Fishy Freeze Tag

Adapted from: "Quick Frozen Critters" in Project WILD: K-12 Activity Guide. The Council for Environmental Education, 1992.

Grade Level: basic

Duration: 20 to 45 minutes

Setting: large playing field

Summary: Students go through a simulation to understand predator/prey relationships, how both have adapted physically and behaviorally to survive.

Objectives: Students will gain an understanding of predator/prey relationships, describe the importance of adaptations, and recognize that limiting factors affect wildlife populations.

Related Module Resources:
- "Fish Food" Activity
- Microscope Slides
- Mounted Specimen

Vocabulary: predator, prey, limiting factor, adaptations, camouflage, warning coloration, mimicry, countershading

Materials (Included in Module):
- Food tokens (poker chips, clear box)
- Rope circles
- Orange vests
- Whistle or bell (clear box)

Additional Materials (NOT Included in Module):
- None

ACADEMIC STANDARDS: ENVIRONMENT AND ECOLOGY

7th Grade

4.3C Explain biological diversity.
- Explain the complex, interactive relationships among members of an ecosystem

4.6A Explain the flows of energy and matter from organism to organism within an ecosystem.
- Describe and explain the adaptations of plants and animals to their environment
- Demonstrate the dependency of living components in the ecosystem on the nonliving components.
- Explain the importance of predator/prey relationship and how it maintains the balance within ecosystems
- Understand limiting factors and predict their effects on an organism

4.7A Describe diversity of plants and animals in ecosystems.
- Identify adaptations in plants and animals
- Recognize that adaptations are developed over long periods of time and are passed on from one generation to the next.

4.7B. Explain how species of living organisms adapt to their environment.
- Explain how an adaptation is an inherited structure or behavior that helps an organism survive and reproduce.
- Explain how living things respond to changes in their environment.

10th Grade

4.6A. Explain the biotic and abiotic components of an ecosystem and their interaction.
- Compare and contrast the interactions of biotic and abiotic components in an ecosystem.
- Analyze the effects of abiotic factors on specific ecosystems.

4.7B Explain how structure, function and behavior of plants and animals affect their ability to survive.
- Describe an organism's adaptations for survival in its habitat
- Compare adaptations among species

12th Grade

4.6A Analyze the interdependence of an ecosystem.
- Analyze the relationships among components of an ecosystem
- Explain limiting factors and their impact on carry capacity

BACKGROUND:

A **predator** is an animal eats other living organisms (animals and plants) for food. **Prey** is the organism that is eaten by another organism. The predation / prey relationship includes the more common animal eating animal (a trout eating an aquatic insect), but it can also include an animal consuming a plant (a stonefly nymph eating algae on rocks). Predation is an important factor in adaptive evolution because eating and avoiding being eaten are apart of reproductive success. Natural selection refines successful strategies for both predators and prey. Individual organisms that effectively forage for food are most likely to leave the most offspring and prey

that are more successful at avoiding predation are most likely to breed successfully.

Animals display a variety of behaviors in predator/prey relationships. These are adaptations to survive – getting enough food or avoiding being eaten. **Adaptations** are specialized characteristics that animals and plants have developed over time in response to environmental pressures. They may be physical features or specialized behaviors. Defense mechanisms range from spiny covering, sharp teeth, and sleek bodies to fear scents and schooling behaviors.

Predators and prey live together but their relationship is not necessarily stable. Minor environmental changes may result in large imbalances such as a **trophic cascade**, where change occurs at all levels of the ecosystem. For example, the introduction of alewife into Lake Michigan resulted in the near disappearance of two large species of zooplankton, the decline of five other species, and an increase in 10 species of small zooplankton (Wells, 1970). A way in which balance can be achieved is through **optimal foraging theory**. This theory suggests that a fish may switch to feeding on prey that are just as satisfying but take less energy to feed on. For example, a bluegill may become just as fulfilled eating zooplankton than invertebrates that live in the cover of aquatic plants. However, when bluegills feed far away from the cover provided by aquatic plants there is increased predation by large mouth bass.

There are many influences in the life history of an animal. When one of these (such as disease, climate, pollution, accidents, or shortages of food) exceeds the limits of tolerance of that animal, it becomes a **limiting factor**. It then drastically affects the well being of that animal. Predators are limiting factors for prey. Prey are limiting factors for predators. Predators and prey populations exert intense environmental pressures on one another so it forces the development of successful foraging strategies and behaviors that may evolve through time.

Both predators and prey can have adaptive coloration to help them survive. Some animals have developed colors, patterns, and shapes that help blend them into their surroundings. This is called **camouflage** and helps make prey, or in some cases a predator, difficult to spot in a natural background. Fish that live in weeds generally have vertical bars or stripes. The fish that live in open water have horizontal stripes or **countershading**, where the belly is lighter than the back. Prey with **warning coloration** (bright colors) that lets predators know that they are distasteful or poisonous is not as common in aquatic environments as terrestrial. **Mimicry**, when a creature evolves to resemble something else such as a twig or leaf, is also not very common in aquatic environments.

Some prey behaviors that may help them escape predation can include: flight, scrambling for cover, hiding, fighting, signaling to other for warning, or remaining still to escape detection. Fleeing or fighting is a costly anti-predator response in terms of energy, so many animals flee into a temporary shelter and avoid being caught without expending the energy required for a prolonged flight. Minnows will dart into crevices or thick vegetation when faced by a predator. Commonly you may have notice frogs that jump

into a pond and bury themselves into the mud in the face of danger. Active self-defense such as fighting is often a last resort by prey and often fighting is undertaken in an effort to protect young and offspring. Another common prey behavior that fish use is living in large groups. Schools of fish will move together with a safety in numbers concept. Predators can be confused by the multiplicity of moving prey items having trouble concentrating on a single fish.

The kind of behavior exhibited by prey partly depends on how close the predator is when detected. Of course, the organism's behavior will also be specific to the kind of organism that it is – minnows will react differently than worms. Each animal has a threshold for threat levels. If a predator is far enough away for the prey to feel some safety, the prey may signal to others that a predator is near. If the predator comes closer, the prey may try to run away. If the predator is too close to make running away feasible, the prey may attempt to scurry to a hiding place. If the predator is so near that none of these alternatives is available, the prey may freeze in place so the predator cannot detect the prey through movement. The closer the predator comes to the prey animal, the more likely it is that the prey will freeze in place. This freezing occurs as a kind of physiological shock in the animal.

OVERVIEW: Students go through a simulation that is like a game of freeze tag to understand predator/prey relationships, how both have adapted physically and behaviorally to survive. Various rounds will be used to demonstrate the impact that prey and predators have on each other's populations and to demonstrate the effectiveness of adaptations for survival.

PROCEDURE:

1. Think of a pair of aquatic animals that are predator and prey, or use one of the pairings below:

Predator	Prey
Bowfin	Bass
Bass	Minnow
Minnow	Dragonfly nymph
Dragonfly nymph	Midge larva or Aquatic worm

   Identify students as either predators or prey for a version of freeze tag. There should be approximately one predator per every four to six prey.

2. Designate one end of the playing field as the "food source" and the other end as the "permanent shelter." The size of the playing field will depend on the number of students playing and their athletic level – 15 yards wide by 30 yards long may be good to start with.

3. Four or five "temporary shelters" or "cover" should be available in the open area between the shelter and the food. Four or five rope circles (provided in the module) can represent these areas, though hula-hoops can be used if available.

4. Food tokens (poker chips) are placed in the food source zone on the ground. Allow three food tokens for each prey animal.

5. Predators should wear orange vests (provided in module) so they can be clearly identified.

6. Start the round with a ring of the bell or blow the whistle. When the round begins, prey start from their permanent shelter. The task of the prey animals is to move from the permanent shelter to the food source, collecting one food token each trip, and returning to the permanent shelter. To survive, prey have to obtain three food tokens. (If this number of tokens is not appropriate for your class, decide on a better number of tokens for the students to collect.) Their travel is hazardous, however, because they need to be alert to possible predators. If they spot a predator, they can use various appropriate prey behaviors – including warning other prey that a predator is near. Prey have two ways to prevent themselves from being caught by predators: they may "freeze" any time a predator is within five feet of them; or they may run to cover (with at least one foot within one of the rope circles). Frozen prey may blink, but otherwise should be basically still without talking.

7. Predators start the activity anywhere in the open area between ends of the field and thus are randomly distributed between the prey's food and primary shelter. Predators attempt to capture prey to survive, tagging only moving (<u>not frozen</u>) prey. Each predator must capture two prey in order to survive. Captured prey are ***<u>taken to the sidelines</u> by the predator*** who captured them. (Make sure that rules are established so students do not get hurt: e.g., no full tackles.)

8. A time limit of five to seven minutes is suggested for each round of the game so that captured prey do not get restless. Remind prey that they can remain frozen for as long as they like, but if they do not have enough food at the end of the activity they will starve to death. In nature, an animal must balance the need to find food with the sometimes conflicting need for safety.

9. At the end of each round, determine how many prey and predators survived. Students may fill in the data sheet to record these number and the various conditions of the game round.

10. Play about four rounds, allowing new students to have a turn to be a predator.

11. Conduct different rounds in different ways to help demonstrate the effectiveness of physical and behavioral adaptations, and demonstrate what happens when populations of prey and predators are not in balance. You can have students try to create ideas for additional round, but examples of possible other rounds are below:
    - Have more predators. Do they wipe out the prey population or is there not enough food to support them?
    - Reduce the amount of food tokens. What happens to the prey?

- Eliminate the prey's ability to "freeze". Did it make it tougher for the prey to survive?
- Eliminate some or all of the temporary shelter used by the prey for hiding. What effect did this make?
- Can students think of a way to make the predators in the game more camouflaged? *Do not have the predators wear the orange vests – they do not stand out now and will blend in more with the other classmates' outfits.*
- If many students have running through the playing field at the same time during the course of the game, indicate that this is similar to fish moving in a group or school. Do a round in which they do not move in a school by having only one prey run across the playing field at a time. Was the prey more susceptible to predation in a group or individually?

DISCUSSION:

Discuss with the students about the ways they escaped capture when they were prey. Which ways were easiest? Which were most effective? What means did they use as predators to capture prey? Which ways were best? What did the predators do in response to a prey animal who froze? In what ways are adaptations important to both predator and prey?

What happened when the predator population increased? *Prey population may have declined.* What would happen to the predator population eventually if they kept eating all the prey not allowing them to reproduce? *A shortage in prey (food) will eventually limit the predator population. When the predator population declines, it may allow the prey population to rebound again. The two populations depend on each other and are limiting factors for each other.*

Can students think of real circumstances in which a temporary shelter or hiding places in an aquatic ecosystem may disappear or be eliminated*? Human activity can disrupt the habitats of waterways. Cracks, crevices, or access to the underside of rocks can be filled in by siltation caused by soil erosion. Downed tree trunks (natural hiding places for fish) may be removed from streams to clear the channel, keep flooding from happening.*

What are some other adaptations used by prey or predators that were not covered in the game? *Warning coloration, mimicry, signaling or causing a distraction (though this may have been done in the game), prey fighting the predator to survive (this better not have been done in the activity), prey camouflage, predator physical adaptations like claws, sharp teeth, etc.*

EVALUATION:

- Describe the behavioral and physical adaptations that predators and prey have.
- Explain how predators and prey are limiting factors for one another.
- Discussion questions above
- Have students graph the data collected by the simulation and explain why populations fluctuated for the prey and predators.

EXTENSIONS AND MODIFICATIONS:

- Conduct the activity for three or four rounds, recording the number of captures each playing period. Have students who are captured become predators, and each predator not getting enough food become a prey animal in the succeeding round. This quickly leads to the concept of dynamic balance as prey and predator populations fluctuate in response to each other.
- Have student research and make a list of examples of predators and prey in a stream/river community.
- Select an aquatic creature and research its behavior patterns for avoiding detection and capture. Reports or demonstrations of behavior could be presented to the class.

NOTES (TEACHERS, PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE):

Activity Version: January 2002

Data Sheet: Fishy Freeze Tag

Student Name _____ Date _____

	Round 1	Round 2	Round 3	Round 4
# of Prey at Start				
# of Prey at End				
# of Predators at Start				
# of Predators at End				
# Temporary Shelters				
Could Prey Freeze?				
Other Conditions in the Round				

	Round 5	Round 6	Round 7	Round 8
# of Prey at Start				
# of Prey at End				
# of Predators at Start				
# of Predators at End				
# Temporary Shelters				
Could Prey Freeze?				
Other Conditions in the Round				