# Hard Drive:Users:eschultheis:Desktop:KBS Logo.png

# K-12 Partnership Lesson Plan

# Pat Hanly, Marcia Angle

# *Food Web Control of Beneficial and Pest Species*

# *Who eats who and why should we care?*

## Overview

This lesson teaches the importance of understanding how the context of the entire food web can shape whether or not we find species in an ecosystem or not. Both the life requirements and controlling factors (abiotic & biotic) that combine to determine where species can live are discussed.

Using two freshwater ponds, students will generate hypotheses about what they expect different food webs to look like and whether or not they will support focal species based on differences in environmental conditions. The biodiversity at multiple trophic levels and the water chemistry of the two ponds will be sampled by students to generate food webs and test the validity of their hypotheses.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Think critically about how species of interest are influenced by the community in which they are found.
* Construct food webs that show how species are linked in a community through their feeding linkages.
* Identify pond organisms at both the microscopic and macroscopic scales.

**Length of Lesson**

This lesson requires approximately three class periods of one hour each or, preferably, one three hour class session. In the first hour, students are introduced to the freshwater pond ecosystem and generate their own hypotheses about how the differences between two ponds may affect the presence and abundance of a species of interest. The second hour takes students outside to sample ponds and identify the organisms in their ponds at a basic taxonomic level. Students will construct food webs in the final hour, share their findings with the class, and see if their hypothesis was supported by their data.

**Grade Levels**

This lesson is appropriate for grades 5 through 9, but could be adapted for higher grade levels with the inclusion of more advanced water chemistry or taxonomy.

**Standards covered (NGSS)**

Disciplinary Core Ideas:

 *Elementary School*

* **5-PS3-1**: use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun
* **5-LS2-1**: develop a model to describe the movement of matter among plants, animals, decomposers, and the environment

*Middle School*

* **MS-LS2-3:** develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
* **MS-LS2-2**: construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems

Cross Cutting Concepts:

* Patterns
* Systems and system models

Science and Engineering Practices

* Asking questions and defining problems
* Developing and using models
* Planning and carrying out investigations
* Engaging in argument from evidence

***Previous Michigan Standards Met:***

* **S.IP.06.11**: generate scientific questions based on observations, investigations, and research
* **S.IA.06.12**: evaluate data, claims, and personal knowledge through collaborative science discourse
* **S.IA.06.13**: communicate and defend findings of observations and investigations using evidence
* **MS.LS2-3**: develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
* **MS.LS2-4**: construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations

**Materials**

* Waders for each student
* Two aquatic sweet nets per group of 4-6 students
* One plankton net per group
* One dissecting microscope per group
* One 5-gallon bucket per group for collecting macroinvertebrates
* One 50 mL tube per group for collecting zooplankton
* Petri dishes and slides for viewing organisms under the microscope
* Water chemistry meters as available (pH, DO, etc.)
* Poster paper and markers for drawing food webs
* PowerPoint Introduction
* Student Handouts
	+ Worksheet for generating a hypothesis
	+ Common pond invertebrate organism ID data sheet

**Background**

The presence or absence of species in a habitat is often controlled by many factors, including whether or not there are sufficient food resources, whether abiotic conditions are suitable, and whether they are limited by predators or competitors. The ecology and distributions of species are often not simple and can often be unintuitive since so many biotic and abiotic factors are interacting with some additional element of chance. Thus, we often need a wide range of information in order to determine whether a habitat is suitable for a species.

In this lesson, students may focus on any organism of their choosing (e.g., tadpoles) and how it may be controlled by the abiotic and biotic conditions of the available ponds. Some important variables for comparison that should have a large effect on pond food webs include: open vs. shaded, fish vs. fishless, natural vs. artificial, and small vs. large.

### Activities of the session

1. Introduce food webs using the PowerPoint
2. Select two ponds that vary in some variable of interest (fish vs fishless, sunny vs shaded, different habitats, etc.). Select a species of interest.
3. Use student worksheet to make predictions about which pond will have the highest biodiversity and the greatest abundance of the species of interest.
4. Sample macroinvertebrates – identify and count all of the macroinvertebrates that you see in your tank using the accompanying ID guide and data sheet. Use sweep nets to remove invertebrates if you need to look at them with a magnifying glass or under a microscope.
5. Sample zooplankton – Use a 1 liter container to take 5 vertical water samples from 5 points in the pond. Pour this water into a plankton net. Count all of the plankton you see in 25% of the water sample under a microscope and record them on the accompanying data sheet.
6. (optional) Take water chemistry measurements – Use water chemistry meters to measure chlorophyll *a*, dissolved oxygen, nitrate, and temperature. Chlorophyll *a* will be used as our algae abundance for this exercise.
7. Create your food web – Use the poster paper to display your food web in the manner of your choosing. Add tick marks next to each labeled species to indicate the abundance of that species you found. Draw arrows to indicate feeding relationships among species.
8. Share data with other groups and make conclusions about the validity of your hypothesis where you justify your claims with evidence

**Resources**

* Laurentian University [Practical Guide to Identifying Freshwater Crustacean Zooplankton](http://www3.laurentian.ca/livingwithlakes/wp-content/uploads/2012/06/Zooplankton-Guide-to-Taxonomy.pdf) (<http://www3.laurentian.ca/livingwithlakes/wp-content/uploads/2012/06/Zooplankton-Guide-to-Taxonomy.pdf>)
* University of New Hampshire [Image-Based Key to the Zooplankton of North America](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB8QFjAA&url=http%3A%2F%2Fcfb.unh.edu%2Fcfbkey%2Fhtml%2F&ei=OkvFU-DdGcm1yATBs4HYBg&usg=AFQjCNE0OpytIxaS4u-8K_FTSIAjcDkr6Q&sig2=RZLD-FJfyl3gs1QKajMUkg) (<http://cfb.unh.edu/cfbkey/html/>)
* Open Air Laboratories (OPAL) [Water Survey Chart](http://www.opalexplorenature.org/sites/default/files/7/file/Water-survey-fold-out-chart-WEB-EDIT.pdf) with guide to invertebrates (<http://www.opalexplorenature.org/sites/default/files/7/image/WATER%204pp%20chart.pdf>)

**Extensions and Modifications**

This lesson is focused on a comparison of two different ponds but available ponds may not be appropriate for asking this question. Other aquatic systems such as streams (or even terrestrial systems) may adapt this lesson plan, although creation a new ID sheet and data sheet will be required.

High school students could generate more advanced hypotheses and collect more detailed data to test their hypotheses. For example, they could use dichotomous keys to identify organisms to the species level and ask questions about form, function, and taxonomic relatedness. Students could use more advanced chemical methods to assess water quality such as using a colorimetric assay for testing nitrate concentrations.

**Assessment**

Students can be directly graded on the quality of their hypotheses, food web construction, and conclusions from the lesson plan. An engineering extension of this lesson plan is to have students create food webs to fulfill certain design goals such as to encourage total biodiversity, to discourage certain species, or to promote water quality.