

# Be AIS Aware Unit

## Lesson 2 Food Web Challenge

Do you ever wonder how non-native aquatic invasive species can impact an aquatic food web?

### Overview

*Subject Areas: Life Science, Environmental Science, Ecology, and Human Impacts*

*Key Topics: ecosystems, food chains or webs, producers, consumers, aquatic invasive species*

Students complete a lake food web challenge, learn how all organisms in the lake ecosystem are interconnected, and explain how aquatic invasive species can impact the food web.

### Objectives

Students will be able to:

- build a lake food web.
- explain how aquatic invasive species impact the lake food web.
- demonstrate how an ecological disturbance can occur in an ecosystem.

### Grade Level

Middle School

### Duration

Preparation Time: 30 minutes

Activity Time: 60 minutes

### Skills

Organizing: Interpreting; Applying

### Materials

#### *Warm Up*

- Computer, projector
- Student worksheets #1-2 (double sided)

#### *Activity*

- Laminated or printed food web cards (1 full set/group; included in AIS teaching trunk)
- Scissors or paper cutter
- Color pencils or markers (1 set/group)
- Glue/glue stick (1/group)
- 2' x 3' Poster paper (1/group)

#### *Wrap Up*

- 4" x 6" lined index card or 8 ½" x 11" wide-ruled paper (1/group)



- Alternatively, students may create a video using a Chromebook/tablet

## Advanced Preparation

- Laminated cards are included with the teaching materials. If you prefer to glue the cards down, print and pre-cut the food web cards from the template.
- Arrange classroom so that the students can work in groups of 3-4.
- Gather colored pencils, markers, glue, and poster paper.
- Prior to class, pre-load the Food Web Challenge presentation found on the associated thumb drive or obtain the presentation by contacting us.

## Background

An **ecosystem** is a community of organisms that all share a particular habitat and interact with each other as they work to survive. These organisms are often organized into different trophic levels based upon how they acquire their food energy. **Producers** are organisms that can create their own food from inorganic (non-living) chemicals in the environment. Phytoplankton are microscopic algae found in lakes, rivers, streams, wetlands, and oceans. Plankton is derived from *planktos*, which means “to wander or drift.” Therefore, phytoplankton are producers often found drifting where there is abundant light for photosynthesis. Phytoplankton use sunlight to convert water and carbon dioxide into sugar and oxygen through photosynthesis. This oxygen and sugar is then used to make chemical energy needed for survival. In contrast, **consumers** are organisms that cannot make their own food. These organisms must find and consume their food from their surrounding environment. Zooplankton are examples of primary consumers that eat phytoplankton as they drift through the water.

A **food chain diagram** is a visual representation of the flow of food energy through an ecosystem. Typical food chains start with a producer and are composed of at least three types of organisms. For example, when zooplankton eat phytoplankton, the energy from the phytoplankton goes into the zooplankton. Likewise, when young trout eat zooplankton the energy from the zooplankton and the phytoplankton collectively goes into the juvenile trout population. This food energy is further passed on when larger organisms such as adult trout, osprey, or bald eagles eat the juvenile trout. It is important to remember that even though we simplify a food chain diagram by depicting one individual organism, in reality this organism represents a population of that organism in a specific ecosystem.

A **food web** is simply a collection of interwoven food chains that represent the flow of energy throughout the system. It is important to explain that the food chains and web in this lesson are a small representation of the larger web that exists in the natural environment.

Since producers are the base or foundation to every food chain within an ecosystem, there are typically more producers than consumers in any given habitat. Freshwater lakes in Northwestern Montana are often filled with a variety of phytoplankton, periphyton (slimy algae on rocks or other surfaces), submerged vegetation, emergent aquatic plants (i.e. water lilies), and wetland plants that border the lake. These producers support a wide variety of animal life in and around the lake. The animals in the lake ecosystem can either be found in the lake or around the lake. For example, there are many different types of waterfowl (e.g., ducks, geese) and raptors (e.g., osprey, eagles, hawks) that find their food in, on top of, or near the lake.



**Aquatic invasive species (AIS)** are non-native species that may cause environmental and/or economic harm to an ecosystem. Aquatic invasive species can often create physical and/or biological disturbances that have drastic impacts upon the entire ecosystem. Some AIS can create an **ecological disturbance** that impacts established food chains within an ecosystem. The story of *Mysis relicta*, a freshwater shrimp, and its impact in Flathead Lake is a well-documented example.

*Mysis* shrimp were intentionally introduced into lakes in Northwest Montana with the goal of providing Kokanee salmon populations with a new source of food. These shrimps eventually found their way into Flathead Lake. Unfortunately, Kokanee are sight feeders that hunt in the surface waters of the lake; whereas, *Mysis* shrimp hide in the dark, deep waters during the day and only come up at night to feed on zooplankton. These shrimps quickly began to eat the smaller zooplankton (copepods and *Daphnia sp.*) that was the Kokanee's primary food source. In addition, the non-native lake trout found in Flathead Lake began to eat the shrimp, to get bigger, and to prey upon the Kokanee salmon. Due to a decrease in food and an increase in predators, the Kokanee salmon populations immediately collapsed. Subsequently, the bald eagle populations that depended upon these fish as a source of food also declined. The introduction of the shrimp caused a dramatic ecological disturbance and altered the Flathead Lake food web. Since invasive zebra and quagga mussels eat the phytoplankton at the base of our aquatic ecosystems, their introduction could cause a more devastating ecological disturbance than the shrimp.

### Vocabulary:

**Carnivore:** A consumer that only eats other animals.

**Consumer:** An organism that eats or consumes other organisms to survive.

**Decomposer:** Consumer such as a fungi or bacteria that chemically breaks down organic matter.

**Detritivore:** A consumer that orally feeds on detritus (dead or decomposing organic matter).

**Ecological disturbance:** An event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

**Ecosystem:** A community of organisms and the non-living environment they inhabit.

**Food Chain:** A series of organisms linked together by the transfer of food energy from one population of organisms to another population of organisms.

**Food Web:** A series of interlocking and independent food chains found in an ecosystem.

**Herbivore:** A consumer that only eats photosynthetic plants and/or algae.

**Omnivore:** A consumer that eats both plants/algae and animals.

**Producer:** An organism that can use light or chemical energy to produce its own food from inorganic (non-living) substances (ex. plant, algae, or cyanobacteria) typically via photosynthesis.



## Procedure

- **Warm Up (20 minutes)**

- Turn on the projector, display the Food Web Challenge slide show, and pass out the student worksheets.
- Draw a two-column chart on the board. Label one column “Plants” and one column “Animals”
- Slide #2: Conduct a 30-second brainstorm and have the students write down what they think all plants need to survive. Ask 4-5 students to share their answers and post the answers in the chart on the board.
- Slide #3: Conduct a 30-second brainstorm and have the students write down what they think all animals need to survive. Ask 4-5 students to share their answers and post the answers in the chart on the board.
  - *Review that all plants and animals need water, energy/food, oxygen, a space to live, and the ability to respond to their environment. While the sun serves as a critical source of energy for plants, plants themselves help to directly or indirectly feed animals in each ecosystem.*
- Slide #4: Students record one observation they have about the ecosystem on their worksheet. Ask 1-2 students to share their observations to the class.
- Slide #5: Ask students to record the most abundant type of organism they see in the ecosystem (plants).
- Slide #6: Students examine the biomass diagram and identify/record the group of organisms that has the most biomass globally (plants).
- Slide #7: Students look at the calculated percent of biomass for each group.
  - *Review that 82% of all biomass on Earth is made up of plants, 17% is bacteria/fungi/protists/archaea, which are mostly microscopic, and 0.3% is composed of animals.*
- Slide #8: Students record one SPECIFIC reason why they think plants are the most abundant.
  - *Plants are the foundation of all ecosystems and so we need more of them to support all life.*
- Slides #9-14: Briefly, review the difference between producers and consumers. The organisms on these slides are all found in the Tundra ecosystem.
- Slide #15: Review what a food chain is.
- Slide #16: Read the top of “Understanding a Food Chain” worksheet and review the provided chain.
  - *Students then write one more food chain (from any habitat) on their paper. Ask students to share.*
  - *Conduct a 30-second brainstorm and have the students list all the ways the food chain in the example could be negatively impacted or disrupted (Slide 17).*
  - *Answers may vary: flood, introduced species, aquatic invasive species, too many nutrients to the lake (ex. eutrophication causes algal blooms that are then eaten by bacteria in the water, which leads to low oxygen conditions in the lake), drought, pollution, etc.*
- Slide #18: Use the provided tundra food web to review what a food web is.
- Slides #19-20: Explain what an ecological disturbance is and how *Mysis* shrimp caused a local disturbance.

- **The Activity (25 minutes)**



- Pass one food web card set and markers to each group (if using paper cards pass out the glue/tape). Display the food web challenge directions (slide #21) and explain that they have 25 minutes to complete the food web challenge.
  - Students identify the producers in the web, build the food chains, organize the chains to build the food web, have the instructor check the web (especially if they are gluing or taping the cards down) and lastly draw the arrows moving up through the web. *Note – if using laminated cards, see recommended modifications on the next page.*
- **Wrap Up (15 minutes)**
    - After they build and label the web, they must label the zebra mussel card as an aquatic invasive species.
    - Students write a paragraph (or create a video) that explains how this species could impact the lake food web and possibly cause an ecological disturbance. Students must identify the organisms that would be directly impacted by predation or a loss of food.

## Teacher Resources

### Assessment Options

Have students:

- write a paragraph or create a video clip that summarizes how the invasive mussels would impact the lake food web.
- conduct a think aloud with a partner to explain how energy flows through an ecosystem and how invasive species can disrupt the food web.
- conduct research to learn about a different aquatic or terrestrial habitat, build a food web for that habitat, and identify an invasive species that could potentially disturb the ecosystem.
- design a cause-and-effect poster about a specific ecological disturbance.

### Modifications

- If the students have already learned about food chains/webs, shorten the warm up activity to review the concepts as needed.
- If using the provided laminated cards, students may arrange them on the poster, trace the cards, and write the organism names in the boxes. This will allow the cards to be used for multiple periods in one day.
- Simplify the food web by removing food chains from the web.
- Enlarge the food chain cards and worksheets as needed.

### Extensions

Students can:

- add in another aquatic invasive species to the food web activity to predict how the new organism could impact the food web.
- research traditional Native American uses for organisms found in the lake food web and how those practices have been impacted by the introduction of non-native fish and other aquatic invasive species.
- create a short story from the perspective of an organism in an ecosystem that has been invaded by an aquatic invasive species.

### Standards

#### NGSS & Montana Science Standards:

- MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- LS2.B: Cycle of Matter and Energy transfer in Ecosystems
- Crosscutting Concept(s): Energy and Matter; Cause and Effect
- Science & Engineering Practice(s): Develop and Use Models

### Books:

Elton, C. S. (2000). *The Ecology of Invasion by Animals and Plants* (new ed.). Chicago, IL: University of Chicago Press.

Lockwood, J. L., Hoopes, M. F., & Marchetti, M. P. (2013). *Invasion Ecology* (2<sup>nd</sup> ed). West Sussex, UK: John Wiley & Sons, Ltd.

### Online Resources

- Montana Field Guide: <http://fieldguide.mt.gov/>

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