Food Web Dynamics

Grades 6-12

What is a common lake food web found in N.W. Montana and what ecological roles do the producers and consumers play in this ecosystem?

Overview

Subject Areas: Life Science, Environmental Science, and Ecology

Key Topics: Food chains, food webs, producers, consumers, plankton

Students build a lake food web, learn how all organisms in the lake ecosystem are interconnected, and explain the roles phytoplankton and zooplankton play in the lake ecosystem as primary producers and consumers.

Objectives

Students will be able to:

- build a lake food web.
- describe the ecological roles of phytoplankton and zooplankton in the lake ecosystem.

Grade Level

Middle and High School

Duration

Preparation Time: 45 minutes

Activity Time: 30 minutes

Skills

Applying information, Organizing, Interpreting

Materials

Warm Up/Activity

- Student worksheets #5-9
- Teacher Resources #1-2
- Scissors
- Glue/glue stick (1/pair)
- Laminate/paper protectors

Advanced Preparation

- Print a copy of the student worksheets #5-9 single-sided for every 5-8 students and 1 or 2 extra copies.
- Cut out the organism pictures and descriptions.
- Match the image to the correct description and glue together (back-to-back).
- Cover the paper with laminate or another protective material if desired.

Student worksheets and organism pictures with descriptions can be obtained from the Flathead Lake Biological Station's Education and Outreach program.

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 shrimp 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 shrimp 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.

Vocabulary:

Carnivore: A consumer that only eats other animals.

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

Decomposer: A 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).

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.

Phytoplankton: A single-celled organism (often called algae) that photosynthesizes and drifts with the currents in the lakes, streams, rivers, and wetlands.

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.

Zooplankton: A microscopic animal that drifts with the water that consumes phytoplankton to survive.

Procedure

- **Warm Up (5 minutes)**
  - Lay out all of the sets of organisms and description cards on a table.
  - Organize students into groups of 5 to 8 (depending on class size).
  - Explain to students that they will be learning more about the organisms that live in and around Flathead Lake.
  - Have a brief discussion about food chains and food webs to ensure that students understand. Explain to the students that they will be building a food web of Flathead Lake.

- **The Activity (15 minutes)**
  - Have students select one organism card and return to the group.
  - In their groups, students work together to build a food web.
  - After a short time, ask the students if they are able to make a food web with the organisms they grabbed.
    - Explain to students that if they are missing a key component of their food web they are able to come back up to the table to select more organisms and return duplicates they may have.
    - Students can continue to add organisms to their food webs until they think they have completed it.
- **Wrap Up (10 minutes)**
  - Once the groups are done building their food webs, have the student's gather around one food web.
    - Have a student or two from that group explain their food web and the thought process behind building it.
    - Conversely you could have students swap groups and compare their food web to another groups.
  - As an entire class, review the food webs that they built.
    - It's very likely that students will have left out phytoplankton or another producer. Explain to them the important role these organisms play and that much of the other life in the food web wouldn't be able to survive without them.
    - Bacteria will likely be placed in different spots around the food web. Have a discussion about where bacteria would fall in a food web (it can go anywhere).

Teacher Resources

Assessment Options

Have students:

- build the Lake Food Web with their group to show how the aquatic organisms are interconnected.
- summarize their understanding by explaining what the food web represents and what roles the organisms play.

Modifications

- Students may build the web in pairs or smaller groups.
- Simplify the food web by removing food chains from the web.
- Enlarge the food chain images as needed.

Extensions

Students can:

- observe phytoplankton and/or zooplankton collected from a local water source using plankton nets.
  - Supplies needed: zooplankton net (~64 mm), phytoplankton net (~20mm), sampling jars, microscopes, microscope slides for phytoplankton, microscope depression slides for zooplankton, cover slips, and disposable plastic pipettes.
- design a cause-and-effect poster about a specific ecological disturbance that could disrupt the lake 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.

Standards

NGSS & MT 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*
- *Core Ideas: LS2.B*: Cycle of Matter and Energy Transfer in Ecosystems
- *Crosscutting Concept(s):* Energy and Matter
- *Science & Engineering Practice(s):* Develop and Use Models

Online Resources

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

Acknowledgements

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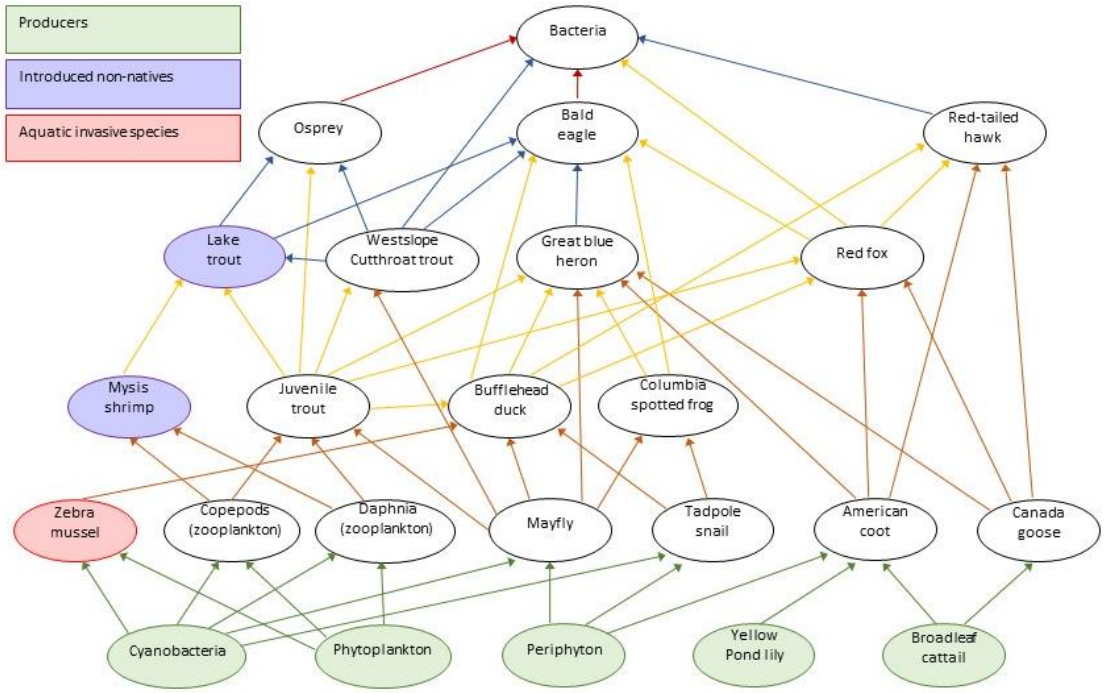

Flathead Lake Food Web Diagram