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# K-12 Partnership Lesson Plan

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# *Effect of fish on pond invertebrate community structure*

## Overview

This lesson offers and introduction to aquatic invertebrates living in ponds, and a look into how the presence of absence of a top predator – fish – affects the community composition and structure. This is a lesson teachers can do at KBS if they are interested – just contact Gary Mittlebach.

**Objectives**

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

* Display familiarity with techniques used to sample aquatic invertebrates
* Describe how predators influence prey community composition and structure
* Identify several major groups of aquatic invertebrates
* Use microscopes to examine zooplankton

**Length of Lesson**

If classes want to come out to the KBS pond laboratory, we would suggest allowing at least a half day to spend on the facilities. This will allow time for

* an introduction to the history and research done at the pond lab
* an introduction to the study system and questions
* brainstorming research questions and hypotheses
* examining zooplankton under microscopes
* sampling the ponds for macroinvertebrates and tadpoles
* identifying and quantifying sampled macroinvertebrates
* measuring macroinvertebrates for size
* summarizing the data and offering conclusions, discussion

**Grade Levels**

Activity can be modified for grades 3-12

**Standards covered (NGSS)**

Disciplinary Core Ideas:

 *Elementary School*

* **2-LS1-1**: make observations of plants and animals to compare the diversity of life in different habitats.

*Middle School*

* **MS-LS2-4:** construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations

*High School*

* **HS-LS2-6:** evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem

Cross Cutting Concepts:

* Patterns
* Stability and change of systems

Science and Engineering Practices

* Asking questions and defining problems
* Planning and carrying out investigations

**Materials**

* At least one pond with fish and one without fish
* 1 dip net for every 6 students
* At least 4 minnow traps
* Two 5-gallon buckets
* 1 sorting tray and ice cube tray for every 6 students
* 1 clipboard for every six students
* 1 pencil for every six students
* Rubber boots or hip waders for students interested in getting in the water (all these resources are available for trips to the Kellogg Biological Station)

If you’re working with zooplankton, you will also need:

* 1 dissecting microscope and 1 compound microscope for every 6-12 students
* Zooplankton collection net
* Pipettes
* Petri dishes

**Background**

The experimental pond lab facility is unique because of the opportunity to replicate aquatic studies on an ecosystem level. There are currently ponds with and without fish in them. The effects of predators on prey communities can be drastic and observed easily. In this lesson we will be examining how the presence of fish changes the macroinvertebrate, zooplankton, and tadpole populations and communities. In a pond with fish and a pond without fish we will have the students examine diversity (number of species or types of prey), the abundance of each of these types, and the relative size of each prey type.

If some species are found in the fishless pond and not the fish pond it may be because some prey species may not be able to survive in the presence of a predator. They may not be able to survive in high enough numbers to continue the population and so the population dies off. Another reason may be that one species may outcompete another in the presence of predators. Through selection (eating certain phenotypes), predators can change the size of their prey communities. If a predator always eats the larger individuals in a population, the large individuals are removed and only the small individuals are left to reproduce. This is selecting for smaller individuals.

### Activities of the session

The lesson begins with a discussion of how students think fish might affect community composition (what species are present) and structure (how abundant are the species – net and relative – and what are the size distributions within species (a lot of little, a lot of big, evenly distributed). Then students are asked how, ideally, they would test these predictions.

Then the lab, based at Kellogg Biological Station or another location where there are known ponds with and without fish, is introduced. There are two “stations” involved in this lab: zooplankton and macroinvertebrates. Students may start at either, but for the lesson plan we will introduce zooplankton first.

Instructors may have collected zooplankton a day or two in advance. They must be collected in the same way from both ponds (fish and fishless), and deposited in two separate aquaria in a cool place, with bubblers to keep oxygen in the water. First show the students the two tanks, and ask them to guess which samples were from a pond with fish. (The fishless pond should have more zooplankton). Talk about why this would be true. Then show the students how to sample zooplankton with a pipette into a petri dish, and how to look at them under the microscopes. The rest of the time at this station is exploration – most students will be naturally excited to look at and try to identify the different zooplankton.

The macroinvertebrate station can be right next to the ponds. First you can pull up the minnow traps to see if there are tadpoles, and if so, how abundant they are in each pond.

Students should work in pairs for this portion of the lab. First teach students how to use the dipnets – stirring up the bottom a bit and scraping against the vegetation to pick up the most invertebrates. The contents of the net can then be dumped in a sorting tray. From there, vegetation is removed and the invertebrates are sorted into ice cube trays for easier inspection. Students should use the exact same sampling effort in both ponds – the same dipping and scraping motion, and the same number of dips. This is a good opportunity to talk about the importance of consistent protocol in science; what would happen if you sampled one pond twice as much as the other? What would you incorrectly conclude about community composition and structure if the fish pond was oversampled, or if the fishless pond was oversampled?

Once the macroinvertebrates are sorted, the students should identify, count, and measure them. After they have done this for both ponds, the students can discuss and write their conclusions about how fish affect community composition and structure. Then they can discuss their conclusions with other pairs, and see how/if an increased sample size (more student pairs) changed the results.

**Resources**

* Link to a New York Times article on fishless lakes:
	+ http://www.nytimes.com/2009/04/28/science/earth/28Lake.html?emc=eta1&\_r=0

**Extensions and Modifications**

More advanced students can form and test their own hypotheses about how ponds with and without fish may differ. Vegetation, water chemistry, soil chemistry and quality, and oxygen levels are a few variables they could consider.

Younger or developmentally disabled students can focus on just sorting the invertebrates they find into different types they can identify, without worrying about what their official scientific identity is. Learning how to catch and handle invertebrates alone is a very valuable lesson.