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