ACTIVITY 30

GETTING CAUGHT

DO SOME HUMAN ACTIVITIES CHANGE THE FEEDING RELATIONSHIPS, AND THUS THE ECOLOGICAL BALANCE, OF A FOOD WEB?

SCIENCE SKILLS:
- organizing
- inferring
- predicting
- experimenting

CONCEPTS:
Removing the top carnivores from a habitat can change the feeding relationships at other levels of the food chain.
Human management of natural areas requires an understanding of the importance of a balanced food web.

MATH AND MECHANICAL SKILLS PRACTICED:
- averaging numbers

SAMPLE OBJECTIVES:
- Students will be able to identify human activities which affect feeding relationships in an aquatic environment.
- Students will be able to identify correct fisheries management practices.

INTRODUCTION:
In this simulation activity your students will learn how the basic ecological principals relating to food chains, which they have experimented with in Activities 28 and 29, can be applied to the management of aquatic habitats. Human activities may affect food chains in many ways. Pollution and habitat destruction cause obvious changes that are easy to see. Dead fish are hard to ignore. It is also easy to understand the consequences of filling a pond or marsh in order to build a shopping center or add another field to a farm. The whole habitat goes away. Much more subtle changes may result from the extensive harvesting or removal of selective levels of the food chain or the addition of new species which change the relationships among levels.

When we selectively remove some fish, we are making changes that may have a significant impact on the other animals and on the plants in the pond, lake or ocean. Very careful planning of fishery regulations are necessary to be able to remove animals from a system on a long term basis without destroying the ECOLOGICAL BALANCE of the entire system. The result of this careful planning is a calculation of how many fish can be taken year after year without upsetting this balance, the SUSTAINED YIELD. The people who study these problems are in a field called FISHERIES or WILDLIFE MANAGEMENT. They set fishing limits for both sportfishing and commercial fishing and enforce them. They make use of practical applications of the kinds of ecological principles learned in this exercise.

MATERIALS:

For each student:
- 10 markers (poker chips, plastic counters or other non-destructible small items)
- small paper or plastic bag

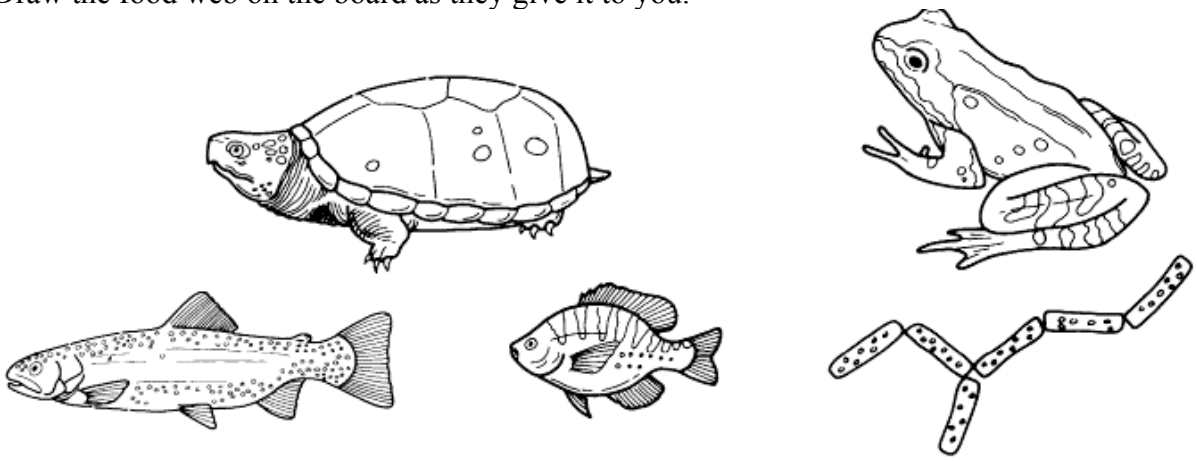
For the teacher:
- plastic or crepe paper flagging or cloth strips in three colors
- whistle
- pad or chalk board and pen or chalk
- data sheets to record results (use sheets from Activity 29)

LESSON PLAN:

BEFORE CLASS: Use Activities 28 and 29 prior to this activity. This experiment combines the effects of COMPETITION from Activity 28 and PREDATION from Activity 29. The two taken together establish the idea of a balanced food chain and the way that feeding regulates reproduction rates. The materials and location for this activity are the same as those two exercises.

DURING CLASS:

METHODS: Explain that the class is going to continue to experiment with food chains, but this time the students are going to ask questions about the impact that humans can have on the balance of a food chain. Ask for some ways that some people might affect the animals in the pond food chain that they have been using as a model. While the students are most likely to think of things relating to pollution, someone will probably come up with fishing. Ask them to tell you what the feeding levels were in the pond model and what kinds of animals lived at each. Draw the food web on the board as they give it to you.



Which level is the most likely to be taken by humans? Since people like to catch big fish rather than tiny minnows, big fish are the likely candidates for human removal. The children are less likely to think of hunting for sport or trapping for fur. Another top carnivore, the raccoon, is frequently hunted with dogs as a sport. During the winter, raccoons are trapped for their fur which is used in fur coats. Ask if anyone has seen a coat made of or trimmed with raccoon fur. (It has long hairs and is a mix of tans or browns.) Therefore, in our model pond, we are going to

assume that people come to the pond and catch all the big fish while other folks hunt all the local raccoons. We now have decided how humans are going to disturb the pond food chain in our model.

Run the first experiment. The first time around see what happens before humans are involved. People will be added to the system in a later run. Start by designating 3/4 of the students as herbivores - the zooplankton, insects, and crayfish. Make 2 students top carnivores - the big fish and raccoons. The remaining students will be carnivores that feed on the herbivores - the frogs and small fish. Hand out the colored flags which show their feeding level and the bags to hold the food they eat.

Scatter 10 food items per herbivore. Each herbivore needs 10 to survive and reproduce. Each carnivore needs 20 pieces and each top carnivore needs 40 to survive and reproduce. When any animal has enough food, it can go to hide in a safe place. When any animal has been tagged by its predator, it has been "eaten" and must give up its food and sit down.

Allow the students to play the game until everyone has either gotten enough to eat, run out of food to eat or been eaten. Was this in reasonable balance? That is, did some members of each level survive? Record the results.

Now repeat the experiment with one big change. A trapper came and caught the raccoon and a fisherman or woman got the big fish. Have the same children take each role, but the two top carnivores sit out. Have the students predict the outcome. Run the game again.

RESULTS:

What happened to the balance? Did the herbivores get eaten much worse? What would the children predict would happen in the next generation? Ask the students if they can see the direct consequence of removing the top carnivores on the structure of the food chain. Even in one generation, there should be the obvious result that there is no longer a balance. The secondary consumers are now able to eat almost all the herbivores, leaving few to reproduce in the following year. With the herbivores gone, the carnivores will starve in the following years.

CONCLUSIONS:

Natural food chains are generally balanced over a period of years. When all of one level is removed, the other levels will be affected. Any human harvesting of natural populations must take into account the effect on the other levels of the food chain. Top carnivores are an important part of the balance of the food chain, not bad things that should be killed. Have the students list other top carnivores that are hunted in the ocean: tuna, billfish and large sharks are all being harvested much faster than they can reproduce. Can they predict possible outcomes?

EXTENSIONS:

1. For a comparison of what has happened in cases where people have actually selectively removed whole levels of a food chain, consider the following:

a. In the early part of this century, extensive hunting of mountain lions in northern Arizona effective removed predation from the deer herds. In the years that followed, the deer herds grew because their predators were gone. Eventually there were so many deer that they ate all the vegetation. Then the deer started starving during the winters. They had virtually destroyed the vegetation on which they depended. During succeeding years the deer population declined dramatically due to starvation. In this case removing the top carnivore resulted in starvation of its prey and such extensive damage to the plants that neither the vegetation nor the deer have ever recovered properly.
b. Recently extensive fishing for small fish called capelin has so reduced the numbers of these animals that the sea birds such as puffins that depend upon capelin for food are experiencing reproductive failure as their young starve. It is possible to overfish capelin because they swim in tight schools. By hunting for the schools with planes and surrounding them with large nets from boats, humans can catch so many that there are not even enough fish left to reproduce.
2. Have students research your state fishing and hunting regulations. These are management practices that should be based on an understanding of food chains and ecological balances.