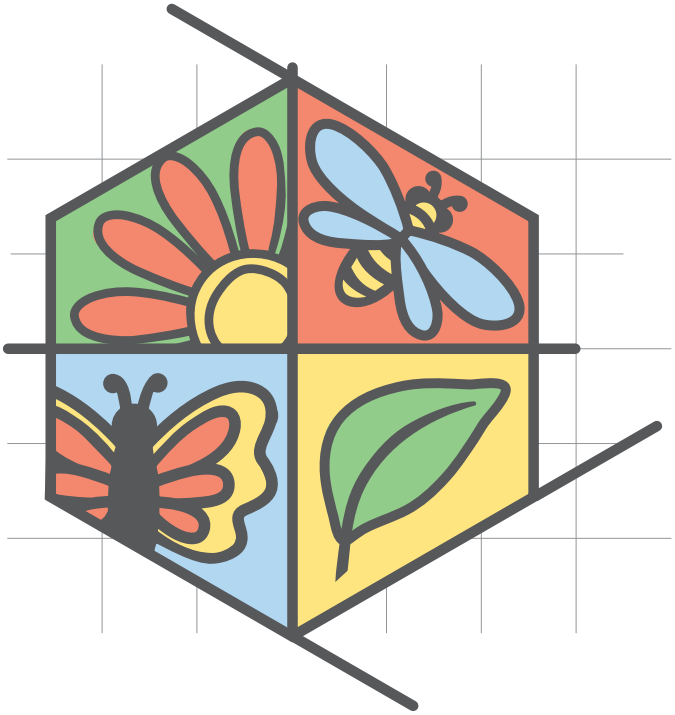
Inspired by Nature



1st Grade Life Science Storyline to support the New Plants kit

STEM

6.11.19

ABOUT THIS UNIT

We are excited to present this NGSS Storyline Unit to help support educators in our region as we shift towards providing students with NGSS-aligned, phenomenon-based and project-based learning experiences. Our vision is to provide students with high-quality and equitable learning experiences that empower them to develop fluency in STEM and literacy. This unit strives to engage students in solving an everyday household problem that their family needs help in solving with the use of inspiration from nature.

This unit also contains links to online resources created by other organizations which may use a different license. Please make sure that you understand the terms of use of third-party resources before reusing them. Prior to publishing this unit of study, we have reviewed the content of this unit to ensure that all materials are in accordance with creative commons regulations. If you notice that a part of this unit infringes another's copyright, please contact us.

A digital copy of this document is available on the STEM Materials Center website at:
https://www.stemmaterials.org/inspiredbynature

ATTRIBUTION

This unit is a result of a collaborative effort between Educational Service District 112 and educators and specialists from other school districts and agencies.

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STEM
Science
Technology
Engineering
Math

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OSPI

CLIME TIME
CLIMATE SCIENCE LEARNING

UNIT OVERVIEW

This unit helps students understand the concept of biomimicry and how humans can use the traits and behaviors of plants and animals to create solutions to many human-related problems. The unit starts by highlighting the practice of biomimicry by helping students make connections to everyday objects that have been inspired by the natural world. Then, each lesson helps students dig deeper into the traits and patterns of behavior that organisms exhibit in nature. The structure of the unit includes a combination of hands-on FOSS investigations, engineering tasks, and other lessons that help students deepen their understanding of plant and animal traits.

For your convenience, all resources have been uploaded to this Google drive folder, New Plants (Inspired by Nature NGSS Storyline), bit.ly/inspiredbynaturestoryline for easy access. Since curriculum revision during the school year will be limited, any additional resources and changes will be reflected in the live documents on the Google drive. You may also make comments for suggested revisions on these documents. In order to modify the Google resources to make changes, click "file" and "make a copy." This will create a copy in your drive that you can edit to fit your needs.

LESSON 1: How Can Nature Inspire Us? *pg. 8*

In this lesson, students will:

- Engage in phenomenon of biomimicry and engineering
- Ask questions about and define everyday problems that need solutions
- Construct and explanation for what a science does
- Work as a group to create an anchor chart about plant/animal traits and behaviors and human inspired technology

Session	Materials Needed	Page
1. Launching the unit	• Intro slides • Large butcher paper and markers for anchor chart • Homework assignment to brainstorm problems	**9**
2. What is a scientist?	• *Ada Twist, Scientist* by Andrea Beaty • "What does a scientist look like?" worksheet	**11**
3. Connecting to the driving question and creating the anchor chart	• Large chart paper for anchor chart	**13**

UNIT OVERVIEW (cont.)

LESSON 2: What Makes a Living Thing? *pg. 15*

In this lesson, students will:

- Explore characteristics of seeds and explain why a seed is or isn't living and come up with an explanation of what a living thing is
- Compare a seed to a rock and explain how they are different
- Describe how seeds of the same kind are similar and how seeds of different kinds are different
- Analyze images to explore different types of coats animals have for different purposes
- Construct an explanation and draw an illustration to show how one specific animal uses its coat
- Construct an explanation for what an engineer does
- Design a coat to keep a pom pom safe from the elements
- Reconnect with the storyline and make connections between plant and animal structures and human technology

Session	Materials Needed		Page
1. What's in a seed?	• Computer with projector • Lima beans	• Seed Prediction Papers • Magnifying Glass	**16**
2. Comparing a seed to a rock and Venn Diagram activity	• Lima beans • Rocks	• Eggs (optional)	**18**
3. Looking at coats in seeds: Why do we use coats?	• A few different types of seeds (black beans and pumpkin seeds)	• Apricot or apple seeds (not provided)	**19**
4. Coats on animals	• Slides presentation	• Coats on Animals Worksheet	**20**
5. Connecting to the storyline: Coats that we use	• Slides presentation	• Student coats	**22**
6. What is an engineer?	• *Rosie, Revere, Engineer* by Andrea Beaty	• What does an engineer look like?	**23**
7-8. Designing a coat for a pom-pom	• Pom-poms • Construction paper • Plastic wrap • Aluminum foil	• Wax paper • Tissue paper • Seed Prediction Papers • Coats on Animals Worksheet	**25**
9. Connecting to the storyline	• Anchor chart		**26**

UNIT OVERVIEW (cont.)

LESSON 3: Parents and Babies *pg. 28*

In this lesson, students will:

- Conduct an investigation (**FOSS Investigation 2**) and make observations to study what happens as a wheat grass seed grows into a plant
- Explain how a baby plant is similar and different from its parent by studying images and videos of baby and adult plants
- Obtain, evaluate and describe evidence from images and videos to make observations about how baby and adult animals are the same and different
- Construct an explanation using evidence to show how a specific baby animal was similar to and yet different form their parent
- View videos/images, and read texts and describe how parents and babies have behaviors that help babies survive

Session	Materials Needed		Page
1. FOSS Investigation 2 (Parts 1 and 3)	• **FOSS Investigation 2 materials** (See lesson for full list)	• Observation template for ongoing observations	**29**
2. How are the seedlings and adults different and the same	• Seedlings • Grown-up plants	• Baby plants different from parents worksheet • Hand lenses	**34**
3. What's the same and different about babies and grown-ups	• Slides Presentation		**35**
4-5. Differences between babies and parents	• Pictures of students and parents • Babies and Parents: same and different worksheet	• Baby and parents matching cards • Computers with internet	**36**
6. Protection and communication	• Parents and babies communicating slides • *Meet My Family* by Laura Purdie Salas	• Anchor Chart • *Follow Me!* By Shira Evans	**37**

UNIT OVERVIEW (cont.)

LESSON 4: Drinking, Eating, and Protection *pg. 39*

In this lesson, students will:

- Take a FieldSTEM walk outdoors to connect structures and patterns to observable phenomena in students' lives
- Discuss what "survival" means and what plants and animals need in order to survive
- Students take on the lens of a scientist and figure out how animals solve different survival problems
- Investigate and discuss how bulbs use their stored resources to survive in winter (**FOSS investigation 4: Part 1**)
- Investigate how plants use roots for survival (**FOSS investigation 4 Part 2**)
- Through the use of pictures and videos students identify and explain how plants and animals collect water and food and protect themselves from the weather and predators
- Connect back to the idea of biomimicry by cataloging and organizing ideas on the anchor chart

Session	Materials Needed	Page
1. FieldSTEM outdoor walk	• Outdoor Observation template	**40**
2. What is survival?	• Chart paper and markers	**42**
3. FOSS Investigation 4: Bulbs and Roots, Part 1	• **FOSS investigation 4: Bulbs and Roots Part 1 materials** • Anchor chart	**43**
4. FOSS investigation 4: Bulbs and Roots, Part 2	• **FOSS investigation 4: Bulbs and Roots Part 2 materials** • Anchor chart	**44**
5. Water!	• Drinking Water Slides • Water brainstorm student sheet	**45**
6. Food and nutrition: How do animals eat?	• Animals eating slides • Animal eating worksheet • *Meet my Family* by Laura Purdie Salas • *Follow Me!* By Shira Evans	**47**
7. Protection	• Slides about plants and animals that protect • *We Build Our Homes: Small Stories of Incredible Animal Architects* by Laura Knowles	**49**
8. Connecting to the storyline and wrapping up the anchor chart	• Anchor chart	**50**

UNIT OVERVIEW (cont.)

LESSON 5: Engineering a Nature-inspired Device to Solve a Problem

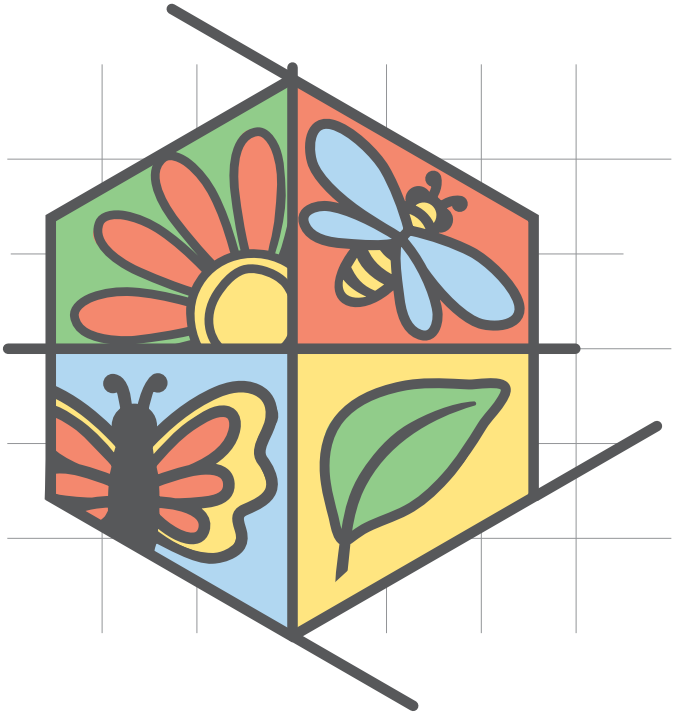
pg. 52

In this lesson, students will:

- Identify and define a problem to focus their design solution on
- Ask questions to dissect the everyday problem they chose to focus on
- Research different plants and animals that have a similar problem that they solve in nature
- Imagine and plan a device that will help solve a problem using inspiration for plants/animals
- Create the device using recyclable materials
- Use peer feedback to optimize the device
- Showcase the device and highlight how it is inspired by nature in a presentation to guests

Session	Materials Needed	Page
1. Picking a problem	• Anchor chart • Engineering Design Process Template • Human-related problems brainstorm (from lesson 1) • Computer access for teacher slides	**54**
2. Asking questions about the problem	• Engineering and Biomimicry Slides • Engineering Design Process Template	**62**
3. Researching	• Engineering Design Process Template • Computers with internet access	**63**
4. Imagining a solution	• Engineering Design Process Template • Post-it notes	**64**
5. Plan	• Engineering Design Process Template	**65**
6-7. Create	• Misc materials for building device Scissors, tape, glue, construction paper, paint, paintbrushes, etc	**66**
8. Peer feedback for optimizing	• Engineering Design Process Template • Students' projects	**67**
9. Optimizing! Work session	• Engineering Design Process Template • Students' projects	**68**
10. Getting ready to share	• Chart paper • Printer with access to color printing • Computers with internet • Markers • Glue • Scissors	**69**
11. Share! Biomimicry showcase!	• Students' projects	**70**

LESSON 1: How Can Nature Inspire Us?



STRATEGY: ENGAGE

In this lesson, students will engage in the driving question of the unit: ***How can we use our understanding of nature to help our family solve a problem?*** Students will be introduced to the concept of biomimicry, where people use nature as an inspiration to solve a human problem. Students will work with the teacher to create an anchor chart which will be used throughout the unit to collect evidence of students' learning about various structures and behaviors that animals have that help them survive.

SESSION 1:
Launching the unit

Warm-up

Start the unit by presenting students with these examples of nature inspired human devices or processes. Facilitate a discussion by having students think-pair-share. You can use this slides presentation to jumpstart the unit.

Main activity

Show students the images of plant/animal structures and ask them to share with an elbow partner before sharing with the whole group:

- What do you see?
- What are the characteristics of the object or thing in nature that you are seeing?

Then show students the nature-inspired human technology that goes with each image. Ask students:

- What do people use that device for?
- How does the shape of this device help it do what it is supposed to?

Present students with the driving question of the unit: *How can we use our understanding of nature to help our family solve a problem?*

Setting up the project

Ask students to think of problems that they are facing on the daily basis. "In this unit, we will be studying about plants and animals and will be using nature to inspire us to create something that helps people!" Let students think alone for a minute before sharing with a partner and then with the whole group. Write student generated ideas of "problems" on a chart so students can continue to add to the list and make connections with what they are learning. You can also assign this homework assignment where students go home and work with their parents to brainstorm and share some problems. Talk to students about examples of the types of problems we are trying to solve and what types of problems are not appropriate (ex. opening jars that are too tight, or getting rid of fruit flies in the summer NOT "I don't like my baby brother" or "I don't want to go to bed").

Materials Needed

Intro slides

Large butcher paper and markers for anchor chart

Homework paper to brainstorm household problems

Everyday Problems

at home

Dear parents,

Our current science unit focuses on our students using nature as an inspiration to design a solution to an everyday household problem. As a part of the project, we would like you to share some common problems around your house. Our first graders look forward to finding you some solutions!

Sincerely,
Our class

Some of the common problems around our house are:

- Example 1: Reaching high shelves.
- Example 2: Too many fruit flies in the summer.
- _____
- _____
- _____
- _____
- _____
- _____

SESSION 2:
What is a scientist?

Warm-up

Remind students that for this unit, students will be scientists! Ask students to quickly sketch a picture of what a scientists looks like. Give students 5 minutes to finish their drawings. Bring students to the rug and ask them to bring their drawings with them. How many pictures had an adult? How many of the pictures were of a man? How many had a person wearing a lab coat? Ask students, "can kids be scientists?" Ask students to share their ideas.

Main activity

Ask students: What is a scientist? What do you think a scientist is? Make a chart using students' ideas. Then, read *Ada Twist, Scientist* by Andrea Beaty to students. After the reading, ask students, "What do you think now? Can a kid be a scientist? What are some of the traits of a scientist?" You can also read What is a Scientist? By Barbara Lehn (or show this video reading). Facilitate a discussion where students are able to share their thoughts and discuss the idea that they too, can be scientists!

Wrap-up

This worksheet, What does a scientist look like? can be used as homework or a short follow-up activity.

Materials Needed

Ada Twist, Scientist by Andrea Beaty

What does a scientist look like? worksheet

What does a scientist look like?

Has eyes to observe nature.

Has a brain for wondering.

Has ears for listening to ideas of other scientists.

Has hands to use tools and make measurements.

Has feet to help explore old and new places!

A scientist looks like me!

SESSION 3: Connecting back to the driving question and creating the anchor chart

In this unit, students will be studying the structures and behaviors of plants and animals and will be using these ideas to create a device or object that helps solve a problem. In order to track learning throughout the unit and help students connect to the driving question, we suggest that you create an anchor chart. This is an example of a possible way that you can track learning throughout the unit as a class. Please feel free to take and modify to fit your needs.

Materials Needed

Large pieces of chart paper for anchor chart

Reintroduce the driving question of the unit: *How can we use our understanding of nature to help our family solve a problem?*

Ask students to think of the structures they have seen so far that have helped humans solve a problem. Write up student ideas on the anchor chart. Write: 1) the plant or animal structure/behavior and 2) the problem it solves

How Lesson 1 Supports Next Generation Science Standards

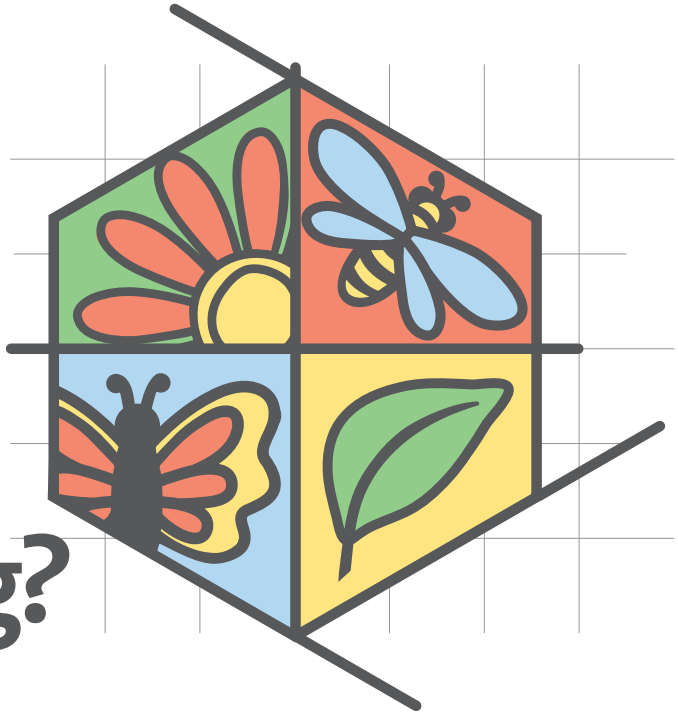
1-LS1-1 From Molecules to Organisms: Structures and Processes

Performance Expectation	**Connections to Classroom Activity,** *Students:*
1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	• Begin to study how everyday objects have been inspired by nature. • Observe and explain how different devices that humans have created have been inspired by plants or animals. • Identify problems that their family have that can be solved later in the unit.
SCIENCE & ENGINEERING PRACTICES	
Constructing Explanations and Designing Solutions Asking Questions and Defining Problems	• Construct explanations about how some human devices have been inspired by nature (ex. burr seeds and Velcro) • Ask questions about the structure and function of different human-created items and how they relate to certain plants and animals. • Ask questions about a real problem in their home and define the problem or problems (homework).
DISCIPLINARY CORE IDEAS	
LS1.A: Structure and Function LS1.D: Information Processing	• Begin to study different animals and the structures they use for survival (structures used for eating, protection, or reproduction). • Study specific external parts of plants and animals • Begin to study some of the behaviors that different animals have to aid in survival. • Compare the function of different external body parts to things that humans have created.
CROSSCUTTING CONCEPTS	
Structure and Function Influence of Science, Engineering and Technology on Society and the Natural World	• Connect different structures that animals/plants have to structures found in human-made devices and discuss the similarities of the functions of both. • Identify different problems that can be solved using a body part or device that has a specific structure. • Identify ways that technology has been inspired by forms found in nature (the influence that nature has on technology).

The materials/lessons/activities outlined in this activity are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/lessons/activities will be required.

www.nextgenscience.org/sites/default/files/evidence_statement/black_white/1-LS1-1 Evidence Statements June 2015 asterisks.pdf

LESSON 2: What Makes a Living Thing?



STRATEGY: EXPLORE

This lesson will help students delve into the basics of life science by having them investigate what the characteristics of living things are. Students will also begin to study the structures that living things have to help survival (ex. seed coats and fur coats) and will engineer a coat to keep a pom-pom safe. Students will make the connection between coats in nature and coasts that we use as humans.

STEM

SESSION 1:
What's in a seed?

(Note: Soak dry lima beans in water for at least 8 hours before lesson, best if done overnight).

Materials Needed

- Computer with projector
- Lima beans
- Seed Prediction Papers
- Wheat grass, alfalfa and rye seeds

Warm-up

Ask students the questions, "What's in a seed? Is a seed alive?" Allow students to first share with a partner and then with the whole class.

Main activity

1. Provide each student with a soaked lima bean.
2. Tell students to pick up the lima bean and examine it. Ask students, "What do you think the inside of the seed will look like? Why?" Have students illustrate their prediction on their Seed Prediction Papers.
3. Ask students to rub the soaked bean between their fingers. The seed coat should rub off. Ask, "Why might the seed coat important?"
4. Now have students split the seed in two (there is a slit going down the middle of the seed, where it should come apart with a little help).
5. Observe the inside (students can use a magnifying glass). Have students describe and draw what they see on their templates. Were your predictions correct? Why or why not? Ask students if they think that a seed is alive or not? What evidence or observations do they have to support their idea. Provide students with these sentence frames to help organize their thinking: I think a seed is alive/not alive because _____. Ask students if they know what happens when a seed is planted in soil? Does that support the idea that a seed is alive or that it isn't? **Note:** Scientifically speaking, a seed is considered a living thing. A seed contains a plant embryo which is in suspended animation and existing in a dormant state, but is still alive. Certain conditions are needed to reanimate and speed up the growth of the seed.
6. Set aside students' dissected seeds to dry for further observations next time.

Planning ahead!

In lesson 3, which will not happen until a few weeks from now, students will need to compare little wheat grass, alfalfa, and rye seedlings with grown-up seedlings. It is recommended that you plant a few cups of wheat grass and rye seeds so students will be able to observe the differences between the "baby" and "adult" plants. It is not necessary to plant one per group, a couple of examples can be rotated amongst the class for observations.

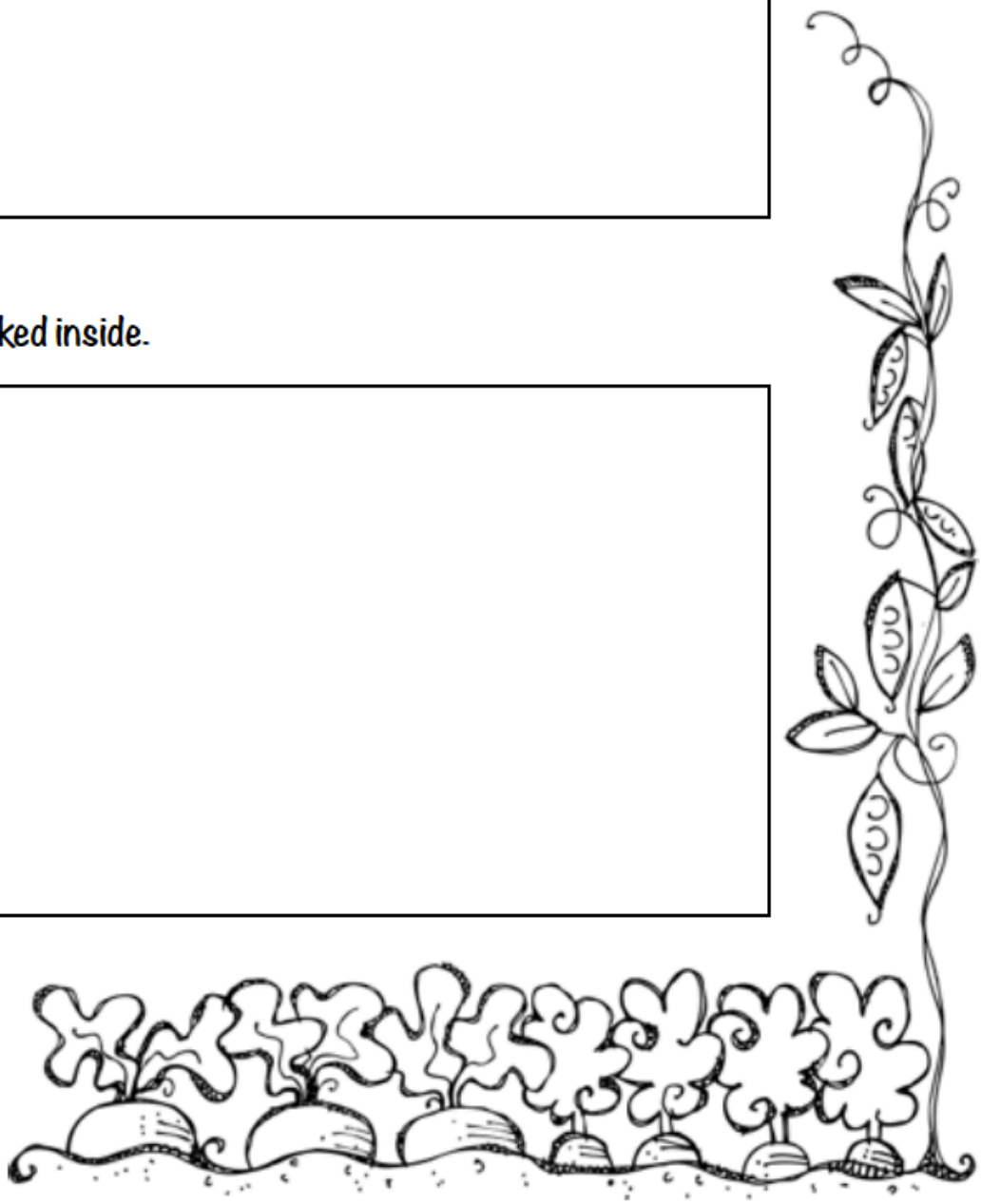
Materials Needed

- Soil
- Plastic cups
- Wheat grass, alfalfa and rye seeds

Bean Seed Dissection

1. What do you think the inside of your bean will look like when you open it?

2. Draw how your bean looked inside.



SESSION 2: Comparing a seed to a rock discussion and Venn Diagram activity

Warm-up

Remind students, "Do you remember when we dissected a lima bean which is a seed? What did we find inside that seed? Can you remember?" Allow students to share their ideas and remember their previous observations/look at their recording sheet.

Creating the diagram

How is a rock similar to and different from a seed? Have students share their thoughts and questions with their partner and then share with the whole group. Ask students to share any wonderings they have about the rock and the seed. Create a Venn Diagram with students' ideas comparing and contrasting both. Ask students, is a rock alive? Why or why not? Allow students to think-pair-share. Incorporate student ideas into the venn diagram. Optional extension: if able to, the teacher can buy eggs and have students gently observe an egg and compare it to the lima bean and the rock. Which is the egg more like, the lima bean or the rock? Why? Have students talk to their partners and then have them share as a class.

Materials Needed

- Lima beans
- Rocks
- Egg (optional)
- Venn Diagram (on chart paper)

SESSION 3: Looking at coats in the seeds: Why do we (living organisms) use coats?

Warm-up

Connect back to the experience that students had with the lima beans: "Do you remember the coat of the lima beans when you were dissecting them? Today, we will be looking at different seeds and the coats that they have. Do you remember ever seeing a seed in your lunch (ex. an apple or pear seed)?

Main activity

Provide students with different types of seeds that they can study (black bean, pumpkin seed, apricot pit).

Ask students to work with a partner or in a group of three. Ask them, how are the black beans similar to each other? How is one kind of seed similar to another kind of seed (ex a black bean and a pumpkin seed)? How is one kind of seed different to another kind of seed (ex, a bean to an apricot pit)?

Wrap-up

Ask students to share their ideas a whole group. Connect with the storyline by asking students, is there anything that humans have created or use that reminds them of a seed?

Materials Needed

A few different types of seeds (black beans and pumpkin seeds)

Apricot or apple seeds (not provided)

SESSION 4:
Coats on animals

Warm-up

Remind students about the session where we compared the coats of different seeds. Ask students, do animals and humans have coats? Allow students to share their ideas.

Main activity

Show students examples of coats on animals using this slides presentation. Pause at each image and allow students to make lots of observations. Ask students, why do these animals have coats? Pause at each image to allow students to answer.

Assessment

Ask students to think of one animal that interested them in particular. How does that animal use its coat to survive? Turn and Talk: have students turn to a partner and talk about how their animal uses their coat. Why is this animal so interesting to them? Use this Coats on Animals Worksheet to have students write a one-sentence explanation about how their animal uses its coat and ask them to draw a picture underneath. (Some students might benefit from sentence frames like "The _____ uses its coat to _____" or " My animal, the _____ , has a coat so_____.").

Materials Needed

- Slides presentation
- Coats on Animals Worksheet

Coats on Animals

Name_____

Write an explanation about how your animal uses its coat.

The _____ uses its coat to _____

_____

_____

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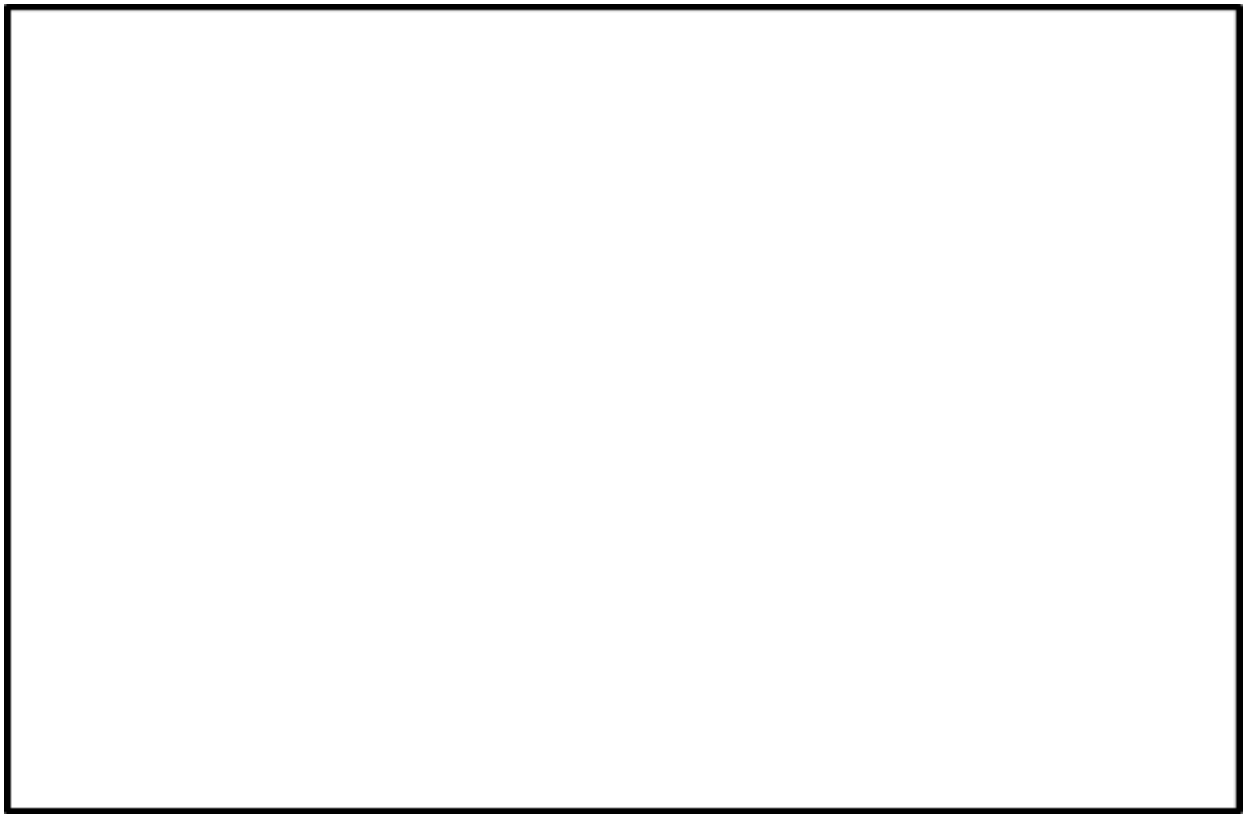


SESSION 5: 📖 Connecting to the storyline: Coats that we use (10-15 min)

Warm-up

Ask students to think about the animals and all the coats they looked at in the previous session. Why was their animal's coat great, what did it do?

Main activity

Reconnect to the storyline by showing students different coats using this slides presentation. Pause at each picture and allow students to share their thoughts. Does the coat remind you of an animal's coat? Which animal? What kind of weather would you wear this coat in?

Wrap-up

Do you see a connection between the animal's coats and the coats we make? Check in with the class's anchor chart and ask students: "Is there something we can add to our anchor chart? Some structure that plants and animals both have that protects them?" Students will likely bring up coats. Take some time to hear students' ideas about how plant seeds use coats and how animals use coats. Write their ideas on the anchor chart. Then shift students' attention to the outside of the graphic organizer. How are we (humans) inspired by the coats found in nature? Write students' ideas on the chart.

Extension (if weather permits)

The next time students line up for recess or lunch (or at the end of the day) when they have their coats on, ask students to talk to a partner: What material is your coat made of? How does it keep you warm and/or dry? Does it remind you at all of an animal's coat? Which animal?

Materials Needed

Slides presentation

SESSION 6:
What is an engineer?

Warm-up/discussion

Tell students that for this unit, we will have to be both scientists and engineers. Tell students to listen for clues that tell what an engineer does and show students this video that describes what an engineer does (you may want to stop the video at 2 min 25 seconds). Ask students to share what they learned from the video first with a partner and then with the whole group. Write students' ideas on the board. Underline and emphasize the points that 1) an engineer is someone who helps others by solving a problems and 2) an engineer is someone who is interested in how and why things work.

Materials Needed

Rosie, Revere, Engineer by Andrea Beaty

What does an engineer look like?

Main activity

Read *Rosie, Revere, Engineer* by Andrea Beaty. Ask students to talk about what Rosie did that helped her to be successful? Did she give up? Why or why not? Present students with this worksheet, What does an engineer look like? Read the captions with students before so they understand what they should include in their drawings. Allow them to draw tools that they feel an engineer might use in their work. The purpose of this activity is to help validate and reaffirm students' natural curiosity and creativity while helping them to perceive themselves as capable in a profession like engineering.

Wrap-up

Tell students that in this unit, there will be several times that they will be acting like engineers and will be trying to solve a problem.

What does an engineer look like?

Has eyes to observe nature.

Has a brain that is curious and creative.

Has a heart that wants to help solve other people's problems.

Has hands to use tools and design things.

Has feet to help explore old and new places!

An engineer looks like me!

SESSIONS 7-8: Designing a coat for a pom-pom (mini-engineering design challenge, works best in rainy weather)

Warm-up

Tell students that today we will be building a coat for a pom-pom animal to keep it dry and warm in wet and cold weather.

Main activity

Before students start to create, ask them to answer the two questions: "What material do you want to use? What shape do you want to make the coat?" Allow students to explore the materials that they are able to use. By asking students to think before they build, we are prompting students to ask questions about which materials will be most useful. Also, ask students to sketch a quick drawing of how they want their coat to look. Then, allow students to start building. Provide students with a variety of materials they can use to build their coats.

Testing their coats

If it is raining, take students outdoors and allow them to test their coats by exposing the pom-poms to the rain for a 10-20 seconds. If it is not raining, it is possible to simulate rain by taking the coat-wearing pom poms to an outdoor space and sprinkling water on them (the effect will not quite be the same).

Wrap-up

Once the test is done, have students come back inside and see if their pom-pom stayed dry. Have them talk to their partner: Was the coat able to protect the pom pom? Why or why not? What could we do differently next time? Have students share their reflections as a group.

Materials Needed

- pom-poms
- construction paper
- plastic wrap
- aluminum foil
- wax paper
- tissue paper
- anchor chart

SESSION 9:
Connecting to the storyline

Main activity

Have students sit in a group near the anchor chart. Ask students to remember the different types of coats that seeds or animals have and why. Write down at least a few different types of coats and their purposes under the plant and animal sections of the anchor chart. Ask students, what types of coats do we humans use that are similar to the coats that plants and animals have? Write down students' responses in the "humans" section and make arrows to connect ideas.

Materials Needed
anchor chart

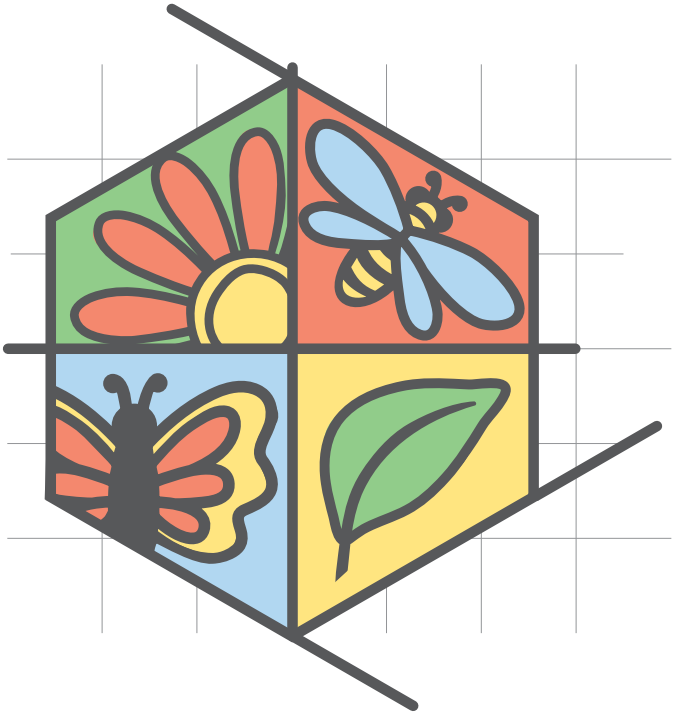
How Lesson 2 Supports Next Generation Science Standards

1-LS1-1 From Molecules to Organisms: Structures and Processes

Performance Expectation	**Connections to Classroom Activity,** *Students:*
1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	• Design a coat for a pom-pom that mimics the coat of an animal and keeps the pom-pom dry. • Discuss how humans are inspired by things they observe in nature. • Describe how animals use their coats to survive.
SCIENCE & ENGINEERING PRACTICES	
Constructing Explanations and Designing Solutions Asking Questions and Defining Problems	• Ask questions about the structure and function of different parts of a seed. • Analyze and compare the structure of different seeds. • Define the problem that a seed coat aims to solve. • Construct an explanation of how an animal uses its coat to help it survive. • Design a coat to keep their pom-pom safe from the outside.
DISCIPLINARY CORE IDEAS	
LS1.A: Structure and Function	• Study the structure and functions of different parts of a seed. • Describe how some seeds are different than others. • Discuss how external structures (coats) on animals help them survive.
CROSSCUTTING CONCEPTS	
Structure and Function Influence of Science, Engineering and Technology on Society and the Natural World	• Study the structure of different seed coats and their purposes. • Determine how different animals use their coats to survive in their environment. • Connect idea of "coats" to the different coats that humans have created to help solve problems (ex. feeling cold in the winter or getting wet in the rain)

The materials/lessons/activities outlined in this activity are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/lessons/activities will be required.

www.nextgenscience.org/sites/default/files/evidence_statement/black_white/1-LS1-1 Evidence Statements June 2015 asterisks.pdf



LESSON 3: Parents and Babies

STRATEGY: EXPLAIN

In this lesson, students will dig deeper into DCIs LS3.A (Inheritance of traits) and LS3.B (Variation of Traits). By the end of the lesson, students should be able to construct an evidence-based argument that young plants and animals are similar to, but not exactly like, their parents (PE 1-LS3-1).

STEM

SESSION 1:
FOSS Investigation 2 (Parts 1 and 3)

Students plant rye grass, alfalfa seeds and wheat grass and watch it grow. (note: please skip Part 2 of the investigation, "Mowing the Lawn," as we would like students to see the difference between adult plants and seedlings and size will be a factor)

Warm-up

Show students the small cup of adult rye grass, alfalfa, and wheat grass that you grew previously. Tell students that we will be planting these three types of seeds and will study how they turn into adults. We will be comparing how the seed changes to finally grow into a grown-up grasses.

Main activity

Follow the FOSS procedure for planting the seeds for the lawn and planting the wheat grass seed in the straw. Please see FOSS guide in your curriculum binder for details about set-up.

Wrap-up

Ask students to make predictions about what they think will happen to the seeds. Have them write their predictions in their science notebooks.

Materials Needed

FOSS Investigation 2 Materials

Part 1:
- Planter cups with holes
- Label
- Paper towels*
- Plastic cups (9 oz)
- Spoon (1 mL)
- Container (½ L)
- Vial
- Pencils*
- Scissors*
- Alfalfa seeds
- Rye grass seeds
- 2 basins
- 1 planter tray
- 1 class calendar
- Potting Soil
- Water*
- Newspaper*

Part 3:
- Straws (clear, marked at 7.5 cm)
- Paper towels*
- Wheat seeds
- Label
- Plastic cup
- Pencils
- Container (1/2 liter)
- Permanent marker
- White glue*
- Ruler*
- Water*
- Scissors*
- Class calendar

**not provided in kit*

Ongoing Observation Sessions (10-15 min each)

Have students make detailed observations of the seedlings on a daily basis for a week. This observation template can be used as a space for students to draw their observations. Magnifying glasses can also be helpful for students to study the smaller structures they see. Walk around as students are drawing their observations. If students are not including structures such as the roots, call their attention to that part of the seedling and ask prompting questions.

Materials Needed

Hand lenses for ongoing observations

Name _____

Grass Observations

Day 1:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 2:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 3:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 4:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 5:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 6:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 7:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

Day 8:
Date _____ Time _____

	What do the rye seeds look like?	What do the alfalfa seeds look like?	What do the wheatgrass seeds look like?
Words			
Illustration with labels			

SESSION 2: How are the seedlings and adults different and the same?

Warm-up

Have students bring their seedlings to their desks so they can observe them closely. Also bring out the adult plants that you have been growing for a few weeks prior, this wheat grass should be fully grown by now. Give students a few minutes to write their observations down in their science notebooks.

Main activity

Ask students "now that the seedlings are visible, how are they the same or different from the grown up?" Let students share their thoughts (the main difference will be that the babies are smaller). Is there anything else that is different with the adults? Show students this timelapse video of a plant growing. Explain to students that the video is a fast forwarded compilation of a plant growing over the span of several days (not a plant growing super fast). Ask students, what structures do you see the baby plant needs to grow? Students might mention the stem, roots or leaves.

Check-in with the unit anchor chart

Have students share: what structures did the baby plants have that helped them survive? Write students' ideas on the anchor chart. Be sure to ask students why how the plant uses those structures (why does the baby plant need roots? Leaves? A stem?) and write students' descriptions of the function of each structure on the chart.

Assessment

Ask students to work in pairs to construct an explanation to answer the question: how are baby plants the same and different than adult plants? Students can use pictures or words to describe their thinking. This template can be used to have students draw their ideas. Have each pair share their ideas with another pair.

Materials Needed

- Seedlings
- Grown-up plants
- Baby plants different from parents worksheet
- Hand lenses for ongoing observations

SESSION 3: What's the same and different about babies and grown-ups?

Warm-up

Tell students that today we'll be talking more about babies. Open this slides presentation and show students the pictures of the kittens. Have students discuss in pairs: What do you notice is similar about the kittens who are all the same type of animal?

Materials Needed

Slides presentation

Main activity

Show students pictures of the puppies and ask them what is the same and different about them: "What do you notice about what is the same with all the puppies which are all the same type of animal (they are all puppies)? Are the puppies all exactly the same? Why or why not?" Create a space where students have a chance to share their ideas with their partner and have time to make observations. After students have talked with their partners, ask them to share as a whole group. Write students observations down so they can refer to them later. It may be helpful to create a t-chart with same and different on either side so students' ideas can be written down.

Next, show students the slides with the adult animals and have them continue to talk in their pairs to find similarities and differences. We suggest using the turn-and-talk strategy often because it provides a safe and low-risk environment for students who are less comfortable speaking in larger groups.

Wrap-up

Ask students to talk in pairs about the following questions:

- What did we observe about babies and adults that were the same type of living thing?
- What did we observe about babies and adults that were a different type of living thing?

You may want to provide sentence frames or modify the frames in slide 11 to fit your students' needs.

SESSIONS 4-5:
Differences between babies and parents

Before the class session: Bring a picture of you and your parents (or yourself and your children if you have kids).

Materials Needed
Pictures of students and parents
Babies and Parents: same and different worksheet
Baby and parents matching cards
Computers with internet

Warm-up

Bring students to the rug. Tell students that today we will be talking about parents and babies. Ask students to look at the pictures you brought for them to look at. Ask students to turn and talk with their partner about *how you look similar* to your parents. After students have talked for a few minutes, ask students to share their ideas with the whole group. Then, ask students, *how you look different* from your parents. Allow them to share their ideas.

Main activity: Parents & babies matching game

Show students the laminated pictures of baby and adult animals. Ask students to look at all the baby and adult animals and to work in pairs to try and match the babies with their parents. How do they know which adult animal matches with the baby? Ask students to discuss their ideas with their partner. Then ask students to share as a group.

Ask students to talk to their partner about the following question: What do the babies and adults have in common (examples of student responses: color, features, body parts, shapes of body parts)? As a whole group, pair pictures appropriately and ask students to identify a few features or ***traits*** that helped them figure out that this pair belonged together. (ex. baby salmon and parent salmon both live in the water and have fins, scales and a tail)

What is different about the babies and adults (examples of student responses: size, color, and certain body parts)? Have students talk in their pairs, and then have them share with the group.

Assessment

(Please note that you will need tablets or laptops for this activity)

Please note that you will need tablets or laptops for this activity. In this performance task, students will be obtaining, evaluating, and communicating information about the animal they chose. Ask students to pick an animal that they find interesting.

- Students can go to this website to browse animals if they are not sure what to pick. https://kids.nationalgeographic.com/animals/. If you feel that students are not going to be successful in researching on their own, provide them with pictures of baby and parent animals using a couple examples (ask them to pick a few animals).
- Then, have students use this template to first draw the baby and adult animal.
- Split students up into groups of 4 and have students share the research they did about their animal. Allow students to practice using the sentence frames before they present to their group, it may be helpful to have students actually write their responses before they present their ideas, this can also serve as a formative assessment:
  - My baby animal was similar to the adult because_____.
  - My baby animal was different than the adult because_____.

SESSION 6:
Protection and communication

Warm-up

Ask students, what might an animal need to protect itself from? Then ask, "what are some things that we protect ourselves from (ex. Cold, rain)?" Allow students to share their ideas. Ask students, how do you communicate with an adult at home if you are hungry or if you need something? Show students this slide presentation that shows several examples of animal parents and babies communicating. Feel free to add additional examples of animals that you'd like students to think about. Please note that under each slide in the "notes" section, there are question prompts and explanations for videos/images. Ask students to talk to a partner about each video or picture and then have them reflect as a group.

Main activity

Read *Meet My Family* by Laura Purdie Salas. Before reading, ask students to look out for different baby and parent behaviors that the animals showed in order to help the baby survive. Pause throughout the story to allow students to identify and share their thoughts. *Follow Me!* by Shira Evans is also a text that can be used to help students identify the different behaviors that parents and babies have that ensure the survival of babies.

Wrap-up

Check-in with the anchor chart for the unit. What structures or behaviors did animals have to protect and communicate with their babies? Add these behaviors or structures to the anchor chart. Ask students to think, do we as humans have objects that do something similar for our babies as the animals did for theirs? (ex: baby carriers are similar to a kangaroo's pouch).

Materials Needed

Parents and babies communicating slides

Meet My Family by Laura Purdie Salas

Follow Me! by Shira Evans

Anchor chart

How Lesson 3 Supports Next Generation Science Standards

1-LS3-1 Heredity: Inheritance and Variation of Traits
1-LS1-1 From Molecules to Organisms: Structures and Processes

Performance Expectation	**Connections to Classroom Activity,** *Students:*
1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. 1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	• Identify the structures that a plant seedling needs in order to survive and grow. • Identify the structures that specific animals have for survival that distinguish them from other animals. • Construct an explanation about how young and adult plants are similar but not identical. • Construct an argument about how a specific baby animal is similar to and yet different from their parent.
SCIENCE & ENGINEERING PRACTICES	
Constructing Explanations and Designing Solutions	• Conduct an investigation and make observations to study how a seedling becomes a plant and what structures help it to survive and grow. • Analyze data of growth of the seedlings. • Construct an explanation based on evidence for how young plants are similar to but not identical to their parents. • Construct an argument showing how one type of baby animal was similar to their parent and different at the same time.
DISCIPLINARY CORE IDEAS	
LS3.A: Inheritance of Traits LS3.B Variation of Traits LS1.A: Structure and Function	• Study the traits of baby plants and the traits of adult plants and how they are similar and different. • Compare pictures of themselves and their parents and how they are similar but different at the same time. • Identify which animals are parent/baby pairs in a matching game. • Identify traits that are not exactly the same in babies and parents. • Create an illustration showing how traits of a baby and parent animal are similar and different.
CROSSCUTTING CONCEPTS	
Patterns Structure and Function	• Identify similarities between baby and parent plants and animals. • Identify patterns of differences between baby plants and animals. • Identify structures that certain plants/animals have that perform a certain function and help that plant/animal survive.

The materials/lessons/activities outlined in this activity are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/lessons/activities will be required.

www.nextgenscience.org/sites/default/files/evidence_statement/black_white/1-LS1-1 Evidence Statements June 2015 asterisks.pdf

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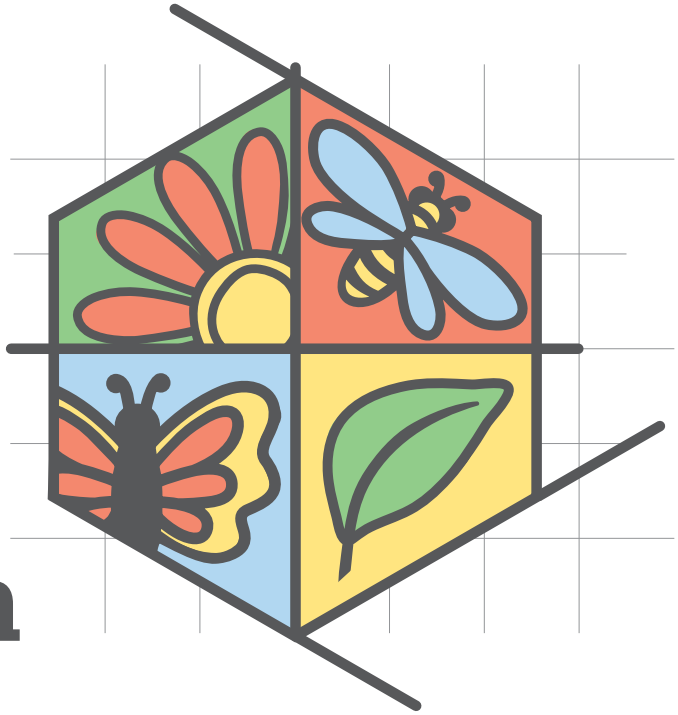
LESSON 4: Drinking, Eating, & Protection



STRATEGY: ELABORATE

In this lesson, students will study how babies and parents work together to survive. The lesson will start out with a discussion about what living things need and what survival means. Then, students will study different plants and animals, and the different traits and behaviors they have that aid in their survival. ***The anchor chart that was started at the beginning of the unit will serve as an important log of student learning throughout the lesson, and will help to connect to the storyline of biomimicry.***

SESSION 1:
FieldSTEM outdoor walk

Warm-up

Tell students that today we will be taking an outdoor walk to collect data on the patterns and shapes in nature that inspire us. Discuss protocols for safety with students (ex. No running, stay with the group, no yelling).

Materials Needed

Outdoor Observation template

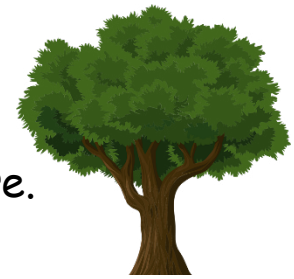
Main activity

Take students outdoors and provide them with a stable surface (clipboards or notebooks) to make observations. Ask students: what interesting shapes and patterns do you see in nature? This template can be used to help provide a space for students to draw their observations. Be sure to ask students to made detailed sketches in their notebooks by accurately representing what they see.

Wrap-up

Bring students inside and gather them on the rug. Have them share the patterns that they recorded with a partner and then ask groups to volunteer and share with the whole group. Tell students, that studying nature very carefully is the first step in the process of biomimicry, where we use designs in nature to inspire how we make things. Revisit the driving question: How can we use our understanding of nature to help solve a problem? Redirect students to the anchor chart. What structures, patterns, or behaviors did students see?

My Field Observation Notes



Draw some patterns and shapes that you see in nature.

Name_____ Date_____ Location_____

SESSION 2:
What is survival?

Main activity

Present students with the idea of "survival." Ask students, what does it mean for a plant or animal to survive? Where have they heard those ideas before? Ask students to share their ideas. Then present the question: What do plants and animals need in order to survive? Create a chart using students' ideas. Prompt students until they come up with the following ideas: water, food & nutrition, protection.

Materials Needed
Chart paper and markers

SESSION 3: FOSS Investigation 4: Bulbs and Roots, Part 1

Warm-up

Teacher note: to implement this lesson, follow Investigation 4 Part 1: Bulbs in your FOSS guide located in your curriculum binder.

The discussion in Part 1 of "guiding the investigation" will be very important in setting students up for the investigation. Be sure to ask prompting questions that help students connect the bulb to the idea of survival. How does the bulb survive harsh weather conditions?

- In addition to the questions provided by FOSS, ask students, how does the bulb survive in the ground over the winter? [it has a compact capsule of smaller leaves that create a little bud. The bud is protected by bulb until it is ready to grow again]
- **Check-in with the unit anchor chart:** This whole process of a bulb's original plant dying off during the end of the growing season, and coming back to life is a process that can be added to the anchor chart for students to potentially think about as a design inspiration to solve a family problem.

Main activity

Follow directions in FOSS to have students plant the bulbs and make observations. Ask students what the bulbs need to grow and continue to have students talk about the structures they see and the functions of these structures.

Note: It is suggested that you plant the roots (next session) promptly after the bulbs so students can watch them both growing at the same time and make comparisons.

Materials Needed

FOSS investigation 4: Bulbs and Roots Part 1 materials:

Plastic cup (250 mL)
Lid with holes
Cotton balls
Container (½ liter)
Vial
Label
Onion or garlic bulb
Pencil*
Class calendar
Water*
Scissors*
Paring knife*

**not included in kit*

SESSION 4: FOSS Investigation 4: Bulbs and Roots, Part 2

Warm-up

Teacher note: to implement this lesson, follow Investigation 4 Part 2: Planting Roots in your FOSS guide.

The discussion in Part 2 of "guiding the investigation" will be very important in setting students up for the investigation. Be sure to ask prompting questions that help students connect the roots to the idea of growth and survival.

- In addition to the questions provided by FOSS, ask students, what does the root need in order to grow into a plant? What do you predict will happen if we plan these roots into the vermiculite?
- Have students observe the roots over a span of 2-3 weeks and have them log their observations in their science notebooks.
- **Check-in with the unit anchor chart**: This whole process of a root growing into a plant can be added to the anchor chart for students to potentially think about as a design inspiration to solve a family problem, after all, it is a process in nature that we could possibly borrow from. Ask students to think about things that humans have created or use that is similar to a root or a bulb. Can they think of any?

Investigation 3 of New Plants is an investigation about stems, and is optional. Use as an extension if you'd like to extend student thinking and have students look at the important structures that emerge when a stem is placed in water (roots).

Materials Needed

FOSS investigation 4: Bulbs and Roots Part 2 materials:

Plastic cup (250 mL)

Label

Carrot or radish*

Container (1/2 L)

Vial

Pencil*

Potting Soil (Vermiculite not included)

2 basins

Water*

Newspaper*

Scissors*

Pairing knives*

Anchor chart

**not included in kit*

SESSION 5:
Water!

Warm-up

Ask students to think about all the observations they made of the wheat grass, the bulbs and the roots. What structures did these plants have to get water? Listen to students' ideas.

Materials Needed

Drinking Water Slides

Water brainstorm student sheet

Main activity

Show students this slideshow of different plants and different ways that they obtain and store water. Ask students to share observations with their partner and then have students share as a group. Then show students the videos of different animals drinking water. What do they observe about how the different animals drink water? Does this remind them of any things that humans use to get water?

- **Brainstorming session:** Have students work in pairs to think of ways that we humans collect water. Are there any things that we already use that resemble some of these structures? This template called the Water Brainstorm can be used as a place where students can draw their ideas while or after they are brainstorming.

Wrap-up

Check-in with the anchor chart for the unit. What structures did the plants or animals use to drink or collect water? Can you think of anything similar that we use to drink or collect water? (some examples, using straws to drink, using water bottles to store water, using wells to get water from the ground). Write students ideas on the anchor chart.

Name_____

What are some ways that people collect, drink or use water?

Draw your ideas in this box.

SESSION 6:
Food and nutrition: How do animals eat?

Warm-up

Ask students, how do we eat food? Ask them to talk to their partner and then allow students to share their ideas with the whole group. Students might bring up the organs that they use to eat (mouth, teeth, tongue, throat, hands, etc.) or they may mention some of the utensils that we use to eat (fork, spoon, knives, etc.).

Materials Needed

- Animals eating slides
- Animal eating worksheet

Main activity

After students have shared their ideas, show them these pictures and videos of animals in nature eating or capturing food. Give students time to talk about the **structures** they see in each video. Also ask students to think of the **behaviors** that are helping the animals have full tummies. If students have identified many structures or behaviors, this may be a good time to check in with the unit anchor chart.

Assessment option

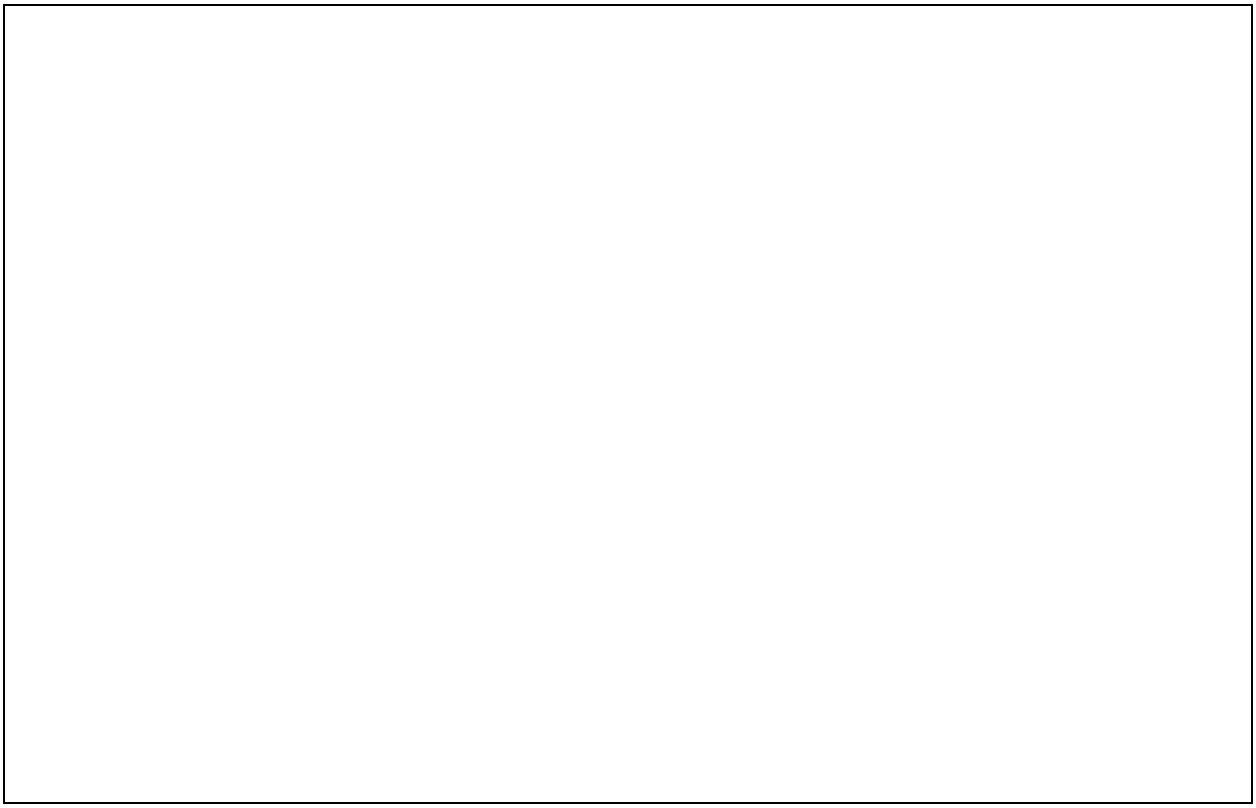
Ask students to pick the animal that was most interesting to them. This simple template can be used to have students pick and animal and write/draw about how the animal collects food.

Wrap-up

Check-in with the anchor chart for the unit. What structures did the animals use to catch or eat food? Can you think of anything that has a similar structure that we use to eat or gather food? (fish nets for fishing, shovels for digging up roots in the ground, tools for reaching up to grab fruit in trees). Write students ideas on the anchor chart and be sure to make connections between the animal and plant boxes and the outside of the chart (how humans use similar structures or processes).

Name_____

Drawing of animal



My animal eats by_____

_____

_____

_____

_____

SESSION 7:
Protection

Warm-up

Ask students, what might an animal need to protect itself from? Allow students to share their ideas.

Main activity

Show this slides presentation and give students the time to share their thoughts and ideas. Feel free to add additional examples of animals that you'd like students to think about. Please note that under each slide in the "notes" section, there are question prompts and explanations for videos/images. Ask students to talk to a partner about each video or picture and then have them reflect as a group. Read *We Build Our Homes: Small Stories of Incredible Animal Architects* by Laura Knowles and have students identify interesting structures that animals create that help them to stay safe from the elements.

Wrap-up

Check-in with the anchor chart for the unit. What structures or behaviors did animals have to protect themselves? What types of protection did animals create to stay safe?

Materials Needed

Slides about plants and animals that protect

We Build Our Homes: Small Stories of Incredible Animal Architects by Laura Knowles

Anchor chart

SESSION 8: Connecting to the storyline and wrapping up the anchor chart

Warm-up

Tell students that we have been studying how different plants and animals use their structures or behaviors for survival. Direct students' attention to the anchor chart.

Materials Needed
Anchor chart

Main activity

Have students look at some of the different things that were listed as structures or behaviors of plants. Go through and highlight/circle/flag the plant and animal problems that we can relate to as humans. Draw arrows from the inside of the anchor chart to the outside circle. Ask students to think about the tools, objects, or behaviors that we have adopted to solve a similar problem. Write down students ideas on the outside of the anchor chart.

How Lesson 4 Supports Next Generation Science Standards

1-LS3-1 Heredity: Inheritance and Variation of Traits
1-LS1-1 From Molecules to Organisms: Structures and Processes

Performance Expectation	Connections to Classroom Activity, *Students:*
1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. 1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	• Study a variety of images, videos and texts to identify different structures and patterns of behavior that help animals survive. • Obtain, evaluate and communicate information about the structures and behaviors between parents and babies that help babies survive. • Make connections between animal/plant structures and the structures that we humans use to solve our problems.
SCIENCE & ENGINEERING PRACTICES	
Constructing Explanations and Designing Solutions Obtaining, Evaluating and Communicating Information	• Construct an explanation about how bulbs and roots help a plant survive and propagate. • Research to obtain information about how an animal uses its specific structures to obtain food for survival. Communicate this idea to peers. • Connect with anchor chart and ask questions about the connections between different plant/animal structures and human created devices.
DISCIPLINARY CORE IDEAS	
LS1.A: Structure and Function. LS1.B: Growth and Development of Organisms. LS1.D: Information Processing.	• Identify different structures that plants and animals us to get water for survival and growth. • Identify different structures that help students to find and eat food. • Interpret data from different images and media to identify different behaviors that help baby animals survive. • Read texts to identify different ways that parents and babies work together for the babies' survival.
CROSSCUTTING CONCEPTS	
Patterns Structure and Function Influence of Engineering, Technology, and Science on Society and the Natural World.	• Identify patterns of behaviors that allow baby animals to communicate with their parents for survival. • Identify structures that plants and animals have that allow them to effectively collect water and food. • Make connections between different traits and behaviors that help an animal drink, eat and protect itself and different devices that humans have created to perform a specific function and solve a problem.

The materials/lessons/activities outlined in this activity are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/lessons/activities will be required.

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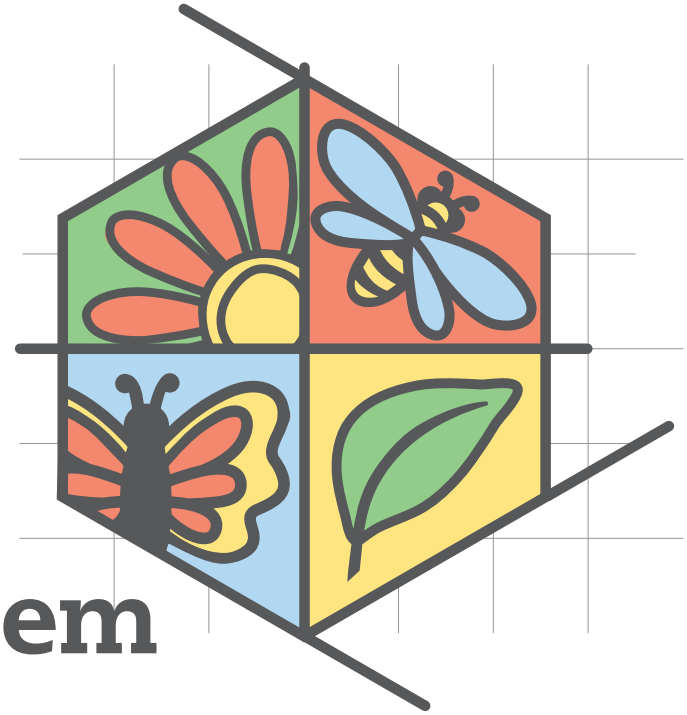
LESSON 5: Engineering a Nature-inspired Device to Solve a Problem



STRATEGY: EVALUATE

This is the culminating lesson of this Storyline Unit. So far, students have been studying plant and animal structures and behaviors that aid in survival. Students have also looked at the similarities and differences between parents and their offspring, and some of the behaviors that help offspring survive. Throughout the unit, attention has been given to connect what can be observed in the natural world and what we create as humans. This concept of biomimicry should be a familiar idea for students at this point in the unit. In this lesson, students will apply their understanding of plant and animal characteristics within the context of engineering. Students will create a nature-inspired device that can help solve a human problem. This lesson connects the SEPs of constructing explanations and designing solutions and asking questions and defining problems to the DCIs of LS1.a Structure and Function, LS1.b Growth and Development of Organisms, and LS1.d Information processing.

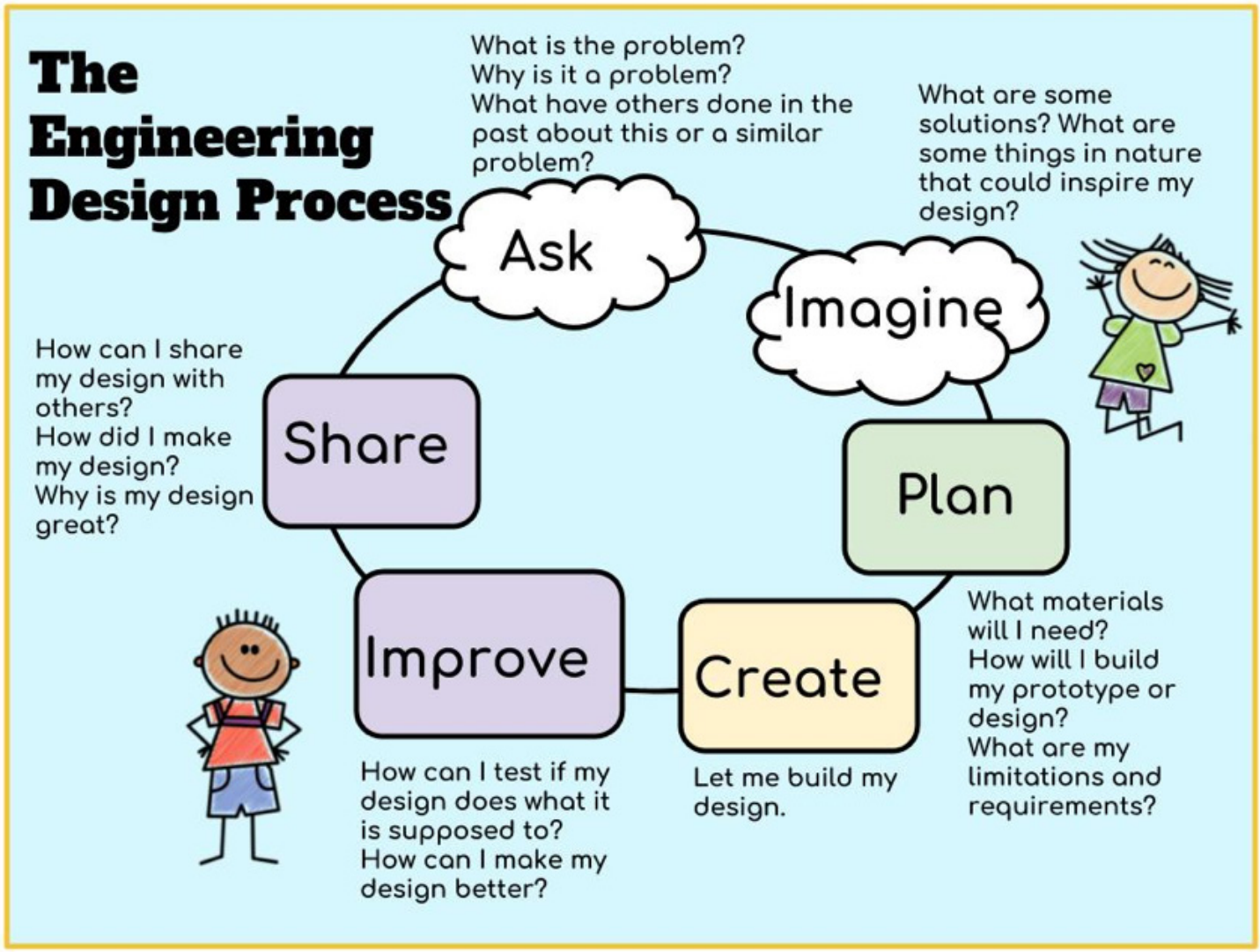
LESSON 5:
The engineering design process

Template

Engineering Design Process Template: This engineering design process template can be used to help provide a space for students to record their thoughts and ideas throughout the lesson.

Engineering Design Process

Students will engage in the engineering design process. For first graders, it is best to separate parts of the process over a span of days and provide direct modeling and scaffolding for each part of the process. Use the slides with session notes below to model the process for students and then to provide them intermittent work time to work on their problem.



SESSION 1:
Picking a problem

Warm-up

Ask students to look back at the list of human-related problems that was brainstormed at the beginning of the unit and developed throughout the unit. What was the one problem that resonated most with them? Tell students that for the remainder of the unit, we will become engineers and will bring our brilliant ideas to life by engineering prototypes of devices that can help people (note: A prototype is the first version of an object created in the process of engineering). Whether the students are working individually or in groups of 2-3 depends on teacher choice.

Main activity

Ask students to work with their team to identify the one problem they would like to focus their engineering solution on.

Materials Needed

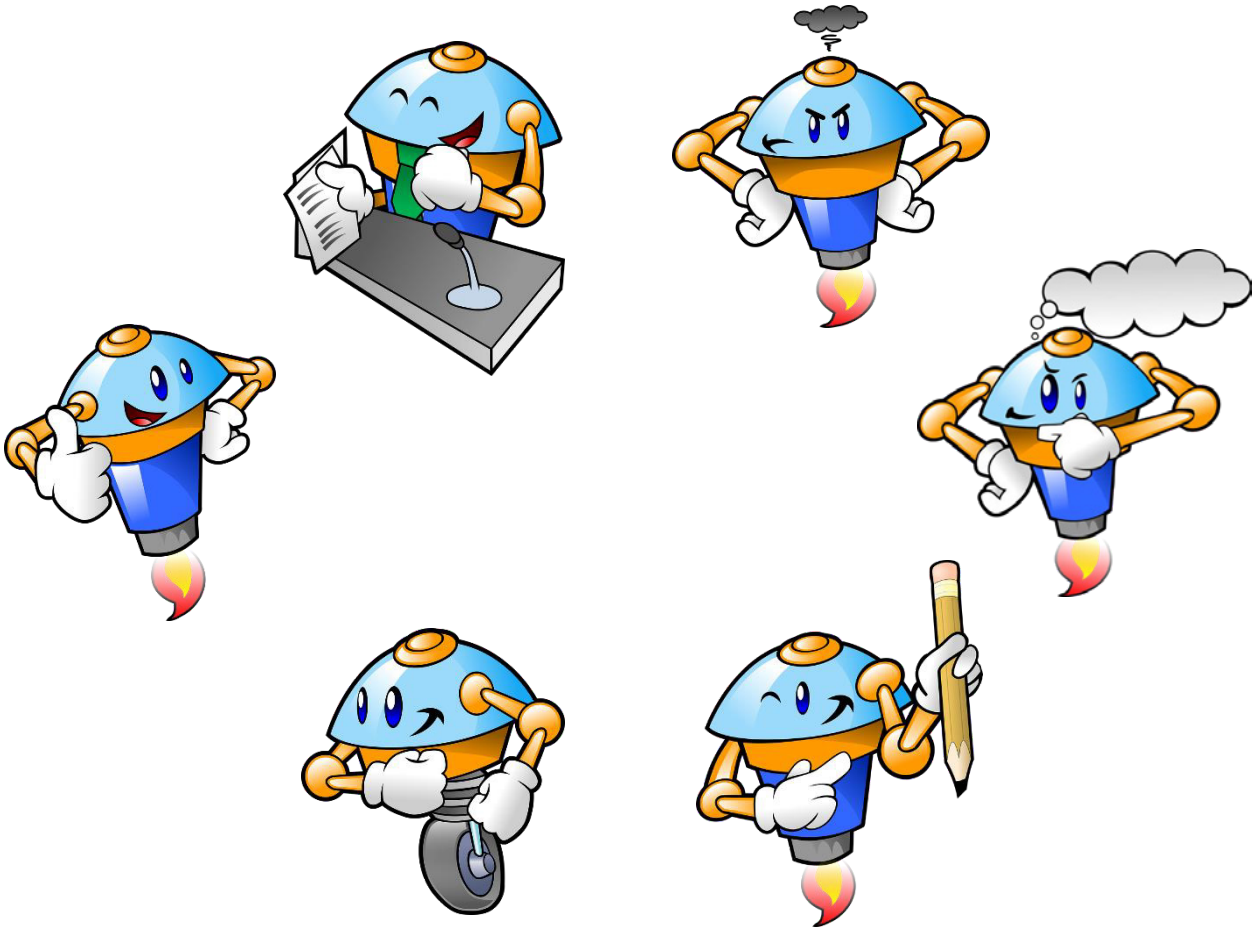
Anchor chart

Human-related problems brainstorm (from lesson 1)

Computer access for teacher slides.

Engineering Design Process Template

Engineering Design Project



Name:_____

STEP 1: WONDER

What is the problem?

Use words or pictures to draw the problem you are trying to solve.

STEP 2: IMAGINE

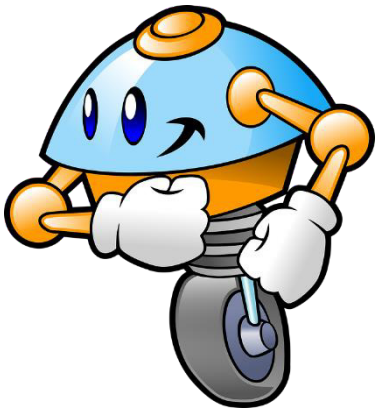
What are some solution ideas?

STEP 3: PLAN a prototype

Draw what your solution looks like. What materials will you use?

STEP 4: CREATE a prototype

Build!



STEP 5: OPTIMIZE your solution

Does your design work? How can you make it better?

STEP 6: Share

Share why your design is great! Who should know about it?

SESSION 2:
Asking questions about the problem (20 min)

Warm-up/modeling the problem

Present students with the scenario of the Japanese bullet train by using this slides presentation. Tell students that the problem with the Shinkansen train was that it would make a very loud sonic boom when it came out of a tunnel.

- Ask students: "Why would this be a problem for people who live near the tracks where the bullet train comes out of a tunnel? Can you imagine living next to the tracks? How would that feel?" Give students time to turn and talk to one another before sharing with the whole group.
- Ask students: "Can we agree that there was a problem with this? What was the problem?" Tell students that this is the first part of the engineering design process, where we ask questions to understand the problem. Ask students: what questions would you ask about the bullet train if you were trying to solve this problem for the people who lived nearby? Make a list of students' responses.
- Work through the rest of the slides presentation and present students with the driving question of the unit again.

Student work time

Now have students think about the human problem they chose to solve for their project. What is the problem? Why is this a problem for people? Allow students to sketch the problem using this template. Ask students to write a sentence draft to describe their problem. Monitor student progress and help students who are struggling to articulate or draw their problem.

Materials Needed

Engineering and Biomimicry Slides

Engineering Design Process Template

SESSION 3:
Researching (20-30 min)

In this session, students will be able to research the solution to their problem by thinking of places in nature where they can get inspiration.

Materials Needed

Engineering Design Process Template

Computers with internet access

Warm-up

Engage students by having them revisit their engineering design template where they sketched out their problem. Tell students that "today, we will be looking on the internet to see if there are plants and animals in nature that could help solve our problem."

Main activity

- Start students off by directing their attention to the anchor chart that you have created together as a class. What were some plant or animal structures that inspired things that humans have created? What does it mean for us to be inspired by nature?
- Pair students up so they have a thinking buddy for this session. If possible, provide each pair of students with a device so they can work together to research each other's' problems. If students are already working in teams, provide each team with a device. These are some websites that you can direct students to for their research. Since the text in some of these resources may be above grade level, have students focus on identifying structures by studying images of animals.
  - National Geographic Animal Facts Database: https://kids.nationalgeographic.com/animals/
  - Animal Exploration: See who's out there! http://animalexploration.tripod.com/animalexploration.html
  - Exploring Nature and Science Education: https://www.exploringnature.org/db/animals
  - ABC Splash (has lots of videos): http://education.abc.net.au/home#!/topic/495776/animals
- Ask students to sketch ideas in their template. What animal structures did they find that could be an inspiration for a device?

Wrap-up

Have students share their ideas with a different group.

SESSION 4:
Imagining a solution (20 min)

Warm-up

Ask students to take out their research sketches from the last session. Have them pair up with a partner and share the plant/animal structure or structures they found that could help solve their problem. Have one student describe what they have found and planned so far. Allow the students to talk for a few minutes and then switch the roles.

Drafting ideas

Give students time to sketch what their object will look like. They can even create several drawings for different ideas that they have (no idea is too crazy at this point in the process).

Peer feedback

Pair students and have them share their ideas.

Materials Needed

Engineering Design Process Template

Post-it notes

SESSION 5:
Plan (20 min)

This is where students will plan out how they will build their device. Provide students with materials so they can plan on which materials they will use. Do not allow them to start building yet.

Materials Needed

Engineering Design Process Template

Warm-up/intro

Tell students that today they will be planning how to create their device. This is the part of the engineering process right before the prototype is physically made. By the end of this session students must:

- Decide what materials they will be using to build their device.
- Draw a diagram showing what the prototype will look like.

Main activity

Give students time to explore materials and work with their partner to create a drawing of their device.

Peer feedback

Pair students and have them share their ideas.

SESSIONS 6-7:
Create (two 30 min sessions or more if needed)

Main activity

Give students time to create their prototype devices. Students can work individually or in pairs (teacher discretion). Monitor as students build their devices. Provide assistance in building (cutting cardboard, hot gluing, etc.). Students may be frustrated when building if things are not working as they planned. Provide support and encouragement. It should not be an option for students to opt out of building. Please provide enough time and differentiation for each student group to succeed.

Materials Needed

Misc materials for building device Scissors, tape, glue, construction paper, paint, paintbrushes, etc.

SESSION 8:
Peer feedback for optimizing

Warm-up

Tell students that just like engineers and scientists, we will be thinking of ways that we could make our design better at what it is supposed to do. When we make something better, that means we are optimizing it. Can you say "optimize?" Tell students that they will be presenting their device to their group and will be asking for one piece of helpful feedback from their team. Before students get started, ask them to think about two things 1) what is my device supposed to do? and 2) does my device do what it is supposed to? 3) What could I use some help with?

Materials Needed

Engineering Design Process Template

Students' projects

Main activity: Getting peer feedback

1. Have students take their devices and join a group of 3 students. Tell students that they will be taking turns sharing their device, telling their team what it should do, and asking for help with one part that they are struggling with. Each student will have 3 minutes to share with their team, and then their team will have 2 minutes to talk to them with feedback.
2. Set a timer and give the first student 3 min to share their device and what they'd like help with. After 3 min, tell students that the presenter must stop talking and the team is to discuss.
3. Let the team discuss the one student's project for 2 minutes (set a timer) and then stop the conversations.
4. Have students rotate so another student is presenting their project. Repeat steps 2 and 3 for remaining students.

Wrap-up

Ask students to partner with a person who was not on their team. Ask them to share, what ideas do they have that they will use to optimize their device?

SESSION 9:
Optimizing! Work session

Main activity: Getting peer feedback

Give students another session to make modifications to their design to optimize it based on the feedback they got from their peers. Ask them, "how can you make your design even better?"

Materials Needed

Engineering Design Process Template

Students' projects

SESSION 10:
Getting ready to share

Warm-up

Tell students that we will be sharing our designs with our parents and community. In order to best describe our device to them, we will create a diagram that will show how it works.

Main activity

Provide students with a large sheet of paper (small poster size) and ask them to:

1. Draw a diagram of their device.
2. Use words to label that the important parts do (ex. grabs food from high shelves)
3. Draw a picture or print a picture of the plants or animals that inspired the design. Draw this on separate sheet.

Wrap-up

Have students pair up and practice how they will present to the guests during the showcase. Ask students to practice by doing the following 1) share the problem you were trying to solve 2) describe your device and how it works.

Materials Needed

- Chart paper
- Printer with access to color printing
- Computers with internet
- Scissors, glue, and markers

SESSION 11:
Share! Biomimicry showcase!

Note: You can hype up and publicize this final session as much as you see appropriate. If possible, have parents and administrators come in to participate in student presentations. You can also invite another class (same or different grade level).

Materials Needed
Students' projects

Warm-up

Welcome parents and other guests and explain how hard the students have worked to solve household problems using their study of plants and animals during this unit. Explain the concept of biomimicry and let guests know that students have been studying how humans are inspired by nature in what we build and create to solve our own problems. Tell parents that each student will describe the problem they were trying to solve, their device, and how it works. Then, parents can guess which plant/animal inspired the design of the device. After a few guesses, the student reveals how their device was inspired by a specific animal or plant.

Main Activity

Have students share the problem they were trying to solve, their design, and how it works. Then prompt students to ask parents/guests to guess which animal might have inspired the design.

Wrap-up

Wrap up the session by thanking the guests and students for their hard work. Show students the anchor charts and share the driving question. Explain to students how proud the class is that they were able to answer the driving question through study and investigation throughout the unit.

How Lesson 5 Supports Next Generation Science Standards

1-LS1-1 From Molecules to Organisms: Structures and Processes

Performance Expectation	**Connections to Classroom Activity,** *Students:*
1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	▪ Identify a real-world problem that their family has that they would like to solve. ▪ Use at least one plant or animal structure to inspire the design for a device that will solve a problem. ▪ Create a diagram with a caption to show how the device was inspired by a plant or animal.
SCIENCE & ENGINEERING PRACTICES	
Constructing Explanations and Designing Solutions Asking Questions and Defining Problems Developing and Using Models Obtaining, Evaluating, and Communicating Information Analyzing and interpret	▪ Ask questions about a real-world problem they have and design a nature-inspired solution. ▪ Research to find different animals that have traits that can be used to solve a human problem. ▪ Imagine and plan a design solution to their problem. ▪ Create a diagram (model) that shows how the device will work and how it is inspired by nature. ▪ Build a prototype device that solves a problem. ▪ Use feedback to revise and optimize the prototype. ▪ Communicate to guests and present the device and how it was inspired by nature.
DISCIPLINARY CORE IDEAS	
LS1.A: Structure and Function LS1.D: Information Processing	▪ Study how the Japanese bullet train mimicked a specific animal structure. ▪ Research how different animal structures perform specific functions to help an animal survive. ▪ Incorporate at least one animal trait into the prototype by mimicking its structure and function to solve a common problem. ▪ Create captions on prototype diagram showing how animal/plant traits were mimicked in the design. ▪ Demonstrate how a mimicked structure helps solve a specific problem.
CROSSCUTTING CONCEPTS	
Structure and Function Influence of Science, Engineering and Technology on Society and the Natural World	▪ Incorporate at least one animal-like or plant-like structure into the prototype design of a device that is supposed to solve a specific problem. ▪ Describe how a nature-inspired device helps to solve a common everyday problem.

The materials/lessons/activities outlined in this activity are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/lessons/activities will be required.

www.nextgenscience.org/sites/default/files/evidence_statement/black_white/1-LS1-1 Evidence Statements June 2015 asterisks.pdf