Deadly Multiplication

Extension Activity for "Healthy Habitats"

Objectives:
Students will be able to:

1. demonstrate mathematically how poisons become more concentrated as they travel up an aquatic food chain;

2. describe the possible consequences of poisons in aquatic food chains, to humans as well as aquatic animals.

Method:
Students become zooplankton feeding on the bottom sediments of a river. They calculate the average amount of poison the zooplankton consume, as well as the amount consumed by the aquatic animals above them in the food chain.

Time:
45 to 60 minutes

Materials:
pieces of small white and colored materials that can be picked up easily by students. Provide 8 pieces per student with a ratio of four white pieces to one colored piece. (Suggested materials include pipe cleaners, 1-inch paper squares, or 6-inch lengths of yarn.)

a paper bag or envelope for each student to store game pieces

Procedure:
1. Prepare your river either outside on the school grounds or inside a gym, cafeteria, or large hallway. To make your river, simply spread the game pieces in a long, winding, river-like course. The actual shape and size of your river will be determined by the amount of playing space available to you.

2. Tell the students that they are going to take part in a food chain multiplication game. (Do not reveal the "deadly" title at this time.) Review a typical aquatic food chain (see below).

Then explain that each student will be a hungry zooplankton or aquatic insect. They will have only a few minutes to gather bits of phytoplankton (game pieces) from the bottom of the river. To make the game more meaningful, you may want to name your river after a river near your school.

3. Give each student an envelope or paper bag and take them to the river.

Here are the rules:

• When the teacher says "GO" the students pick up the pieces one at a time.

• After they pick up two pieces, the students must travel to the "surface" of the river for air. Then, they can dive back to the river bottom for more pieces of phytoplankton. They repeat this after every two pieces.

Note: The surface can be any area the teacher determines, such as the edge of the pavement, a particular wall in the gym, or one end of a large hallway.

• The students place all the phytoplankton (game pieces) that they pick up in their envelopes or bags. They should continue to pick up pieces until the teacher says "STOP." Every zooplankton needs to eat at least 7 pieces of phytoplankton in order to survive. Stress that more is even better. Or, make it a contest to see who can gather the most phytoplankton.

sun → phytoplankton → zooplankton or aquatic insects → small fish (ex. bluegill) → large fish (ex. bass)

4. You call "STOP" when most of the game pieces are picked up. (You want all the zooplankton to survive. The reasons for the time limits and minimum amounts are to help motivate slower students and to lend an atmosphere of excitement to the activity.)

Ask each student to analyze what he or she "ate." Did everyone get at least 7 pieces? Who ate the most? Now tell them that the colored pieces represent poisons that people, knowingly or unknowingly, put into the river. Examples of such poisons are heavy metals (mercury, lead, copper), DDT and other pesticides, PCB, and dioxin. The white pieces are normal (untainted) bits of phytoplankton. Have each student write on the blackboard the total number of colored pieces (poison) that he or she ate. Record the numbers on the lower half of the chalkboard as shown below. Find the average number of poison pieces per zooplankton for the class and record this on the blackboard.

Deadly Multiplication	class average
zooplankton (poison phytoplanton eaten) x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x	___

x = number of poison pieces from each student, assuming there are 27 students (zooplankton)

You could also ask each student to calculate the percent of poison in his or her diet like this:

$$\frac{\text{number colored pieces}}{\text{total number colored and white pieces}} \times 100 = \_\_\_\_\%$$

Tell the zooplankton that they all survived. They didn't get enough poison to die, but the poison was stored in their bodies.

5. Now ask the zooplankton to group themselves into small groups of three or four. Each group becomes a meal for one small fish (e.g. bluegill). Say, "When the small fish eats you, it also consumes the poison stored in your bodies. Now the small fish has all that poison in its body." Ask each group to add up the total number of poison pieces the small fish would have consumed after eating the three or four zooplankton in the group. Each group writes its total on the blackboard. Again, the class computes the average number of poison pieces a small fish might receive in its zooplankton meal.

Deadly Multiplication	class average
small fish # # # # # # # #	___
zooplankton x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x	___

= number of poison pieces from each group of small fish (approximately 9 fish)

Ask the students which animal, on the average, has more poison in its body: the zooplankton animal or the small fish.

6. Ask the class to pretend that all the small fish survived and became food for two predator fish (e.g. largemouth bass). Gather all the small fish groups into two large groups of approximately the same size. These two groups will represent the meals for the two predator fish. Add up the total number of poison pieces that each predator fish consumed when it ate all the small fish in its group.

Put these two totals on the blackboard and compute an average. Your blackboard will now look something like this:

Deadly Multiplication	class average
predator fish ✻ ✻	___
small fish # # # # # #	___
zooplankton x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x	___

✻ = number of poison pieces from half the class

Ask the students which animal in the aquatic food chain has the most poison in its body, a zooplankton, a small fish, or a predator fish (the predator fish). What could this mean for the predator fish? (It could die. It could become weak and develop a disease or ulcerous sores on its body.) Ask the students to summarize what happens to some poisons as they travel up the food chain. (The poisons can multiply or become more concentrated.) Make sure that the students understand that a small amount of poison in the river can become a big problem especially for the animals at the top of the food chains.

You may use this opportunity to share with students about how DDT, a pesticide, traveled up the food chain, harming vast numbers of wildlife. Eagles, pelicans, and other fish-eating birds inadvertently ate DDT, which caused their eggshells to thin and be crushed by the female. For some time, the populations of these birds were severely threatened.

7. Consider what might happen to a human who eats the two predator fish in this activity. How much poison would that person consume? If the person eats two predator fish from this river each month for one year, how much poison could accumulate in his or her body? What could eventually happen to that person?

Evaluation:
Orally summarize the effects of poisons as they travel up the food chain.

Credit:
This activity is adapted from "Deadly Links," **Project N.C. WILD.**

Bring this discussion to the real world. Ask students to look up the consumer advisories on fish consumption in the state fishing regulations booklets. Point out the fish that are top predators, and compare the advisories.

Healthy aquatic habitats are important for all creatures, including us.

BiT Extensions:

Use a version of tag to play this game. Select three links in the food chain (mayflies, minnows and bass, for example) and issue color coded visors so that slightly more than half of the students are consumers, while only one or two are at the top of the food chain (18 mayflies, 10 minnows and 2 bass, for example). Once the mayflies have had time to collect all the food, let loose the minnows to "eat" them. With a gentle tag from the minnow, the mayfly passes along its food to the predator and moves to the sideline. This should continue until all mayflies have been eaten. Then introduce the bass who should similarly eat the minnows until they are all gone.

This is the time to inform students that the colored sticks are actually poison. Point out the number of poison sticks the bass hold, and compare it with the numbers previously held by the lower order consumers.

Credit: This activity is gratefully reprinted and adapted with permission from the N.C. CATCH program.