Competing for Food

Adapted from: "Competing for food" in Living in Water. The National Aquarium in Baltimore. 1997.

Grade Level: intermediate

Duration: 1-2 class periods

Setting: classroom or outside

Summary: Students model how food availability can limit numbers of the animals that feed on that food.

Objectives: Students model a simple food chain and explain how the availability of food can limit the population which depends on that food. Students will understand what carrying capacity is.

Related Module Resources:
- "Quick Frozen Critters" Activity
- Books: on algae, protozoa, plankton, Microorganisms Notebook
- Video: World of Protozoa
- Poster: Protists
- Microorganism Slides

Vocabulary: plankton, zooplankton, phytoplankton, protozoa, carrying capacity

Materials (Included in Module):
- Poker chips
- Plastic sandwich bags
- Bell or whistle
- Field markers

Additional Materials (NOT Included in Module):
- Clipboard / Pencils

ACADEMIC STANDARDS (ENVIRONMENT AND ECOLOGY)

7th Grade

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

4.6.7.A Explain the flows of energy and matter from organism to organism within an ecosystem.
- 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
- Explain energy flow through a food web

10th Grade

4.3.10.C Explain biological diversity as an indicator of a healthy environment.
- Analyze the effects of species extinction on the health of an ecosystem

4.6.10.A Explain the biotic and abiotic components of an ecosystem and their interaction.
- Describe how the availability of resources affects organisms in an ecosystem
- Explain the concept of carrying capacity in an ecosystem

12th Grade

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

BACKGROUND: **Plankton** are small marine and freshwater organisms that drift on or near the water surface. There are two types of plankton- phytoplankton and zooplankton. **Phytoplankton** generally singled celled organisms (plants). They contain chlorophyll and photosynthesize their own food and therefore are considered producers. Some species form cooperative colonies and chains or strands called filaments. Most are free-living either floating or moving around. Some move around from the wind or from the current moving the water while some can control limited movement on their own. Phytoplankton are common any water depths that have sunlight and have enough nutrients.

Zooplankton consist of protozoa, small crustaceans, jellyfish, worms, mollusks, and also the eggs and larvae of aquatic animals. **Protozoa** are one-celled organisms that lack chlorophyll, so they must catch their own food and thus are considered consumers. Zooplankton are most abundant in fertile waters where phytoplankton is abundant. Examples of zooplankton

that are commonly found include- water fleas (Daphnia), Copepods, and Hydras.
The phytoplankton act like plants, providing the first link in the aquatic food chain. Phytoplankton is eaten by zooplankton, which is eaten by larger organisms, and so on.

Zooplankton are herbivores because they feed on the plantlike phytoplankton. Zooplankton compete with each other for the phytoplankton to insure their survival. In extreme, cases herbivores may starve to death if they are unable to out compete other organisms for their food. In the wild, animals that are suffering from lack of food frequently fall prey to predators or diseased before they starve. Predators prefer weak animals because they require less energy to catch. If there are no predators however, food availability frequently limits the number of herbivores in a population.

Another result of insufficient food supply is a decrease in the number of offspring. The result of the combination of increased mortality (death by whatever cause) and decreased birth rate (caused by low food supply) is a decline in the number of animals competing for the food. This lower competition means there will be more resources (food) to go around for the next generation. Therefore, the ecosystem will be able to sustain a larger population. The number of animals that an area can support on a permanent basis is called the **carrying capacity**.

OVERVIEW: Through and active simulation, students learn how populations of zooplankton can be affected by food availability and gain an understanding of carrying capacity.

PROCEDURE:

1. Explain to the student that some zooplankton consume phytoplankton. Have students predict what would happen to a population of zooplankton in a pond if phytoplankton were reduced.

2. Mark out an area designated to be the pond that the plankton live in, using the field markers. The area should be approximately the size of a basketball court.

3. Scatter the chips (phytoplankton) on the ground, 10 chips for every student using 1/3 of the class.

4. Designate 1/3 of the class to be zooplankton by giving each student one of the bags to collect phytoplankton.

5. Tell students they must try and collect as much food as possible in the time allowed. This may range from about thirty seconds to a minute or two, depending on the area and the class involved. (The time given should be enough that most of the phytoplankton chips can be collected.) Ring the bell / blow whistle to indicate that time is up.

6. At the end of thirty seconds record the amount of food each student (zooplankton) collected on the data sheet.

7. Those zooplankton that got fewer than nine chips die (they are out of the game), 9-11 have one offspring (another student enters the game), 12-13 have two and those with more than 13 have three offspring.

8. Rescatter the *same amount* of chips (phytoplankton) used in step 3 for the first generation (round).

Zooplankton Offspring:

< 9 chips = die, no offspring
9-11 chips = 1 offspring
12-13 chips = 2 offspring
> 13 chips = 3 offspring

9. Tell students that the first generation of zooplankton have died off and it is time for their offspring to play the game. Choose new students to represent the number of offspring determined from round one. This is the second generation.

10. Allow students to collect food for the same amount of time, tally the results, figure out how many offspring they had, and then kill them off for a new third generation to play.

11. Repeat steps 7-11 two or three more times so there are at least four or five generations.

12. Once you have your data, you might allow the students to change the rules, one at a time, and see what happens to the population. Ask the students to think of one change that would increase the number of zooplankton that survive. Increasing the food should be a suggestion – putting more chips out. Eventually a new herbivore limit is reached, although at a higher level. Decrease the number of chips (phytoplankton) and see how this affects zooplankton populations.

DISCUSSION:

When students return to the classroom place their results on the board or a transparency. Discuss who were the more effective at finding the food. They should be able to determine this by how many offspring each zooplankton had. You may want students to graph their data to practice making appropriate graphs.

Did it seem as though there was the same amount of offspring from generation to generation? *Probably not - this is a prime example of what carrying capacity is.*

Do they think that food availability and carrying capacity also influence other types of predator and prey relationships in an ecosystem? What are examples of other creatures that could have been used in this game?

What other functions, in addition to food availability, contribute to an ecosystem's carry capacity? What influences other than food availability that were not represented in this activity may affect the population of zooplankton? *Other predation, pollution, disease.*

EVALUATION:

- Understand what phytoplankton and zooplankton are. Describe their relationship (who eats who). Explain how this relationship can establish the ecosystem carrying capacity.
- Explain how the availability of food can limit populations that depend on that food.
- Completed data sheet and correlating graphs.
- Discussion questions above.

EXTENSIONS AND MODIFICATIONS:

- Have them look at examples of phytoplankton and zooplankton (either live ones you catch) or microscope slides
- Have students research other examples of carrying capacity

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

Activity Version: January 2002

DATA SHEET: COMPETING FOR FOOD

Student Name _____ Date _____

Generation Number	Initial zooplankton	Final zooplankton (survivors)	Number of offspring (which will be initial zooplankton for next round)
1			
2			
3			
4			
5			
6			

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1			
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Notes about game conditions: