The Evolution of the T2L Science Curriculum

Over the last four years, the Teach to Learn program created 20 NGSS-aligned science units in grades K-5 during our summer sessions. True to our plan, we piloted the units in North Adams Public Schools, and asked and received feedback from our science fellows and our participating teachers. This feedback served as a starting point for our revisions of the units. During year 2 (Summer of 2015), we revised units from year 1 (Summer/Fall 2014) and created new units to pilot. In year 3, we revised units from years 1 and 2 and created new units of curricula, using the same model for year 4. Our understanding of how to create rich and robust science curriculum grew, so by the summer of 2018, our final summer of curriculum development, we had created five exemplar units and established an exemplar unit template which is available in the T2L Toolkit.

We made a concerted effort to upgrade all the existing units with exemplar components. We were able to do much, but not all. So, as you explore different units, you will notice that some contain all elements of our exemplar units, while others contain only some. The fully realized exemplar units are noted on the cover page. We did revise all 20 units and brought them to a baseline of "exemplar" by including the Lessons-At-A-Glance and Science Talk elements.

Grade 3

Adaptation and Heredity

MCLA NAPS Williams

Teach To Learn

A collaboration between MCLA, Williams College, and North Adams Public Schools

Funded by NSF DUE-IUSE Award #1432591

T2L Curriculum Unit

Adaptation and Heredity

Life Science/Grade 3

This unit engages students in an exploration of how changes to an environment or habitat affect the ability of animals and plants to survive and thrive. This unit explores these major themes: adaptation, heredity, evolution, and natural selection. Students will learn that animals and plants inherit traits from their parents; that adaptation leads to variation in those traits; that traits can be influenced by the environment; some traits are learned and learning is acquired and therefore not an adaptation, and that natural selection guides evolution. Also included are activities that explore how societal actions impact habitats and the plants and animals living there thereby crossing over from Life Science to Earth Sciences.

The lessons incorporate hands-on experiments, data collection, and discussions with peers and teachers. They have been adapted from DESE's 3rd grade Model Curriculum Unit *Survival of Organisms* and from the Williams' Elementary Outreach Adaptation Unit, among others. The goals of this unit are to foster intellectual curiosity and provide hands-on, real world scientific experiences aligned with Next Generation Science Standards and Practices.

This unit was developed with National Science Foundation funding (Grant #1432591). It is a DRAFT document that will be revised as the unit is piloted and feedback received.

Unit Creation and Revision History

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Unit Plan

Stage 1 – Desired Results

Note: Both the new MA draft science standards and the current science standards are referenced below. The current standards are italicized here and throughout the lessons.

3-LS-1. Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen. [Clarification Statements: Examples can include different ways plants and animals begin (e.g., sprout from a seed, born from an egg), grow (e.g., increase in size and weight, produce a new part), reproduce (e.g., develop seeds, root runners, mate and lay eggs that hatch), and die (e.g., length of life). Plant life cycles should focus on those of flowering plants. Describing variation in organism life cycles should focus on comparisons of the general stages of each, not specifics.] [State Assessment Boundary: Detailed descriptions of any one organism's cycle, the differences of "complete metamorphosis" and "incomplete metamorphosis," or details of human reproduction are not expected in state assessment.]

3-LS3-1. Provide evidence, including through the analysis of data, that plants and animals have traits inherited from

Meaning

UNDERSTANDINGS

Students will understand that…

- Changes in an environment can affect the survival of animals
- Explain how specific bird beaks are adapted to eat a certain type of food.
- Predict what type of food different birds eat based on the shape of their beak
- Bird populations will change if the environment is changed
- Variations in characteristics among individuals of the same species may provide advantages in surviving
- Some of the reasons that animals and plants survive well, less well, or do not survive in an environment

ESSENTIAL QUESTIONS

How do living things (animals and plants) adapt to their environment so they are better able to survive?

How do people affect the environment of living things (animals and plants)?

Student Learning Targets

Students will be able to….

1. Compare and contrast acquired and inherited traits
2. Give examples to show that all living things have traits that are inherited or acquired.
3. Recognize that different animals can have different responses to changes in an environment.
4. Recognize that different animals have different needs that may or may not be met by a particular environment.

parents and that variation of these traits exist in a group of similar organisms. [Clarification Statements: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Focus should be on non-human examples.] [State Assessment Boundary: Genetic mechanisms of inheritance or prediction of traits are not expected in state assessment.] **3-LS3-2.** Distinguish between inherited characteristics and those characteristics and that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment. [Clarification Statements: Examples of the environment affecting a characteristic could include normally tall plants stunted because they were grown with insufficient water or light, a lizard missing a tail due to a predator, and a pet dog becoming overweight because it is given too much food and little exercise. Focus should be on non-human examples.] **3-LS4-2.** Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. [Clarification Statements: Examples can include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer, and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to produce offspring. Examples	5. Describe the process of evolution by relating how adaptations over millions of years allowed whales to move from the land to the water. 6. Give one example of how animals and plants depend on each other for survival. 7. List ways that changes in the environment affect the survival of the plants and animals. 8. Recognize that human activity can lead to environmental changes. 9. Use evidence to support the explanation that the environment can influence traits. 10. Analyze and interpret data to provide evidence for conclusions. 11. Explain how changes in an environment can affect the survival of different kinds of plants and animals. 12. Create a bar graph to show fluctuations in habitat components and the population of a model animal (deer). 13. Collect and record data to determine which beak is best suited for which type of food.

of evidence could include needs and characteristics of the organisms and habitats involved.] **3-LS4-3.** Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.] **3-LS4-4.** Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. [Clarification Statements: Changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat. *3-5 LS.5 Differentiate between observed characteristics of plants and animals that are fully inherited (e.g. color of flower, shape of leaves, color of eyes, number of appendages) and characteristics that are affected by climate or environment (e.g. browning of leaves due to too much sun, language spoken).* *3-5 LS.6 Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g. shape of beak or feet, placement of eyes of head, length of neck, shape*	

of teeth, color.
3-5 LS.7 Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).

(Related Earth Science Standards)
K-2-ESS3.C Human impacts on Earth systems. Things people do can affect the environment, but they can make choices to reduce their impacts.

3-5-ESS3.C Societal activities have had major effects on land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments

ESS2.E Living things can affect the physical characteristics of their environment.

Mathematics
3.MD.B.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

Literacy
W3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Technology G3-5: 2.7 Explain that some Web sites and search engines may include sponsored commercial links.	
Stage 2 – Evidence	
Evaluative Criteria	**Assessment Evidence**
Pre-unit Assessment (if any)	Unit Assessment **CEPA: Design a Bird: An Evidence-Based rationale (See appendix)** Students "create" their own bird-like creature and develop a scientific argument that supports their chosen beaks and feet based on what their created bird eats and where it lives.
Stage 3 – Learning Plan	
Prior grade level knowledge (review if necessary) Habitats and environment Use principles of the physical world to analyze living systems Use evidence and reasoning to develop scientific claims and engage in discussions of scientific and technical topics	
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Tiered Vocabulary List

Tier 1	Tier 2	Tier 3
Habitat	Survive	Reproduction
Drought	Model	Decomposition
Community	Environment	Naturalist
Beak	Traits	Common
Nostrils	Generation	Descent
Rainforest	Hypothesize	Organism
senor	Evolution	Adaptation
	Extinction	Inherited trait
		Acquired trait
		Variable trait
		Species
		Heredity
		Dominant gene
		Mutation
		Fluked tail
		Natural selection
		Amazon Rainforest
		Deforestation
		Kapok Tree

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Lessons at a Glance

Lesson	Core Activities	Optical Extensions	Tech Integration
1	• Oh Deer! Game • Oh Deer! Graph	• Check out a book on a wild animal and make top-down web	YouTube, iPad
2	• Darwin Evolution video • Bird "Beaks" experiment	• Use different tools in other stations • Raccoons Living in the City Video • *Beaks, Feet and Feathers* puppet show	YouTube, iPad
3	• Plant Traits video • Human traits activity • Closing: Group Presentation	• Bring in Flowers • Use PowerPoint • Tap-down web of human traits • Take-home traits sheet	iPad
4	• Eggles Experiment • Eggles Mutation Experiment (optional)	• Build-a-bird Online Activity	iPad
5	• Wolves 2 Dog video • Evolution of Whales Activity • Closing: Group Presentation		YouTube
6	• Deforestation Videos • Deforestation PowerPoint	• Raccoons Living in the City Video	YouTube
7	• Amazon Rainforest video • Kapok Tree book and worksheet	• Real Images Great Kapok Tree • Read the Lorax	YouTube

Lesson Feature Key

Lessons in this unit include a number of features to help instructors. This key is a quick guide to help identify and understand the most important features.

Icons

 **Talk science icon:** Look for this icon to let you know when to use some of the talk science strategies (found in the unit resources of this unit)

 **Anchor phenomenon icon:** Indicates a time when an anchoring scientific phenomenon is introduced or when an activity connects back to this important idea**.**

Text Formatting:

[SP#: ....] Any time you see a set of brackets like this, it indicates that students should be engaged in a specific science or engineering practice.

Underlined text in the lesson: This formatting indicates important connections back to the central scientific concepts and is useful to note these connections as an instructor, as well as for students.

Callouts

Teaching Tip

In these call-out boxes, you'll find tips for teaching strategies or background information on the topic.

Student Thinking Alert

Look out for common student answers, ways in which students may think about a phenomenon, or typical misconceptions.

Lesson 1: Oh Deer!

BACKGROUND

Overview of the Lesson

Students will explore the impact of change to an environment on the survival of deer populations through game play. They will learn that habitats provide resources that allow plants and animals to survive and reproduce, and when the environment changes, it can adversely impact the organisms that rely on it. Students will also learn that a habitat can be as large as an ocean or as small as a pool in a river, if it provides the components for survival and reproduction. This lesson is adapted from http://www.projectwild.org/documents/ohdeer.pdf

This lesson will require the use of a large space, so make sure to coordinate with the teacher ahead of time to secure a large space for this lesson.

Focus Standard(s)

3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.]

3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. [Clarification Statements: Changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat.]

3-5 LS.7 *Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).*

3.MD.B.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

Learning Targets

I can explain how changes in an environment can impact the survival of animals.
I can recognize that animals can have different responses to changes in an environment.
I can recognize that animals have different needs that may or may not be met by a particular environment.
I can create a bar graph to show fluctuations in habitat components and the population of a model animal. (deer)

Assessment

In their science journals have students:

- Draw a picture of the deer and the four resources "played" in the game.
- Draw a second picture and eliminate one of the four resources and describe how and why it impacts the deer population.

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Targeted Academic Language/ Key Vocabulary

Tier 1: habitat, drought, community
Tier 2: survive,
Tier 3: reproduction, decomposition

RESOURCES AND MATERIALS

Quantity	Item	Source
	Space (playground, gym, etc.)	Classroom Teacher
20	Graph paper & pencils	Classroom Teacher
1	Game Rounds Data Table	Binder, teacher to copy
1	Oh Deer Graphing Worksheet	Binder, teacher to copy
1	**Bucket or bin to hold survival component "popsicle sticks"**	**Bin**

25	**Popsicle sticks, labeled for each of the 5 survival component (5 each)**	**Bin**
1 roll	Masking tape to mark areas	Bin
1	Large flip chart (with the same data table as handout) to record class data	Classroom Teacher

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/Activator

1. Ask students what a habitat is. Elicit responses. Ask if they think a pool of water in a river is a habitat? (It is.) **[SP1-Asking Questions/Defining Problems]** Encourage students to answer in full sentences, giving them examples of your own to model what the desired response is. Example:
    - A habitat is_____.
    - When I think of a habitat I think of_____.
    - I think a habitat has _____.
2. Building on student ideas, explain or review/reinforce that a habitat is an area that includes food, water, shelter, and space for plants and animals. Ask students to share some examples of habitats they have learned about, including tropical rainforests, deserts, grasslands, woodlands, wetlands, arctic, oceans. (Students might not have had any formal instruction in habitats.) Ask them to "pair and share" and describe to their partner the habitat in their backyard or their favorite park.
3. Ask what happens to plants or animals in the habitat when there is a change to the environment/habitat. Give some examples. Elicit responses.
4. Discuss how these changes affect the existence of the plants or animals. Introduce key vocabulary like life cycle, decomposition, and reproduction and explain to the students that they will be doing an activity that simulates these conditions.
5. Ask if changes in an environment only affect animals or might they affect plants, too. (Give the example of the American Chestnut Tree, 99.9% have died from an imported disease, ask students to hypothesize what happened to the birds that build nests in the trees, the small animals that ate the nuts from the trees, etc.) Elicit responses.

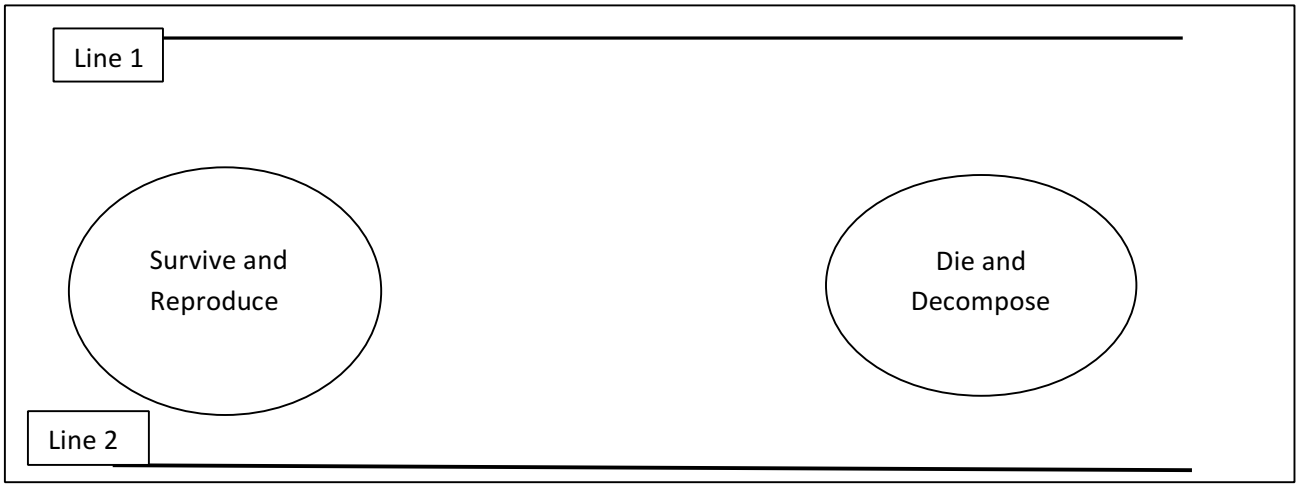
Oh Deer! The game

(Lesson likely done over two days –break between the activity and discussion/data analysis)

1. Tell students they will be participating in an activity that emphasizes the most essential things animals need to survive. Review the essential components of a habitat with the students: food, water, shelter, air, and favorable temperature.
    a. Explain they will be playing a simulation or game that represents what happens in nature. An animal needs all of the habitat components and is seeking these components to survive. If an animal isn't able to eat, drink, find shelter, and have space to grow and reproduce it does not survive.
    b. Explain they will play multiple rounds of this game and they will have an opportunity to play different parts during the game.
    c. Explain they will need to take time between each round to count the deer who survived and those that did not. They will write this data in their own data table and they will graph this data together during the next day.
    d. Explain the rules of the game once before students move to the space.

Setting up the play area: Using masking tape mark off 2 parallel lines at least 10 feet apart, and 2 holding areas, one for deer that "Survive and Reproduce" (i.e., ***do*** *find their habitat component) and one for deer that "Die and Decompose" (i.e.,* ***don't*** *find their habitat component).*

Simulation Lay Out of Space/Room



Ask the students to count off in fives. (If the number of students in the class is too low for five habitat components, air and favorable temperature can be combined and labeled as "space". Explain to the students that having a habitable living space entails air and favorable temperature that is conducive to surviving.) Have all the 1's go to Line 1 and find a space on the line; all 2's, 3's, 4's, and 5's, go to Line 2 and find a space on that line. At the beginning of the game and the first round, the 2 lines of students should be facing each other. (See diagram in Worksheets/Additional Resources Section at the end of this unit.) Tell the 1's they represent "deer." Explain all animals, including deer need a good habitat to survive. Ask the students what the essential components of habitat are (food, water, shelter, space). Explain that the deer (1's) need to find one of those 4 things to survive. (The deer will know what they need by randomly selecting a Popsicle stick out of the container with one of the 4 habitat components written on it. They will look for what they need based on how the students on Line 2 are holding their hands to represent each component.)

2. Tell the 2's, 3's, 4's, and 5's they are the habitat components of food, water, shelter, and space. The student will also randomly select a Popsicle stick out of the container with one of the 4 habitat components written on it. The students depict which component they selected by holding their hands in a specific way:
    a. To represent food, put hands over their stomach.
    b. To represent water, put hands over their mouth.
    c. To represent shelter, hold hands together over their head.
    d. To represent space, hold hands out from their sides.

    Have the entire class practice the hand motions that represent each habitat component by shouting out, "food," "water," "shelter" and "space" while modeling the hand placement.

4. Ask the students to count the number of deer on Line 1. Record that number in the class data table. Ask the students to count the habitat components on Line 2. Record that number in the class data table. Ask the students to predict if they think all of the deer will find the habitat component they need during the first round. Ask a few students to explain their thinking around their prediction. Note the predictions on the class table. Encourage them to use their

science words such as "I predict" in their responses.

5. The activity starts with all players lined up behind their respective lines (deer on one side, habitat components on the other side). Tell the students to all turnaround so the 2 lines of students have their backs to each other.

6. Begin the first round by walking down the deer line and handing each deer a "deer" Popsicle stick. The "habitat components" also select a Popsicle stick out of the habitat container. It will have one of the 4 habitat components written on it

7. Give the students a few moments to put their hands in place—over stomachs, over mouths, over their heads, or straight out.

8. When the students are ready, say, "Oh Deer!" Each deer and each habitat component turn to face the other.

9. When deer see the habitat component they need, they should skip to it. Each deer must hold the Popsicle stick until "capturing" a student who represents that component. Each deer that acquires its necessary habitat component takes itself and the habitat component student to the "Survive and Reproduce" box. "Capturing" a component represents the deer successfully meeting its needs and successfully reproducing as a result. Both the deer and the habitat component will be deer in the next round. Any deer that fails to find its food, water, shelter or space should move to the "Die and Decompose" box. Any deer that died will be a habitat component in the next round; they become the food, water, or shelter available to the deer that are still alive.

10. Ask the students to count how many deer were in the "Survived and Reproduced" box (e.g., they found their habitat component) after Round 1. Ask the students how many deer died and decomposed (e.g., they did not find their habitat component). Most deer should have survived and reproduced. There will be many habitat students who did not pair up with a deer. They go back to the habitat line. If any deer died, they now go to the habitat line and become a habitat component. The teacher records the number total survivors and total deer deaths at the end of each round in the class data table. Continue the activity for approximately 2-3 more rounds. At the end of each round, the "deer students"

return their Popsicle sticks to the container and draw new sticks (to get new survival component) once they are on the line. At the start and end of each round, the teacher should take time to count the deer and habitat components, and the survivors and dead.

The teacher should take time at the end of each round to talk about what happened.

- Why are there more deaths at the end of a round?
- What happened?
- Why are there more or fewer habitat components?

Students should start to see, as the number of deer increases, there are fewer habitat components for that deer due to competition, limited resources, and population growth.

11. For Round 4, the teacher should secretly tell the habitat students that *there is a drought and so there is no water available for the deer.* They may only be food, shelter/space. Run the simulation. Count those who survived and reproduced and those who died. Record on the class data table. Discuss what happened and offer the reasons for it.

12. For Round 5, whisper to the habitat students that the drought continues and without water, food can't grow. Habitat students may only make the signs of shelter and space. Deer continue to randomly select the Popsicle sticks from the entire assortment. Note the results at the end of the round on the class data table. Take time to discuss student thinking about what is happening as the habitat changes.

13. For Round 6, whisper to habitat students that humans have decided to develop the area (build houses or a new factory), so there is no longer space or shelter. Tell them they may only make the signs of food and water. Deer continue to randomly select the cards from the entire assortment. Note the results at the end of the round on the class data table. Take time to discuss student thinking about what is happening as the habitat changes.

14. Continue playing rounds of "Oh Deer" as time permits. Limit the habitat in a variety of ways so students understand there is a relationship between animals that are able to meet their needs and survival/reproduction.

15. At the end of the simulation, bring the students back to the classroom/gathering space to place the data from the class simulation into their own data table.

16. Encourage students to talk about what they experienced and saw in the simulation and encourage them to use the data as evidence for their reasoning **[SP7-Arguments from Evidence]**. For example, they saw a small herd of deer (7 students in a class size of 20) begin by finding more than enough of its habitat needs. However, because the population of deer expanded over two to three rounds of the activity it exceeded the ability of the habitat to supply what it needed to survive and reproduce; there was not sufficient food, water, and shelter for all members of the herd. At that point, deer starved or died of thirst or lack of shelter, and they returned as part of the habitat. The deer population was above the *carrying capacity* of the environment. The graph will show the relationships between the number of deer in a habitat, the number of habitat components, and the ability of the deer to survive and reproduce.

17. Brainstorm some suggestions for the title of the graph, and write them on the board. Students will copy the class graph onto their own graphing sheet, titling it whatever they choose. Discuss what makes a good title for a graph and what information (e.g., the cause-and-effect relationship being measured) it should convey to the reader.
18. When the students have completed their graphs, have them glue it into their journals making sure they date the entry.

Lesson Closing

Whole class comments and questions posed by teacher or science fellow:

- Why did some deer live and some deer die?
- What 4 necessary resources does a habitat provide?
- How do those help the survival of the deer?
- What happened to the resources as the deer population grew, or got smaller?

Assessment

In their science journals have students:

- Draw a picture of the deer and the four resources "played" in the game.
- Draw a second picture and eliminate one of the four resources and describe how and why it impacts the deer population.

Optional Extension

During library time, students can check out a book on a wild animal and complete a top down web, including aspects like habitat, diet, physical traits and behavior trait. Discuss the importance of different aspects to its survival and make connections to the Oh Deer game.

Lesson 2: Adaptation: For the Birds

(Birds and Their Beaks)

(Adapted from Center for Learning in Action, Lesson 5, Bird Beak Adaptation)

BACKGROUND

Overview of the Lesson

Animal adaptations are any body shape, process, or behavior that allows an organism to survive in its environment. Populations of animals change over time in response to their environment. Why do birds have different shaped beaks? Birds have many different kinds of beaks, depending on what they eat and where their food source is. For instance, birds may find their food in water, mud, flowers, seeds, or wood. Different shaped beaks allow easier access to these various food supplies. Adaptation to a particular environment occurs over time as organisms best suited to the environment survive, reproduce, and pass their inherited traits to the next generation. This hands-on lesson models different types of beaks **[SP2-Modeling]**. **This lesson has lots of materials and 6 stations, so it will take time to set up.** Each station will have a food source and a set of three different utensils, which students use as sample "beaks". (Note: Much of this concept is integral into the CEPA).

The specific birds that eat each type of food should be discussed at **the end of class** after the group presentations.

1. Nectar (colored water) needs to be sucked out—Hummingbird
2. Worms (gummy worms) need to be dug and pulled out—Robin
3. Seeds (sunflower seeds) need to be cracked open—Sparrows, Finches
4. Fish (Styrofoam pieces) need to be scooped out of the water—Heron
5. Small insects (rice) need to be pried out of small crevices—Woodpeckers
6. Meat (marshmallows) will need to be pulled off of bones—Owls, Hawks

Focus Standard(s)

3-LS4-2: Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. [Clarification Statements: Examples

can include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer, and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to produce offspring. Examples of evidence could include needs and characteristics of the organisms and habitats involved.]

3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.]

(2006)3-5 LS.6 *Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g. shape of beak or feet, placement of eyes of head, length of neck, shape of teeth, color.*

Learning Targets

I can explain how specific bird beaks are adapted to eat a certain types of food.
I can predict what type of food different birds eat based on the shape of their beak.
I can collect and record data to determine which type of beak is best suited for which type of food.
I can hypothesize what would happen to a bird population if its environment changed.
I can explain the results of the bird beak experiment to the class.

Assessment

- Discussion questions
- Record of Experiment
- Science Journal Entry: Identify a food source and draw a beak that would be best suited to eating that food source, giving evidence for why the beak would be good for eating that food source. Optional: Write a description (as a "beak user's guide" or "how-to manual") for how the beak would eat the identified food source.

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Targeted Academic Language/ Key Vocabulary

Tier 1: beak
Tier 2: model, environment (as in habitat)
Tier 3: naturalist, common descent, organism, adaptation

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Projector or ability to play videos	Classroom Teacher
1	Bird Beak PowerPoint or PDF (pictures of bird beaks)	CMC Website
1	Bird Beak Adaptation Station Worksheet (2 sheets)	Binder, teacher to copy for students
	Darwin Video: https://www.youtube.com/watch?v=4ekGLlKd_HU	CMC Website
	Raccoons Living for the City Video: http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/	CMC Website
 1 1 1 1 1	Station 1 Graduated cylinder (add water) Cup Shoestring Dropper Sponge strip	All in Bin
 1 bag 1 1 bag 1	Station 2 Gummy worms Cup Potting soil Deep pan	All in Bin

1 1 1	Straw Chopsticks Pliers	
 1 bag 1 1 1 1	<u>Station 3</u> Sunflower seeds Cup Pliers Chopsticks Tweezers	All in Bin
 5 1 1 1 1 1	<u>Station 4</u> Styrofoam pieces Cup Shallow pan (add water) Chopsticks Tweezers Slotted spoon	All in Bin
 1 1 1 1 1	<u>Station 5</u> Rice in circular piece of Styrofoam Cup Dropper Tongs Tweezers	All in Bin
 1 1 1 1 1	<u>Station 6</u> Marshmallows tied to string Cup Chopsticks Tongs Tongs Skewers	All in Bin

****Items in bold should be returned for use next year****

LESSON DETAILS

Setup

You will need to set up six stations in advance of teaching this lesson. **There are lots of materials so it will take time to set up.**

Lesson Opening/ Activator

1. Students watch the video Darwin Evolution (https://www.youtube.com/watch?v=4ekGLlKd_HU) and discuss the adaptation of tortoises' different traits that enable them to find food in their environment (lots of greenery vs. high cactus) as a bridge to understanding how bird beaks are adapted for the food their habitats offer. Discuss the following questions as a class. What does adaptation mean? What are some examples of adaptations? How might living things become adapted to their environment? (Remember, adaptations must be inherited.) Give examples of adaptations: (inherited traits that change over time to enable organisms to survive, e.g., shape of beak or feet, color of petals on flowers, length of claws, size of paws, placement of eyes on head, length of neck, shape of teeth, color of feathers).

2. Now, relate adaptations to birds. Ask the students to share with the class what they know about birds. What makes a bird a bird? What do birds need to survive? What kinds of food do they think birds eat? (Insects, seeds, berries, and meat are among the most common.) Where do birds live? What birds do they see and hear every day? Play static video (http://youtu.be/quJBrYU7hnM) of *Bird Beak Adaptations*, pausing after each image. This can also be provided as PDF or in PowerPoint format.

During the Lesson

1. Arrange the following materials in front of the class
   a. A graduated cylinder filled with colored water (replace the colored water with clear water for the challenge station)
   b. A pan of potting soil with gummy worms buried throughout
   c. Sunflower seeds spread throughout a pan
   d. A dish of shallow water with Styrofoam cubes floating in it

e. Rice grains tucked into Styrofoam
f. Marshmallows hanging on strings

Discuss with students that each of these items represents a type of food eaten by various birds. Ask students if they can hypothesize what a bird would have to do in order to reach the food supply. Does the shape of a bird's beak limit what they can eat?

2. Divide students into groups of at least three per group and assign each group to a station.

3. Make sure the stations and equipment are set up around the room. (Each station should have a set of instructions, a recording sheet, a food source, a cup to place used food source, and a set of three different utensils, which they are to use as sample "beaks." Each station should take approximately 5-10 minutes for the students to try out the different utensils.)

4. After reading their instructions, ask students to predict which "beak" will work best for "eating" their specific "food" on their recording sheet.

5. Each group will see which food is easiest to gather with each utensil.

Teaching Tip

Set the stations up in a circle to help the flow of student traffic in the room. This way it will be easier to transition from one station to another with as little distraction as possible for students.

Station #1
Food source: Graduated cylinder with water
Sample beaks: shoestring, dropper, and sponge strip
Procedure:

1) Experiment with all three tools and decide which “beak” works best to take water from the graduated cylinder and put into a cup.
2) Record answers and give evidence to support the conclusion.

Station #2
Food source: Gummy worms in potting soil in a pan
Sample beaks: straw, chopsticks, and pliers
Procedure:

1) Experiment with all three tools and decide which "beak" works best to remove gummy worms from the potting soil and put into a cup.
2) Record answers and give evidence to support the conclusion.

Station #3
Food source: Sunflower seeds spread out in a pan
Sample beaks: pliers, chopsticks, and tweezers
Procedure:

1) Experiment with all three tools and decide which "beak" works best to crack open the sunflower seeds, then remove the seeds and put them into a cup.
2) Record answers and give evidence to support the conclusion.

Station #4
Food source: Floating Styrofoam squares in a pan of shallow water
Sample beaks: chopsticks, tweezers, and slotted spoon
Procedure:

1) Experiment with all three tools and decide which "beak" works best to remove all of the Styrofoam from the water.
2) Record answers and give evidence to support the conclusion.

Station #5
Food source: Rice stuck into Styrofoam
Sample beaks: dropper, plastic tongs, and tweezers

Procedure:

1) Experiment with all three tools and decide which "beak" works best to remove rice from the Styrofoam and put into a cup.
2) Record answers and give evidence to support the conclusion.

Station #6

Food source: Hanging marshmallows
Sample beaks: Chopsticks, tongs, and skewer
Procedure:

1) Experiment with all three tools and decide which "beak" works best to remove the marshmallows from the string.
2) Record answers and give evidence to support the conclusion

Optional Activity: "Roll a Beak": students will have a dice and each number will represent a different beak. They would discuss the type of food that the beak would eat best and why.

Optional Activity: If the students have access to the internet, have them go to: http://projectbeak.org/adaptations/beaks.htm
This website will allow them to explore different aspects of birds and their habitats and let them test their knowledge in small quizzes they can take at the end of each section.

Lesson Closing

Discuss the following questions as a class or in their groups **[SP7-Arguments from Evidence]**:

- In these experiments, why were some tools (beaks) better at getting food than others?
- How did the tools resemble the different shapes of bird beaks?
- What did your results tell you about bird beaks?

Assessment

1. Discussion questions
2. Record of Experiment
3. Science Journal Entry: Identify a food source and draw a beak that would be best suited to eating that food source, giving evidence for why the beak would be good for eating that food source. Optional: Write a description (as a "beak user's guide" or "how-to manual") for how the beak would eat the identified food source.

Optional Extensions

1. Additional Experiment: Have students take their tools to another station and compare which is better. Students will have to "repair" stations to do a follow-up experiment.
2. View *Raccoons living-for-the-city* http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/ Discuss the difference between adaptation and response to a situation. This video gives a preview of what is to come in the unit, so it would be very helpful to introduce it early on.
3. Perform the puppet show *Beaks, Feet, and Feathers* and discuss after how different animals used different traits to escape the cat (and survive).

Lesson 3: Who Are You? Your Family Traits

BACKGROUND

Overview of the Lesson

Traits are qualities, features or other things that distinguish one organism from another. Traits can include things like hair color, color of petal for flowers, tooth shape, leaf shape, beak shape, bone size, or muscle structure. Traits come in two varieties: acquired (learned or gained) and inherited (heredity). Inherited traits are passed down from one generation to the next and acquired traits are learned or obtained over an individual's life, but not passed onto the next generation. Student will learn that traits are the "features and qualities" that change to help plants and animals adapt. This lesson uses YouTube videos, please review the videos ahead of time to prepare for this lesson.

Focus Standard(s)

3-LS3-1. Provide evidence, including through the analysis of data, that plants and animals have traits inherited from parents and that variation of these traits exist in a group of similar organisms. [Clarification Statements: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Focus should be on non-human examples.] [State Assessment Boundary: Genetic mechanisms of inheritance or prediction of traits are not expected in state assessment.]

3-LS3-2. Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment. [Clarification Statements: Examples of the environment affecting a characteristic could include normally tall plants stunted because they were grown with insufficient water or light, a lizard missing a tail due to a predator, and a pet dog becoming overweight because it is given too much food and little exercise. Focus should be on non-human examples.]

[2006] 3-5 LS.5 *Differentiate between observed characteristics of plants and animals that are fully inherited (e.g. color of flower, shape of leaves, color of eyes, number of appendages) and characteristics that are affected by climate or environment (e.g. browning of leaves due to too much sun, language spoken).*

Learning Targets

I can explain the difference between acquired and inherited traits.
I can identify if traits are inherited, acquired (or both), through observations, outside knowledge, and group discussions.
I can give examples to show that all living things have traits that are inherited and traits that are acquired.

Assessment

Type II (written in science journals)

- List three traits and say whether they are inherited or acquired
- Give an example of a plant or animal that has both inherited and acquired traits
- Explain the difference between inherited and acquired traits

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Targeted Academic Language

Tier 2: traits
Tier 3: inherited traits, acquired (learned) traits, variable trait

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Projector or ability to play videos	Classroom Teacher
1	A plant	Classroom Teacher
	Science journals	Classroom Teacher
1	Inherited Traits Handout (Pictures)	Binder, teacher to copy for students
6 copies (1 per	"Who Has" Tally worksheet	Binder, teacher to copy

station)		for students
1	Frequency Table Worksheet	Binder, teacher to copy for students
	Traits Plant Variety Video: http://youtu.be/4_Pje5RdT0A	CMC Website

****Items in bold must be returned to the bin at the end of the lesson****

LESSON DETAILS

Lesson Opening/ Activator

Science fellows and teachers should review the video ahead of time: *Traits Plant Variety* (http://youtu.be/4_Pje5RdT0A). Play the videos for the students and pause to discuss the inheritable traits of plants and how they are breed for certain traits like color and leaf size. Decide if you'd like to play the videos through to the end and continue to pause when appropriate for more discussion.

1. Brainstorm a list of inherited (e.g., traits you are born with) human traits, including eye color, hair color, freckles, dimples, curling the tongue, earlobes. Broaden the discussion to include inherited traits of dogs or other pets.
2. Brainstorm a list of acquired (e.g., traits that are learned) human traits, including riding a skateboard, doing addition, speaking another language, learning to read. Ask about the acquired traits of dogs or other pets (to shake hands, lay down, sit).
3. Brainstorm a list of inherited traits of plants (e.g., bark of trees, color of petal for flowers, taste of fruit).
4. Brainstorm a list of acquired traits in plants (e.g., shape of a bush after it is trimmed).

During the Lesson

1. Pass out Inherited Traits Picture worksheet. Review the worksheet as a class and relate it to the examples students gave. You may need to discuss or demonstrate the meaning of the word "variable" (relate it to the differences observed in the human traits; e.g., color of hair, size of second toe).

2. Set up 6 stations around the classroom. Each station will focus on collecting data on one of the inherited traits listed on the worksheet. Divide the students up into 6 groups and assign each group to be in charge of a station (they will later present the data collected at this station).
    a. Set up the stations so that the "Who Has…" worksheet is visible and accessible for students to write on; and the particular trait the station is focusing on is visible and clear with a picture or drawing.
    b. Have each student go around the stations and fill out the worksheet with their name and whether or not they have the trait the station was assigned. (It is okay if they don't get to all the group.)

3. Once the students have gone through the stations, have groups return to their assigned station and tally up their findings. Pass out graphing sheets and have each group discuss, review the tally, and graph their findings.

4. Group presentation: Have the groups come up to the front of the classroom and present the findings from the data collected.

Optional Activity: Show or draw for the student's pictures of two flowers and explain that one is the father and one is the mother. Have the students draw a flower that is the offspring of these parents, making sure to emphasize that the offspring needs to have traits from both the father and the mother. This can be handed in as an assessment, or put on the wall when students are finished.

Lesson Closing

1. Ask the class if there were any surprises or confusion when surveying classmates?
2. What are some examples of inherited traits of people?
3. What are some examples of inherited traits of animals?
4. What do inherited traits explain? Ask students to record conclusions in their science journals. Students should use at least on piece of data from their worksheet as evidence to support their conclusions

Assessment

Type II (written in science journals)

- List three traits and say whether they are inherited or acquired
- Give an example of a plant or animal that has both inherited and acquired traits
- Explain the difference between inherited and acquired traits

Lesson 4: Heredity-The Eyes Have It

BACKGROUND

Overview of the Lesson

This lesson is a hands-on experiment that follows the adaptation of a fictional species (the Eggles) through birth, maturity, reproduction, and death, using eyes as the trait that is influenced by the environment. The focus of this lesson is on the idea that the "dominant gene" is what is seen as a result of adaptation **[SP2-Modeling]**. The lesson should be split into three parts (over three days). **Feel free to start the next lesson and have two lessons occurring simultaneously.** The teacher and science fellow should coordinate how much time to spend on this lesson and when the three parts of the lesson will take place.

Focus Standard(s)

3-LS1-1. Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen. [Clarification Statements: Examples can include different ways plants and animals begin (e.g., sprout from a seed, born from an egg), grow (e.g., increase in size and weight, produce a new part), reproduce (e.g., develop seeds, root runners, mate and lay eggs that hatch), and die (e.g., length of life). Plant life cycles should focus on those of flowering plants. Describing variation in organism life cycles should focus on comparisons of the general stages of each, not specifics.] [State Assessment Boundary: Detailed descriptions of any one organism's cycle, the differences of "complete metamorphosis" and "incomplete metamorphosis," or details of human reproduction are not expected in state assessment.]

3-LS3-1. Provide evidence, including through the analysis of data, that plants and animals have traits inherited from parents and that variation of these traits exist in a group of similar organisms. [Clarification Statements: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Focus should be on non-human examples.] [State Assessment Boundary: Genetic mechanisms of inheritance or prediction of traits are not expected in state assessment.]

3-LS3-2. Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment. [Clarification Statements: Examples of the environment affecting a characteristic could include normally tall plants becoming stunted because they were grown with insufficient water or light, or a lizard missing a tail due to a predator, and a pet dog becoming overweight because it is given too much food and little exercise. Focus should be on non-human examples.]

3-LS4-2: Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. [Clarification Statements: Examples can include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer, and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to produce offspring. Examples of evidence could include needs and characteristics of the organisms and habitats involved.]

Learning Targets

I can explain that variations in characteristics among individuals of the same species may provide advantages in surviving.
I can use evidence to support the explanation that the environment can influence traits.
I can analyze and interpret data to provide evidence for conclusions.

Assessment

- On the third day, have the students refer to their graphing sheets and write the story of the Eggles, explaining how the eyes had adapted to no light and that it required a generation for that adaptation to occur.
- Use evidence to support how the variation in the Eggles eyes provided advantages in surviving.

Targeted Academic Language

Tier 2: generation
Tier 3: species, heredity, dominant gene, mutation

Resources and Materials

Quantity	Item	Source
1	The Eyes Have It Worksheet	Binder, teacher makes copies
5	**Identical clear plastic bins 1 labeled Gen 1, 2 labeled Gen 2, 2 labeled Gen 3**	**Bin**
1	**Generation 1 Bin: 25 eggs (several of each color (blue/yellow/green), but not exactly same number of each), all small eyes)**	**Bin**
1	**Generation 2 Bin: 25 eggs (several of each color, but not exactly same number of each, all small eyes)**	**Bin**
1	**Generation 3 Bin: 25 eggs (several of each color, but not exactly same number of each, some eggs are large eyed)**	**Bin**
1	**Purple egg with purple pipe cleaners**	**Bin**
1	**Empty Generation 2 bin**	**Bin**
1	**Empty Generation 3 plastic bin**	**Bin**
2 bags	**Confetti**	**Bin**

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

1. Review what the students learned about adaptation from the lesson on bird beaks. Have them pair and share with a partner something they remember about their experiment, and ask a few students to share their insights with the class.
2. Then tell students that something very exciting happened today: they just got a shipment of a new unstudied species! Now pull out the Generation 1 bin and ask them to come up with a name for the new species. Sample ideas: Eggies,

Eggles, or anything that a student makes up (avoid a name that is too similar to a student's name).

During the Lesson

Suggested Lesson Schedule

Day 1 in Eggles Lifespan

1. Start Generation 1 with three Eggles, one of each color. (Add plenty of seeds in them to then reproduce a larger number of Eggles in Generation 2).
2. Count together how many blue, green, and yellow eggs there are.
3. Students should record and graph their data (Use colored pencils if available).
4. Students should make observations together as a class and record them in their science journals:
    a. What happens when you shake the eggs?
    b. Do the eyes move?
    c. Are all the eyes the same size
5. Then tell the students that this generation's lives are almost over. But don't worry! As this generation dies, it releases its "seeds" (pipe cleaner pieces) to reproduce the next generation. Open up the eggs and discover the "seeds" (pipe cleaner pieces) inside.
6. Discuss "What types of seeds come from blue eggs? From green eggs? From yellow?" Have the students record their observations.
7. Have each student deposit his or her "seeds" (pipe cleaners) into the empty Generation 2 bin. Let the bin sit in plain view, exposed to classroom light for the rest of the school day. Shake up the bin and tell the students that these "seeds" will combine (two together) to grow into new eggs. Add in some confetti for "food". For fun, you can always check the bin during the day to increase student engagement/excitement.
8. After students leave that day, replace the empty Generation 2 seed-filled bin with the egg-filled Generation 2 bin (to simulate the seeds growing into eggs).

Day 2 in Eggles Lifespan

1. Do the same activities as Day 1. Have students count the number of eggs and graph the number of each color. In their observations, students should compare their Day 2 graph to their Day 1 graph.
2. Collect the "seeds" from Generation 2 and place them in the empty Generation 3 bin this time, place Generation 3 with

the "seeds" in the dark, inside a closet or under a box that limits the light. Make sure the students are aware that this has occurred.

3. At the end of Day 2 (after students leave), replace the Generation 3 seed bin with the egg-filled Generation 3 bin that have some large-eyed eggs.

Day 3 in Eggles Lifespan

1. Have the students count up the eggs in the egg-filled Generation 3 bin, then graph the data and compare it to the previous graphs. This time make note that there is a new trait that isn't observed in the parents.
2. Discuss with students why some eggs might "grow" large eyes (to "adapt" to the low light/dark environment). Discuss why this adaptation might (or might not) increase survival (in the dark, large eyes make it easier to find "confetti" food). Be careful to distinguish individual changes that are inherited from those that happen to an individual during their life. Also discuss the concept of the "dominant gene" with this generation (the dominant gene in this case is blue, so make sure that each generation has a larger number of blue eggs).

Optional Concept

An optional concept that can be discussed is mutation, represented by a purple egg and purple pipe cleaners. Discuss how genes are passed down by a way of different combinations, and while the dominant gene is the gene that continues over generations and beats all the others (hence the word dominant), it can sometimes be the case, by random chance, that another gene gets added into the mix and can be seen in species.

Assessment

- On the third day, have the students refer to their graphing sheets and write the story of the Eggles, explaining how the eyes had adapted to no light and that it required a generation for that adaptation to occur.
- Use evidence to support how the variation in the Eggles eyes provided advantages in surviving.
- **Optional:** Have the students draw the different stages of the experiment, from what the seeds looked like on day 1 to what it looks like now on day three.

Teaching Tip

Consider the art assessment as one that should be done by the students. It is a great way for visual learners to express their learning in a varied form from the writing component.

Lesson 5: Evolution- Large Lizard to Whale in 47 Million Years

BACKGROUND

Overview of the Lesson

Students will watch an animation that simulates the evolution of the whale from a land-based creature to the whale, as it is known today. Students will learn that adaptations can occur over millions of years. As a way to make this concept more easily understood, we use wolves and their evolution into dogs. As well as explaining this evolutionary process, the video will enable students to "see" the process. **Prior to beginning the lesson, be sure to watch both videos (focusing on the *Evolution of Whales*) to effectively narrate the clips and form questions for the students before beginning the lesson.**

Focus Standard(s)

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. [Clarification Statements: Examples can include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer, and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to produce offspring. Examples of evidence could include needs and characteristics of the organisms and habitats involved.]

3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.]

3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. [Clarification Statements: Changes should include changes to

landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat.]

3-5 LS.6 *Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g. shape of beak or feet, placement of eyes of head, length of neck, shape of teeth, color.*

Learning Targets

I can describe the process of evolution by relating how adaptations made to limbs and organs over millions of years allowed whales to move from the land to the water.

Assessment

Students should respond to the following prompt in their science journal:

- It has taken millions of years for whales to evolve into the form they have today. Explain how adaptations helped the whale move from land to water. Use the words forelimbs, hind legs, fluked tail, and nostrils in your response.

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Targeted Academic Language/ Key Vocabulary

Tier 1: nostrils
Tier 2: hypothesize, evolution
Tier 3: fluked tail, adaptation, natural selection

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Projector or ability to play videos	Classroom Teacher
1	Recording the Evolution of a Whale Worksheet (6 pages)	Binder, teacher to make

		copies
	Wolves to Dogs Video: https://www.youtube.com/watch?v=2aSjUHRr-AE	CMC Website
	Evolution of Whales Video: https://www.youtube.com/watch?v=eIc1WoEEVOY&index=1&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY	CMC Website

****Items in bold must be returned to the bin at the end of the lesson****

LESSON DETAILS

Lesson Opening/ Activator

1. Review concepts from the previous lesson with the class, then have students pair and share with a partner something they remember. Ask a few students to share their insights.
2. Reintroduce the concept of evolution. Ask students to hypothesize which animal a dog is descended from (came from)? Watch the video clip on the evolution (domestication) of wolves into dogs: *Wolves2Dogs (https://www.youtube.com/watch?v=2aSjUHRr-AE).*
   After viewing the video, break the students into groups of four and have them use their previous knowledge regarding dogs and evolution in order to create a Venn diagram in which they write in the traits of wolves, the traits of dogs, and their shared traits (this can also be done together as a class).

During the Lesson

1. Before watching the video, have students draw a picture of what they think the whale looked like 47 million years ago in their science journals.
2. Watch the *Evolution of Whales* (https://www.youtube.com/watch?v=eIc1WoEEVOY&index=1&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY) video together as a whole class. The teacher or science fellow should narrate the video (which has no sound) in order to emphasize the key points to the class and to guide the students to form accurate impressions and ideas

Teaching Tip

Model for the students the types of responses you are looking for. Put on the board a check-list for student presentations so to insure they hit all the main points of their presentation.

related to the evolution of the whale. After this video is complete, discuss what students saw and why they think the various body parts changed.

3. Divide the students into four groups. Explain that you are going to watch the video again, but this time each group will be the scientists responsible for recording the evolution of one body part of the whale by drawing it or describing it via writing. Forelimbs (front paws), hind legs (back legs), fluked tail (flapper), and nostrils (nose). Ask students to see if every "part" of the body evolves at the same time.
4. Hand out worksheets to the respective groups.
5. Play the video again, narrating once again as appropriate, and pausing at all "evolutionary" periods, as indicated by date and name on the screen. At each pause, have students draw or write about the newly evolved version of the creature as indicated by the change in the body part they are documenting. The group assigned the forelimbs notes the changes in the forelimbs on their worksheet; the other three groups do the same for their body part on their worksheets. Do the first evolutionary period together to ensure student comprehension. **[SP2-Modeling]**.
6.  At the end of the video, after the complete evolutionary adaptation has occurred have each group present their findings explaining how the limbs or organs they observed adapted. Encourage the students to use their science words that they have learned, describing the different changes by mentioning the body parts by name and using words such as adapt and evolve.
7. Discuss how the evolution of whale was compared to what they drew at the beginning of the lesson.

Lesson Closing

1. Once again, break the students into four groups and provide the name of an animal (ape, lion, tiger, and wild boar) to each group and ask them to brainstorm what they believe the given animal evolved into. Working together, they will draw the provided animal and the animal that they believe descended from it and prepare sentences explaining their opinions and ideas. The groups will form their opinions and ideas based on prior knowledge and previous learning. The groups will then present their drawings and ideas to the rest of the class, using the previously constructed sentences to validate their claims. After each presentation, the teacher will guide the discussions in order to allow the students to see the connections between the provided animals and their correct descendants (man, domestic cat, and pig)

respectively. An example of this could be if the students hypothesized that a goat is descended from a tiger, the teacher or science fellow would ask guiding questions such as, “Do goat and tigers have the same food source?” or, “What is another animal that looks like a small tiger?” to allow students to create accurate assertions. **[SP7-Arguments from Evidence]**

Assessment

Students should respond to the following prompt in their science journal:

- It has taken millions of years for whales to evolve into the form they have today. Explain how adaptations helped the whale move from land to water. Use the words forelimbs, hind legs, fluked tail, and nostrils in your response.

Lesson 6: Environmental Change

BACKGROUND

Overview of the Lesson

Students will explore different changes to an environment and the effect it has on populations of organisms. They will learn the three factors affecting environmental change, which are: 1) change in climate; 2) change in resource availability (including water, food, and shelter), and 3) change in the shape of the land. They will also analyze and discuss the role of human actions (which are: industrial uses, agriculture, and livestock) in that process. They will learn about the effects of rapid deforestation on plants and animals.

Focus Standard(s)

3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.]

3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. [Clarification Statements: Changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat.]

3-5-ESS3.C Societal activities have had major effects on land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments

W3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

G3-5: 2.7 Explain that some Web sites and search engines may include sponsored commercial links.

Learning Targets

I can explain how changes in an environment can affect the survival of different kinds of plants and animals.
I can recognize that human activity can lead to environmental changes.
I can employ information from online sources (videos) in order to create and justify ideas regarding deforestation.

Assessment

In their science journals, students should respond to the following prompts:

- List three main causes of deforestation.
- Describe how plants' and animals' survival is affected.
- Do you see signs of deforestation in your area? where and what are they?

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Targeted Academic Language/ Key Vocabulary

Tier 1: habitat, rainforest
Tier 2: extinction
Tier 3: amazon, deforestation

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Video access and projection equipment	Classroom Teacher
1	PowerPoint on the history and impacts of deforestation	CMC Website
	Deforestation Video: https://www.youtube.com/watch?v=YCJL8e6_YqA&index=5&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY.	CMC Website

	Amazon Timelapse Video: https://www.youtube.com/watch?v=l1vcNO0jyxU&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY&index=2	CMC Website

****Items in bold must be returned to the bin at the end of the lesson****

LESSON DETAILS

Lesson Opening/ Activator

We will review the needs of animals—food, water, shelter and space—and the Oh Deer! Game. Particularly, we will talk about shelter and space as important resources that are necessary for life. Break students into five groups and brainstorm what they think the biggest threats to the plants and animal in both the forest and the rainforest are. We will collaboratively create a list and then share these lists with the entire class. Discuss the possible consequences of deforestations with students and ask them whether or not they think that deforestation is a threat to the plants or animals in the forest and rainforest. **[SP1-Asking Questions/Defining Problems]**

During the Lesson

Teaching Tip

If students are having trouble understanding the term deforestation and the possible consequences, the teacher could ask them to predict what would happen if it were not just one tree being

Place students into five groups, explain that the students are going to watch a video about deforestation (review what deforestation is). The groups will then, either through illustrations or text, describe what they believe will happen to the plants and animals in the rainforest. Explain that these are not simple situations, but very complex. Navigate to the video using Google, choosing the correct link based on student input, allowing them to begin differentiating between commercial and academic links. Before playing the video, remind the students to take notes about what they believe to be important information. Play the video: *CNN explains: Deforestation* https://www.youtube.com/watch?v=YCJL8e6_YqA&index=5&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY. Now review the predictions made by the students, relating them to the information presented in the video as necessary through a class wide discussion.

1. Present the PowerPoint on the history and impacts of deforestation. Explain that deforestation does not simply affect animals, but all organisms on Earth and also endangers their habitats. Help students make connections between the different types of deforestation explained in the video.
2. Ask students, how do people affect the habitat of animals and plants in the environment? Review the concept of "deforestation" referencing the video and ask students to break into their previous groups (if they are not still in them), and, working together, list the three reasons for deforestation (as introduced in the CNN video) and three impacts of deforestation.

Lesson Closing

The groups will then present their lists regarding the three reasons for deforestation. After each presentation, other classmates can ask questions and give compliments to the presenting group, allowing them to practice appropriate classroom etiquette while reinforcing the impact that humanity has on the forest and rainforest.

Extension

1. View *Raccoons living-for-the-city* again http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/ http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/Be sure to point out that not all changes to an environment cause extinction; sometimes an organism moves or finds a way to adapt to the change, and sometimes a change to an environment can allow some organisms to thrive while others die out.
2. Tell them they are going to see another video about deforestation. Play the video *Amazon Timelapse Deforestation* https://www.youtube.com/watch?v=l1vcNO0jyxU&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY&index=2. Explain to the students that time lapse is used just like in the whale video except, rather than taking 47 million years, this video takes place over 35 years. Pause the video to point out changes. Ask students to discuss whether they think animals can adapt in such short a time.

Assessment

In their science journals, students should respond to the following prompts:

- List three main causes of deforestation.
- Describe how plants' and animals' survival is affected.
- Do you see signs of deforestation in your area? Where and what are they?

Lesson 7: The Great Kapok Tree

BACKGROUND

Overview of the Lesson

Students will consider the interdependent relationships among plants and animals in an environment and how changes can make it difficult for a given plant or animal to survive. (For examples of potential student projects, see study guide at end of lesson.)

Focus Standard(s)

3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the different organisms (species) and habitats involved.]

3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. [Clarification Statements: Changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat.]

W3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Learning Targets

I can give one example of how animals and plants depend on each other for survival.
I can list ways that changes in the environment affect the survival of the plants and animals that live there.
I can explain some of the reasons that animals and plants survive well, less well or do not survive in an environment.

Assessment

Have students respond to the following in their science journal: Think about the animal you drew earlier in the lesson and answer the following questions:

- How does the animal depend on plants for survival?
- What might happen to your animal if its habitat disappeared?
- What would be required in the environment for your species of animal to survive?
- What conditions in the environment might make it difficult for your species of animal to survive?

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Targeted Academic Language

Tier 1: señor, species
Tier 2: extinction
Tier 3: Amazon Rainforest, Kapok Tree

Resources and Materials

Quantity	Item	Source
5	***The Great Kapok Tree* by Lynne Cherry**	**Bin (teacher can make copies if needed)**
1	*The Great Kapok Tree* Worksheet (4 pages)	Binder, teacher to make copies
1	Projector	Classroom Teacher
	Amazon Rainforest Video	CMC Website
	Mrs. Thomas Reads The Great Kapok Tree Video: http://youtu.be/OWpLkt_Lm9o	CMC Website
	Real Images Great Kapok Tree: http://youtu.be/qoV03D914HQ	CMC Website

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activation

1. Explain that today we will learn some ways or reasons why animals have difficulty surviving and how some struggle to survive and may become extinct.

2. Show the Amazon rainforest video which can be found on the CMC Website.

3. Introduce Lynne Cherry's T*he Great Kapok Tree*. Explain this story takes place in a Kapok Tree, which is in the Amazon rainforest and is a habitat for many animals. You have the option to read the story to the students or play *Mrs. Thomas Reads The Great Kapok Tree*, http://youtu.be/OWpLkt_Lm9o. Before beginning the recording or reading, ask the students if any of them speak Spanish. After discerning whether or not any of the students speak Spanish, write the word "señor" on the whiteboard (if any of the students know what this word means, allow them to explain it to the class before proceeding). If not, explain that this word means "mister" in Spanish and that they will be hearing it in the story because the Kapok tree is found in the Amazon where many people speak Spanish. Then ask the students to listen closely to what each animal says, to try to find out how it feels and why because later they will each write about one of the animals.

During the Lesson

1. Assign students an animal in the book (it is okay if a few students are assigned to the same animal).
2. Tell the students to listen carefully as you read the story out loud again focusing on the animal they were assigned. You can pause at various points during the story to ask the students guiding questions.
3. Now ask students to draw the animal they were assigned and write a sentence explaining what is threatening the animal's existence (habitat destruction, lack of food, etc.). They could also draw a quick picture and write a few words about what is threatening the animal if writing is an intimidating task for some students.
4. Model the worksheet (see appendix) so students are clear on how to fill it, then hand out the worksheets for the students to complete.
5. **Optional:** If students have access to iPads or computers, let them listen to the book in their groups so that they can pause and play when needed throughout the story to write about their animal.

Lesson Closing

1. Put students into groups of 3-5 to share their pictures and read their responses. Discuss their responses in light of Essential Question #1: How do living things (animals and plants) adapt to their environment so they are better able to survive? **[SP4-Analyzing and Interpreting Data]**

Extension

1. View *Real Images Great Kapok Tree* (http://youtu.be/qoV03D914HQ), a video collage of photographic images taken from where the Great Kapok Tree grows in the Amazon. Discuss the difference between photographic images and illustrations.
2. Read *The Lorax* in class. Point out the parallels between *The Lorax* and the environmental changes they learned about in the lesson. Make sure to also make connections to *The Kapok Tree.*

Assessment

Have students respond to the following prompts in their Science Journals:
Think about the animal you drew earlier in the lesson and answer the following questions in your journal:

- How does the animal depend on plants for survival?
- What might happen to your animal if its habitat disappeared?
- What would be required in the environment for your species of animal to survive?
- What conditions in the environment might make it difficult for your species of animal to survive?

CEPA

Create Your Bird

Students will

1. Create a bird based on beak and feet adaptations
2. Describe (drawn and written) this bird and its adaptations
3. Describe how adaptations can help with the survival of birds in their habitat

Explanation of procedure

1. The teacher should decide if the CEPA activities should include feet as well as beaks. If so, ask students to study bird's feet with the same scientific eyes they used to examine birds' beaks. Using the bird beak and feet cards, discuss which beaks and feet are adapted for which environment(s).
2. Teacher should decide if students can work as individuals or in pairs.
3. Tell students this project is to create and design a mythical bird species. They have to create the birds by choosing beak and feet and then describe an environment in which the bird can survive and reproduce.

Procedure

1. Review and Revisit lessons 1 and 3 as well as examples of animals and their adaptations discussed throughout the unit.
2. Give each student or pair of students a set of bird feet cards and bird beak cards from *Design a Bird* packet.
3. Students will choose one card from each category: one bird beak type and one bird feet type.
4. Tell the students they will "design a bird". Which entails the following,
   a. Draw a picture of their bird referencing the adaptation cards they chose.
   b. Give their bird a name.
   c. Draw its habitat.
   d. Write paragraph about the habitat. (Their habitat must match at least one of their adaptations, and some birds may be able to survive in more than one habitat depending on what beak/feet they have chosen).

Science Talk and Oracy in T2L Units

Science talk is much more than talking about science. In line with the science and engineering practices, students are expected to make a claim that can be supported by scientific evidence. The MA STE Standards (and the NGSS) value the importance of engaging in an argument from evidence. NGSS defines how this practice takes form in the real world: *"In science, reasoning and argument are essential for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon. Scientists must defend their explanations, formulate evidence based on a solid foundation of data, examine their own understanding in light of the evidence and comments offered by others, and collaborate with peers in searching for the best explanation for the phenomenon being investigated."*

Students are asked to participate in articulate and sensible conversations in which they can communicate their ideas effectively, listen to others to understand, clarify and elaborate ideas, and reflect upon their understanding. These forms of talk can be developed using scaffolds such as the A/B Talk protocol (below) and strategies for class discussions (from the Talk Science Primer, link below). Oracy is developed in the physical, linguistic, cognitive, and social-emotional realms; each of these realms can be expanded upon over time in order to develop a thoughtful speaker. Being able to display appropriate body language, use proper tone and grammar, be thoughtful and considerate thinkers, and allow space for other thoughts and opinions are all important facets of oracy to work on and through with students. Incorporating the appropriate scaffolding is an important aspect of fostering these skills. Techniques for teaching effective science talk often include modeling, discussion guidelines, sentence-starters, and generating roles, while gradually putting more responsibility on students to own their thinking and learning.

Part of creating a safe school environment for students is allowing them a space that is comfortable enough for them to express ideas and ask questions, while being validated for their thoughts and questions; students should be feel comfortable and confident when speaking and listening for understanding. Effective talk is an important part of being an active, intelligent member of a community and society. Successful development in oracy is important for future employability and general well-being of adults.

The following resources should be helpful examples of how to employ effective use of progressive oracy and science talk in your classrooms.

- Oracy in the Classroom: https://www.edutopia.org/practice/oracy-classroom-strategies-effective-talk
- Science Talk Primer: https://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf

A/B Talk Protocol

Adapted from https://ambitiousscienceteaching.org/ab-partner-talk-protocol/

<table>
<tr>
<td>1. Share your ideas
 
Partner A
● I think _____ happened because…
● Evidence that supports my idea is…
● The activity we did with _____ helps me know more about _____ because…
● One thing I'm wondering about is…</td>
<td>2. Listen to Understand
Partner B
 
● I heard you say _____. What makes you think that?
● I heard you say _____. What if _____?
● Can you explain the part about _____ again?
● What do you mean when you say _____?</td>
</tr>
<tr>
<td>3. Clarify and elaborate
Partner A
 
Answer partner's questions or ask for clarification in order to understand a question.</td>
<td>4. Repeat steps 2 & 3 until all questions are answered
 
  </td>
</tr>
</table>

5. Switch roles and repeat steps 1-4  	6. Reflect on your understanding in writing ● My idea about _____ changed when my partner said _____. ● I will add _____ to my idea about _____ because… ● I still have questions about… ● I may be able to answer my question(s) if I could investigate _____.

List of Unit Resources

Lesson 1

Quantity	Item	Source
	Space (playground, gym, etc.)	Classroom Teacher
20	Graph paper & pencils	Classroom Teacher
1	Game Rounds Data Table	Binder, teacher to copy
1	Oh Deer Graphing Worksheet	Binder, teacher to copy
1	**Bucket or bin to hold survival component "popsicle sticks"**	**Bin**
25	**Popsicle sticks, labeled for each of the 5 survival component (5 each)**	**Bin**
1 roll	Masking tape to mark areas	Bin
1	Large flip chart (with the same data table as handout) to record class data	Classroom Teacher

Lesson 2

Quantity	Item	Source
1	Projector or ability to play videos	Classroom Teacher
1	Bird Beak PowerPoint or PDF (pictures of bird beaks)	CMC Website
1	Bird Beak Adaptation Station Worksheet (2 sheets)	Binder, teacher to copy for students
	Darwin Video: https://www.youtube.com/watch?v=4ekGLlKd_HU	CMC Website
	Raccoons Living for the City Video: http://www.pbs.org/wnet/nature/raccoon-nation-video-living-for-the-city/7540/	CMC Website
	Station 1	All in Bin

1	Graduated cylinder (add water)	
1	Cup	
1	Shoestring	
1	Dropper	
1	Sponge strip	
	<u>Station 2</u>	All in Bin
1 bag	Gummy worms	
1	Cup	
1 bag	Potting soil	
1	Deep pan	
1	Straw	
1	Chopsticks	
1	Pliers	
	<u>Station 3</u>	All in Bin
1 bag	Sunflower seeds	
1	Cup	
1	Pliers	
1	Chopsticks	
1	Tweezers	
	<u>Station 4</u>	All in Bin
5	Styrofoam pieces	
1	Cup	
1	Shallow pan (add water)	
1	Chopsticks	
1	Tweezers	
1	Slotted spoon	
	<u>Station 5</u>	All in Bin
1	Rice in circular piece of Styrofoam	

1 1 1 1	Cup Dropper Tongs Tweezers	
 1 1 1 1 1	<u>Station 6</u> Marshmallows tied to string Cup Chopsticks Tongs Skewers	All in Bin

Lesson 3

Quantity	Item	Source
1	Projector or ability to play videos	Classroom Teacher
1	A plant	Classroom Teacher
	Science journals	Classroom Teacher
1	Inherited Traits Handout (Pictures)	Binder, teacher to copy for students
6 copies (1 per station)	"Who Has" Tally worksheet	Binder, teacher to copy for students
1	Frequency Table Worksheet	Binder, teacher to copy for students
	Traits Plant Variety Video: http://youtu.be/4_Pje5RdT0A	CMC Website

Lesson 4

Quantity	Item	Source
1	The Eyes Have It Worksheet	Binder, teacher makes copies
5	**Identical clear plastic bins 1 labeled Gen 1, 2 labeled Gen 2, 2 labeled Gen 3**	**Bin**
1	**Generation 1 Bin: 25 eggs (several of each color (blue/yellow/green), but not exactly same number of each), all small eyes)**	**Bin**
1	**Generation 2 Bin: 25 eggs (several of each color, but not exactly same number of each, all small eyes)**	**Bin**
1	**Generation 3 Bin: 25 eggs (several of each color, but not exactly same number of each, some eggs are large eyed)**	**Bin**
1	**Purple egg with purple pipe cleaners**	**Bin**
1	**Empty Generation 2 bin**	**Bin**
1	**Empty Generation 3 plastic bin**	**Bin**
2 bags	**Confetti**	**Bin**

Lesson 5

Quantity	Item	Source
1	Projector or ability to play videos	Classroom Teacher
1	Recording the Evolution of a Whale Worksheet (6 pages)	Binder, teacher to make copies
	Wolves to Dogs Video: https://www.youtube.com/watch?v=2aSjUHRr-AE	CMC Website
	Evolution of Whales Video: https://www.youtube.com/watch?v=eIc1WoEEVOY&index=1&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY	CMC Website

Lesson 6

Quantity	Item	Source
1	Video access and projection equipment	Classroom Teacher
1	PowerPoint on the history and impacts of deforestation	CMC Website
	Deforestation Video: https://www.youtube.com/watch?v=YCJL8e6_YqA&index=5&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY.	CMC Website
	Amazon Timelapse Video: https://www.youtube.com/watch?v=l1vcNO0jyxU&list=PLsAWD8mKKE97DrZE0gewaiwtssuby2jHY&index=2	CMC Website

Lesson 7

Quantity	Item	Source
5	***The Great Kapok Tree* by Lynne Cherry**	**Bin (teacher can make copies if needed)**
1	*The Great Kapok Tree* Worksheet (4 pages)	Binder, teacher to make copies
1	Projector	Classroom Teacher
	Amazon Rainforest Video	CMC Website
	Mrs. Thomas Reads The Great Kapok Tree Video: http://youtu.be/OWpLkt_Lm9o	CMC Website
	Real Images Great Kapok Tree: http://youtu.be/qoV03D914HQ	CMC Website