

## NGSS UNIT OVERVIEW

### REPRODUCTION

**Performance Expectation MS-LS1-4:** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

**Performance Expectation MS-LS1-5:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

**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 an organism.

**Performance Expectation MS-LS3-2:** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

| Activity Description  | Disciplinary Core Ideas | Science and Engineering Practices  | Crosscutting Concepts  | Common Core State Standards                                     |
|---|-------------------------|--|--|---|
| <p><b>1. View and Reflect: Joe’s Situation</b><br/>                     This activity introduces the fictional scenario of Joe, who has learned that he might have a genetic condition. Students engage in the practices of asking questions and obtaining, gathering, and communicating information as they attempt to understand Joe’s story. As they do this, they explore both the causes and effects of a genetic condition, beginning a focus on the crosscutting concepts of cause and effect and structure and function, which run throughout the unit. Also throughout the unit, students apply what they learn to Joe’s situation. In the final activity of the unit, they will make a recommendation to Joe.</p> | MS-LS1.B                | Asking Questions and Defining Problems<br><br>Obtaining, Evaluating, and Communicating Information                             | Cause and Effect<br><br>Structure and Function<br><br>Connections to Nature of Science: Science Addresses Questions About the Natural and Material World | ELA/Literacy:<br>RST.6-8.2<br>WHST.6-8.9<br>SL.8.1              |
| <p><b>2. Modeling: Creature Features</b><br/>                     Students begin to use the practice of developing and using models to show and revise their ideas about genes and inheritance of traits. The crosscutting concepts of patterns and cause and effect provide helpful lenses for thinking about the results of an imaginary scenario in which animals are bred to produce two generations of offspring. This activity begins a sequence in which students explore core ideas and concepts related to patterns of inheritance of traits as a result of sexual reproduction. Students also begin to engage in scientific argumentation as they evaluate possible hypotheses.</p>                               | MS-LS1.B<br>MS-LS3.B    | Developing and Using Models<br><br>Constructing Explanations and Designing Solutions<br><br>Engaging in Argument from Evidence | Patterns<br><br>Cause and Effect   | ELA/Literacy<br>RST.6-8.7<br>WHST.6-8.1<br>WHST.6-8.9<br>SL.8.1 |

**REPRODUCTION** (continued)

| Activity Description  | Disciplinary Core Ideas                   | Science and Engineering Practices  | Crosscutting Concepts  | Common Core State Standards  |
|---|---|--|--|--|
| <p><b>3. Reading: Reproduction</b><br/>Students engage in the practice of obtaining information as they read about the cellular basis of sexual and asexual reproduction. This information will help them to revise their models and explanations for the inheritance of traits and prepare them for quantitative predictions of the incidence of traits in offspring.</p>  | <p>MS-LS1.B<br/>MS-LS3.A<br/>MS-LS3.B</p> | <p>Constructing Explanations and Designing Solutions<br/><br/>Developing and Using Models<br/><br/>Obtaining, Evaluating, and Communicating Information</p>  | <p>Patterns<br/><br/>Cause and Effect</p>  | <p>ELA/Literacy:<br/>RST.6-8.1<br/>RST.6-8.4<br/>RST.6-8.7<br/>WHST.6-8.2<br/>WHST.6-8.9</p>     |
| <p><b>4. Investigation: Gene Combo</b><br/>Students use a coin-tossing model to investigate quantitatively the outcomes of breeding a second generation of offspring from heterozygous parents. The crosscutting concepts of patterns and cause and effect continue to be emphasized. This activity helps students understand how genes determine traits, distinguish between predicted and actual outcomes of such crosses, and further elaborate their model of inheritance of traits. This will lead into activities where students will learn about Mendel’s work and will use Punnett squares as another model for predicting the outcomes of genetic crosses.</p> | <p>MS-LS1.B<br/>MS-LS3.A<br/>MS-LS3.B</p> | <p>Developing and Using Models<br/><br/>Constructing Explanations and Designing Solutions<br/><br/>Using Mathematics and Computational Thinking<br/><br/>Analyzing and Interpreting Data<br/><br/>Engaging in Argument from Evidence</p> | <p>Patterns<br/><br/>Cause and Effect<br/><br/>Scale, Proportion, and Quantity</p> | <p>Mathematics:<br/>6.RP.A.1<br/><br/>ELA/Literacy:<br/>RST.6-8.4</p>                            |
| <p><b>5. Problem Solving: Gene Squares</b><br/>This activity introduces the use of Punnett squares as a model for predicting the ratios of both genotypes and phenotypes in the offspring of genetic crosses. Students use crosscutting concepts of patterns and cause and effect as they use Punnett squares to predict outcomes of crosses of various pairs of critters.</p>  | <p>MS-LS1.B<br/>MS-LS3.A<br/>MS-LS3.B</p> | <p>Constructing Explanations and Designing Solutions<br/><br/>Developing and Using Models<br/><br/>Using Mathematics and Computational Thinking</p>  | <p>Patterns<br/><br/>Cause and Effect</p>  | <p>Mathematics:<br/>6.RP.A.1<br/><br/>ELA/Literacy<br/>RST.6-8.2<br/>RST.6-8.4<br/>RST.6-8.7</p> |

**REPRODUCTION** (continued)

| Activity Description  | Disciplinary Core Ideas          | Science and Engineering Practices   | Crosscutting Concepts   | Common Core State Standards  |
|---|----------------------------------|---|---|--|
| <p><b>6. Reading: Mendel, First Geneticist</b><br/>                     A reading on Gregor Mendel’s investigations and the principles of genetics he identified through his work provides a perspective on the history and nature of science and the data analysis, recognition of patterns, and use of mathematics central to this important advancement in explaining how genes cause traits. The reading provides data from Mendel’s experiments breeding pea plants and his application of ratios to his analysis and interpretation of his results. Students can compare Mendel’s findings, analysis, and model to their own work with the critter model.</p>   | MS-LS1.B<br>MS-LS3.A<br>MS-LS3.B | Analyzing and Interpreting Data<br><br>Using Mathematics and Computational Thinking<br><br>Obtaining, Evaluating, and Communicating Information<br><br>Constructing Explanations and Designing Solutions<br><br>Connections to Nature of Science: Science Is a Way of Knowing | Cause and Effect<br><br>Patterns<br><br>Scale, Proportion, and Quantity                               | Mathematics:<br>6.RP.A.1<br><br>ELA/Literacy:<br>RST.6-8.7<br>RST.6-8.9          |
| <p><b>7. Laboratory: Do Genes Determine Everything?</b><br/>                     Students are introduced to two traits for seedling color in <i>Nicotiana</i> plants. They are then introduced to experimental design before they plan and conduct an investigation to determine how selected environmental factors affect the phenotype of plant seedlings. They analyze their data to explain the interaction between genetic and environmental factors. They use this experience as the basis for a discussion of the interplay of genetic and environmental factors in determining traits in humans, as well as in plants. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-5.</p> | MS-LS1.B<br>MS-LS3.B             | Analyzing and Interpreting Data<br><br>Planning and Conducting Investigations<br><br>Constructing Explanations and Designing Solutions<br><br>Connections to Nature of Science: Science Is a Way of Knowing   | Cause and Effect  | Mathematics:<br>6.RP.A.1<br>6.SP.B.5   |
| <p><b>8. Reading: Show Me the Genes!</b><br/>                     Students obtain information from a reading that introduces the location of genes on chromosomes and the number of sets of chromosomes in sex cells and the rest of the body. This information helps explain some of the phenomena related to genes that students have been learning about, and also prepares them for future activities where they will model the cause-and-effect relationships between genes (and mutations) and protein structure and function.</p>  | MS-LS1.B<br>MS-LS3.A<br>MS-LS3.B | Developing and Using Models<br><br>Obtaining, Evaluating, and Communicating Information   | Patterns<br><br>Cause and Effect<br><br>Structure and Function<br><br>Scale, Proportion, and Quantity | ELA/Literacy:<br>RST.6-8.2<br>RST.6-8.4<br>RST.6-8.7<br>WHST.6-8.2<br>WHST.6-8.9 |

REPRODUCTION (continued)

| Activity Description   | Disciplinary Core Ideas   | Science and Engineering Practices   | Crosscutting Concepts   | Common Core State Standards   |
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| <p><b>9. Investigation: Breeding Critters — More Traits</b><br/>                     Students model and explain additional patterns of inheritance as they explore cause-and-effect relationships for additional traits of the critters. These patterns help them model and explain the wide variation that can result from sexual reproduction. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS3-2.</p>  | <p>MS-LS1.B<br/>                     MS-LS3.A<br/>                     MS-LS3.B</p> | <p>Constructing Explanations and Designing Solutions<br/>                     Developing and Using Models</p>           | <p>Patterns<br/>                     Cause and Effect</p>   | <p>Mathematics:<br/>                     6.SP.B.5<br/>                     ELA/Literacy:<br/>                     RST.6-8.4</p>   |
| <p><b>10. Investigation: Animal Behavior</b><br/>                     Students analyze and interpret data to create arguments that explain behavioral and other traits in animals that at first glance seem to be either neutral or perhaps even harmful. By looking for patterns in the data, students develop arguments about how these traits cause the individual to have higher reproductive success than those with different traits. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-4, focusing on animal traits. In the next activity, students will focus on plant traits.</p> | <p>MS-LS1.B<br/>                     MS-LS4.C</p>                                   | <p>Engaging in Argument from Evidence<br/>                     Analyzing and Interpreting Data</p>                      | <p>Patterns<br/>                     Cause and Effect</p>   | <p>Mathematics:<br/>                     6.SP.A.2<br/>                     6.SP.B.4<br/>                     ELA/Literacy:<br/>                     RST.6-8.1<br/>                     WHST.6-8.1</p> |
| <p><b>11. Investigation: Plant–Animal Interactions</b><br/>                     Students obtain information about flower pollination and its importance to plant reproduction. They consider a number of adaptive plant structures and traits that attract animal pollinators. Students construct an argument for how these traits cause the individual plant to have higher reproductive success than plants with different traits. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS1-4, focusing on plant–animal interactions.</p>   | <p>MS-LS1.B<br/>                     MS-LS4.C</p>                                   | <p>Engaging in Argument from Evidence<br/>                     Obtaining, Evaluating, and Communicating Information</p> | <p>Cause and Effect<br/>                     Patterns<br/>                     Structure and Function</p> | <p>ELA/Literacy:<br/>                     RST.6-8.1<br/>                     RI.6.8<br/>                     WHST.6-8.1</p>   |

REPRODUCTION (continued)

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|---|----------------------------------|---|--|--|
| <p>12. <b>Modeling: How Do Genes Produce Traits?</b><br/>                     This activity introduces the concept that a gene encodes for a protein, which has a specific function in the cell. These protein functions manifest as traits in the body. Students use a toober and pipe cleaners to model and generate explanations for how a gene’s sequence codes for a protein sequence. They continue using this model to explore how the protein sequence determines the protein structure and function. As students model structure and function, they also examine cause-and-effect relationships between gene sequence and protein function.</p>  | MS-LS3.A                         | Developing and Using Models<br><br>Constructing Explanations and Designing Solutions  | Cause and Effect<br><br>Structure and Function   | ELA/Literacy: RST.6-8.7                              |
| <p>13. <b>Modeling: Fault in the Genes</b><br/>                     Students return to their three-dimensional protein models to begin investigating the cause-and-effect relationship between mutations and protein structure and function. The activity begins with a game that introduces students to different types of mutations: deletions, additions, and substitutions. Students then make predictions about how different mutations may affect their protein structure. Using the toobers and pipe cleaners, students model the mutations and the resulting changes to their protein structures. After investigating different types of mutations, students construct explanations for how a mutation in a gene leads to changes in body function, specifically how a mutation in the fibrillin-1 gene leads to Marfan syndrome symptoms. The activity provides an opportunity to assess student work related to Performance Expectation MS-LS3-1.</p> | MS-LS3.A<br>MS-LS3.B             | Developing and Using Models<br><br>Constructing Explanations and Designing Solutions<br><br>Analyzing and Interpreting Data | Cause and Effect<br><br>Structure and Function   | ELA/Literacy: RST.6-8.7                              |
| <p>14. <b>Talking it Over: Advising Joe</b><br/>                     Students apply what they have learned to Joe’s scenario and create a written communication that explains the causes and effects of Marfan syndrome and the actions Joe and his family might take.</p>  | MS-LS1.B<br>MS-LS3.A<br>MS-LS3.B | Obtaining, Evaluating, and Communicating Information  | Cause and Effect<br><br>Understandings About the Nature of Science: Science Addresses Questions About the Natural and Material World | Mathematics: 6.RP.A.1<br><br>ELA/Literacy WHST.6-8.2 |