The Life Aquatic: Aquatic Food Webs

Material adapted from:
New Jersey Marine Science Center Consortium, Education Program Lesson Plans
http://www.njmsc.org/education/Lesson_Plans/WebOfLife.pdf
Maine Bureau of Land & Water Quality, Lesson Plans
http://www.state.me.us/dep/blwq/docteacher/lessons/foodweb.htm
Citybugs Teacher's Corner
http://www.cnr.berkeley.edu/citybugs/teachercorner/foodwebs.html

Introduction:
A myriad of species, including humans, utilize and inhabit aquatic environments. In this activity, students will discover interrelationships between these species by examining feeding habits and assembling typical aquatic food webs for both freshwater and marine ecosystems.

Objectives:

Students will be able to:
- Identify some basic aquatic species found in Oregon
- Recognize that aquatic species are dependant upon each for survival
- Appreciate the complexity of aquatic food webs, noting similarities and differences between freshwater and marine environments
- Understand that humans are dependant on aquatic ecosystems and can contribute to their preservation or demise.

Materials:

(Materials in **bold** are provided by SMILE)

Ball of twine (~100') (Split in half for 2 groups)
2 Sets of Food Web Cards: Freshwater (Pond) & Marine (Pelagic)
4 Sun Images
10 'Zoop' Ziploc Bags
6 Paper Bags
4 Mini Fish Nets
Bag of Split Peas

Materials provided are enough to support **20** students

Handouts/Overheads:

Scenario Narrative

Part A: Web of Life

1. Give a brief review of food webs/chains. Brainstorm with the students different types of aquatic ecosystems, classifying them under 'freshwater' and 'saltwater/marine'. Ecosystems could include ponds, lakes, streams/creeks, rivers,

estuaries, coasts (sandy beach/rocky intertidal), deep sea (pelagic), ocean floor (benthic), etc

2. Divide the students into 2 groups. Assign group 1 as the freshwater ecosystem and group 2 as the marine ecosystem. Ask to students to form a circle and hand out the food web card sets accordingly. Students should receive one species card each from their group's set, making sure they read their card and become familiar with their organism.

3. Inform the students they are going to make a representation of a food web for their aquatic ecosystem and ask them where an ecosystem gets its initial energy (the sun).

4. Place a sun card in the center of each group circle and a ball of twine. One student should hold up the sun card and start the food web by asking the other students to look at their cards and find an organism that gets its energy from the sun. The student that has such an organism takes the ball of twine and holds onto the end (producer).

5. Next, students look at their cards again to find an organism that depends on this producer. Once agreed, the producer hands the ball of twine to the new organism, who holds the length of twine stretched between the two students in one hand and the ball of twine in the other. Students continue in this manner until they reach the top predator for their ecosystem. Each time a student takes the ball of twine they should describe to the rest of the group:

A What their organism is
B Whether it is a producer, consumer or decomposer, plus if it also could be classed as herbivore, omnivore or carnivore.
C What the organism preys upon and what are its predators

This will result in an interconnected 'web' to form between the students.

6. Now ask the students to carefully raise the twine above their heads, continuing to hold onto it, noting the number of interrelationships that are represented in their food web. Ask them what they think may happen if the population of one of the organisms in the aquatic system changes (other organisms will be impacted either directly or indirectly).

7. Have the students lower the web again. Read aloud to them two scenarios that could affect their ecosystem, one that is a natural occurrence and one that is human induced. See the scenario narrative for examples (also written below).

Natural - *It is mid summer and a period of unusually heavy rain and storms have occurred. For the marine environment this has meant stronger winds and waves, causing more nutrients in the water, such as nitrates, to be churned up into the surface depths. The sudden onset of additional nutrients has caused the phytoplankton to bloom, increasing their population significantly. For the freshwater environment, sudden heavy rain has altered the pH slightly and caused greater soil erosion around the shoreline, leaching more sediment into the water than normal. The increased turbidity in the water has temporarily reduced the amount of sunlight* *entering the water and, coupled with a sudden pH change, has caused a population decrease with the aquatic plant life.*

Ask the producers in each group to gently tug upon the twine. Have the rest of the students in the group raise their hand if they could feel the tug. Have them discuss in each group what this is representing and what factors are changing in the system.

Human – *Your ecosystem is an area often fished by humans. Recently the area has become overfished, causing a significant reduction in the fish populations.*

Ask the fish organisms in each group to tug gently on the twine. Again, have the rest of the students raise their hand if they could feel the tug. Now tell the students it is a month since the scenario and have the students with their hands already raised to tug *as well* as the producers. Now how many can feel the tug?

Questions to ask the students:

- How many organisms did the each scenario directly affect? How many were indirectly affected?
- What has the food web model shown in terms of aquatic ecosystems?
- Do such scenarios only create negative effects/impacts? Why?
- What if the interconnections were not just predator/prey related, but included some organisms as habitats for others (i.e. pond weed for larvae)

<u>Part B: Aquatic Mayhem Game</u>

1. Explain to the students this game will help to model an aquatic ecosystem food web further. If this game is conducted indoors, move furniture aside for a large central space and have the students walk only. If this game is conducted outdoors, assign boundaries for the game space and allow the students to run if the space is large enough.

2. Assign 8-10 students as zooplankton. Give each of these students a 'zoop' bag. Ask them what they think they may prey upon in the aquatic ecosystem (phytoplankton). Show them the split peas and describe how these will represent the phytoplankton and subsequent energy transfer in this system, spreading them out on the floor of the game area. Explain to the zooplankton that they need <u>at least 5 peas in their zoop bag to survive</u> but must gather as many as they can during the game.

3. With the other group, assign 3-4 students as 'planktivores' – for example larvae or macroinvertebrates that would eat plankton. Give them each a fish net. Explain that they can consume both phytoplankton and zooplankton, as they are omnivorous. This means that they can either collect phytoplankton off the floor, or they can tag the zooplankton, however they can only 'scoop' up their food with their mouths (the nets). To tag the zooplankton they must tag a 'zoop' bag, where the zooplankton must give up all of their peas to them if this occurs. <u>Planktivores need at least 10 peas in their net to survive.</u>

4. Assign 2-3 students as 'piscivores' – fish. Give them each a paper bag to represent their stomach. Explain that they will consume only the planktivores, by tagging them

gently on the shoulder. Once tagged, the planktivore must empty their net into the paper bag stomach. Piscivores need at least 20 peas in their paper bag to survive.

5. Lastly, assign 1 student as a decomposer, such as a tubifex worm. Explain that this student helps to recycle nutrients back into the ecosystem, thus helping phytoplankton growth. As a decomposer feeds on dead decaying matter (detritus), they can tag any other organism, as all organisms will eventually die. If the decomposer tags a student, that students must empty all their peas back onto the floor. Explain to all the students that they will have a time limit and in order to survive they must have enough peas by the end of the game.

6. Spread the peas on the floor of the game space. Remind the students to stay within the boundaries. Start the game with only the zooplankton being allowed to feed. After 20 sec, allow the planktivores to join the game. After another 20 sec, allow the piscivores to join the game. After a further 20 sec, allow the decomposer to join. Let the game run for another 30 sec and then stop.

7. Have the students assess the food they have consumed. If they have enough peas they have survived, if not they must stand off to the side. Ask the students to count how many of each organism is left and draw a table of results on the board.

Questions to ask the students:

- Were the results expected? Why? What is different about this model compared to the web model in part A?
- If the game had run longer what would eventually happen?
- What is this model distinctly lacking in relation to the real world?

8. Repeat the game several more times, changing student roles (representing more/less efficient feeders) and adjusting the number of each organism and/or phytoplankton peas. Mark the results on the table each time and discuss any patterns in results at the end of the session.

Extensions:

1. With part A, have each group repeat the food web activity with the other aquatic ecosystem (i.e. the marine group becomes the freshwater group). Ask them to brainstorm how the marine ecosystem compares with the freshwater system on flipchart paper. Are there more possible interactions within one than within the other?

2. Again with part A, have the students create new food webs in teams, using different aquatic organisms found in Oregon. Provide field guides for them to investigate such organisms.

2. With part B, have the students run this game with younger students, simplifying the game for age appropriateness and/or adjusting it so as to focus on other topics such as population dynamics, eutrophication or bioaccumulation of toxins/pollutants (e.g. DDT/TBT). Alternatively, have them redesign this game for marine biology college students, having them research marine food webs in more detail.

Vocabulary:

Consumer
An organism that gets food from eating other organisms. Also called a heterotroph.
Decomposer
An organism, such as a soil bacterium, fungus or invertebrate, that breaks down organic material.
Food Chain
All living things depend on each other to live. The food chain is an example of how some animals may eat other animals or plants to survive. The food chain is a complex balance of life. If one animal's source of food disappears such as from over fishing or hunting, many other animals in the food chain are impacted.
Food Web
A more complex system of interlocking and independent food chains
Phytoplankton
Plant plankton, includes some algae. The most important community of primary producers in the ocean.
Plankton
Organisms such as jellyfish, seaweeds, and microscopic plants and animals that passively drift or are weak swimmers and are not independent of the currents.
Predator
An animal that hunts and captures other animals for food.
Producer
An organism that makes it own food. Also called an Autotroph.
Zooplankton
Animal plankton (primary consumer) that drift in the ocean currents; different types are found at all depths from the surface down to the deepest depths.

The Life Aquatic: Part B Scenario Narrative

Below are examples of natural and human induced scenarios that can affect aquatic ecosystem. Read aloud or have the students read aloud such scenarios.

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Example of an Aquatic Food Web