# Introducing Biodiversity: Probability and Extinction

In this activity, students are introduced to the concept of biodiversity through probability. The more species in an ecosystem, the more resilient it should be to species loss and change over time.

**Grades - 5-8**

**Length - 45-60 minutes** (45 for main activity, 60 with keystone species extension)

**Setting - Classroom**

**Objectives**

- Students can define biodiversity
- Students understand that biodiversity varies among biomes
- Students can create a food web and define its elements (producers, herbivores, carnivores, decomposers or detritivores, and arrows between organisms showing the flow of energy)
- Students can define a keystone species

**TN State Standards**

5.LS4.2: Use evidence to construct an explanation for how variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction.
6.LS2.2: Determine the impact of competitive, symbiotic, and predatory interactions in an ecosystem.
6.LS2.3: Draw conclusions about the transfer of energy through a food web and energy pyramid in an ecosystem.
6.LS4.1: Explain how changes in biodiversity would impact ecosystem stability and natural resources.
6.ESS3.3: Assess the impacts of human activities on the biosphere including conservation, habitat management, species endangerment, and extinction.
7.LS2.1: Develop a model to depict the cycling of matter, including carbon and oxygen, including the flow of energy among biotic and abiotic parts of an ecosystem.
8.LS4.4: Develop a scientific explanation of how natural selection plays a role in determining the survival of a species in a changing environment.

**Materials**

- Biome worksheets (3-4 copies per biome)
- Dice (2+ per group or 16+ total)
- Pencils and erasers

**Hook**

1) Watch DLiA's "Why should we care about biodiversity?" video (~1 minute): https://www.youtube.com/watch?v=hLaxmsd2gQk

2) Write "biodiversity" on the board. Draw a line between bio and diversity. Have students decode and deconstruct the word. Ask: What does it mean?

Definition from NWF: The term **biodiversity** has been derived from a combination of the terms "**biological**" and "**diversity**". It refers to the variety within and among living things and the **habitats** in which they live. The diversity of living things—or biological diversity—is much more than some obscure scientific concept. It is a fundamental aspect of life on our planet; the **interdependency** among living things is an essential feature that makes life unique and existence possible.

3) Ask: Is biodiversity a good thing? Why should we care about biodiversity? Can use information from the video (watch it again if needed).

From NWF: "A wide diversity of **species**—animals, plants, and other living things—is the key to a healthy, functioning **ecosystem**. While there are many species on the planet, they are disappearing at alarming rates. **Climate change** is one of several causes linked to species decline, specifically due to the increase in average temperatures across the U.S., sea level rise, and rapid precipitation pattern changes. From schoolyard **habitats** to our own backyard, whether in the United States or around the world, we can work to increase **biodiversity**."

**Activity**

4) Distribute dice and biome worksheets to small groups of 3-4 students. All members of a small group should have the same worksheet (group 1 all have the tropical forest, group 2 has savannah, etc.). Students who tend to take more time completing activities could be given a biome with fewer species.

5) Distinguish between **food webs** and **food chains**. Students may have created food chains before. Food webs are more complete and complex. Food webs can have multiple arrows stemming from one species, and include relationships like **parasitism** and **symbiosis** (define these terms if necessary). Arrows in the food web should describe the **flow of energy** through the ecosystem, ie. from **prey** to **predator**. Show example food web images (pages 5-6). I have provided two examples from biomes not included in this activity. In both examples, most of the arrows point in one direction, from **producers** to **carnivores**.

6) Prompt students to read their list of species and ask questions or internet search any species they are unfamiliar with. Students can then sort their species into groups based on what they might eat. Take a moment to review terms:

- Producer - gets its energy from the sun (eg. plants)
- Herbivore - gets its energy from eating plants (eg. rabbit)
- Carnivore - gets its energy from eating animals (eg. shark)
- Decomposer - gets its energy from breaking down other organisms (eg. mushrooms)

7) Prompt students to create their food webs. Groups can work together to decide how to build their webs, but each student should draw/write the web on their own paper.

*__7th grade connection:__ prompt students to include abiotic factors (soil, water, etc.) in their food webs*

Students do not have to use every single species from their list in their food web, especially for the more diverse biomes, but they should think about and include the **main elements of a complete food web: producers, herbivores, carnivores and decomposers** (not all biomes have a decomposer listed). The food web does not have to be “perfect” and they do not have to draw. They can write the names of the species instead.

**Follow-up Discussion Questions**

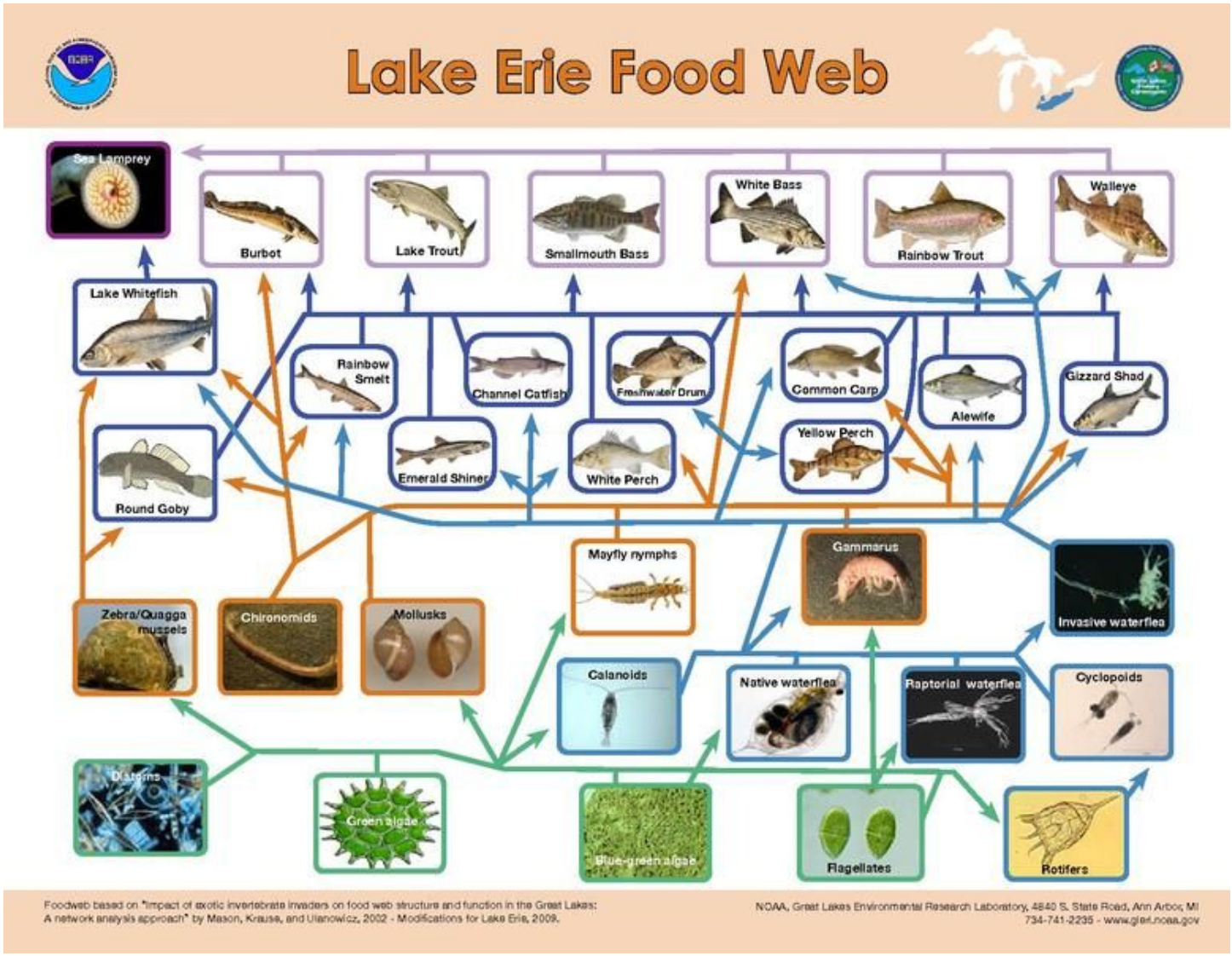
1. Which groups still had functioning food webs at the end of the activity? Which biomes do they represent?
2. Which biomes might be especially vulnerable to climate change?
3. How might humans impact biodiversity?

**Real-world Science: Sources of Error and Multiple Trials**

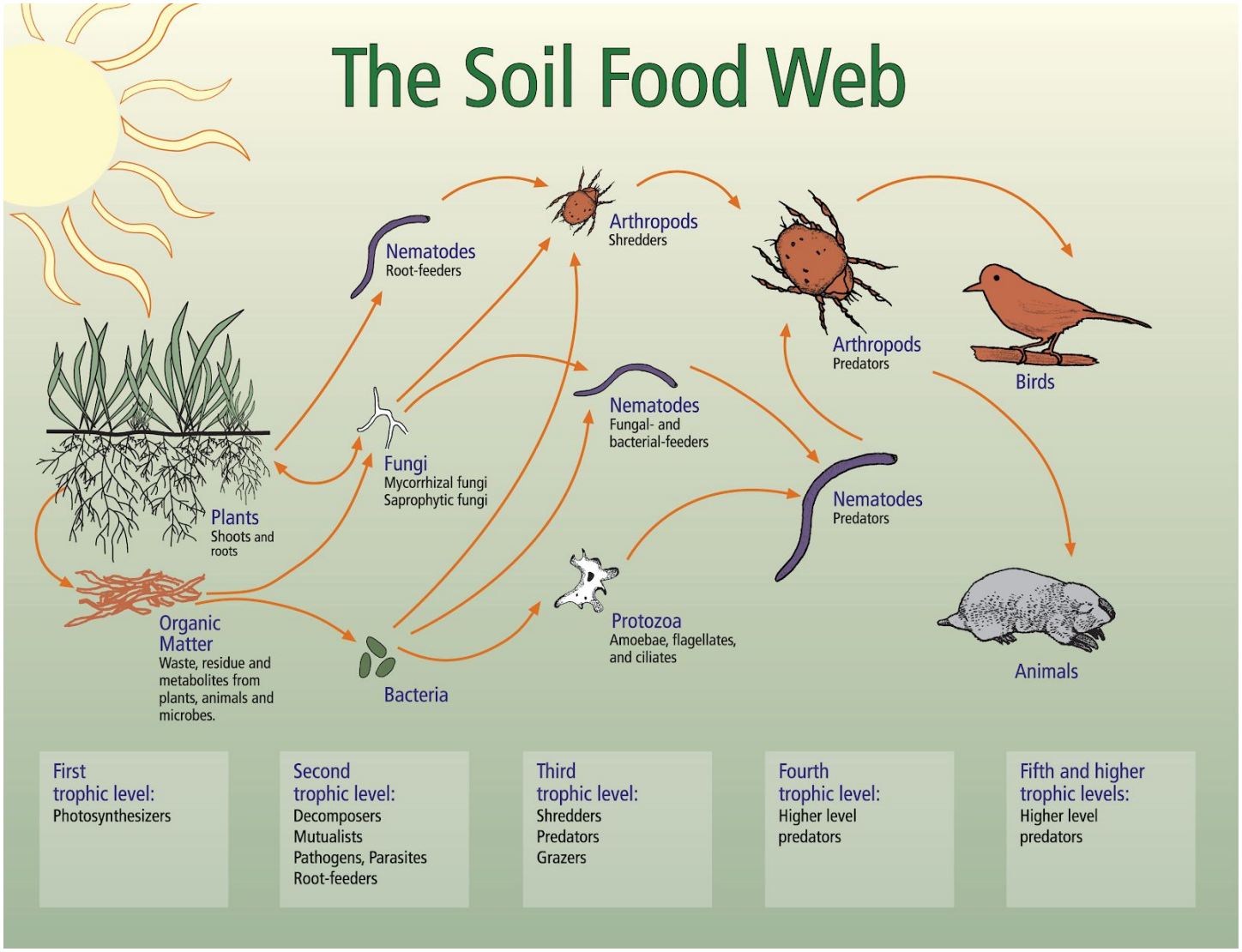
Ask students: Were any of the results surprising (eg. if the desert biome had more surviving species than the tropical forest? Why might that have happened? Identify possible sources of error. Explain that scientists seek out sources of error in their models and experiments so they are sure why they got their results.

If we repeated this same activity, would we get different results? Explain that this activity is a simulation of climate change’s impact on biodiversity. Scientists repeat simulations or experiments multiple times to ensure the accuracy of their conclusions.

# Example Food Web: Lake Erie



# Example Food Web: Soil



# Biome 1: Tropical Forest

Species (25): Rubber tree, Macaw bird, Mahogany tree, Ceiba tree, Jaguar, Bird of Paradise, Banana tree, Peccary, Capybara, Cacao tree, Tree Frog, Poison Dart Frog, Teak tree, Orchid, Spider Monkey, Boa constrictor snake, Bromeliad plant, Three-toed Sloth, Leafcutter Ant, Vampire Bat, Anaconda snake, Tamarin monkey, Quetzal bird, Acai tree, Stinkhorn mushroom

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 2: Savannah

Species (16): Lion, Wildebeest, Antelope, Hyena, Elephant, Giraffe, Baobab tree, Red Grass, Oxpecker bird, Dung Beetle, Fountain Grass, Acacia tree, Baboon, Secretary bird, Grasshopper, Termite

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 3: Desert

Species (7): Cobra, Scarab beetle, Lizard, Camel, Date Palm tree, Tamarisk shrub, Desert Thyme plant

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 4: Grassland

Species (18): Bison, Wolf, Coyote, Prairie Dog, Sage Grouse, Sparrow, Lark, Earthworm, Beetle, Butterfly, Snake, Sunflower, Bluestem grass, Grama grass, Windflower, Sage, Butterfly Weed, Clover

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 5: Mediterranean

Species (14): Cypress tree, Fig tree, Olive Tree, Goat, Jackal, Kestrel hawk, Vole, Lizard, Wasp, Hedgehog, Snail, Grass Snake, Lavender plant, Euphorbia plant

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 6: Northern Coniferous Forest

Species (12): Pine tree, Woodpecker, Cardinal, Bark Beetle, Leaf Beetle, Hemlock tree, Larch tree, Wolf, Deer, Fern, Goldenrod, Moth

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 7: Tundra

Species (9): Caribou, Cotton grass, Snowy Owl, Hawk, Arctic Fox, Lemming, Labrador Tea (bush), Lichen, Moss

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Biome 8: Deciduous Forest

Species (20): Oak tree, Maple tree, Walnut tree, Sassafras tree, Squirrel, Black Bear, Blueberry bush, Barred Owl, Mouse, Woodpecker, Sapsucker insect, Red Fox, Rabbit, Salamander, Alumroot plant, Mosquito, Sphinx Moth, Sparrow, Ant, Spider

Draw a food web for your biome:

Now roll your dice to see which species survive a natural disaster or environmental change. A roll of 4 or higher means that species survives.

Surviving species:

Lost species:

Can your food web still function with only the surviving species?

# Case Study: Coral Reef Biome & Keystone Species

In the last activity, we studied the impact of biodiversity loss on land, or **terrestrial ecosystems**. Here is an example of an **aquatic** or underwater biome with a special element.

Coral reefs are one of the most biodiverse ecosystems or biomes on Earth. The corals in a reef function like the trees in a forest: they are living organisms but also the physical foundation of the ecosystem, the basis for the **food web**. Sea sponges, plants, animals, algae and other corals live and grow on the base layer of reef coral. Corals also calm the water to create a safe place for animals and plants to live.

Corals are sensitive to climate change. As ocean temperatures rise, corals become stressed and undergo a process called **bleaching**, which causes them to turn white and eventually die.

Let's try the dice activity with a coral reef biome.

Species: reef-forming coral, sea sponge, soft-bodied coral, clown fish, anemone, shrimp, algae, barnacle,

If corals die, what happens to the other things that live in the reef?

The coral that forms a coral reef is a **keystone species**. A keystone species provides balance in a food web: just the right amounts of vegetation, herbivores, carnivores and decomposers. Keystone species play critical and irreplaceable roles in that ecosystem, and, without them, the ecosystem will not function the same way.

What are some other examples of keystone species?

(Some answers: mangroves in coastal wetlands, wolves in North America, bison in prairies, otters in Pacific kelp forests)

Wildebeests as keystones in the Serengeti (2:56):
https://www.pbs.org/video/how-wildebeest-saved-serengeti-az7odc/ (excerpt from the PBS Nature documentary "Serengeti Rules." Students can watch the full 60 minute film at home if they are interested)

Video description: "In the 1960s, ecologist Tony Sinclair made a breakthrough discovery when he observed a huge population surge of wildebeest in the Serengeti. He found that the wildebeest were the key to keeping the ecosystem balanced and that keystone species could be prey as well as predators."

Post-video knowledge check:

1. What is the keystone species in this biome?
2. Why did that surprise the scientists?

# Notes and Resources

This lesson was created by Julie Elfin, iScience facilitator and Biodiversity Educator for Discover Life in America, in October 2019. For more information, visit DLiA.org/iScience

We use “food web” instead of “food chain” to emphasize the complex and nonlinear nature of ecosystems. Example food web image sources: https://commons.wikimedia.org/wiki/File:Lake_Erie_food_web.pdf https://www.nrcs.usda.gov/Internet/FSE_MEDIA/nrcs142p2_049822.jpg

Source for biome types: https://www.nature.com/scitable/knowledge/library/terrestrial-biomes-13236757/

More accessible biome database for kids: https://www.blueplanetbiomes.org/

This activity can function as a precursor to a schoolyard biodiversity activity (AKA BioBlitz). Have students download the iNaturalist citizen science app on their phones, or use the iScience-provided iPad, then go outside and take pictures of the life around the school (plants, insects, birds, etc) and upload them to iNaturalist.

How to use iNaturalist: https://www.inaturalist.org/pages/getting+started

Video tutorials: https://www.inaturalist.org/pages/video+tutorials

Tips:

- If they can’t download the app, they can take pictures and email them to you, or upload to their own computer later
- Must have phone location services on to get accurate GPS coordinates for photos
- Take multiple photos for each observation (eg. leaf, bark and branch for trees, top and bottom of insects)
- Don’t upload photos of more than one thing at a time; focus your attention and your camera
- We don’t need every student in the class to photograph the same butterfly; spread out and look at different things

The NWF Biodiversity Audit is a more in-depth (and scientific) version of the schoolyard BioBlitz concept. https://www.nwf.org/-/media/Documents/PDFs/Eco-Schools/Pathways/Biodiversity/Audits/6-8-Biodiversity-Baseline-Audit.ashx?la=en&hash=4509D4C35BA0CD4FB86819FF13BB98B6637FA286

Another term you can introduce if you have time is “ecosystem services”, or the benefits people derive from healthy, functioning ecosystems. https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services