NGSS OVERVIEW

EVOLUTION

Performance Expectation MS-LS4-1: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Performance Expectation MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Performance Expectation MS-LS4-3: Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

Performance Expectation MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

Performance Expectation MS-LS4-5: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Performance Expectation MS-LS4-6: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Performance Expectation MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Investigation: The Full Course** Students use a model to explore the cause-and-effect relationship between inappropriate use of antibiotics and the phenomenon of the evolution of antibiotic resistance. As they use the model, students use mathematical representations to support their analysis of patterns and trends in the results and to develop explanations for how and why the population of bacteria is changing. These explanations are based on the differential survival and reproduction of resistant bacteria when antibiotics are present in their environment (the human body they are infecting).	MS-LS4.B MS-LS4.C	Analyzing and Interpreting Data Developing and Using Models Using Mathematics and Computational Thinking	Patterns Cause and Effect	Mathematics: 6.SP.B.5 6.RP.A.1 ELA/Literacy: RST.6-8.3
2. **Modeling: Hiding in the Background** Students use a model to explain how a change in the environment—a change in predation—can cause changes in trait frequency within a population of prey. Students analyze and interpret data from their model using mathematical representations in their explanations.	MS-LS4.B MS-LS4.C MS-LS2.A	Analyzing and Interpreting Data Developing and Using Models Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking	Cause and Effect Patterns	Mathematics: 6.SP.B.5 6.RP.A.1 ELA/Literacy: RST.6-8.3

EVOLUTION (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
3. **Role Play: A Meeting of Minds** Students develop an understanding of Darwin's Theory of Natural Selection and use it to explain why species change over time. They learn why this explanation has prevailed by listening to arguments supporting Darwin vs. Lamarck. They use the theory to explain how a change in the environment causes a change in trait frequency from one generation to the next.	MS-LS4.B MS-LS4.C MS-LS3.B	Constructing Explanations and Designing Solutions Engaging in Argument from Evidence	Cause and Effect Patterns	ELA/Literacy: RST.6-8.2 WHST.6-8.2
4. **Modeling: Battling Beaks** Students use a model to simulate the role of genetic mutations in natural selection. They discover that mutations provide the variation on which natural selection acts. Some mutations cause traits that have the effect of enhancing an organism's survival in its current environment. Students explain that individuals possessing these adaptive traits survive to have relatively more offspring. Thus, these traits become proportionally more common in the next generation. This activity provides an opportunity to assess student work related to Performance Expectation MS-LS4-4.	MS-LS4.B MS-LS4.C MS-LS2.A MS-LS3.B MS-LS3.A	Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking Developing and Using Models Analyzing and Interpreting Data	Cause and Effect Patterns Structure and Function	Mathematics: 6.SP.B.5 6.RP.A.1 ELA/Literacy: RST.6-8.3 WHST.6-8.2
5. **Modeling: Mutations: Good or Bad?** Students follow the inheritance of a hemoglobin mutation through two generations. Students identify patterns in their data and investigate the cause-and- effect relationship between environmental conditions and the frequency of a trait in a population. Based on their data collection and analysis, students construct explanations for how changes to a gene influence an organism's ability to survive and reproduce. Specifically, students use the example of hemoglobin to explain how structural changes to genes, or mutations, lead to changes in protein structure and function, and how this can lead to changes in the function of red blood cells, which, in turn, can affect survival of individuals with the mutation. This activity provides an opportunity to assess student work related to Performance Expectation MS-LS3-1.	MS-LS4.B MS-LS3.A MS-LS3.B MS-LS4.C	Developing and Using Models Using Mathematics and Computational Thinking Constructing Explanations and Designing Solutions	Structure and Function Cause and Effect Patterns Scale, Proportion, and Quantity	Mathematics: 6.RP.A.1 6.SP.B.5 ELA/Literacy: SL.8.1 SL.8.4

EVOLUTION (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
6. **Computer Simulation: Mutations and Evolution** Students continue investigating the inheritance and selection for the hemoglobin mutation using a computer simulation. Students use mathematical representations and analyze graphs to determine the distribution of the mutation in their population over time. Students manipulate different parameters to investigate multiple cause-and-effect relationships between environmental conditions and natural selection in their population. This activity provides an opportunity to assess student work related to Performance Expectation MS-LS4-6.	MS-LS4.C MS-LS4.B MS-LS3.A MS-LS3.B	Using Mathematics and Computational Thinking Constructing Explanations and Designing Solutions Asking Questions and Defining Problems Developing and Using Models	Cause and Effect Patterns Structure and Function	Mathematics: 6.RP.A.1 6.SP.B.5 ELA/Literacy: SL.8.1 SL.8.4
7. **View and Reflect: Origins of Species** Students explore and explain how one species of finch arriving on the Galapagos Islands 3 million years ago evolved into the current 13 species. They also explore how recent changes in the environment have selected for different beak shapes and sizes within a species, reinforcing cause-and-effect relationships. Students learn that evidence from the Galapagos finches supports scientists' assumptions that the same processes that operated in the past are operating today; thus, the same cause-and-effect relationships happening in Galapagos finches today also happened in the past.	MS-LS4.A MS-LS3.B MS-LS4.B MS-LS4.C	Constructing Explanations and Designing Solutions	Cause and Effect Patterns Connections to Nature of Science: Science Is a Human Endeavor	ELA/Literacy: RST.6-8.9 WHST.6-8.2
8. **Reading: History and Diversity of Life** Students obtain information through text and graphics about the history and diversity of life. They learn how life forms have evolved over time, with all organisms sharing a common ancestor. They build un their understanding of speciation and evolutionary trees as a way to represent evolutionary relationships, and they are introduced to the process of extinction.	MS-LS4.A	Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	Patterns	ELA/Literacy: RST.6-8.7 WHST.6-8.2

EVOLUTION (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
9. **Laboratory: Fossil Evidence** Students examine actual fossils of four species representing a diversity of life forms that existed at different points in the past. Then they examine simulated stratigraphic data to detect patterns in the fossil record. They analyze and interpret these patterns to place the four species in chronological order and, thus, determine their relative ages.	MS-LS4.A MS-ESS1.C	Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Patterns Cause and Effect Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems	ELA/Literacy: RST.6-8.3
10. **Investigation: Fossilized Footprints** Students look for patterns in a set of fossilized footprints, a kind of trace fossil. They analyze the patterns to draw inferences about the organisms that left these traces, including the behavior and size of the organisms. They argue for the most plausible explanation for these patterns.	MS-LS4.A	Analyzing and Interpreting Data Engaging in Argument from Evidence Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Patterns Cause and Effect Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems	ELA/Literacy: RST.6-8.3
11. **Investigation: Family Histories** Students analyze and interpret data to look for patterns in the evolution and extinction of families from three classes of vertebrates. They summarize how life forms have evolved over time, assuming that the same natural laws have always operated and will continue to operate in the future. This activity provides an opportunity to assess student work related to Performance Expectation MS-LS4-1.	MS-LS4.A	Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Patterns Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Mathematics: 6.SP.B.5 ELA/Literacy: RST.6-8.7
12. **Investigation:** A Whale of a Tale Students compare anatomical structures in modern adult whales and embryos with fossil whales to construct an explanation about the evolutionary history and relationships of whales. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS4-2.	MS-LS4.A MS-ESS1.C	Constructing Explanations and Designing Solutions Analyzing and Interpreting Data Engaging in Argument from Evidence	Patterns Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Mathematics: 6.SP.B.5 ELA/Literacy: RST.6-8.7

EVOLUTION (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
13. **Investigation: Embryology** Students analyze and interpret skeletal and embryological images to identify patterns of similarities and differences across species that look very different as mature animals. Students identify patterns of similarities throughout developmental time to infer evolutionary relationships not obvious in the mature animals. This activity provides an opportunity to assess student work related to Performance Expectation MS-LS4-3.	MS-LS4.A	Analyzing and Interpreting Data	Patterns Structure and Function	ELA/Literacy: RST.6-8.7
14. **Talking it Over: The Sixth Extinction?** Students analyze and interpret patterns of large-scale extinctions over the entire history of Earth, and identify the five mass extinctions detected by scientists. Students compare the possible causes of those extinctions, and learn that there may be multiple causes. They analyze data on the current rate of extinction and engage in argument based on evidence about whether there is currently a sixth mass extinction caused by human activity.	MS-LS4.A MS-ESS3.C MS-LS4.D MS-LS4.B	Analyzing and Interpreting Data Engaging in Argument from Evidence Asking Questions and Defining Problems	Patterns Cause and Effect Stability and Change Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Connections to Nature of Science: Science Addresses Questions About the Natural and Material World	ELA/Literacy: RST.6-8.7 WHST.6-8.9
15. **Reading: Bacteria and Bugs: Evolution of Resistance** Students obtain information about four types of organisms that have evolved resistance to chemical control methods. Students identify the cause-and-effect relationship between human activity and the evolution of resistance to chemical controls, and they consider whether this pattern is likely to continue in the future. They conclude by using the principles of natural selection to explain the phenomenon of the evolution of antibiotic resistance.	MS-LS4.B MS-LS4.C	Obtaining, Evaluating, and Communicating Information Constructing Explanations and Designing Solutions	Cause and Effect Patterns	ELA/Literacy: RST.6-8.1 WHST.6-8.9

EVOLUTION (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
16. **Investigation: Manipulating Genes** Students obtain and synthesize information from multiple sources about technologies that people have used over time to change the traits of organisms to make them more useful or desirable to people. They evaluate this information for its accuracy, reliability, and bias. They consider the impact of this technology on people and other organisms. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS4-5.	MS-LS4.B MS-LS4.D	Obtaining, Evaluating, and Communicating Information	Cause and Effect Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology Connections to Nature of Science: Science Addresses Questions About the Natural and Material World	ELA/Literacy: WHST.6-8.2 WHST.6-8.8
17. **Project: Superbugs and Other Ways Humans are Affecting Evolution** Students synthesize their understanding of evolution by natural selection to communicate to an audience of peers and community members one important thing they have learned about how evolution has shaped and continues to shape life on Earth.	MS-LS4.B MS-LS4.C MS-LS3.B	Obtaining, Evaluating, and Communicating Information	Cause and Effect	ELA/Literacy: WHST.6-8.2

EVOLUTION

Unit Issue: How people can affect and be affected by evolution.

Anchoring Phenomenon: Populations change over time. Some changes take place over very long time periods, while others take place over observable time periods. People can cause and be affected by these changes. Examples include: there are more life forms now than there were in the past; some kinds of organisms have gone extinct, like large dinosaurs; organisms that are harmful, like some bacteria and pests, have developed resistance to our methods of eliminating them. Students generate and answer questions such as: How have populations changed over time? What caused these changes? How are people affected by and affecting evolution? Are people causing a mass extinction?

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
Humans can change the way species, including bacteria, look or behave.	How are humans affecting evolution?	What happens when a person does not take antibiotics as prescribed? (Activity 1)	1 [14, 15, 16, 17]	MS-LS4-4 MS-LS4-6	Some bacteria are more resistant to antibiotics than others, and because of that, can become more abundant over time.
Populations change over time.	How do populations change over time?	How does the environment affect an individual's probability of survival and successful reproduction? (Activity 2)	1, 2, 3, 4, 5, 6	MS-LS4-4 MS-LS4-6 MS-LS3-1	Some traits increase an individual's chance of survival in a specific type of environment.
		How does natural selection happen? (Activity 3)			Natural selection is the process by which some traits become relatively more common in a population over time.
		What role does genetic variation play in the process of natural selection? (Activity 4)			Variation in traits is caused by mutations, and mutations are passed on to offspring; the frequency of the trait in the population depends on the environment.
		How do mutations affect survival? (Activity 5)			The sickle cell mutation is harmful when a person has two copies because it affects the structure and function of red blood cells; it is beneficial when a person has one copy in an environment with malaria.
		Why does sickle cell trait frequency vary across the world? (Activity 6)			The frequency of the sickle cell trait depends on two environmental variables—the frequency of malaria and the availability of health care.

PHENOMENA, DRIVING QUESTIONS AND SEPUP STORYLINE

EVOLUTION (continued)

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
Evidence of species that no longer exist can be found in fossils.	What information can we learn from fossils?	How do new species evolve? (Activity 7)	7, 8, 9, 10, 11, 12, 13	MS-LS4-1 MS-LS4-2 MS-LS4-3	Natural selection happening over a short period of time leads to changes in trait frequency in a population; when it happens over a long period of time, populations with different traits may evolve into separate species.
		How are the diverse species living today related to one another and to the species that once lived on Earth? (Activity 8)			Speciation is a continual process that has resulted in many life forms and billions of species, most of which have gone extinct; all species are related to one another, sharing either a recent or distant ancestor.
		What kind of evidence do fossils provide about evolution? (Activity 9)			Fossils provide evidence for evolutionary relationships of organisms that lived in the distant and recent past.
		What other kinds of information can we get from fossils? (Activity 10)			Fossils can also provide information about the habits, traits, and environments of extinct organisms.
		What can you learn about evolution by comparing the fossil records of fish, mammals, and reptiles? (Activity 11)			Life forms have evolved over time, with some life forms having been relatively more abundant in the past, and other life forms becoming relatively more abundant more recently.

PHENOMENA, DRIVING QUESTIONS AND STORYLINE

EVOLUTION (continued)

Investigative Phenomena	Driving Questions	Guiding Questions	Activities	PE	Storyline
		How did whales evolve? (Activity 12)			Whales, despite sharing superficial similarities with fish, are aquatic mammals that evolved from terrestrial relatives; this evolutionary history is informed by fossil evidence and evidence from embryos.
		How can embryos provide evidence about evolutionary relationships? (Activity 13)			Embryos can reveal evolutionary relationships that are not apparent in the adult organisms.
Humans can change the way species look or behave, including bacteria.	How are humans affecting evolution?	Is the current rate of extinction typical? (Activity 14)	1, 14, 15, 16, 17	MS-LS4-4 MS-LS4-5	People are affecting evolution by causing a significantly higher rate of extinction than in the past.
		What is the evidence that resistance to chemical controls is evolving in other types of organisms? (Activity 15)			People are affecting evolution by changing selection pressure on organisms that cause problems for us; the evolutionary responses of these organisms can lead to additional problems for us.
		How have humans manipulated genes in other organisms? (Activity 16)			People have manipulated genes and, therefore, evolution of organisms for thousands of years, most recently through genetic engineering.
		How are humans affecting and affected by evolution? (Activity 17)			There are many ways humans are affected by and affecting evolution, and understanding evolution by natural selection is important for understanding and anticipating these processes.

NGSS CORRELATIONS

EVOLUTION

Crosscutting Concepts		Activity number
Cause and Effect	Cause and effect relationships may be used to predict phenomena in natural or designed systems.	14, 15, 16, 17
	Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	1, 2, 3, 4, 5, 6, 7, 9, 10, 14, 16, 17
Patterns	Patterns can be used to identify cause and effect relationships.	1, 2, 3, 4, 7, 8, 10, 12, 14, 15
	Graphs, charts, and images can be used to identify patterns in data.	5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Scale, Proportion, and Quantity	The observed function of natural and designed systems may change with scale.	5
Stability and Change	Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.	14
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.	4, 5, 6, 13,
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	7, 16
Connections to the Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Science assumes that objects and events in natural systems occur in consistent patterns and are understandable through measurement and observation.	1, 2, 7, 9, 10, 11, 12, 13, 14
Connections to the Nature of Science: Science Addresses Questions About the Natural and Material World	Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	14, 16

Science and Engineering Practices		Activity number
Asking Questions and Defining Problems	Ask questions to determine relationships between independent and dependent variables and relationships in models.	6
	Ask questions that challenge the premise(s) of an argument or the interpretation of a data set.	14
Analyzing and Interpreting Data	Analyze and interpret data to determine similarities and differences in findings.	1, 2, 4, 9, 10, 11, 14
	Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	12, 13
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.	15
	Construct an explanation that includes qualitative or quantitative relationships between variables that predict or describe phenomena.	2, 3, 4, 5, 6, 7
	Apply scientific ideas to construct an explanation for real world phenomena, examples, or events.	8, 9, 11, 12
Developing and Using Models	Develop a model to predict and/or describe phenomena.	1, 2, 4, 5
	Use and/or develop a model of simple systems with uncertain and less predictable factors.	1, 4, 6
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.	3, 10, 12, 14
	Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.	3
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.	8, 15, 16, 17
	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.	16, 17
	Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.	16
Using Mathematics and Computational Thinking	Use mathematical representations to describe and/or support scientific conclusions and design solutions.	2, 4, 5, 6
Connections to the Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Scientific knowledge is based on logical and conceptual connections between evidence and explanations.	9, 10, 11

Disciplinary Core Ideas		Activity number
Interdependent Relationships in Ecosystems (LS2.A)	In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.	2, 4
Inheritance of Traits (LS3.A)	Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.	4, 5, 6
Variation of Traits (LS3.B)	In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.	3, 4, 5, 6, 7
Evidence of Common Ancestry (LS4.A)	The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.	7, 8, 9, 10, 11, 12, 14
	Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.	7, 8, 9, 10, 11, 12, 13
	Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	12, 13
Natural Selection (LS4.B)	Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	1, 2, 3, 4, 5, 6, 7, 15, 17
	In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.	5, 14, 15, 16

Disciplinary Core Ideas		Activity number
Adaptation (LS4.C)	Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.	1, 2, 3, 4, 5, 6, 7, 15, 17
Biodiversity and Humans (LS4.D)	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.	14, 16
The History of Planet Earth (ESS1.C)	The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	9, 12
Human Impacts on Earth Systems (ESS3.C)	Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.	14
	Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	14

Performance Expectations		Activity number
Heredity: Inheritance and Variation of Traits (LS3)	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. (MS-LS3-1)	5
Biological Evolution: Unity and Diversity (LS4)	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. (MS-LS4-1)	11
	Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (MS-LS4-2)	12
	Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. (MS-LS4-3)	13
	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. (MS-LS4-4)	4
	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. (MS-LS4-5)	16
	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. (MS-LS4-6)	6

COMMON CORE STATE STANDARDS: CONNECTIONS AND CORRELATIONS

EVOLUTION

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, activities 1, 2, and 4 all require students to follow a multi-step procedure (RST.6-8.3) when using hands-on models for examining the process of natural selection. Activities 9 and 10 also require students to follow multi-step procedures when examining evidence of evolution from fossils. Students must determine the central idea of a text (RST.6-8.2) when they read an imaginary conversation between Lamarck and Darwin to understand the difference in their explanations for evolution. In Activity 7, students gather information about evolution from a video and relate that to information presented textually in earlier activities (RST.6-8-9). Students have multiple opportunities in the unit to integrate quantitative and textual information with information expressed visually (RST.6-8.7). For example, in Activity 13, students compare information gathered from photographs of embryos with textual information to make sense of evolutionary relationships among vertebrates. In Activity 15, students gather and cite textual evidence (RST.6-8.1) about the ways that human activities lead to resistance to pesticides and drug treatments. In Activities 5 and 6, students present claims on the evolutionary connection between the sickle cell mutation and malaria to other students, using evidence and reasoning from their models (SL.8.4). They listen carefully to other students' claims to help them develop a coherent argument (SL.8.1). Throughout the unit, students have multiple opportunities to write about natural selection and evolution as a form of sensemaking. In Activity 14, students draw evidence from text and quantitative data to analyze and reflect on whether the Earth is experiencing The Sixth Extinction (WHST.6-8.9). In Activity 16, students gather relevant information from multiple sources about the various ways humans have genetically modified organisms (WHST.6-8.8). In the culminating activity, students write an informative text or give a presentation on one way that humans are affecting and affected by evolution (WHST.6-8.2). 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)	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (RST.6-8.1)	15
	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)	3
	Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)	1, 2, 4, 9, 10
	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)	8, 11, 12, 13, 14
	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)	7

Common Core State Standards – English Language Arts		Activity number
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. (SL.8.1)	5, 6
	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound and valid reasoning, and well-chosen details: use appropriate eye contact, adequate volume, and clear pronunciation. (SL.8.4)	5, 6
Writing in History/ Social Studies, Science, and Technological Subjects (WHST)	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)	4, 7, 8, 17
	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (WHST.6-8.8)	16
	Draw evidence from informational texts to support analysis, reflection, and research. (WHST.6-8.9)	3, 14, 15

Making Connections in Mathematics

This unit introduces multiple opportunities for students to engage in two math 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, throughout the first learning sequence (Activities 1-6), students use the concept and language of ratios (6.RP.A.1), to describe the frequency of a trait in a population and how that frequency changes over time due to natural selection. For example, in Activity 1, students use ratios to express the frequency of antibiotic resistance among bacteria, while in Activity 4 students use the concept of ratios to understand the evolution of beak shape due to changes in food availability. Throughout this learning sequence, and in Activities 11 and 12, students analyze and interpret data sets to better understand evolution by natural selection and evidence for evolution from fossils (6.SP.B.5). For example, in Activity 11, students examine data on the first and last appearance of vertebrate families to understand the timeline of vertebrate evolution. To support students in creating and interpreting graphical displays of data in activities 4, 5, and 11 an optional student sheet entitled "Scatterplot and Line Graphing Checklist" is provided in Appendix C: Science Skills in the Student Book.

Common Core State Standards – Mathematics		Activity number
Ratios and Proportional Reasoning (RP)	Understand the concept of a ratio, and use ratio language to describe a ratio between two quantities. (6.RP.A.1)	1, 2, 4, 5, 6
Statistics and Probability (SP)	Summarize numerical data sets in relation to their context. (6.SP.B.5)	1, 2, 4, 5, 6, 11, 12