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BASIS Lesson Plan

Lesson Name: Adapting to Survive: Predators & Prey

Grade Level Connection(s)

NGSS Standards: Grade 3, Life Science (3-LS4)
FOSS CA Edition: Grade 3, Life Science (Structures of Life)

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

This hands-on lesson introduces students to natural selection through the concepts of camouflage and adaption. Students will first examine different bird species to determine the variation that is present within a species and engage in a discussion about which features will help that animal to survive (adaptations). Students will then participate in a fun model-based experiment to discover how and why certain species evolve over time.

Lesson Objectives

- Students will better understand the concepts of adaptation and natural selection
- Students will better understand the role the environment plays in the survival of a species
- Students will model a predator-prey system in two different environments and examine how different variables (environmental color, prey color) are involved in natural selection

Vocabulary Words

- **Organisms**: Living things
- **Species**: A group of organisms that are similar enough to one another that they can produce offspring together
- **Camouflage**: An animal's natural coloring or form that enables it to blend in with its surroundings
- **Predator**: An animal that hunts and kills other animals for food
- **Prey**: An animal that is hunted and killed by another animal for food

- **Adaptation**: A feature or behavior of an organism that helps it survive in its environment. Developing adaptations is a very long process that takes place over many generations.
- **Generation**: All the individuals born around the same time. (You and your friends are one generation; your parents and their friends are one generation; your grandparents and their friends are one generation)
- **Natural selection**: The process by which organisms that are better adapted to their environment tend to survive longer and have more offspring than organisms that are less well adapted

Materials

Scientist Volunteers will bring:

To be restocked after each lesson:

- ☐ Black habitat data record sheets (at least 8 needed for each lesson)

To be reused for each lesson:

- ☐ Bird species with variation, laminated (12 total, 2 of each variation type)
  - Long-tailed widowbird (tail length)
  - Blue grosbeak (color)
  - Hummingbird (bill length)
  - Rock ptarmigan (camouflage)
  - Raptor (body size)
  - Albatross (wing length)
- ☐ Laminated images with images representing roles for simulation game:
  - Predator
  - Prey Counter
  - Data Recorder
  - Baby Bird Maker
- ☐ Plastic cups “Predator Stomach” (12)
- ☐ Forceps “Predator Jaws” (12)
- ☐ Initial “Prey” population Ziploc bags, each with 10 black and 10 white beans (8)
- ☐ Black construction paper (16)
- ☐ Black beans, “Baby Maker” Ziploc bags (8)
- ☐ White beans, “Baby Maker” Ziploc bags (8)
- ☐ Timer
- ☐ Copies of the lesson plan (3)

Extension materials:

- ☐ White habitat data record sheets (at least 8 needed for each lesson)
- ☐ White construction paper (16)

Classroom Set-Up

Students should be in groups of 4 (a few groups of 3 also work). Groups will progress through the lesson together, guided by volunteers and students will share materials within their group.

Classroom Visit

1. Introduction (10 minutes)

Role Model Introduction:
Being a role model is an important part of being a BASIS volunteer! Begin your lesson by explaining who you are and what you do as a scientist. Feel free to tell your "story" as if giving an elevator pitch to elementary school students: Why did you become a scientist? What questions are you trying to figure out? What do you do in your job? Why should students relate to you? Feel free to bring in photos, specimens, and other props. Let your personality shine through!

Topic Introduction:
After you introduce yourselves as role models, take some time to introduce the topic of this lesson: species and variation within species. It may be helpful to keep the suggested take-away in the back of your mind throughout the lesson: **Species adaptations evolve over long periods of time through natural selection.**

Your topic introduction should cover, at a minimum, the following information. As much as possible, try to frame this information as questions posed to the class, rather than as a lecture. This helps activate students' prior knowledge and facilitate student-guided conversation.

- Today we're going to talk about **organisms** (living things) and how they survive.
- Can anyone tell me what a **species** is? [Define, write on board]
- **Variation** is another word for differences [Define, write on board]. Do you think there is variation within one species? Are all of us in this room the same species? [Yes!] Do we all look the same? [No! We have lots of variation – eye color, hair color, height, etc]
- We're going to do some fun activities to explore variation within species. Let's get started!

Teaching Tip:
As much as possible, try to frame the information you bring to students as a back-and-forth conversation between you and the students, rather than as a lecture. This helps activate students' prior knowledge and facilitates student-guided conversation.

2. Learning Experience (45 minutes)

Students will work in table groups of 4 (some groups of 3 will also work). Remember that these activities are designed to address the take-away in a particular way: **Species adaptations evolve over long periods of time through natural selection.**

Activity 1: Variation and Adaptation

1. Engage students in a conversation about species and variation.
    a. See topic introduction above. We're going to pass out a sheet to each table group that has one bird species on it. But you'll notice that there are 4 pictures of the bird species. Each image shows some **variation** within the species. Once you get your bird species, I want you to work with your partners to discuss the following:
        i. What is the main variation in your bird species?
        ii. Why would looking like bird #1 help the bird to survive?
        iii. Why would looking like bird #4 help the bird to survive?
2. Do the bird variation activity
    a. Pass out sheets with the bird species to each group
    b. Check in with each group of students to make sure they understand directions and engage in a productive discussion within their group
    c. Emphasize to students that there is not one correct answer! This is a great opportunity to have students engage in argumentation, making sure that they provide reasoning and evidence to support their claims.
    d. Once students have had a few minutes to discuss, tell students to select 1-2 representatives from each group to discuss their findings with the rest of the class.
    e. Call on each student table group to present their bird's variation and discuss why bird #1 may survive better or worse compared to bird #4
3. Connect the activity to the big picture
    a. You all talked about how certain variation can help that bird to survive, maybe by avoiding predators using camouflage, having bigger talons to gather more food, or by having beautiful tail feathers that could help them to fly faster, or help them to attract a mate. All of these features are called **adaptations** [Define, write on board]
    b. These adaptations help animals to survive in their environment. But how do these adaptations actually come to be? If an animal lived in the snow, could it concentrate really hard and then it would turn white? [No!] So how does it happen?
    c. It happens over a long, long, long period of time. Over many, many **generations** [Define, write on board]. We're going to play a game now to see how adaptations happen!
    d. Emphasize the overall takeaway of the lesson: **Species adaptations evolve over long periods of time through natural selection.**

Activity 2: Predator & Prey Activity

1. Engage students in a conversation about models/simulations
    a. Biologists often use models or simulations to understand and explain what happens in nature. Today we're going to do an experiment to understand how animals adapt to their environment. We are going to play a game and I'm going to explain the rules.
    b. At each table, there will be a black sheet of paper. This will represent the environment in our game. You will also get a bag of black and white beans. These beans represent prey. For our experiment, we will pretend that they are birds with some variation in their color – just like we examined in the previous activity.
    c. Pass out role cards, face side down. Each of you will be a role in the game.
        i. **Predator:** you will have forceps ("predator jaws") and a cup ("predator stomach"); when I say the magic word "Adaptation", you will have 10 seconds to 'eat' or collect as many beans as you can using only your jaws!
        ii. **Prey Counter:** once the predator is done eating, your job is to count how many prey SURVIVED in the environment. Do NOT count the ones that are in the predator stomach!
        iii. **Data Recorder:** once the Prey Counter adds up the numbers, you record that number on the data sheet
        iv. **Baby Bird Maker:** you will use the number on the data sheet to decide how many offspring or babies you need to add into the environment. If 3 white beans and 7 black beans remain, then add 3 more white beans and 7 more black beans into the environment for a total of 6 white and 14 black beans.
    d. Don't worry if you are not the predator the first round! We will rotate the roles, so that everyone gets a chance to be every role!
2. Do the natural selection activity
    a. Pass out the materials to each group of students.
    b. Say the magic word "Adaptation" and start timer. Give **Predator** 10 seconds. Tell students to stop and make sure to put their "jaws" down.
    c. Remind them that the **Prey Counter** should now count how many white beans and how many black beans survived in the environment. Do NOT count the ones in the cup!
    d. Once this has been done, then the **Data Recorder** should write these numbers down.
    e. Using these numbers, the **Baby Bird Maker** then adds that number of beans into the environment.
    f. Rotate the student roles and repeat this activity 3 additional times. Each student in a group of 4 should get the chance to be each role.
3. Record the class data
    a. After four rounds, collect all the materials except for the data sheets.
    b. Have each group report their final number of black beans and white beans.

c. If time allows, have the students do some simple addition with you to get the grand totals for black beans and white beans across the experimental replicates of the class.
d. Generally, the activity should show that there are many more black beans that survive. Some groups may not show this effect simply due to chance, which is why a class total can be used here.

4. Connect the activity to the big picture
   a. Our data (our numbers) show that there are a greater number of black prey than white prey that survived in the environment. Why is that? [Gather student ideas from the class – the white beans were easier to pick up; the black beans were harder to see against the black background – they were camouflaged in their environment]
   b. Are these adaptations? Yes! After many, many generations, the birds that had the black feathers would survive better over time and they will have more baby birds that are black because babies look like their parents. These adaptations arose through what we call **natural selection**. This bird species is evolving over time through natural selection.
   c. Emphasize the overall takeaway of the lesson: **Species adaptations evolve over long periods of time through natural selection.**

Classroom Management Tip: Communicate Expectations

Keep things from becoming chaotic by clearly setting rules ahead of time:

- If a bean drops on the ground, stop and pick it up
- When time is up, put down tweezers and look to the front

3. Wrap Up: Review and Discuss the Learning Experience (5 minutes)

It's important to leave time to review and discuss the learning experiences at the end of the lesson. This might take the form of a review of the take-away of the lesson:

- What are adaptations? How do those adaptations happen?
- Does this happen quickly or slowly?
- Make sure that students understand that adaptations and evolution are not *conscious* processes: eg the foxes do not *decide* to change their coat color; the moths did not *decide* to change color to better camouflage; the process happened over time, as better adapted animals survived and had more offspring.

4. Connections & Close (5 minutes)

Connections to the real world around students:

- Invite students to think about examples of evolution that might be happening around them: eg if there is less water due to the drought, plants that need lots of water might die out and plants that need less water might survive better.
- Invite students to offer other questions they have that they might want to investigate in the future, to better understand how animals adapt to their environments, or how species change over time.

Close:
Wrap up as a role model by leaving a few minutes for students to ask questions about science, about being a scientist, and about becoming a scientist. Then, thanks and goodbye!

Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- http://www.crscience.org/educators/helpfulreports
- http://www.crscience.org/educators/treasuretrove

Standards Connections

NGSS:

- Connections by topic
  - Life Science: 3. Inheritance and Variation of Traits: Life Cycles and Traits
- Connections by disciplinary core ideas:
  - 3-LS3. Heredity: Inheritance and Variation of Traits
  - 3-LS4. Biological Evolution: Unity and Diversity
- Connections by scientific & engineering practices
  - 1. Asking questions & defining problems
  - 2. Developing and using models
  - 6. Constructing explanations
- Connections by crosscutting concepts
  - 2. Cause and effect: Mechanism and explanation
  - 4. Systems and system models
  - 7. Stability and change
- Connections by performance expectation:
  - 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

FOSS CA Edition kit: Grade 3 Module: Structures of Life; Investigation 3: Meet the Crayfish