This lesson and accompanying student handout, are the work of a COSEE Coastal Trends Scientist-Educator Team that conducted research on aquatic food webs at Horn Point Laboratory in Cambridge, MD during the summer of 2011.

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Overview

Scientists often use models to study naturally occurring systems that may be too complex to bring into the laboratory. Scientists spend a great deal of time building, testing, comparing and revising models, they are one of the principal instruments of modern science. Marine biologists can't always study aquatic food webs in their natural environment so a model simulating the environmental conditions of an aquatic food web allows scientists to study this system and all its variables. This activity explores how nutrient availability and other environmental conditions affect the dynamics of an aquatic food web.

Instruction Time

One 45-minute class period.

Objectives

- Students will observe the interactions of the components of an aquatic food web based upon the availability of nutrients.
- Students will use a model, which represents an aquatic system of nutrients, phytoplankton, zooplankton, and detritus.
- Students will manipulate the various components of the aquatic system to see the dependency upon one another.

Materials

- Computer with access to the internet
- Model Handout

Procedure

1. Students will go the website: http://www.hpl.umces.edu/~jpierson/applet

2. Following the instructions on the Aquatic Modeling handout (available below) students will manipulate the various components of a food web model and immediately see the effects on the other elements of the food web.
3. After studying and manipulating the model students will answer the questions in the handout.

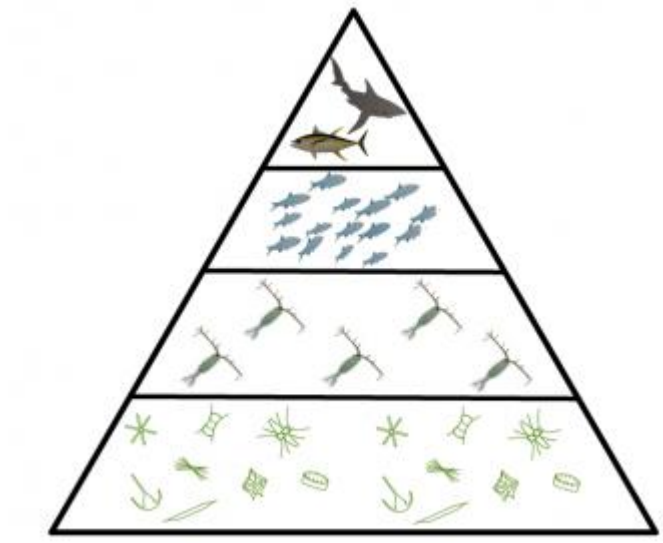
Lesson Resources

4. Student Handout

5. Background:

What eats what?

Aquatic food webs are complex groups of organisms that perform different functions in the ecosystem. Phytoplankton are small primary producers suspended in water. They use nutrients along with carbon dioxide to harness sunlight energy and create biomass through the process of photosynthesis. Phytoplankton biomass is usually the primary food for other aquatic organisms, including zooplankton. Zooplankton are small, heterotrophic organisms that feed on phytoplankton and other zooplankton, and are themselves food for larger planktivores. In this way, the sun's energy is transferred up aquatic food webs, eventually feeding apex predators such as sharks and other large fish.



Aquatic trophic pyramid with phytoplankton as primary producers, zooplankton as primary consumers, and planktivorous and predatory fish as secondary and tertiary consumers. (Image credit: Diagram: David Elliott; Symbols: UMCES Integration and Application Network)

What factors shape food webs?

Aquatic food webs can be characterized by the number of trophic levels and the amount of biomass in each level. Nutrient availability is central in shaping food webs. Plants require nutrients in specific quantities in order to photosynthesize and convert nutrients into useable food. Low quantities of certain nutrients can limit the food energy available in the web. Another factor shaping food webs is the amount of biomass in each trophic level. For example, a food web with many predators may have little prey biomass than one with fewer predators, because the predators eat more of the prey.

Fish dead, suspected to be from toxic algal bloom entrapped in floating seagrass matt. Algal blooms are accelerated due to excessive nutrient use by humans. (Image credit: Adrian Jones, IAN Image Library-ian.umces.edu/imagelibrary/)

Where do humans fit in?

Human activities change aquatic environments and food webs in many ways. We dam rivers to the sea and then reclaim land and re-populate it. Aquatic organisms may be transported around the world through, for example, bilge water in ships, potentially establishing populations of invasive species. Most human populations reside near water, and human activities introduce excess nutrients to aquatic systems through sewage, detergents, fertilizer and animal waste. Humans rely on the oceans for food, and thus play a role as apex predators, influencing aquatic food webs through overfishing. Human activities may decrease the biomass of fished animals, decrease biodiversity, and alter the species present in an ecosystem.

National Science Education Standards

9-12 C Life Science
-Molecular basis of heredity
-Biological evolution