Food Web and Bioaccumulation

Time Frame: 35-45 minutes
Grade: 6^{th}-8^{th}
Class Size: 20-30 students
Setting: Indoors or outdoors
Staff: 1
Use: In-Class

NYS Education Standards:
MST Section 4: Living Environment
Students will: understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- *Key Idea 5***:** Organisms maintain a dynamic equilibrium that sustains life.
- *Key Idea 6***:** Plants and animals depend on each other and their physical environment.
- *Key Idea 7*: Human decisions and activities have had a profound impact on the physical and living environment.

Objectives:

- ✓ Students will be able to identify different organisms found in an aquatic ecosystem
- ✓ Students will be able to classify the feeding roles of different organisms found in an aquatic ecosystem
- ✓ Students will be able to discuss human impacts on the environment and possible solutions
- ✓ Students will be able to explain how bioaccumulation effects an ecosystem
- ✓ Students will be made aware of fish consumption advisories

Motivation: Game

Materials: Fish mounts/pix/dead on ice, 28 *Freshwater or Saltwater Life Cards*, poker chips (at least 3 different colors; 1 color 30% of total number), small plastic/paper/cloth bags or containers, large clear area, boundary markers/table cloth (optional), chalk/dry erase board, and chalk/dry erase markers

Pre-Lesson Procedures:

1. Designate fairly large area for bioaccumulation game. Identify boundaries for the game.
2. Determine number of students in class; take out life cards if necessary. Card removal suggestions: either 1-2 small fish (only eat 1 zooplankton and dead in gills) and 1-2 zooplankton (any).

Lesson Procedures:
Introduction (1-2 minutes)

1. Introduce yourself and the I FISH NY program.
2. Introduce the day's activities.
    a. Food chain terms
    b. Human impact

Food Chain Brainstorming (12-15 minutes)

1. Have students brainstorm different biotic factors/organisms (plants and animals) found in either a freshwater or marine ecosystem. Write answers on board. Option: have students write brainstormed words on separate sheet of paper.
    a. Be sure to include 'plankton' and its 2 types (zoo- and phyto-plankton); also include a decomposer or two, birds, marine mammals, etc.
    b. Say: On X you will be going fishing at X location. On your fishing trip, what biotic factors or living organisms do you think you will see?
2. Discuss food chain terms: producer, consumer, and decomposer.
    a. Consumers or heterotrophs are those that cannot perform photosynthesis or make own food to obtain energy.
    b. Producers or autotrophs are those make own food through photosynthesis
    c. Decomposers, also a heterotroph, consume dead organisms; recyclers of materials.
3. With students, decide whether the brainstormed organisms are a producer, consumer or decomposer. Write a 'p', 'c,' or 'd' next to word. Option: have students do the same on their piece of paper.
4. Draw a triangle on board. Tell students each of these terms (producer, consumer, etc.) occupy a level in a food triangle. Option: Have students do the same on their scrap paper.
5. Define terms: primary consumer, secondary consumer, and tertiary consumer.
    a. Place terms in proper order on triangle as follows: producers on bottom, then primary consumers, then secondary consumers, and finally tertiary consumers.
    b. Define terms associated with different consumer levels: carnivore, herbivore, and omnivore.
6. As a group, determine whether the consumers listed in the brainstorm are a carnivore, omnivore or herbivore. Tell students what each organism eats and have students respond chorally with what type of consumer the organism is.
    a. Discuss how some of the organisms can fit into more than one category (e.g. fish may be an herbivore at an early stage in life and an omnivore at a later stage of life).
    b. Save fish for last. Show fish models/pix/dead on ice here. Discuss names, what eats, and what type of feeding relationship.
7. Appraisals. Tell students that these organisms are connected together via imaginary lines. Option: Draw some connecting lines on board. Ask students what lines represent (food chains). Define food chain.
8. Draw a simple food chain on board. Use 3-4 organisms from brainstormed list. Option: Have a student come up to the board.
    a. For example, in a marine environment: phytoplankton, zooplankton, baitfish/small fish, large fish/seal, shark
    b. For example, in a freshwater environment: phytoplankton, zooplankton, insects or small fish/panfish, largefish/gamefish, osprey
    c. Say: Good work. We have created a simple food chain that occurs in this ecosystem.

Bioaccumulation Introduction (3-6 minutes-Can vary based on discussion)

1. Tell students that we have forgotten one important biotic aspect of the ecosystem--humans.
2. Have students brainstorm how humans negatively impact the environment. Define chemical runoff and discuss vectors (residential, business). Ask students what happens to chemicals after sprayings.
    a. Say: Human impact on the environment is always going to happen. The impact can be positive or negative, however unfortunately the impact is usually negative.
    b. Say: Another idea is called 'runoff', which involves the water cycle. For example, take three examples: a farmer (grub problem/pesticide), golf course manager (yellow grass/fertilizer), and people in your neighborhood (yellow grass/fertilizer). When it rains, excess chemicals can seep into our groundwater or runoff/drain into different water bodies such as ponds, rivers, or bays.
3. Ask students if the chemicals that ran into a local water body can affect the organisms that live within it. Introduce bioaccumulation.
    a. Say: The chemicals that runoff can have effects upon the organisms that live in that water. For example, the chemicals can be absorbed and get stored in the fat cells of an organism.
    b. Use food chain example, e.g. when another organism eats that organism; now that organisms gets chemicals or toxins in their fat cells. This chemical or toxin will eventually move and build up through the food chain.
4. Write bioaccumulation on the board. Define it as "the build up of chemicals/toxins in an organism."
5. Tell students they are going to play a game to show how bioaccumulation works. Tell students they are going to become an organism from the food chain example earlier.

Tracing the Toxin Game (10-15 minutes)

1. Identify area as the fresh or saltwater "ecosystem." Point out boundaries. Tell students the boundaries represent their "home."
2. Disperse poker chips in "home." The poker chips symbolize a phytoplankton bloom that has just occurred.
3. Hand out a *Life Card* to each student. Tell students to quietly read their *Life Card* to themselves. Tell students that each *Life Card* is different.
    a. For a marine environment example: zooplankton, fish, seal, shark
        i. Assign roles: 15 zooplankton, 9 fish, 3 seals, 1 shark
    b. For a freshwater environment example: zooplankton, small fish/panfish, large fish/gamefish, osprey
        i. Assign roles: 15 zooplankton, 9 small fish, 3 gamefish, 1 osprey
4. Ask students which organism(s) out of the 4 eats the phytoplankton.
    a. Say: So which organism eats the phyto- or plant plankton? {animal or zooplankton} Good!
    b. Ask the zooplankton to come to the playing area. Hand out a food bag/cup to each of the 'zooplanktons'. Tell students that the zooplankton have 10-15 seconds to graze on or eat the phytoplankton. In order to pick up the chips, students must bend down pick up one chip, stand up, and then place it into their cup. Tell the students they are not allowed to take handfuls of chips at a time.

        i. Emphasize that students follow their *Life Card* instructions.
        ii. Begin the first round.
    c. At the end of 10-15 seconds, tell the zooplankton to stop picking up chips.
5. Second round: now involve the fish.
    a. Ask students who is the next level in our food chain {small fish/fish}. Ask the small fish/fish to come to the playing area.
    b. Tell students they have 10 seconds to eat the zooplankton. Remind students to follow their *Life Card* instructions. If need be, ask each student how much they can eat.
    c. Tell the zooplankton to continue feeding on the phytoplankton, but to be aware of predators.
        i. Tell students to symbolize a predator "eating" their prey by tagging their prey's elbow. If tagged, the student hands their food bag/cup to the student who tagged them.
    d. After 10 seconds, tell all the zooplankton, tagged or not, to return to their seats along with their bag/cup.
6. Third round: now involve the gamefish/seals.
    a. Ask students who is the next level in our food chain {gamefish/seals}. Ask the gamefish/seals to come to the playing area.
    b. Tell students they have 10 seconds to eat the small fish/fish. Emphasize that students follow their *Life Card* instructions. If need be, ask each student how much they can eat.
        i. Tell students to symbolize a predator "eating" their prey by tagging their prey's elbow. Again, if tagged, the student hands their food bag/cup to the student who tagged them.
    c. After 10 seconds, tell all the small fish/fish, tagged or not, to return to their seats along with their bag/cup.
7. Last, fourth round: now introduce the shark/osprey.
    a. Ask students who is the next level in our food chain {osprey/shark}. Ask the osprey/shark to come to the playing area.
    b. Tell students they have 10 seconds to eat the gamefish/seals. Emphasize that they must follow their *Life Card* instructions. If need be, ask the student how much they can eat.
        i. Tell students to symbolize a predator "eating" their prey by tagging their prey's elbow. Again, if tagged, the student hands their food bag/cup to the student who tagged them.
    c. After 10 seconds, tell all the remaining players, tagged or not, to return to their seats.
8. Re-cap game.
9. Tell students that some of the phytoplankton are actually toxic!
    a. Say: Specifically, the red poker chips.
    b. Please note that if running with multiple classes, change the color so the other classes don't let the cat out of the bag!
10. Have students go through their food bag and sort food. If a student does not have a bag, tell them to work with a partner.
11. Tell students to count the total number of poker chips and the total of red poker chips they collected.

a. Using board, create 3 columns: organism, total # poker chips, total # of red poker chips.
b. Ask each group (zooplankton, fish, etc.) to tell you their answers; write on board.
c. Average amount of red chips/feeding level.

Debrief Game (3-5 minutes)

1. Tell students that we are going to "see" how bioaccumulation works through the fresh or saltwater ecosystem. Point out to students that as one moves up through the food chain, so does the amount of toxin or chemical.
    a. Say: As we move up through the food chain, what happens to the toxin or chemical? {increases}
    b. Say: What do we call this? {bioaccumulation}
2. Discuss human relationship.
    a. Say: Humans were not part of the game, however could bioaccumulation effect humans?
3. Discuss conclusions fish consumption advisories. Tell students that this lesson does not serve as a warning to not eat fish but as a reminder that we should be aware that this information exists. If time permits, discuss shellfish advisories as well.
    a. Option: Distribute current Department of Health Fish Consumption Advisories.

Closing (1-2 minutes)

1. Great job. Ask for any questions.
2. Go over trip rules, clothing, food, details, etc.

Post-Activity/Assessment

1. Time permitting, distribute *Food Web worksheet*. Option: The worksheet can also be used as a post-activity or for assessment.

Adapted From: Bigelow Laboratory for Ocean Science's education page: http://www.bigelow.org/edhab/tracing_toxins.html and Discovery Channel education page: http://school.discoveryeducation.com/lessonplans/programs/forests/