Project-Based Inquiry Science: Good Friends and Germs
Storyline

Targeted Performance Expectations:
· MS–LS1–1 · MS–LS1–2 · MS–LS1–3 · MS–LS1–5 · MS–ETS1–1 · MS–ETS1–2 · MS–ETS1–3 · MS–ETS1–4

Good Friends and Germs: What's the Big Question?
How Can You Prevent Your Good Friends from Getting Sick?

Storyline (with Disciplinary Core Ideas and Science Content)	Science and Engineering Practices	Crosscutting Concepts
In the introduction to *Good Friends and Germs*, students examine the *Big Question: How can you prevent your good friends from getting sick?* Students are introduced to this Unit by considering how diseases are spread. They pass around a microbe doll covered in an undetectable powder that is sensitive to ultraviolet light to begin their understanding on how germs are passed from person to person, which also helps them to define communicable disease. They are introduced to the challenges of the Unit, and set up the *Project Board* as a tool to help meet their learning goals as they answer the *Big Question*.	**Obtaining, Evaluating, and Communicating Information** (examine how diseases are spread from human to human) **Asking Questions and Defining Problems** (students create the *Project Board* and list what they think they know and construct questions they would like to investigate) **Developing and Using Models** (use a model to describe how diseases spread)	Unit Level: **Patterns** **Cause and Effect** Section Level: **Systems and System Models**

Good Friends and Germs: Learning Set 1
How Do You Get Sick?

Storyline (with Disciplinary Core Ideas and Science Content)	Science and Engineering Practices	Crosscutting Concepts
Introduction to *Learning Set 1*: In the introduction to *Learning Set 1*, students begin to consider how people get sick.		
Section 1.1: This section engages students in active reflection on how diseases are spread in preparation for answering the *Big Question*. Working collaboratively, they identify what they think they know about how people get sick, what they are unsure of, and what needs to be investigated. Students formulate questions in their groups that might help them answer the *Learning Set* question: *How do you get sick?* Groups select their two most interesting questions to share with the class and the *Project Board* is updated.	**Asking Questions and Defining Problems** (students create the *Project Board* and add what they think they know and questions they would like to investigate)	Unit Level: **Cause and Effect**
Section 1.2: Students assume the role of epidemiologists as they work to determine the initial carrier of a disease. Using a model to simulate the passage of germs between members of the class. After the first investigation students face the challenge of trying to recall sufficient details to determine the initial carrier. This experience underscores the need for keeping detailed, accurate records during an investigation. The class then designs a method for recording and organizing the data needed to reconstruct the interactions in sufficient detail. They repeat the investigation, putting their ideas into action. Upon completion of the second iteration, students share their data with the class, collaborate, analyze and then determine the initial carrier.	**Developing and Using Models** (use an interactive model to simulate the passage of germs between class members) **Analyzing and Interpreting Data** (collect data to determine the initial carrier in a disease spreading simulation) **Planning and Carrying Out Investigations** (use a model to investigation the spread of diseases)	Unit Level: **Cause and Effect** **Patterns**

Section 1.3: Students develop academic vocabulary as they read about communicable and non-communicable diseases. Students identify both types of diseases and recall what they observed from the simulations to develop claims about how they can get sick from a communicable disease. They then make recommendations about staying healthy. **Disciplinary Core Ideas:** **ETS1.B: Developing Possible Solutions** · A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) · There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) · Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) · Models of all kinds are important for testing solutions. (MS-ETS1-4)	**Obtaining, Evaluating, and Communicating Information** (reading informational text to examine types of diseases) **Construction Explanations** (develop a claim using evidence about how you can get sick with communicable diseases)	Unit Level: **Cause and Effect** **Patterns**
Back to the Big Question: Students reflect on the key ideas in *Learning Set 1* as they begin to think about the *Big Question* and its challenges. Students update the *Project Board* as a record of their learning and understanding of communicable diseases and progress toward the goal of the Unit—to make a recommendation on how to prevent their friends from getting sick. **Disciplinary Core Ideas:** **ETS1.B: Developing Possible Solutions** · A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) · There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) · Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) · Models of all kinds are important for testing solutions. (MS-ETS1-4)	**Obtaining, Evaluating, and Communicating Information** (communicate new knowledge while updating the *Project Board*)	Unit Level: **Cause and Effect** **Patterns**

Good Friends and Germs: Learning Set 2
What Kinds of Things Make You Sick?

Storyline (with Disciplinary Core Ideas and Science Content)	**Science and Engineering Practices**	**Crosscutting Concepts**
Introduction to *Learning Set 2*: This *Learning Set* is designed to engage students in active consideration of the question, *What Kinds of Things Make You Sick?*	**Asking Questions and Defining Problems** (update the *Project Board* with questions related to the *Big Question* and the *Learning Set* objectives)	Unit Level: **Cause and Effect**
Section 2.1: Working collaboratively, students identify what they think they know about what makes people sick and formulate questions that will help them answer the *Learning Set* question. Groups evaluate whether their questions meet the criteria that questions are interesting to them personally, require several resources to answer, relate to the *Big Question*, require collecting and using data, and not have a yes/no answer. Each group then selects their two most interesting questions to share with the class, and the *Project Board* is updated.		

Section 2.2: Students develop academic vocabulary as they are introduced to the causes, symptoms, spread, prevention, and treatment of gastrointestinal illnesses. They begin the *Communicable-Disease Information Table* to keep track of many aspects of diseases which will assist them in answering the *Big Question*. This brief introduction to germs prepare students for upcoming investigations into cells and bacteria, and gives them base knowledge for when they learn about viruses later in the Unit.	**Obtaining, Evaluating, and Communicating Information** (develop knowledge about the causes, symptoms, spread and prevention of a common communicable disease)	Unit Level: **Cause and Effect** **Patterns** Section Level: **Stability and Change**
Section 2.3: Students compare and contrast animal and plant cells as they explore the structure and functions of specific organelles. They are introduced to the compound microscope and magnification as they observe prepared slides cells and prepare a wet mount of their own. Students make detailed drawings of what they observe, share and discuss the drawings with their group. After labeling all the cellular structures they are able to identify, they pick one cell and make a poster of it, labeling the organelles and their functions. Groups present their posters to the class and discuss their observations. The class updates the *Project Board*, connecting what they have just learned about cells to understanding the nature of germs. *More To Learn*: Students explore the mechanisms of magnification within a microscope and work with ratios to estimate size of an object in the field of vision. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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) · Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)	**Obtaining, Evaluating, and Communicating Information** (identify cell structures, compare and contrast plant and animal cells) **Developing and Using Models** (create drawings of cells and cell structures)	Unit Level: **Patterns** Section Level: **Structure and Function**
Section 2.4: Students deepen their academic vocabulary as they extend what they have learned about cells to include bacteria. They learn about the cellular structure of bacteria and distinction between prokaryotic and eukaryotic cells. Students consider ways in which bacteria may be beneficial or harmful. They explore why bacteria are considered to be alive and how their ability to adjust to changes in their environment enables them to survive under a wide range of conditions. Students consider how bacteria can make us sick as they develop new knowledge, which will help them answer the *Big Question*. **Disciplinary Core Ideas:** **LS4.D: Biodiversity and Humans** · Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)	**Obtaining, Evaluating, and Communicating Information** (explore bacteria as a one celled organism and their role in making people sick)	Unit Level: **Cause and Effect** Section Level: **Structure and Function**

Section 2.5: Students apply what they have learned about bacteria as they examine a case study involving of a restaurant catering service whose customers complain about getting sick after eating the restaurant's food. Students analyze data in their small groups to determine the cause of the sickness, present their conclusions with supporting evidence to the class and come to consensus as to the cause. They *Update the Project Board* with new learning about what makes people sick as they work toward answering the *Learning Set* question	**Engaging in Argument from Evidence** (present explanations about the causes of customers illness, arguing from evidence) **Analyzing and Interpreting Data** (organize and analyze data from observations) **Constructing Explanations** (present explanations about the causes of customers illness, creating claims with evidence from data)	Unit Level: **Cause and Effect** **Patterns** Section Level: **Scale, Proportion, and Quantity**
Section 2.6: Students collaborate as a class to design an investigation about where bacteria can be found in the classroom. They develop a question to guide the investigation, predict the outcome, identify the independent and dependent variables as well as any controls, and develop a procedure. In their small groups students run the investigation, collect then analyze data, share the results with the class and consider sources of error in their procedure. Students make a claim based on scientific evidence about the presence of bacteria on the tested surfaces. **Disciplinary Core Ideas:** **ETS1.A: Defining and Delimiting Engineering Problems** · The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)	**Asking Questions** (determine a question to guide an investigation) **Planning and Carrying Out Investigations** (plan then carry out an investigation to determine where bacteria can be found) **Obtaining, Evaluating, and Communicating Information** (share the results of an investigation and reflect on the fairness of the procedure) **Constructing Explanations** (present claims with evidence about the presence of bacteria on classroom surfaces)	Unit Level: **Patterns** Section Level: **Scale, Proportion, and Quantity**
Section 2.7: Students extend their experience from *Section 2.6* about bacteria in the classroom to develop their own research question. They gain experience in designing their own investigation, by identifying the independent and dependent variables as well as any controls, and create the series of steps to be taken. They determine how they will gather and grow the bacteria, determine the amount and consider precautions they should take. Students share their procedure with the class, make revisions based on feedback from their peers, then run the investigation, collect and analyze the data. Students share the results with the class by making a poster about what they have learned about where bacteria live. **Disciplinary Core Ideas:** **ETS1.A: Defining and Delimiting Engineering Problems** · The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)	**Asking Questions** (determine a question to guide an independent investigation) **Planning and Carrying Out Investigations** (carry out an investigation to collect data on the presence of bacteria) **Analyzing and Interpreting Data** (collect then analyze data to answer the research question)	Unit Level: **Patterns** Section Level: **Scale, Proportion, and Quantity**

Section 2.8: Students are presented with information about viruses as a disease carry agent. Viruses and bacteria are compared and contrasted, and students examine information about a variety of diseases caused by viruses, including how they are spread, the effect of the disease on the body, and if a cure has been found. Students then consider whether viruses are alive and the how viruses reproduce. Students deepen and use their academic vocabulary as they add and organize new knowledge to the *Communicable Disease Information Table*. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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) · Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)	**Obtaining, Evaluating, and Communicating Information** (develop new knowledge about viruses by reading informational text)	Unit Level: **Cause and Effect** Section Level: **Structure and Function**
Section 2.9: Students explore a disease caused by a virus by examining a case study about smallpox. They consider both the characteristics of the disease and the historic role smallpox played in the development of immunization by vaccination.	**Obtaining, Evaluating, and Communicating Information** (develop new knowledge about viruses by reading informational text)	Unit Level: **Cause and Effect**
Section 2.10: Students work in small groups to examine case studies of infectious diseases. Each group becomes an expert for a single disease then orally shares what they have learned with the class. Students add information about the diseases presented by other groups to their *Communicable-Disease Information Table* building knowledge, which will help them answer the *Big Question*.	**Obtaining, Evaluating, and Communicating Information** (develop new awareness about communicable diseases by reading informational text then communicating new knowledge)	Unit Level: **Cause and Effect** **Patterns** Section Level: **Stability and Change**
Back to the Big Question: Students review the key ideas of *Learning Set 2* and reflect on what they have learned. They create an explanation with specific supporting evidence about how people can get sick from communicable diseases. Groups share their explanation with the class then come to consensus on an explanation. Students then consider how what they have learned will help them to answer the *Big Question* and revisit their recommendations about how to keep from getting sick and how to prevent friends from getting sick. They *Update the Project Board* with new knowledge as they work toward addressing the *Big Question*. **Disciplinary Core Ideas:** **ETS1.B: Developing Possible Solutions** · A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) · There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) · Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) · Models of all kinds are important for testing solutions. (MS-ETS1-4)	**Constructing Explanations and Designing Solutions** (create explanations with supporting evidence about how you can get sick from communicable diseases)	Unit Level: **Cause and Effect** **Patterns**

Good Friends and Germs: Learning Set 3 What Happens to You When You Get Sick?		
Storyline (with Disciplinary Core Ideas and Science Content)	**Science and Engineering Practices**	**Crosscutting Concepts**
Introduction to *Learning Set 3*: This section introduces the concept of body systems and elicits students' prior knowledge of organs and body systems.		
Section 3.1: Students record what they think they know about the organs that comprise their body systems. They formulate questions that will help them answer the guiding question of *Learning Set 3*. Working collaboratively within their groups, students evaluate whether their questions meet the criteria for a good question then select their two most interesting questions to share with the class, as they *Update the Project Board*.	**Asking Questions** (formulate questions about what happens when people get sick)	Unit Level: **Cause and Effect**
Section 3.2: Students explore how cells are organized into multicellular organisms. They build academic vocabulary as they examine the levels of organization from cells to tissue, organs and organ systems and how they are interrelated. Students add to their knowledge about how body systems work together to keep us healthy as they add to their knowledge to help answer the *Big Question*. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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)	**Obtaining, Evaluating, and Communicating Information** (explore how the parts of the body work to help keep us healthy)	Section Level: **Scale, Proportion, and Quantity** **Structure and Function** **Systems and System Models**
Section 3.3: Working with a partner, students investigate measuring their breathing rate while at rest and after exercise. They collect and record data from three trials of each rate, analyze the data then communicate their results with the class. Students consider differences between the class average, their own breathing rate and the average breathing rate of the general population. Students then reflect upon their results and identify cause-and-effect relationships between breathing rate and activity level.	**Analyzing and Interpreting Data** (analyze data to find correlation between resting and active breathing rates) **Use Mathematical and Computational Thinking** (calculate averages, find ranges of data, compare and contrast data sets with others) **Planning and Carrying Out Investigations** (record data on breathing rates at rest and after exercise)	Unit Level: **Cause and Effect** Section Level: **Stability and Change** **Structure and Function** **Systems and System Models** **Scale, Proportion, and Quantity**

Section 3.4: Students read about the structure and function of the respiratory system, then build a working model of the respiratory system and use the model to simulate breathing. Building on their investigation from *Learning Set 3*, students investigate how the various parts work together in their model in the process of breathing. Students explore effects of various diseases on the functioning of the respiratory system, add information about respiratory-system diseases to the *Communicable-Disease Information Table* and *Update Project Board* with new knowledge as they work towards answering the *Big Question*. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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)	**Obtaining, Evaluating, and Communicating Information** (read informational text to deepen scientific understanding of the respiratory system, examine diagrams and record information) **Developing and Using Models** (create and run a model of the respiratory system)	Unit Level: **Cause and Effect** Section Level: **Systems and System Models** **Structure and Function**
Section 3.5: Students build on their experience of breathing rates in *Learning Set 3* to investigate their heart rate while at rest and after exercise. They collect and record data from several trials, analyze the data then share their results with the class. Students consider differences between the class average, their own heart rate, and the average heart rate of the general population. Students reflect upon their results and identify cause-and-effect relationships between heart rate and activity level.	**Analyzing and Interpreting Data** (analyze data to find correlation between resting and active heart rates) **Use Mathematical and Computational Thinking** (calculate averages, find ranges of data, compare and contrast data sets with others) **Planning and Carrying Out Investigations** (record data on heart rates at rest and after exercise)	Unit Level: **Cause and Effect** Section Level: **Stability and Change** **Structure and Function** **Scale, Proportion, and Quantity**
Section 3.6: Students simulate the flow of blood by assuming active roles representing the heart, lungs, big toe, and blood. They arranging themselves around the classroom along imaginary circulatory paths between the body parts and simulate gas exchange by trading cards representing oxygen and carbon dioxide. Students connect the model to the circulatory system and extend their understanding by reading about the structure and function of the circulatory system and the role it plays in spreading disease. Students reflect on the strengths and weaknesses of the model, make connections with their previous investigations of breathing and heart rate, add new information to their *Communicable-Disease Information Table* and *Update the Project Board* with scientific information to help answer the question: What happens to you when you get sick? **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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)	**Developing and Using Models** (develop and critique an interactive model of the circulatory system to explain the movement of blood and gas exchange) **Planning and Carrying Out Investigations** (using a model to plan and carry out a simulation of the circulatory system)	Unit Level: **Cause and Effect** Section Level: **Stability and Change** **Structure and Function** **Scale, Proportion, and Quantity**

Section 3.7: Students build a model of the digestive system as a story describing the journey of food through the digestive system is read. Students consider and decide how well the model represents the organs of the digestive system, then read about the ways in which the digestive and circulatory systems work together to provide food to all of the cells in the body. They connect what they know about how germs can enter the body via the digestive system, to actions that can prevent this from happening as they continue to develop their knowledge about what happens when people get sick. Students also read about non-communicable diseases of the digestive system as they update the *Communicable-Disease Information Tables* and *Update the Project Board*. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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)	**Obtaining, Evaluating, and Communicating Information** (reading informational text about the digestive system) **Developing and Using Models** (develop an interactive model of the digestive system to explain the movement of food through the body) **Planning and Carrying Out Investigations** (using a model to plan and carry out a simulation of the digestive system)	Unit Level: **Cause and Effect** Section Level: **Stability and Change** **Structure and Function** **Scale, Proportion, and Quantity**
Section 3.8: Students deepen their understanding about the body's system of defense against disease and gain academic vocabulary by reading informational text. The concept of immunity, introduced in *Learning Set 2*, is extended to describe various methods employed by the body to prevent germs from entering and to combat germs once they have entered. Groups use a poster to present information about one part of the immune system to the class. The class then collaborates to construct a more complete understanding of how the parts of the immune system work together to keep people healthy. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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)	**Obtaining, Evaluating, and Communicating Information** (reading informational text about the immune system, communicate information to others)	Unit Level: **Cause and Effect** Section Level: **Stability and Change** **Structure and Function** **Scale, Proportion, and Quantity**
Back to the Big Question: Students collaborate in small groups to create transparencies of four different body systems showing organs in their correct size and position in relation to the body. They collaborate within their group to identify ways in which the body systems are interconnected and how they interact and overlay the transparencies to illustrate their ideas. Groups then present their findings to the class as they work towards developing an explanation on how people get sick and then a recommendation for staying healthy. *More To Learn:* More in depth information is provided on other systems of the body. Students gain experience reading increasingly difficult informational text as they build academic vocabulary. **Disciplinary Core Ideas:** **LS1.A: Structure and Function** · 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) **ETS1.B: Developing Possible Solutions** · A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) · There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) · Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) · Models of all kinds are important for testing solutions. (MS-ETS1-4)	**Developing and Using Models** (create layers of transparencies to model body systems) **Constructing Explanations** (construct explanations with supporting evidence to explain how people get sick through a body system, and how the body system works to keep us healthy)	Unit Level: **Cause and Effect** Section Level: **Stability and Change** **Structure and Function** **Scale, Proportion, and Quantity**

Good Friends and Germs: Learning Set 4 How Do Scientists Identify and Stop Disease Outbreaks?		
Storyline (with Disciplinary Core Ideas and Science Content)	**Science and Engineering Practices**	**Crosscutting Concepts**
Introduction to *Learning Set 4*: This section is designed to engage students in active reflection about disease outbreaks in preparation for answering the *Big Question*.		
Section 4.1: Students work collaboratively to identify what they think they know about disease outbreaks, what they are unsure of, and what needs to be investigated. Students formulate questions that might help them answer the *Learning Set* question and share with their group. Each group then selects the two most interesting questions to share with the class, and the *Project Board* is updated with new questions. **Disciplinary Core Ideas:** **ETS1.B: Developing Possible Solutions** · A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) · There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) · Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) · Models of all kinds are important for testing solutions. (MS-ETS1-4)	**Asking Questions** (students formulate questions that will help them answer the *Learning Set* question)	Unit Level: **Cause and Effect** Section Level: **Stability and Change**
Section 4.2: Students read informational text to examine how scientists identify and contain disease outbreaks. Students consider how incubation periods influence the spread of disease, and how quarantine is used to stop the spread of a disease. Students examine a news release about avian flu outbreak, and consider ways in which the flu spreads, the effects of incubation period, and possible methods of preventing its further spread. **Disciplinary Core Ideas:** **LS4.D: Biodiversity and Humans** · Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)	**Analyzing and Interpreting Data** (examine information about the spread of avian flu) **Obtaining, Evaluating, and Communicating Information** (read informational text about the how disease outbreaks can be identified)	Unit Level: **Cause and Effect** Section Level: **Stability and Change**
Section 4.3: Students trace a disease outbreak to the sentinel case (initial carrier). Small groups work to trace a disease through a series of simple interactions by creating an interaction diagram to determine the sentinel case and share their results. Students apply what they learned from the first investigation to trace a disease through a more complex set of interactions, collaborating in groups to develop interaction diagrams and evaluating one another's reasoning. They share their diagrams and their reasoning with the class and compare and contrast the two investigations.	**Engaging in Argument from Evidence** (use evidence to determine the initial carrier of a disease)	Unit Level: **Cause and Effect** **Patterns** Section Level: **Systems and System Models**

Section 4.4: Students build academic vocabulary as they read about disease outbreaks that have become pandemics, and how they have influenced history and the outcomes of wars. Students consider the roles of long incubation period and worldwide travel in increasing the spread of a disease outbreak. They consider ways in which governments work together with scientists to identify disease outbreaks early enough for them to be contained.	**Obtaining, Evaluating, and Communicating Information** (read informational text about the how disease outbreaks can be identified and tracked)	Unit Level: **Cause and Effect Patterns**
Back to the Big Question: Students collaborate in small groups to create explanations using scientific evidence to support their ideas on how diseases spread through and across populations. They develop recommendations for helping populations stay healthy providing supporting scientific information they have learned in this Unit. They *Update the Project Board* with the knowledge and information they will need to answer the *Big Question*. **Disciplinary Core Ideas:** **ETS1.B: Developing Possible Solutions** · A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) · There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) · Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) · Models of all kinds are important for testing solutions. (MS-ETS1-4)	**Engaging in Argument from Evidence** (develop recommendations supported by scientific knowledge for helping populations stay healthy) **Constructing Explanations** (create explanations for the spread of disease through a population)	Unit Level: **Cause and Effect Patterns**

Good Friends and Germs: Answer the Big Question
How Can You Prevent Your Good Friends from Getting Sick?

Storyline	Science and Engineering Practices	Crosscutting Concepts
Students synthesize and apply the knowledge gained in this Unit to answer the *Big Question*. Collaborative groups are assigned a specific disease and develop a comprehensive description of that disease, then formulate recommendations in ways of preventing the spread of that disease. They provide supporting evidence and science knowledge on a poster and make a class presentation about their disease, descriptions and recommendations. The class then collaborates to update the *Project Board* with information from these presentations. The class comes to consensus by developing a set of recommendations for making their classroom and school a healthier place and creating posters that can be displayed throughout the school. **Disciplinary Core Ideas:** **ETS1.C: Optimizing the Design Solution** · Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) · The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	**Engaging in Argument from Evidence** (develop recommendations supported by scientific knowledge for helping populations stay healthy) **Constructing Explanations** (create explanations for the spread of disease through a population)	Unit Level: **Cause and Effect Patterns**