

Unit Summary

What kinds of traits are passed on from parent to offspring?

What environmental factors might influence the traits of a specific organism?

In this unit of study, students acquire an understanding that organisms have different inherited traits and that the environment can also affect the traits that an organism develops. The crosscutting concepts of *patterns* and *cause and effect* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *analyzing and interpreting data*, *constructing explanations*, and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 3-LS3-1 and 3-LS3-2.

Student Learning Objectives

Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. *[Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.] (3-LS3-1)*

Use evidence to support the explanation that traits can be influenced by the environment. *[Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.] (3-LS3-2)*

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Unit Sequence	
Part A: What kinds of traits are passed on from parent to offspring?	
Concepts	Formative Assessment
<ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort and classify natural phenomena (e.g., inherited traits that occur naturally). Many characteristics of organisms are inherited from their parents. Different organisms vary in how they look and function because they have different inherited information. 	<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> Sort and classify natural phenomena using similarities and differences. <i>(Clarification: Patterns are the similarities and differences in traits shared between offspring and their parents or among siblings, with an emphasis on organisms other than humans).</i> Analyze and interpret data to make sense of phenomena using logical reasoning. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. <i>(Assessment does not include genetic mechanisms of inheritance and prediction of traits, and is limited to nonhumans.)</i>

Unit Sequence	
Part B: What environmental factors might influence the traits of a specific organism?	
Concepts	Formative Assessment
<ul style="list-style-type: none"> Cause-and-effect relationships are routinely identified and used to explain change. Other characteristics, which can range from diet to learning, result from individuals' interaction with the environment. Many characteristics involve both inheritance and environment. The environment also affects the traits that an organism develops. 	<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> Identify cause-and-effect relationships in order to explain change. Use evidence (e.g., observations, patterns) to support an explanation. Use evidence to support the explanation that traits can be influenced by the environment. Examples of the environment's affect on traits could include: <ul style="list-style-type: none"> ✓ Normally tall plants that grow with insufficient water are stunted. ✓ A pet dog that is given too much food and little exercise may become overweight.

What It Looks Like in the Classroom

Scientists sort and classify organisms based on similarities and differences in characteristics or traits. Students can easily observe external traits of animals such as body coverings; type, shape, and number of external features; and type, shape, and color of eyes. Similarly, they can observe external traits of plants such as the type of root system or the shape, color, and average size of leaves. The characteristics that organisms inherit influence how they look and how they function within their environment. As students observe parents and their offspring, they will notice that parents and offspring share many traits. As they observe a larger number of organisms from the same group, they will notice similarities and differences in the traits of individuals within a group. Students can observe similarities and differences in the traits of organisms and use these observations as evidence to support the idea that offspring inherit traits from parents, but these traits do vary within a group of similar organisms.

Sometimes, variations among organisms within a group are due to fact that individuals inherit traits from different parents. However, traits can also be influenced by an individuals' interaction with the environment. For example, all lions have the necessary inherited traits that allow them to hunt, such as sharp claws, sharp teeth, muscular body type, and speed. However, being a successful hunter also depends on the interaction that individual lions have with their parents and their environment. A lion cub raised in captivity without parents will have the same type of claws, teeth, and muscular body as all other lions, but it may never have the opportunity to learn to use its traits to hunt. Additionally, the environment can affect an organism's physical development. For example, any plant that lacks sufficient nutrients or water will not thrive and grow as it should. It will most likely be smaller in size, have fewer leaves, and may even look sickly. Likewise, too much food and lack of exercise can result in an overweight dog.

To investigate how the environment influences traits, students can plant the same type of seedling in different locations, which will provide variations of light, water, or soil. Data can be collected about rates of growth, height, and heartiness of the plant. The information gathered can be analyzed to provide evidence as to how the environment influenced the traits of the plant. As students read about, observe, and discuss these ideas, they learn that even though every organism inherits particular traits from its parents, the environment can have a marked effect on those traits and the development of others.

Connecting with English Language Arts/Literacy and Mathematics*English Language Arts*

In order to integrate the CCSS for English language arts, students will need opportunities to read about inherited traits of animals and plants in a variety of texts and resources. During discussions, teachers might pose questions such as "What kinds of traits are passed on from parent to offspring?" or "What environmental factors might influence the traits of a specific organism?" Students should be able to refer specifically to the text when answering questions, articulate the main idea, and describe the key ideas using supporting details in their explanations. Additionally, they should describe the relationship between scientific ideas or concepts, using language that pertains to time, sequence, and cause and effect.

During this unit, students also need opportunities to write informative/explanatory texts to convey ideas and information gathered through investigations and from other resources. For example, after reading texts about a given organism, students should be expected to use key details and appropriate facts about that organism to compose an informative piece of writing. This piece should list some of the organism's traits that were passed on from its parents, describe how those traits enable the organism to interact in its environment to meet its needs, and describe any influence the environment has on the organism's traits. Students should also have the opportunity to report orally on a given topic related to traits and the way they are influenced by the environment. They should share relevant facts, details, and information while speaking clearly and at an understandable pace.

Mathematics

This unit also has connections to the CCSS for mathematics. Students can use rulers to measure the growth of organisms, then generate and plot the data they collected on line plots, making sure the horizontal scale is marked off in appropriate units (whole numbers, halves, or quarters). For example, students might chart out data in line plots to document the growth (over time) of each of a number of plants grown from a single parent. As students analyze their data, they will observe that the offspring are not the same exact height as each other or as the parent, but that the height of all plants is very similar when the plants are grown under the same conditions. Students might also make similar line plots to compare the same type of plants grown with varying amounts of water or sunlight, then compare these data to the growth data of the parent plant. Analyzing this data will help students understand that environmental factors influence/affect the traits of organisms. As students collect, organize, and analyze their data, they have opportunities to reason abstractly and model with mathematics.

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: [All Standards, All Students/Case Studies](#) for vignettes and explanations of the 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)

Research on Student Learning

N/A ([NSDL, 2015](#)).

Prior Learning

By the end of Grade 1, students understand that:

- Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents.
- Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.

Future Learning

By the end of middle school, students will understand that:

- Animals engage in characteristic behaviors that increase the odds of reproduction.
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.
- Genetic factors as well as local conditions affect the growth of the adult plant.
- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
- 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 affect 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.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.
- 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 are harmful, and some are neutral to the organism.

Connections to Other Units

N/A

Sample of Open Education Resources

[Guppies Galore](#): Groups of students set up a small freshwater aquarium (made from gallon jars) that feature a male guppy, a female guppy, and a green plant. After the female guppy goes through her pregnancy and gives birth, the students will then observe, over time, the development of the fry into male and female guppies with characteristics similar to the parents.

Teacher Professional Learning Resources**[NSTA Web Seminar: Teaching NGSS in Elementary School—Third Grade](#)**

The web seminar began with explaining how to unpack the performance expectations in third grade. It continued with a focus on scientific practices in relation to the specific standard and performance expectations. Science Talk - what it looks like and sounds like, and how to use it in the classroom, as well as claims, evidence and reasoning strategies were discussed. The web seminar concluded with an overview of NSTA resources on the NGSS available to teachers by Ted, and a Q & A with Carla, Mary, Kathy and Kimber.

[Teaching NGSS in K-5: Constructing Explanations from Evidence](#)

Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the NGSS for K-5th grade. The web seminar focused on the three dimensional learning of the NGSS, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.

Continue discussing this topic in the [community forums](#).

[NGSS Core Ideas: Heredity: Inheritance and Variation of Traits](#)

The presenter was Ravit Golan Duncan of Rutgers University. The program featured strategies for teaching about life science concepts that answer questions such as "How are the characteristics of one generation related to the previous generation?" and "Why do individuals of the same species vary in how they look, function, and behave?"

Dr. Duncan began the presentation by discussing the importance of heredity as a disciplinary core idea. She then described how student learning should progress across grade levels and showed examples of common preconceptions. Dr. Duncan also shared strategies and resources for teaching about heredity. Participants had the opportunity to submit their questions and comments in the chat.

Visit the [resource collection](#). Continue discussing this topic in the [community forums](#).

Appendix A: NGSS and Foundations for the Unit

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Use evidence to support the explanation that traits can be influenced by the environment. *[Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]* **(3-LS3-2)**

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
<p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1) <p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> Use evidence (e.g., observations, patterns) to support an explanation. (3-LS3-2) 	<p>LS3.A: Inheritance of Traits</p> <ul style="list-style-type: none"> Many characteristics of organisms are inherited from their parents. (3-LS3-1) Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2) <p>LS3.B: Variation of Traits</p> <ul style="list-style-type: none"> Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) The environment also affects the traits that an organism develops. (3-LS3-2) 	<p>Patterns</p> <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort and classify natural phenomena. (3-LS3-1) <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. (3-LS3-2)

English Language Arts	Mathematics
<p>Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2) RI.3.1</p> <p>Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-1),(3-LS3-2) RI.3.2</p> <p>Describe the relationship between a series of historical events, scientific ideas or</p>	<p>Reason abstractly and quantitatively. (3-LS3-1),(3-LS3-2) MP.2</p> <p>Model with mathematics. (3-LS3-1),(3-LS3-2) MP.4</p> <p>Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or</p>

<p>concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1),(3-LS3-2) RI.3.3</p> <p>Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-1),(3-LS3-2),(3-LS4-2) W.3.2</p> <p>Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS3-1),(3-LS3-2) SL.3.4</p>	<p>quarters. (3-LS3-1),(3-LS3-2) 3.MD.B.4</p>
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