**Lesson 4: Specialists and Generalists**

**Lesson Summary:** Students complete a food web and explore specialist and generalist diets. Both are important parts of a healthy ecosystem.

**Materials**

* A bag of lima beans (red tree voles)
* A bag of black-eyed peas (mice)
* A bed sheet

**Next Generation Science Standards**

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| * **Practices** ☐Asking questions ☐Developing and using models ☐ Planning / carrying out investigations  **x** Analyzing / interpreting data ☐Math / computational thinking  **x** Constructing explanations ☐Engaging in argument from evidence ☐Obtaining / evaluate / communicate | **Crosscutting Concepts** ☐ Patterns **x** Cause and effect: Mechanism / explanation ☐ Scale, proportion, and quantity  **x** Systems and system models  **x** Energy / matter: Flows, cycles, conservation ☐Structure and function ☐Stability and change |
| **Disciplinary Core Ideas and Concepts**  3-LS4.C: Adaptation  5-LS2.A: Interdependent Relationships in Ecosystems  MS-LS2.B: Cycle of Matter and Energy Transfer in Ecosystems  MS-LS2.A: Interdependent Relationships in Ecosystems  MS-LS2.C: Ecosystem Dynamics, Functioning, and Resilience | |

**Environmental Literacy Strands**

1. Understand the physical and biological world and our interdependent relationship with it

3. Sense of place, region, nation, and global community

**Teacher Background Information:**

A food web involves connecting each organism to all the things it eats. Those animals that eat one type of plant or animal can be severely harmed if the plant or animal population that is sole source of food disappears or becomes toxic. Species that can live in many different types of environments, and have a diverse diet are considered **generalists. Specialist** species are animals that require a relatively restricted set of resources. Often, these species have a very limited diet, or need a specific habitat condition to survive. Barred Owls are a good example of a generalist species. The barred owl is a very opportunistic predator and preys on voles, mice, shrew, rats, bats, opossums, mink, weasels, squirrels and other prey items. Its ability to be successful in a variety of different environments has enabled its population to grow and spread.

Spotted owls are an example of a specialist. Northern spotted owls are non-migratory and they prefer old-growth forests, particularly Douglas-fir forests that typically take 150 to 200 years to mature. Small rodents such as northern flying squirrels, red tree voles, and woodrats are the primary prey of northern spotted owls. While spotted owls are picky eaters, barred owls consume almost anything, including spotted owls. However, spotted owls, because they are specialists, are much more efficient hunters for their prey than are barred owls.

Specialist species are more likely to suffer from habitat loss and disruption than generalist species. As a result, many specialist species are becoming threatened, endangered, or extinct due to human activities. In contrast, generalist species are becoming more common. Northern spotted owls were federally listed as threatened in 1990. When spotted owls are forced to live in small patches of forest they become more susceptible to starvation, predation, or further loss of habitat due to natural destruction such as windstorms.  More recently, competition from encroaching barred owls also has caused an apparent decline in spotted owls across most of their range.  Barred owls are larger than spotted owls, more aggressive, and have a broader diet, which makes them more resilient to declines in habitat quality.

**Activity:**

1. Complete the *“Weaving the Web”* activity and then use the background information to explain to students that not all organisms in a food web are affected equally if the population of a species in the food web changes. Introduce the terms generalist species and specialist species.

2. Draw a simple diagram on the board that shows the barred owl and spotted owl feeding relationships to explain the difference between generalist and specialist species. Tell students that though barred owls have a wide variety of prey; we will only using two possible prey types to simplify the concept, red tree voles and mice.

3. Ask students to gather around the bed sheet on the floor. Take out the bag of black-eyed peas. Inform students that the lima beans will represent red tree voles. Scatter two handfuls of peas on the sheet. Then, inform students that black-eyed peas will represent mice. Scatter a handful of lima beans on the sheet as well. Ensure that students understand spotted owls feed only on red tree voles while barred owls will eat red tree voles and mice. Let students know that since barred owls sometimes eat spotted owls one of the barred owls will be allowed to prey on spotted owls (the spotted owls will not know which one), but they can only do this when you say “Hunt”. Designate one of the barred owls to be the one that hunts spotted owls by discreetly tapping one of the students. Barred owls can “catch” a spotted owl by tagging them. Once they get one then the spotted owl is no longer part of the game. You can randomly call out “hunt” throughout the activity.

4. Divide the class in half. Identify half as barred owls and half as spotted owls. Inform students that they, as predators, will need to find enough food each day to meet their needs. The nutritional needs of the spotted owl differ from those of the barred owl. Since the spotted owl is a smaller owl it only needs to eat 8 red tree voles per day to get the nutrition they need. Inform students that the barred owl is much bigger and needs 10 red tree voles to survive; however, barred owls may also eat mice. One mouse is nutritionally equivalent to a red tree vole so, a barred owl may get any 10 prey items.

5. Ask everyone to stand side-by-side around the sheet. You will give all of the birds five seconds to find their daily food. When you’re ready, allow the students to walk around the sheet looking for prey. After the five seconds, ask students if everyone was able to find their food. If anyone was not able to find their food in time, they have moved to another part of the forest in search of food and may sit on the side. Ask students to place their beans back on the sheet.

6. Remove about half of the lima beans (red tree voles). Inform students that red tree voles are temperature sensitive and cannot thrive in cold weather. There was a freeze last night that killed a good part of the population. Half of the red tree voles have died. Allow students to forage once again for five seconds. Were all of the owls able to survive? The owls that were not able to collect enough prey should sit on the side. Ask students to throw the lima beans back on the sheet.

7. Remove another half of the lima beans. Tell students that there has been an extended drought that decreased red tree vole populations. Allow students to forage for five seconds once again.

8. Use the following questions to wrap up this activity and check students’ understanding:

* How many barred owls died as the red tree voles populations decreased?
* How many spotted owls died as the red tree voles populations decreased?
* Why were more barred owls able to survive as red tree vole populations decreased?
* Are generalist species affected differently than a specialist species by a change in a food web?
* What kind of adaptations might make spotted owls more efficient hunters than barred owls?
* What does this mean for the forest?

**Resources**

University of Florida SFRC Extension

<http://sfrc.ufl.edu/extension/ee/foresthealth/whatisahealthyforest/files/FH_middle_school_ext45.pdf>

US Fish and Wildlife Service

<http://www.fws.gov/oregonfwo/species/data/northernspottedowl/>

Wildlife Encounters

<http://www.fws.gov/oregonfwo/species/data/northernspottedowl/>

National Wildlife Federation

<http://www.nwf.org/wildlife/wildlife-library/birds/northern-spotted-owl.aspx>

**Simplified diagram of Barred Owl and Spotted Owl feeding relationships**