases. Students generate and answer questions such as: How are the cells of various organisms alike? How are they different? How do these similarities and differences relate to the functions of these cells?

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
Some diseases can be spread from person to person.	How did scientists discover that microbes could cause and spread disease?	How do scientists figure out the source of an infectious disease outbreak? (Activity 1)	1, 2, 3, 4 (14, 15)	MS-LS1-1	An infectious disease can be transmitted from person to person.
		What can cause an infectious disease? (Activity 2)			Microscopic living organisms are the cause of some infectious diseases.
		How can tools such as microscopes help scientists provide evidence about living organisms? (Activity 3)			Microscopes provide evidence of organisms at scales too small to be observed by the human eye.
		How did the cell theory lead to the germ theory of disease? (Activity 4)			The idea that all living organisms are made of cells led to the germ theory of disease.
Even though organisms may look different on the outside, their cells have a lot in common.	What structures and functions do living cells have in common?	What evidence can you gather that cells are alive? (Activity 5)	5, 6, 7, 8	MS-LS1-2	Cells are alive and respire.
		How do the structures in animal and plant cells relate to their functions? (Activity 6)			Cells of all organisms have similar structures, and these structures function similarly in each organism.
		What is the function of a cell membrane? (Activity 7)			The cell membrane is an example of a cell structure that functions similarly in different organisms.
		How do the parts of a cell work together? (Activity 8)			Models can be used to demonstrate and describe cell structures and their functions.

PHENOMENA, DRIVING QUESTIONS AND SEPUP STORYLINE

FROM CELLS TO ORGANISMS (continued)

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
Some organisms are just one cell, while other organisms have many cells.	What is the difference between unicellular and multicellular organisms?	How do the cells of multicellular organisms compare with the cells of single-celled organisms? (Activity 9)	9, 10	MS-LS1-1 MS-LS1-3	Microscopes provide evidence that living things are made of one or many cells and that cells of different organisms share certain structures.
		What is the relationship between cells, tissues, organs, and organ systems within a multicellular organism? (Activity 10)			Animals and plants have levels of organization, including cells, tissues, organs, organ systems, and organisms.
Living organisms need food to survive.	How do living organisms obtain and use the matter and energy they need to survive?	How does food provide energy and matter for organisms? (Activity 11)	11, 12, 13	MS-LS1-6 MS-LS1-7	Food is rearranged through chemical reactions that support growth and/or release energy for cells.
		What structures in plant cells convert energy from the sun into energy stored in food? (Activity 12)			Plant cells contain structures for photosynthesis, a process that uses sunlight to synthesize food.
		What is the evidence that plants both produce and break down sugars? (Activity 13)			Experiments can provide evidence of photosynthesis and respiration in plants.
Infectious diseases can be diagnosed and treated.	How can knowledge of cells be used to identify and treat microbial diseases?	How can knowledge of cell structure and function be used to treat disease? (Activity 14)	14, 15	MS-LS1-1 MS-LS1-2	Knowledge of cell structure and function has helped scientists develop drugs that treat diseases caused by unicellular organisms.
		What microbe caused the outbreak? (Activity 15)			An understanding of cells and infectious agents can help identify the source and transmission of infectious diseases.

NGSS CORRELATIONS

FROM CELLS TO ORGANISMS

Crosscutting Concepts		Activity number
Cause and Effect	Cause and effect relationships may be used to predict phenomena in natural or designed systems.	1, 2, 14, 15
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.	11, 12, 13
	The transfer of energy can be tracked as energy flows through a designed or natural system.	5, 11, 12, 13
Patterns	Patterns can be used to identify cause and effect relationships.	1
	Graphs, charts, and images can be used to identify patterns in data.	1
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.	3, 4, 6, 7, 8, 9, 10, 12
Systems and System Models	Systems may interact with other systems and be a part of larger complex systems.	6, 8
	Models are limited in that they only represent certain aspects of the system under study.	8
Scale, Proportion, and Quantity	Phenomena that can be observed at one scale may not be observable at another scale.	1, 2, 3, 4, 6, 7, 8, 9, 10, 14
Connections to Engineering, Technology, and Applications of Science	Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems	2, 3, 4, 9, 14
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.	14
	Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	1, 2, 4, 9, 14
	Advances in technology influence the progress of science, and science has influenced advanced in technology.	3, 4, 9

Science and Engineering Practices		Activity number
Analyzing and Interpreting Data	Analyze and interpret data to determine similarities and differences in findings.	3, 9, 13
	Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	1
	Analyze and interpret data to provide evidence for phenomena.	1, 5, 7, 15
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.	4, 5, 9, 10, 11, 12, 13, 15
	Apply scientific ideas to construct an explanation for real world phenomena, examples, or events.	1, 6, 14, 15
Developing and Using Models	Develop a model to predict and/or describe phenomena.	6, 7, 8
	Develop a model to describe unobservable mechanisms.	5, 7, 11
	Evaluate limitations of a model for a proposed object or tool.	8
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.	2, 10
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.	4, 6, 8, 10, 14
Planning and Carrying Out Investigations	Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.	3, 5, 7, 9, 13
	Evaluate the accuracy of various methods for collecting data.	3
Using Mathematics and Computational Thinking	Use mathematical representations to describe and/or support scientific conclusions and design solutions.	1
Connections to the Nature of Science	Scientific knowledge is based on logical and conceptual connections between evidence and explanations.	7, 11, 15

Disciplinary Core Ideas		Activity number
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).	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15
	Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.	4, 6, 7, 8, 10, 12, 14
	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.	10, 14, 15
Organization for Matter and Energy Flow in Organisms (LS1.C)	Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.	12, 13
	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, 11
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.	5, 11, 12, 13
Performance Expectations		**Activity number**
From Molecules to Organisms: Structures and Processes (LS1)	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. (MS-LS1-1)	9
	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (MS-LS1-2)	8
	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. (MS-LS1-6)	13
	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. (MS-LS1-7)	11

COMMON CORE STATE STANDARDS: CONNECTIONS AND CORRELATIONS

FROM CELLS TO ORGANISMS

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 activity 1, students follow a multi-step procedure as they gather and analyze data from a model of the spread of an infectious disease (RST.6-8.3). In activities 2 and 4, students watch a video of historical disease spread and complete a reading on the development of cell theory and the germ theory of disease to compare and write about their initial understanding in light of new information (RST.6-8.9; WHST.6-8.9). Students continue to build their knowledge of disease spread in activity 6, where they read text and construct diagrams to develop connections to cell structure and function (RST.6-8.7). In activity 8, students use a computer simulation to better visualize cell structure and function (SL8.5), and to create and explain their own models (WHST.6-8.2). Towards the end of the unit, in activity 11, students complete a reading to develop a more sophisticated understanding of cell function by focusing on the breakdown of food for matter and energy (RST.6-8.2). In the final activity (15) of this unit, students use data as evidence to construct arguments about the microbial source of an outbreak, and write recommendations for preventing the spread of this infectious disease (WHST.6-8.1). In addition, Appendix E: Literacy Strategies 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)	11, 15
	Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)	1, 3, 5, 7, 9, 12, 13
	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)	6, 8, 14
	Compare and contrast the information gained from experiments, simulations, video, or multi-media sources with that gained from reading a text on the same topic. (RST.6-8.9)	2, 4, 6, 10, 11, 14
Speaking and Listening (SL)	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (SL8.5)	8
Writing in History/ Social Studies, Science, and Technological Subjects (WHST)	Write arguments focused on discipline-specific content. (WHST.6-8.1)	15
	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)	7, 8
	Draw evidence from informational texts to support analysis, reflection, and research. (WHST.6-8.9)	4, 6, 10

Making Connections in Mathematics

Students have several opportunities to summarize numerical data sets in the context of the experiments and investigations (6.SP.B.5). In Activity 1, students gather, graph, and analyze data on the spread of a disease based on a hands-on model conducted as a class. In Activity 7, students have the opportunity to conduct a quantitative investigation on the role of the cell membrane, gathering and analyzing data from their experiment. This unit also provides several opportunities for students to engage in the important mathematical practice of reasoning abstractly and quantitatively (MP.2). For example, in Activity 5, students compare the results of their own investigation with quantitative data provided for them to reason about the similarities between respiration between yeast and humans. In Activities 6 and 10, students reason abstractly about the relative sizes of different types of cellular organisms and different levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms.

Common Core State Standards – Mathematics		Activity number
Mathematical Practice (MP)	Reason abstractly and quantitatively. (MP.2)	1, 5, 6, 7, 10, 15
Statistics and Probability (SP)	Summarize numerical data sets in relation to their context (5.SP.B.5)	1, 7