Grade 3: Life Science Module

Overview

Inheritance, Variation, and Frog Ponds

In the Grade 3 Life Science Module, students build a basic understanding of the principles of evolutionary biology, including life cycles, inheritance of traits, and how an environment can influence an organism's survival. The study of heredity is confined to two generations, and the influence of the environment on the survival of an organism is confined to one generation. (Note: Students do not learn about adaptations over time or "survival of the fittest.") This module is divided into two units to help students work with two separate yet interrelated ideas: how physical traits are influence by heredity and how physical traits are influenced by the environment.

In Unit 1, students learn that organisms inherit traits from their parents. Because these traits come from male and female parents and can combine in many ways, the combination of these traits varies from sibling to sibling. The variation of these traits can sometimes provide an advantage to a particular organism and help it survive in a specific environment. Students begin the unit by looking at inheritance and variation in many organisms, including humans. They then focus on inheritance and variation in frogs.

First, students gather data about the physical traits of parents and offspring, in order to look for patterns of inheritance and variation. Next, they learn about a variety of life cycles, including plant life cycles, and how reproduction is the link between parents and offspring. Then students apply their understanding of inheritance by creating a model of a frog offspring that exhibits characteristics of both the male and female parents. Finally, students learn that variation can affect the survival of an organism and then use this information to construct an evidence-based explanation about the cause and effect relationship between traits and survival.

In Unit 2, students learn that the traits an organism inherits from its parents can be influenced by the environment (e.g., a plant's growth can be stunted if it does not get enough water). Thus, the environment in which an organism lives is very important. An environment has both internal and external factors that affect it. Students learn that one external factor that has the ability to positively or negatively affect an environment is humans. This unit focuses on how humans can help make environments in which many organisms can survive and thrive. As in Unit 1, students explore these ideas by focusing specifically on frogs and a pond habitat.

First, students are introduced to the issue of habitat loss for amphibians. They are challenged to design a frog pond that supports a frog's survival needs throughout its life cycle. They use a bullfrog simulation and an original investigation with duckweed to examine ways in which the environment influences the traits of an organism. Students then learn more about pond habitats and the needs of frogs. They use the Engineering Design Cycle to create a model that explains how their pond provides a healthy habitat for a frog throughout its life cycle. Finally, students use this explanatory model as evidence to argue that they have designed a pond that will support a frog's survival throughout its life cycle.

Throughout the module, students engage in the Science and Engineering Practices (things that scientists and engineers do) by making explanatory models, constructing explanations, and engaging in arguments. Students also consistently use Crosscutting Concepts (concepts that link across various scientific disciplines)—especially patterns and systems—to deepen their understanding of content. Routinely, they track their learning in a student science notebook and practice articulating, questioning, and refining their understanding in Scientists Meetings.

Although this Grade 3 Life Science Module was designed to work in concert with EL Education Language Arts Grade 3 Module 2, it can also stand alone. The content of the Language Arts module complements the student learning about frog life cycles and frog habitats in the Life Science Module, and in both the Language Arts and Life Science Modules, students engage in similar protocols and do close reading.

Guiding Questions and Big Ideas

Unit 1:

Why does an organism look the way it does, and why does it matter?

- *Organisms look the way they do primarily because of the traits they inherit from their parents.*
- *The environment also affects an organism's traits (this learning is the focus of Unit 2).*
- *The cycle of life—birth, growth, reproduction, and death—drives the phenomena of inheritance (this learning is introduced in Unit 1 but assessed in Unit 2).*
- *The traits that organisms inherit from their parents will vary from sibling to sibling.*
- *Variation of traits (such as differences in color or size) can affect an organism's likelihood of surviving, finding mates, and reproducing.*

Unit 2:

What are necessary parts of a frog habitat, and how do they interact to support the survival of frogs throughout their life cycle? How can we build that (in the schoolyard or in the community or in a local park)?

- *Frog habitats must meet the needs of food, water, shelter, space, and air for the frog at all stages of its life cycle.*
- *Frogs have very distinct phases in their life cycle; each phase has unique needs.*
  - *A frog's eggs do not need food, but they do need to be sheltered in a safe place that keeps them wet at all times. This is typically the shallow-water edge of a pond, with leaf litter and twigs to provide protection from possible predators.*
  - *When frogs are tadpoles, the food that is consumed is algae found along the edge or on the bottom of the pond.*
  - *When the tadpoles become froglets, their diet includes small insects in the water.*
  - *As adults, frogs will live on both the shore of the pond as well as throughout the water of the pond. The adult frog consumes insects and minnows—any animal small enough to fit in its mouth.*
- *Frog ponds can be built by finding a suitable site and making a plan for the shape and depth of the pond, as well as what structures and features will meet the needs of the amphibians that will inhabit the pond.*

The 4 T's

TOPIC

Constructing Explanations and Arguments: Inheritance, Variation, and Frog Ponds

TASK

Frog pond explanatory model (with optional extension to build a local frog pond)

TARGETS

— NGSS Performance Expectations fully and explicitly taught and formally assessed: **3-LS3-1**, **3-LS4-2**

TEXTS

— *Bullfrog at Magnolia Circle*

Performance Task

Designed Frog Pond Explanatory Model

This performance task gives students the opportunity to showcase their deepened understanding of life cycles and how an environment can influence an organism's survival through an explanatory model. For this task, students design a frog pond that can help provide a solution to the problem of frog habitat loss. They create an explanatory model to show that their idea includes all the necessary parts of a frog habitat and will support the survival of frogs throughout their life cycle. **This task aligns with NGSS Performance Expectations 3-LS1-1, 3-LS4-3, and 3-LS4-4.** *(Note: This task fully addresses* **3-LS1-1** *and* **3-LS4-3***, but only partially addresses* **3-LS4-4***, which is fully assessed in the Unit 2 Summative Assessment.)*

Summative Assessment

Unit 1:

Explanation on Inheritance, Variation, and Survivability

Students look closely at pictures of two adult bullfrogs to identify their physical traits. After considering some of the possible combination of traits, they create a paper bullfrog offspring model that exhibits characteristics of both the male and female parents. They then construct two on-demand explanations. In the first explanation, students explain why organisms look the way they do and use the paper bullfrog offspring model, along with information gathered in their student science notebook, as evidence. In the second explanation, they explain how an organism's appearance can affect its survival. They use the paper bullfrog offspring model, along with information gathered in their student science notebook, as evidence. **This assessment takes place in Lesson Sequence 6, and aligns with NGSS Performance Expectations 3-LS3-1 and 3-LS4-2.**

Unit 2:

My Frog Pond Is a Good Solution Argument

In conjunction with the performance task, students construct an on-demand argument in response to the following question: "What are necessary parts of a frog habitat, and how do they interact to support the survival of frogs throughout their life cycle? How can we build that?" Students use their designed frog pond explanatory model as evidence, as well as information gathered in their student science notebook, to help them provide scientific reasoning to justify their argument. **This assessment takes place in Lesson Sequence 5, and aligns with NGSS Performance Expectations 3-LS3-2, 3-LS4-3, and 3-LS4-4.** *(Note: This task fully addresses* **3-LS4-4** *but only partially addresses* **3-LS4-3** *and* **3-LS3-2***.)*

Original Student Investigations

Duckweed and Habitat

Students plan and carry out an original investigation to answer the question "Under what conditions in a pond does duckweed grow well?" First, students learn about the different places in a pond habitat and identify conditions that vary by location in the pond (i.e., duration of direct sunlight, water depth, water quality). They then create a test to recreate those conditions and observe how well duckweed grows in each condition. They continue to the test and make observations in their student science notebook for one week. **This original student investigation centers on NGSS Performance Expectations 3-LS3-2 and 3-LS4-3, as well as the Science and Engineering Practice of Planning and Carrying Out Investigations.**

CCSS ELA Connections

This module is designed to address NGSS standards. But the module intentionally incorporates content, protocols, and skills that align with EL Education's ELA Grade 3 Module 2. Both the ELA and Life Science Modules focus on frogs and shared texts, including *Bullfrog at Magnolia Circle* and *Everything You Need to Know about Frogs and Other Slippery Creatures.* In both the ELA and Life Science Modules, students also use similar protocols, including Back-to-Back and Face-to-Face and close readings.

In addition, in the Grade 3 Life Science Module, students routinely have opportunities to read informational texts (CCSS ELA RI.3.1, RI.3.2, and RI.3.3) and write arguments and explanations (CCSS ELA W.3.1 and W.3.2). The student science notebook gives students an additional opportunity to practice informative writing and gathering evidence (CCSS ELA W.3.2 and W.3.8). The Scientists Meetings, which students participate in throughout the Life Science Module, provide students the opportunity to formally practice their speaking and listening skills while collaborating in whole group discussion (CCSS ELA SL.3.1).

Required Trade Book List (for purchase)	Unit 1	Unit 2
Dennard, Deborah, and Kristin Kest. *Bullfrog at Magnolia Circle*. Norwalk, CT: Soundprints, 2002. Print. (one copy per classroom)	✓	✓
Additional Texts (no purchase necessary, linked or included in the module materials)		
"Why Do I Look Like This?" Written by Erika Hedin for EL Education	✓	
"Life in a Pond" Written by Dave Roos for EL Education		✓
"Pollination: Bugs and Flowers Work Together" Written by Erika Hedin for EL Education	✓	
"Wheat Germinating March" (video) Neil Bromhall on YouTube	✓	
"From Seed to Flower" (video) NOVA on PBS Learning Media	✓	
"Time Lapse Dandelion Flower to Seed Head" (video) Neil Bromhall on YouTube	✓	
"Pear Flower to Fruit Swelling Time Lapse Filmed Over 8 Weeks" (video) Neil Bromhall on YouTube	✓	
"Common Frog" (video) BBC Natural History Unit on Arkive.org		✓

NGSS Standard 3-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]

Science and Engineering Practices

Developing and Using Models: Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop models to describe phenomena.

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms: Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.

Crosscutting Concepts

Patterns: Patterns of change can be used to make predictions.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/3-ls1-1-molecules-organisms-structures-and-processes

Note: This Life Science Module addresses this performance expectation, but students are not required to show independent mastery.

NGSS Standard 3-LS3-1 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

3-LS3-1. 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.]

Science and Engineering Practices

Analyzing and Interpreting Data: Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning.

Disciplinary Core Ideas

LS3.A: Inheritance of Traits: Many characteristics of organisms are inherited from their parents.

LS3.B: Variation of Traits: Different organisms vary in how they look and function because they have different inherited information.

Crosscutting Concepts

Patterns: Similarities and differences in patterns can be used to sort and classify natural phenomena.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/3-ls3-1-heredity-inheritance-and-variation-traits

Note: This Life Science Module assesses this full performance expectation.

NGSS Standard 3-LS3-2 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

3-LS3-2. 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.]

Science and Engineering Practices

Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., observations, patterns) to support an explanation.

Disciplinary Core Ideas

LS3.A: Inheritance of Traits: Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

LS3.B: Variation of Traits: The environment also affects the traits that an organism develops.

Crosscutting Concepts

Cause and Effect: Cause and effect relationships are routinely identified and used to explain change.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/3-ls3-2-heredity-inheritance-and-variation-traits

Note: This Life Science Module addresses this performance expectation, but students are not required to show independent mastery.

NGSS Standard 3-LS4-3 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

Science and Engineering Practices

Engaging in Argument from Evidence: Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

Disciplinary Core Ideas

LS4.C: Adaptation: For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Crosscutting Concepts

Cause and Effect: Cause and effect relationships are routinely identified and used to explain change.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/3-ls4-3-biological-evolution-unity-and-diversity

Note: This Life Science Module partially assesses this performance expectation. Students independently construct an argument about one organism and its ability to survive well in a habitat.

NGSS Standard 3-LS4-4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. *[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Science and Engineering Practices

Engaging in Argument from Evidence: Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience: When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die (secondary).

LS4.D: Biodiversity and Humans: Populations live in a variety of habitats, and change in those habitats affects living there.

Crosscutting Concepts

Systems and System Models: A system can be described in terms of its components and their interactions.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/3-ls4-4-biological-evolution-unity-and-diversity

Note: This Life Science Module addresses this performance expectation, but students are not required to show independent mastery.

NGSS Standard 3-LS4-2 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

Science and Engineering Practices

Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., observations, patterns) to construct an explanation

Disciplinary Core Ideas

LS4.B: Natural Selection: Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

Crosscutting Concepts

Cause and Effect: Cause and effect relationships are routinely identified and used to explain change.

For more information, see accompanying evidence statements. https://www.nextgenscience.org/pe/3-ls4-2-biological-evolution-unity-and-diversity

Note: This Life Science Module assesses this full performance expectation.

Module-at-a-Glance

Week 1

Approximately 3 hours of instruction

Unit 1: Lesson Sequence 1 (1.5 hours)

Instructional Focus

- Launch module with an anchoring phenomenon: multiple images showing the diversity of life
- Gather students' background knowledge about variation among organisms, within a species, and within families
- Introduce the student science notebook and Scientists Meeting protocol

NGSS Standards Addressed

- 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. (Based on **NGSS 3-LS3-1)**.
- Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (Based on **NGSS 3-LS4-2**).

Note: The purpose of Lesson Sequence 1 is to launch the module, build student engagement, and establish instructional routines. Therefore, it does not yet explicitly teach any of the Science and Engineering Practices, Crosscutting Concepts, or Disciplinary Core Ideas.

Ongoing Assessment

- Scientists Meeting: Gathering Ideas
- Student science notebook: Anchoring Phenomenon for Inherited Traits entry

Unit 1: Lesson Sequence 2 (1.5 hours)

Instructional Focus

- Build background about variation among organisms within a species and within a family
- Introduce patterns as a Crosscutting Concept
- Introduce the Concepts Scientists Think About anchor chart, the Scientists Do These Things anchor chart, and the Inheritance anchor chart
- Gather baselines data about students' ability to construct an explanation

NGSS Standards Addressed

- Use logical reasoning to make sense of phenomena that the traits of offspring will vary among siblings—for example, animals with the same parents may have different-colored fur. (Based on **NGSS 3-LS3-1**)
- Science and Engineering Practices
  - Analyzing and Interpreting Data

- Crosscutting Concepts
  - Patterns
- Disciplinary Core Ideas
  - **LS3.B** Variation of Traits

Ongoing Assessment

- Student science notebook: Variation among Siblings entry
- Scientists Meeting: Building Understanding

Week 2

Approximately 3 hours of instruction

Unit 1: Lesson Sequence 3 (3 hours)

Instructional Focus

- Build understanding (through reading) of different life cycles
- Develop and revise models of animal and plant life cycles
- Identify patterns in diverse life cycles
- Synthesize learning in Scientists Meeting

NGSS Standards Addressed

- Students develop a model to show that plants and animals have unique life cycles but follow the same pattern of birth, growth, reproduction, and death. (Based on **NGSS 3-LS1-1**)
- Science and Engineering Practices
  - Developing and Using Models
- Crosscutting Concepts
  - Patterns
- Disciplinary Core Ideas
  - **LS1.B** Growth and Development of Organisms

Ongoing Assessment

- Student science notebook: Life Cycle entry
  - General Pattern of Life Cycle model
- Plant and Animal Life Cycle models
- Exit Ticket: Life Cycle
- Scientists Meeting: Building Understanding

Week 3

Approximately 4 hours of instruction

Unit 1: Lesson Sequence 4 (2.5 hours)

Instructional Focus

- Build understanding that traits are inherited from male and female parents
- Practice creating a pattern of inheritance
- Construct explanations with evidence
- Synthesize learning in Scientists Meeting

NGSS Standards Addressed

- Construct an explanation of the observed relationship that offspring inherit traits, such as eye color or leaf shape, from both of their parents. (Based on **NGSS 3-LS3-1**)
- Science and Engineering Practices:
  - Constructing Explanations
- Crosscutting Concepts
  - Patterns
- Disciplinary Core Ideas
  - **LS3.A** Inheritance of Traits

Ongoing Assessment

- Student science notebook: Inheritance of Traits entry
  - Constructing an Explanation: Frog Offspring Possible Inheritance
- Student science notebook: Life Cycle entry
  - General Pattern of Life Cycle model
- Scientists Meeting: Building Understanding

Unit 1: Lesson Sequence 5 (1.5 hours)

Instructional Focus

- Build understanding of camouflage
- Build understanding of variation in flowers.
- Construct an explanation with evidence
- Synthesize learning in Scientists Meeting

NGSS Standards Addressed

- Construct an explanation of the observed relationship between variations in characteristics among animals or plants of the same species and the relative advantages in surviving, finding mates, and reproducing. (Based on **NGSS 3-LS4-2**)
- Science and Engineering Practices:
  - Constructing Explanations

- Crosscutting Concepts
  - Cause and Effect
- Disciplinary Core Ideas
  - **LS4.B** Natural Selection

Ongoing Assessment

- Student science notebook: Variation and Survival entry
  - Water Lily Preference Explanation
- Scientists Meeting: Building Understanding

Week 4

Approximately 2 hours of instruction

Unit 1: Lesson Sequence 6 (2 hours)

Instructional Focus

- Create a paper bullfrog offspring model using a pattern of inheritance
- Identify data of variation in paper bullfrog offspring.
- Construct an explanation of inheritance and variation.
- Test survivability of paper bullfrog offspring.
- Construct an explanation of survivability

NGSS Standards Addressed

- 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. (Based on **NGSS 3-LS3-1**)
- Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (Based on **NGSS 3-LS4-2**)
- Science and Engineering Practices
  - Constructing Explanations
  - Analyzing and Interpreting Data
- Crosscutting Concepts
  - Cause and Effect
- Disciplinary Core Ideas
  - **LS3.A** Inheritance of Traits
  - **LS3.B** Variation of Traits
  - **LS4.B** Natural Selection

Ongoing Assessment

- Paper bullfrog offspring
- Unit 1 Summative Assessment: Explanation on Inheritance, Variation, and Survivability

Week 5

Approximately 4 hours of instruction

Unit 2: Lesson Sequence 1 (1.5 hours)

Instructional Focus

- Build background on pond habitats
- Name the problem of habitat loss and present the solution: design a frog pond
- Gather student ideas about the problem and the solution on Planning a Frog Pond anchor chart

NGSS Standards Addressed

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how the solution meets the criteria and constraints of the problem of habitat loss for amphibians. (Based on **NGSS 3-LS4-4**)

Note: The purpose of Unit 2, Lesson Sequence 1 is to launch Unit 2 and build student engagement in the performance task. Therefore, it does not yet explicitly teach any of the Science and Engineering Practices, Crosscutting Concepts, or Disciplinary Core Ideas.

Ongoing Assessment

- Scientists Meeting: Gathering Ideas
- Student science notebook: Frog Pond Anchoring Phenomenon entry

Unit 2: Lesson Sequence 2 (2.5 hours)

Instructional Focus

- Start the Habitat anchor chart
- Construct explanation based on the Hungry Bullfrog simulation
- Plan and carry out the Duckweed and Habitat Investigation.

Note: The Duckweed and Habitat Investigation begun in this lesson sequence will require a week of observation before students may analyze the data in Lesson Sequence 4. Students may go on to Lesson Sequence 3 while they wait.

NGSS Standards Addressed

- Construct an explanation of a cause and effect relationship in which some traits, such as plant height or animal weight, are influenced by environment. (Based on **NGSS 3-LS3-2**)
- Science and Engineering Practices
  - Planning and Carrying Out an Investigation
  - Engaging in Argument from Evidence
- Crosscutting Concepts:
  - Cause and Effect
- Disciplinary Core Ideas:
  - **LS3.A** Inheritance of Traits
  - **LS3.B** Variation of Traits

Ongoing Assessment

- Student science notebook: Environment and an Organism's Traits entry
- Scientists Meeting: Building Understanding

Week 6

Approximately 2 hours of instruction

Unit 2: Lesson Sequence 3 (2 hours)

Instructional Focus

- Build understanding of the different parts of a pond through text.
- Create a model of a pond
- Synthesize learning in Scientists Meeting

NGSS Standards Addressed

- Develop a diagram to show how the environment can have differences within it; these differences can be constant or changing; these differences can affect an organism's life cycle. (Based on **NGSS 3-LS4-4**)
- Science and Engineering Practices
  - Developing and Using Models
- Crosscutting Concepts
  - Systems and Systems Model
- Disciplinary Core Ideas
  - **LS2.C** Ecosystem Dynamics, Functioning, and Resilience
  - **LS4.D** Biodiversity and Humans

Ongoing Assessment

- Student science notebook: The Pond Is a System entry
  - Communicating Information section: Pond Cross-Section Diagram
- Scientists Meeting: Building Understanding

Week 7

Approximately 3 hours of instruction

Unit 2: Lesson Sequence 4 (3 hours)

Instructional Focus

- Analyze and interpret data from Duckweed and Habitat Investigation
- Construct cause and effect argument based on Duckweed and Habitat Investigation
- Build deeper understanding of frog habitat
- Synthesize learning in Scientists Meeting

NGSS Standards Addressed

- Construct an argument of the observed relationships between the environment and the survival of an organism (surviving well, less well, or not at all). (Based on **NGSS 3-LS3-2** and **3-LS4-3**)

- Science and Engineering Practices
  - Analyzing and Interpreting Data
  - Engaging in Argument from Evidence
- Crosscutting Concepts
  - Cause and Effect
- Disciplinary Core Ideas
  - **LS4.C** Adaptation
  - **LS3.B** Inheritance of Traits

Ongoing Assessment

- Student science notebook: Habitat entry
  - Engaging in Argument: Duckweed Section
- Scientists Meeting: Building Understanding

Approximately 3.5 hours of instruction

Unit 2: Lesson Sequence 5 (3.5 hours)

Instructional Focus

- Use the Engineering Design Cycle to complete the performance task
- Synthesize and articulate learning in Scientists Meeting
- Construct argument about why the frog pond is a good solution and meets the criteria for success
- Reflect on learning

NGSS Standards Addressed

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how the solution meets the criteria and constraints of the problem of habitat loss for amphibians. (Based on **NGSS 3-LS4-4**)
- Science and Engineering Practices
  - Engaging in Argument from Evidence
- Crosscutting Concepts:
  - Systems and Systems Model
- Disciplinary Core Ideas
  - **LS4.D** Biodiversity and Humans
  - **LS2.C** Ecosystem Dynamics, Functioning, and Resilience

Ongoing Assessment

- Performance Task: Designed Frog Pond Explanatory Model
- Scientists Meeting: Making Meaning
- Unit 2 Summative Assessment: My Frog Pond Is a Good Solution

Optional: Community, Experts, Fieldwork, Service, and Extensions

Community:

- If you have a number of English Language Learners speaking the same native language, invite family members to come in and talk about the original student investigations and/or the designed frog pond.
- If you have students who have lived or have family members who have lived near a wetlands area or pond, invite them to give a first-hand account of the characteristics of these habitats.
- After students have completed their frog pond design, invite them to share them with the local school board or PTA.
- Team up with another grade level and share your discoveries.
- Join a citizen science group, like FrogWatch USA at https://www.aza.org/frogwatch/.

Experts:

- Invite a biologist or botanist to come in to talk with the students about aquatic plants and animals.
- Invite a local herpetologist to come in to talk with the students about frogs and other amphibians.
- Invite an engineer to come in and talk with students about designing structures and spaces.
- Invite a local dog breeder to bring in a litter of puppies for students to see the variety of traits in offspring.
- Contact your state's Fish and Wildlife Department to learn about the health of amphibians in your area.

Fieldwork:

- Visit a local pond to observe a pond habitat and the organisms that live there.
- Visit a local zoo, nature center, aquarium, or botanical garden to observe aquatic plants and animals.
- Go on virtual fieldtrips by visiting online resources that are available through zoos, nature centers, aquariums, and botanical gardens.

Service:

- Invite students to volunteer at an amphibian crossing (see http://www.conservewildlifenj.org/protecting/projects/amphibian_crossing/ as an example). Contact local wildlife advocacy groups for more information.
- Invite students to volunteer to clean up a local wetlands area.
- Invite students to organize a Save the Frogs Day where they can educate the public on issues affecting frogs (see http://www.savethefrogs.com/day/index.html for more information).

Extension Opportunities for students seeking more challenge:

- In each lesson sequence, there are optional extensions. Unit 1, Lesson Sequence 3, in particular, has many options for extensions.
- Unit 2 includes the opportunity for students to present their idea for a frog pond to an

authentic audience. Arrange for students to present their frog pond design and argument to an audience that may be able to implement their plan (e.g., the school board, park and recreation board, or neighborhood association).

- For schools with the necessary technology, Unit 2, Lesson Sequence 5 could include a 3D model of the frog pond.

Preparation and Materials

For basic lesson preparation, refer to the materials list and Teaching Notes in each lesson sequence. The following are science-specific materials that will require significant advance preparation. More information on quantities and specific instruction is in the materials list in each lesson sequence.

Before beginning the Grade 3 Life Science Module

- Consider purchasing aquatic plants to grow in your classroom, including water lilies.
- Consider purchasing or acquiring aquatic animals so students can observe the animals throughout their life cycle. Work with a local wildlife expert to find and raise a native frog or other amphibian species. If you have acquired the animals locally and are implementing one of the frog ponds that your students are designing in Unit 2, consider letting the adult animals go in the new home. If you have ordered them online, do not let animals loose in the local habitat.

Week 1

Unit 1: Lesson Sequence 1

- Create a teacher science notebook.
- Copy and assemble the student science notebooks. *(Not needed if your school has purchased the bound Student Science Notebooks.)*
- Create the Diversity of Organisms slideshow.

Unit 1: Lesson Sequence 2

- Bring in three sibling water lilies, if available.
- Create Frog Sibling Poster Session and Family Pass-around Cards.

Week 2

Unit 1: Lesson Sequence 3

- Plan Life Cycle Expert Groups.
- Gather materials for creating Animal Life Cycle models.
- Make copies of expert texts: Life Cycle Stories of Animals.
- Create General Plant Life Cycle picture cards.
- Prepare technology to play time-lapse videos.
- Create Plant Life Cycle model cards.

Week 3

Unit 1: Lesson Sequence 4

- Gather materials for frog call shakers such as: film canisters, prescription bottles, or plastic eggs and materials to put in each canister: sand, paper clips, beads, dry beans, popcorn, rice, small and/or dry pasta noodles.

Unit 1: Lesson Sequence 5

- None

Week 4

Unit 1: Lesson Sequence 6

- Create a class lily pad scene where students can test the survivability of their paper bullfrog.

Week 5

Unit 2: Lesson Sequence 1

- Obtain a copy of *Bullfrog at Magnolia Circle*.
- Create Before and After Habitat slideshow.
- Create Pond Success Stories photo cards.
- Prepare the Planning a Frog Pond anchor chart.

Unit 2: Lesson Sequence 2

- Gather materials for Hungry Bullfrog simulation including: sack for collecting tokens (such as a baby's sock or small bag), tokens (such as larger dried beans or marbles), scale, Hungry Bullfrog Simulation cards.
- Gather materials for Duckweed Investigation, including: duckweed plants, plastic cups, distilled water, trays, various materials for testing, permanent marker, ice cube.

Week 6

Unit 2: Lesson Sequence 3

- Gather materials for creating cross-section diagrams.

Week 7

Unit 2: Lesson Sequence 4

- Create Habitat Stations.
- Gather materials to augment the Habitat Stations, such as: jar of pond water, live specimens of common pond plants, live specimens of common bugs found in and around a pond, and abiotic features of ponds (such as a cup of mud, rocks, small fallen tree branches, or logs).

Week 8

Unit 2: Lesson Sequence 5

- Gather materials for pond explanatory model.

Student Science Notebooks

The student science notebook plays a central role in the science classroom. This notebook is a place for students to track their learning and organize their evidence. Encourage students to take ownership of the notebook and use it to record all of their ideas and questions throughout the module, in addition to writing in response to the formal prompts.

The science notebook is patterned after an "interactive notebook." When opened flat, the left-hand side of the notebook is primarily for instructions and prompts; the right-hand side is primarily for student responses and ideas. When copying, and creating the notebook, be sure to staple correctly.

Students will use the notebook during every science class and return to it several times throughout the block. Consider the classroom systems and structures already in place to help students easily access and store their notebook.

Encourage students to use pencils, because they often will create detailed drawings and diagrams. As students return to and revise their ideas, have them lightly cross out changed thinking (rather than erasing) so their changes in thinking can be documented. Periodically, students may need to attach something to their science notebook. Use tape or staples (glue can make the pages stick together).

Periodically (once a week or so), collect the notebook to formatively assess students' understanding of the Disciplinary Core Ideas and Crosscutting Concepts as well as their ability to apply the Science and Engineering Practices. In each lesson sequence, the ongoing assessment box suggests parts of the notebook to focus on. Remember that the science notebook should *not* be used as a summative assessment. Rather, the notebook is a place where students are encouraged to try out new ideas, revise old ideas, and take risks.

For more information about the student science notebook, see the California Academy of Science, Teacher Perspectives: The Value of Science Notebooking: https://www.calacademy.org/educators/teacher-perspectives-value-science-notebooking.

Living Organisms in the Classroom

Science comes alive for students when there are real plants and animals in the classroom. EL Education encourages teachers to use living organisms in their classroom, and each life science module includes both formal and informal learning opportunities that incorporate live plants and animals. When done with careful thought and preparation, the close observation and study of living organisms not only teaches students about science and nature, but fosters an attitude of respect and kindness toward all living things.

To ensure the best learning experience with living organisms, it's important to plan ahead. First, familiarize yourself with the NSTA guidelines for the responsible use of live animals in the classroom. See (http://www.nsta.org/about/positions/animals.aspx). Then check up on local and state laws and regulations concerning the handling and transportation of animals, particularly non-native species. Most importantly, learn as much as you can about the particular plant or animal that you want to study. Take the time to have your students help you build a clean, safe and attractive habitat for the organism. The more you and your students learn about the safe handling of the organism, the better you will treat and care for the classroom visitor.

When planning classroom activities with a live organism, remember that the highest purpose is to promote observation and scientific curiosity, and instill an appreciation for the value of life. Under no circumstances should an activity cause an animal pain, deprive it of food or comfort, or expose it to harmful substances. Instead of "experimenting" with living things, help student discover ways to improve the organism's life by learning what it needs to thrive. It's not always necessary to have a formal research question. Close observation of an animal — taking notes, asking questions, making hypotheses — can be a powerful learning experience all its own.

A critical part of the planning process is deciding what to do with an animal after it leaves your classroom. If it's a native species, you could send the animal home with a student or release it into the wild. Non-native species require more forethought. If you buy the animal from a biological supply company, ask if they will take the animal back when you are done. If that's not possible, ask the supply company exactly where the animal was raised or collected. Contact a school in that area and see if a local science teacher would be willing to release the animal for you. The safe return of an animal to its home is an important lesson for your students to learn.

Letter Home

Dear Families,

Soon we will begin our Grade 3 Life Science Module. In this module, we will learn some of the basic principles of biology, including life cycles and the fact that plants and animals inherit physical traits from their parent organisms.

In class, we will be talking about heredity and why all organisms, including humans, look the way they do. Students will learn that organisms, including humans, have physical traits that have been inherited from male and female biological parents. Because organisms, including humans, inherit traits from two biological parents, they look similar to but not exactly like either parent. All organisms also look similar to but different from siblings because each organism inherits a variety of traits from the parent organisms. This is true in plants and animals.

Students will learn that parents pass on their traits to their offspring through reproduction. We will not be studying the process or mechanisms of sexual reproduction in any plants or animals. Rather, reproduction will be discussed as part of the general life cycle that includes birth, growth, reproduction, and death.

Finally, students will learn that the traits an organism inherits can be influenced by the environment. For example, although a sunflower may have inherited the trait of height from the parent sunflowers, if it doesn't get enough sunlight and water, the sunflower may not grow to be tall. Because the environment can influence the traits of an organism, and ultimately the survival of an organism, a healthy environment with a suitable habitat is very important. We will be studying the pond habitat of frogs and ultimately creating a model of the perfect pond habitat where frogs can complete their life cycle and pass on their traits to healthy offspring.

Thank you for your support as we become scientists!

Science Background Information for Teachers

Below is science background information about life cycles, heredity, and variation of traits. Also included is information about frogs and duckweed. Use this information to help you effectively teach the science content of the Grade 3 Life Science Module. Refer to the sources and additional resources listed below for more information.

This module focuses on plants and animals that inhabit aquatic environments, specifically ponds. Through these animals, specifically frogs, and aquatic plants, students will learn why plants and animals look the way they do. Students also will learn about aquatic habitats and how they meet the needs of their inhabitants as well as influence their development.

Life Cycles

All organisms change over a lifetime in predictable ways. They progress through life cycles that follow similar patterns of birth (sprouting for plants), growth, maturation to adulthood, reproduction, and eventually death. Within this cycle, additional patterns are evident (e.g., adults reproduce and transfer their genetic information to their offspring). Animals also tend to exhibit those patterns of behavior that enhance their chances of survival, and therefore opportunities to reproduce. Plants, too, have developed a variety of specialized structures to disperse their seeds, sometimes with the help of a passing animal. Whether animal or plant, survival of the species is the purpose of the life cycle.

Heredity

Heredity is a set of "instructions" that specifies the traits of an organism; it is the passage of these instructions from one generation to another. Organisms transmit genetic information through either sexual or asexual reproduction. Regardless of the type of reproduction, some traits are inherited while others result from interaction with the environment.

Sexual reproduction requires both the male (sperm) and the female (egg) to produce offspring. The offspring acquire a mix of traits from their biological parents. This mixture accounts for offspring resembling their parents yet never looking exactly like either parent. The transmission of genetics to offspring also accounts for traits being shared among siblings. Over many generations, these differences can accumulate so that organisms may be very different from their ancestors.

By contrast, asexual reproduction involves a single organism, and traits are inherited from a single parent. For instance, some plants can develop from a fragment of the parent plant and a potato can be cut into many parts and new organisms with the same genetic information will grow. Other examples of asexual reproduction include rhizomes (horizontal underground stems that send shoots upward) and bulbs (like tulips). The advantage of asexual reproduction is the creation of numerous offspring in a relatively short amount of time. The disadvantage is a lack of variation among the species. If there is a disease that affects one plant, it can potentially decimate the whole population (http://www.ucmp.berkeley.edu/glossary/gloss6/asexual.html).

Variation of Traits

The world is constantly changing. Some changes occur quickly, while others take place over extended periods of time. When there is a significant change in an environment, some organisms will be more likely to survive than others. An example of this is the peppered moth of England. Before the Industrial Revolution, the majority of peppered moths were mostly light-colored. But when pollution and coal smoke coated some of the trees in England, the number of dark peppered moths increased dramatically as they were able to hide from predators more easily than the light-colored moths. Differences in traits that are favorable to environmental conditions and allow organisms to survive get passed onto offspring. Organisms without those traits may be eliminated from the gene pool (http://phenomena.nationalgeographic.com/2013/10/09/evolution-in-color-from-peppered-moths-to-walking-sticks/).

Variation among organisms of the same species—organisms that can mate and reproduce—can be influenced by the environment as well as genetics. Environmental factors can affect an organism's development, appearance, behavior, and likelihood of producing offspring. Salamanders in California provide a good example. Over millions of years, the same species of salamanders became separated geographically and followed two very different migratory routes. Those that traveled through forests survived by camouflage, while their relatives who took the coastal route adopted bright color patterns and behaviors of dangerously poisonous newts. Over millions of years, this same species adapted in very different ways to its environments (http://www.pbs.org/wgbh/nova/evolution/evolution-action-salamanders.html).

Differences in where a plant grows or the food an animal consumes can cause organisms with the same genetic background to look and act quite differently. For example, arrow frogs that are poisonous in the wild are not poisonous in captivity. Scientists think this may be because these frogs may gain their poison from a certain arthropod as well as other insects they eat in their native habitat that frogs in captivity do not have access to (http://nationalzoo.si.edu/Animals/Amazonia/Facts/fact-poisondartfrog.cfm).

Frogs: Integral Parts of Ecosystems

Frog habitat loss is an increasingly serious issue as land that was once wetland is gradually destroyed or damaged due to development. Frogs and other amphibians also face challenges caused by pollution, climate change, invasive species, and harvesting for pet and food trades. Frogs contribute to the biodiversity of an area. They are considered an indicator species that can provide information about the health of an ecosystem (because their skin is porous and extremely sensitive to changes in their habitat). A change in frog populations can be a warning that pollutants are invading an area.

Frogs have a unique life cycle that begins in the form of an egg. About four days after eggs are fertilized, tadpoles with gills and tails emerge. Within a few months, tadpoles transform into froglets (tiny frogs) and then, within one to three years depending on the species, froglets grow into adult frogs. They typically hatch from eggs laid in or near water. As adults, frogs live primarily on land but return to the water to breed and hibernate, so their habitat requires access to both land and water (http://www.nwf.org/How-to-Help/Garden-for-Wildlife/Gardening-Tips/How-to-Attract-Frogs-Toads-and-Other-Amphibians.aspx).

Frog populations have been declining at alarming rates. This is a concern because frogs are integral parts of the food web. Tadpoles help clean waterways by feeding on algae. Adult frogs are predators that eat large quantities of insects, including mosquitoes, yet also are an important food source for birds, snakes, and other animals. The loss of one part of the food web creates an imbalance that can result in negative impacts across the ecosystem (http://www.wanderingherpetologist.com/importance-of-amphibians/).

Duckweed: Nuisance or Beneficial to Ecosystems?

Duckweed is an interesting plant to study because it has no stems or leaves and is the smallest flowering plant. Duckweed may have small roots but is primarily a green sphere or pair of spheres (often called fronds, although their proper name is *thallus*). These plants create a bright green, floating cover on the surface of water.

Rather than flowering and producing seeds, duckweed typically reproduces asexually by budding on the edge or base of the "fronds." Each frond can reproduce a number of times before turning yellow and dying of old age. This reproduction process under the right conditions can result in very high growth rates that can quickly cover an entire pond surface. Duckweed then becomes a nuisance that can block sunlight, constrain oxygen exchange, and lower dissolved oxygen levels as plants die and decay.

In areas with cold winters, duckweed produces buds that sink to the bottom of a pond in order to survive harsh temperatures. Although duckweed is found in many different climates, it typically grows in warm topical or temperate regions. Duckweed can survive under a variety of growing conditions. It thrives in nutrient rich, calm water and can grow in either sunlight or shade.

When growth rates are under control, duckweed is an important component in an ecosystem because it provides nutrient-rich food for waterfowl and fish. Smaller creatures also eat duckweed; these are then eaten by larger animals. Duckweed helps control the growth of algae by absorbing nutrients from the water and blocking out sunlight. The shade produced by duckweed also keeps the water cool, therefore having a positive impact on dissolved oxygen levels as well as minimizing water loss through evaporation.

Sources:

"Duckweed and Watermeal." *Water Quality*. PennState College of Agricultural Sciences, 2016. Web. 11 Aug 2016. [http://extension.psu.edu/natural-resources/water/ponds/pond-management/aquatic-plants/duckweed-and-watermeal]

"Environmental Change and Biodiversity." *Cornell Department of Ecology and Evolutionary Biology*. Cornell University, n.d. Web. 11 Aug 2016. [http://ecologyandevolution.cornell.edu/research/environment-sustainability-conservation/environmental-change-biodiversity.cfm]

"Why We Must SAVE THE FROGS!" *SavetheFrogs.com*. Save the Frogs! 2013. Web. 11 Aug 2016. [http://www.savethefrogs.com/why-frogs/index.html]

Additional Resources

For more science background information:

- Bozeman Science has a series of videos that clearly explain many of the Disciplinary Core Ideas addressed in this module. The Bozeman Science YouTube channel is: https://www.youtube.com/channel/UCEik-U3T6u6JA0XiHLbNbOw
  - Inheritance of Traits: https://www.youtube.com/watch?v=v4J4rsGwT6U&index=38&list=PLllVwaZQkS2rtZG_L7ho89oFsaYL3kUWq
  - Variation of Traits: https://www.youtube.com/watch?v=mXvgcBr1rTA&index=39&list=PLllVwaZQkS2rtZG_L7ho89oFsaYL3kUWq
- Information on North American pond habitats, including the organisms that commonly live there: http://www.fcps.edu/islandcreekes/ecology.htm
- Information on frogs and frog habitat loss: http://savethefrogs.com/index.html
- Basic facts about frogs: http://www.defenders.org/frogs/basic-facts
- 10 things you can do to help endangered species: http://www.endangered.org/10-easy-things-you-can-do-to-save-endangered-species/
- Information about how to build a backyard frog pond from the National Wildlife Federation: http://www.nwf.org/How-to-Help/Garden-for-Wildlife/Gardening-Tips/Build-a-Backyard-Pond.aspx
- Information about different types of amphibians: http://animals.sandiegozoo.org/animals/amphibians
- USDA Invasive Species Map that shows the invasive species that live in your state: http://www.invasivespeciesinfo.gov/unitedstates/state.shtml
- Committee on a Conceptual Framework for New K-12 Science Education Standards, et al. "A Framework for K-12 Science Education Standards: Practices, Crosscutting Concepts, & Disciplinary Core Ideas." The National Academies Press, 2012. Web. 11 Aug 2016. [http://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts]
- American Association for the Advancement of Science. "Benchmarks for Science Literacy." *Project 2061*. American Association for the Advancement of Science, 2009. Web. 11 Aug 2016. [http://www.project2061.org/publications/bsl/online/index.php]
- "National Science Education Standards" The National Academies Press, 1996. Web. 11 Aug 2016. [http://www.nap.edu/catalog/4962/national-science-education-standards]

For information on vendors:

- Living organisms can be purchased at:
- Carolina Biological at http://tinyurl.com/glt9u75
- Connecticut Valley Biological at https://www.connecticutvalleybiological.com/

For more information on the NGSS Performance Expectations, including the evidence statements:

- http://www.nextgenscience.org/next-generation-science-standards
- http://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts

For more information on science instruction in the elementary classroom:

- National Research Council, Ready, Set SCIENCE! Putting Research to Work in K–8 Science Classrooms describes the kinds of learning experiences and instructional practices that are necessary for students to develop a deep understanding of science: http://www.nap.edu/catalog/11882/ready-set-science-putting-research-to-work-in-k-8
- The Inquiry Project—Talk Science Primer provides guidance for developing a culture of productive talk in classrooms: http://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf
- Tools for Ambitious Science Teaching provides a constantly evolving set of tools aimed at improving student participation and learning: http://ambitiousscienceteaching.org/
- NGSS@NSTA provides NGSS curriculum planning resources as well as professional learning materials: http://ngss.nsta.org/Default.aspx
- NGSS Resources contains a variety of materials to support implementation of NGSS, including links to the Evidence Statements that help clarify the standards: http://www.nextgenscience.org/resources