Graded Six Unit 1: Growth, Development, and Reproduction of Organisms

Unit Summary
What influences the growth and development of an organism? Students use data and conceptual models to understand how the environment and genetic factors determine the growth of an individual organism. They connect this idea to the role of animal behaviors in animal reproduction and to the dependence of some plants on animal behaviors for their reproduction. Students provide evidence to support their understanding of the structures and behaviors that increase the likelihood of successful reproduction by organisms. The crosscutting concepts of *cause and effect* and *structure and function* provide a framework for understanding the disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *analyzing and interpreting data*, *using models*, *conducting investigations*, and *communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on MS-LS1-4 and MS-LS1-5.
Student Learning Objectives
Use arguments 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. (MS-LS1-4)
Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (MS-LS1-5)

Unit Sequence	
Part A: *How do characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively?*	
Concepts	**Instructional Tools/Materials/Technology/Resources/Learning Activities/Assessment**
• Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. ✔ There are a variety of ways that plants reproduce. • Specialized structures for plants affect their probability of successful reproduction. • Some characteristic animal behaviors affect the probability of successful reproduction in plants. • Animals engage in characteristic behaviors that affect the probability of successful reproduction. • There are a variety of characteristic animal behaviors that affect their probability of successful reproduction. • There are a variety of animal behaviors that attract a mate. • Successful reproduction of animals and plants may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.	**Learning Activities:** Guided reading Exploration activities: determine successful reproduction activities, dissect flower reproductive parts. Engineering solutions: Design a flower Content videos note taking claim-evidence reasoning concept review game **Materials:** Station Cards, Dispersal Cards, plastic, sandwich, Engineering Design Process SetMarker, Tissue paper, Pipe cleaners, Construction paper, Toothpicks, Double-sided tape (suggested) **Formative Assessment:** *Students who understand the concepts are able to:* • Conduct experiments, collect evidence, and analyze empirical data. • Use evidence from experiments and other scientific reasoning to support oral and written explanations of how environmental and genetic factors influence the growth of organisms. • Identify and describe possible causes and effects of local environmental conditions on the growth of organisms. • Identify and describe possible causes and effects of genetic conditions on the growth of organisms. **Summative Assessment:** • Concept attainment quiz • Unit assessment

	Alternative Assessment ● PBL result **Benchmark Assessments**

Unit Sequence	
Part B: *How do environmental and genetic factors influence the growth of organisms?*	
Concepts	**Instructional Tools/Materials/Technology/Resources/Learning Activities/Assessment**
• Genetic factors as well as local conditions affect the growth of organisms. ✔ A variety of local environmental conditions affect the growth of organisms. • Genetic factors affect the growth of organisms (plant and animal). • The factors that influence the growth of organisms may have more than one cause. • Some cause-and-effect relationships in plant and animal systems can only be described using probability.	**Learning Activities:** Guided reading Exploration: genetic factors, survival of the fittest Content videos note taking claim-evidence- reasoning concept review game **Materials:** dice, computer, internet access, STEMScopes curriculum **Formative Assessment:** *Students who understand the concepts are able to:* • Conduct experiments, collect evidence, and analyze empirical data. • Use evidence from experiments and other scientific reasoning to support oral and written explanations of how environmental and genetic factors influence the growth of organisms. • Identify and describe possible causes and effects of local environmental conditions on the growth of organisms. • Identify and describe possible causes and effects of genetic conditions on the growth of organisms. **Summative Assessment:** • Concept attainment quiz • Unit assessment **Alternative Assessment** ● PBL result **Benchmark Assessments**

Three-Dimensional Teaching and Learning
Instruction should result in students being able to use arguments based on empirical evidence and scientific reasoning to support an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants. Students may observe examples of plant structures that could affect the probability of plant reproduction, including bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract pollen-transferring insects, and hard shells on nuts that squirrels bury. Possible activities could include plant experiments (e.g., students could count the number of butterflies on brightly colored plants vs. the number of butterflies on other types of plants and record the data they collect in a table), using microscopes/magnifiers to view plant structures (e.g., dissecting a lily), going on field trips, both virtual and actual (e.g., butterfly garden/botanical garden). Students may observe examples of animal behaviors that affect the probability of plant reproduction, which could include observing how animals can transfer pollen or seeds and how animals can create conditions for seed germination and growth (e.g., students may conduct an experiment using rapid cycling Brassica rapa [Fast Plant] and collect data on how many plants produce seeds with and without the aid of a pollinator. Students could then observe examples of animal behaviors (using videos, Internet resources, books, etc.) that could affect the probability of successful animal reproduction. These behaviors could include nest building to protect young from cold, herding of animals to protect young from predators, and colorful plumage and vocalizations to attract mates for breeding. Students may be able to identify and describe possible cause-and-effect relationships in factors that contribute to the reproductive success of plants and animals by using probability data from the rapid-cycling *Brassica rapa* (Fast Plant) experiments and drawing conclusions about one relationship between animals and plants. At this point, students can present an oral and/or written argument supported by evidence and scientific reasoning that characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. Students may use evidence from experiments or other sources to identify the role of pollinators in plant reproduction. Instruction that results in students being able to construct an evidence-based scientific explanation for how environmental and genetic factors influence the growth of organisms could begin with students conducting experiments and collecting data on the environmental conditions that effect the growth of organisms (e.g., the effect of variables such as food, light, space, and water on plant growth). Students could then examine genetic factors (inherited traits) that influence the growth of organisms, including parental traits and selective breeding. *It is important to note that at this grade level, Mendelian genetics are not a part of student learning. Mendelian genetics will be covered in future grades.* This unit of study could end with students using an oral and/or written argument, supported by evidence and scientific reasoning from their experiments, to explain how environmental conditions and genetic factors affect the growth of an organism.

Leveraging English Language Arts/Literacy and Mathematics
English Language Arts/Literacy • Cite specific, empirical, textual evidence to support analysis of how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

- Trace and evaluate the argument and specific claims in a text about how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. Distinguish claims that are supported by empirical evidence and scientific reasoning from claims that are not.
- Write an argument focused on how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

Mathematics

- Understand that a set of data collected to answer a statistical question about how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively, has a distribution which can be described by its center (mean), spread (range), and overall shape (shape of the distribution of data).
- Summarize numerical data sets, collected to answer a statistical question about how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively, that have a distribution that can be described by its center (mean), spread (range), and overall shape (shape of the distribution of data) in relation to their context.

Future Learning
• Systems of specialized cells within organisms help perform essential functions of life. • Any one system in an organism is made up of numerous parts. • Feedback mechanisms maintain an organism's internal condition within certain limits and mediate behaviors. • Growth and division of cells in organisms occur by mitosis and differentiation for specific cell types.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4),(MS-LS1-5) **RST.6-8.1**
- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5) **RST.6-8.2**
- Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-4) **RI.6.8**
- Write arguments focused on discipline content. (MS-LS1-4) **WHST.6-8.1**
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5) **WHST.6-8.2**
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5) **WHST.6-8.9**

Mathematics

- Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4),(MS-LS1-5) **6.SP.A.2**
- Summarize numerical data sets in relation to their context. (MS-LS1-4),(MS-LS1-5) **6.SP.B.4**

Modifications

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.

- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Technology Resources

Note- *The majority of the student sense-making experiences found at these links predate the NGSS. Most will need to be modified to include science and engineering practices, disciplinary core ideas, and cross cutting concepts. The EQuIP Rubrics for Science can be used as a blueprint for evaluating and modifying instructional materials.*

- STEMScopes https://www.stemscopes.com/
- American Association for the Advancement of Science: *http://www.aaas.org/programs*
- American Association of Physics Teachers: *http://www.aapt.org/resources/*
- American Chemical Society: *http://www.acs.org/content/acs/en/education.html*
- Concord Consortium: Virtual Simulations: *http://concord.org/*
- International Technology and Engineering Educators Association: *http://www.iteaconnect.org/*
- National Earth Science Teachers Association: *http://www.nestanet.org/php/index.php*
- National Science Digital Library: *https://nsdl.oercommons.org/*
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: *http://www.naaee.net/*
- Phet: Interactive Simulations *https://phet.colorado.edu/*
- Physics Union Mathematics (PUM): *http://pum.rutgers.edu/*
- Science NetLinks: *http://www.aaas.org/program/science-netlinks*

Appendix A: NGSS and Foundations for the Unit
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. (MS-LS1-4)
Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (MS-LS1-5)
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence ● Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4) **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 the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5)	**LS1.B: Growth and Development of Organisms** ● Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) ● Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) ● Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)	**Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-4),(MS-LS1-5) ● Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5) **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 structures/systems can be analyzed to determine how they function. (MS-LS1-4), (MS-LS1-5)

English Language Arts	Mathematics

Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4),(MS-LS1-5) **RST.6-8.1** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5) **RST.6-8.2** Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-4) **RI.6.8** Write arguments focused on discipline content. (MS-LS1-4) **WHST.6-8.1** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5) **WHST.6-8.2** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5) **WHST.6-8.9**	Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4),(MS-LS1-5) **6.SP.A.2** Summarize numerical data sets in relation to their context. (MS-LS1-4),(MS-LS1-5) **6.SP.B.4**

Career Readiness, Life Literacy and Key Skills

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

- ❏ CRP1. Act as a responsible and contributing citizen and employee.
- ❏ CRP2. Apply appropriate academic and technical skills.
- ❏ CRP3. Attend to personal health and financial well-being.
- ❏ CRP4. Communicate clearly and effectively and with reason.
- ❏ CRP5. Consider the environmental, social and economic impacts of decisions.
- ❏ CRP6. Demonstrate creativity and innovation.
- ❏ CRP7. Employ valid and reliable research strategies.
- ❏ CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- ❏ CRP9. Model integrity, ethical leadership and effective management.
- ❏ CRP10. Plan education and career paths aligned to personal goals.

❑ CRP11. Use technology to enhance productivity.
❑ CRP12. Work productively in teams while using cultural global competence.

Scientific Literacy and Skills would be considered integral to developing and preparing students for the 21st Century and the literacy and skills specific to science are outlined as follows:

Scientific literacy can be achieved as students inquire about the world. The curriculum includes substantial hands-on laboratory and field experiences, as appropriate, for students to develop and use scientific skills along with the inquiry skills listed below.

❑ **Make observations, raise questions, and formulate hypotheses.**
❑ Observe the world from a scientific perspective.
❑ Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge.
❑ Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.

❑ **Design and conduct scientific investigations.**
❑ Articulate and explain the major concepts being investigated and the purpose of an investigation.
❑ Select required materials, equipment, and conditions for conducting an experiment. • Identify independent and dependent variables.
❑ Write procedures that are clear and replicable.
❑ Employ appropriate methods for accurately and consistently
❑ making observations,making and recording measurements at appropriate levels of precision
❑ collecting data or evidence in an organized way
❑ Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration (if required), technique, maintenance, and storage.
❑ Follow safety guidelines.

❑ **Analyze and interpret results of scientific investigations.**
❑ Present relationships between and among variables in appropriate forms.
❑ Represent data and relationships between and among variables in charts and graphs.
❑ Use appropriate technology (e.g., graphing software) and other tools.
❑ Use mathematical operations to analyze and interpret data results.
❑ Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions.

❏ Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis.
❏ State questions raised by an experiment that may require further investigation.

❏ **Communicate and apply the results of scientific investigations.**
❏ Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations.
❏ Review information, explain statistical analysis, and summarize data collected and analyzed as the result of an investigation.
❏ Explain diagrams and charts that represent relationships of variables.
❏ Construct a reasoned argument and respond appropriately to critical comments and questions. • Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings.
❏ Use and refine scientific models that simulate physical processes or phenomena.

The following links are provided to all the user to obtain additional information on the development and implement of 21st century skills in a specific curriculum.

http://www.state.nj.us/education/aps/cccs/career/

http://www.achieve.org/files/Understanding-Skills-CCSS.pdf

http://www.state.nj.us/education/cte/hl/CRP.pdf

https://drive.google.com/drive/folders/0B1r5RLgULOTJQ1dXYXAwUFpCSTA

http://www.envisionexperience.com/plan-your-future/blog-articles/13-essential-21st-century-skills-for-todays-students

https://www.imls.gov/impact-imls/national-initiatives/museums-libraries-and-21st-century-skills/museums-libraries-and-21st-century-skills-definitions

Increasing the Odds (P)per studentconsumable11Station Cards (P)per classreusable12Seed Dispersal Cards (P)per classreusable25Internet-enabled devicesper classreusable52Bag, plastic, sandwichper classreusable2Explore 3: Engineering Solution Design a Flower1Design a Flower (P)per studentconsumable11Engineering Design Process (P)per groupreusable11Computer with Internet accessper groupreusable11SetMarkersper groupreusable11Poster board or presentation boardper groupreusable11Tissue paper (suggested)per

groupconsumable11Pipe cleaners (suggested)per groupconsumable11Construction paper (suggested)per groupconsumable11Toothpicks (suggested)per groupconsumable11Double-sided tape (suggested)