DEADLY LINKS

Ages 10+

Learning Objectives

- Students will be able to give examples of ways in which pollutants—such as pesticides used in gardening, golf-course management, and agricultural practices as well as mosquito control—enter the food chain.

Summary: Students play a game that illustrates how pollutants that enter the food chain at the bottom work their way up until they finally affect predators at the top of the chain. *This Activity should be adapted to your local ecosystems food chain. Organisms outlined in the *Procedure* can be changed to common organisms found in your area

Subject Area: Science, Physical Education

Time: 30-60 minutes

Background: During the past century, people have developed pesticides (including herbicides, fungicides, insecticides, and rodenticides) to control unwanted organisms such as weeds, insects, fungus, and rats. These pesticides contain poisons and toxic chemicals that settle into the soil or stay on crops until they are washed off by rain or irrigation. Through run-off or groundwater, they eventually reach a wetland or the ocean. Testing the ocean water after this has occurred typically does not show a particularly high concentration of these chemicals—but testing the fish does!

The natural recycling processes of mangrove wetlands do not work very well with toxic chemicals. Rather than being decomposed and broken into harmless products that can be used by plants and animals, toxins enter the bays. They are taken up and concentrated in aquatic plants and animals in a process known as bioaccumulation. Bottom-dwelling organisms such as amphipods siphon the detritus (dead or decaying plant or animal material) from the water and can easily take up pollutants that have settled. These toxins, when ingested, remain inside the bodies of the amphipods and are passed along at each step of the food chain, this process is called biomagnification.

This is how biomagnification works: If an amphipod ingests one piece of detritus containing 10 units of toxin, then it will retain 10 units of toxin: 1 x 10 = 10). If a Mangrove Snapper eats 10 amphipods, each containing 10 units of toxin, then the Mangrove Snapper will retain 100 units of toxin (10 x 10 = 100). If an Osprey eats 10 Mangrove Snappers, each containing 100 units of toxin, then the Osprey will retain 1000 units of toxin (10 x 100 = 1000), and so on.

Materials

- A package of multi-coloured paper straws or popsicle sticks, green, yellow, red, and blue, cut in lengths of approximately 6 cm (2 in) so you have a total of about 100, roughly 25 of each colour (or in a ratio of 30 per student).
- Eighteen stationery envelopes (or one-third the number of students in the class)
- Copy of page 6 showing bioaccumulation
- Eight coloured bibs or hats (optional)

Procedure

Students become "Detritus", primary and secondary consumers like "Amphipods" and "Mangrove Snappers", and predators like "Ospreys" in a highly involving physical activity of a predator-prey relationship illustrating the food chain.

1. Tell the students this activity is about food chains: for example, Amphipods eat by filtering detritus, Mangrove Snappers eat Amphipods, and Ospreys eat Mangrove Snappers.

2. Divide the students as follows: three times as many Mangrove Snappers as Ospreys, and three times as many Amphipods as Ospreys. (In a class of 26, this would give 2 Ospreys, 6 Mangrove Snappers, and 18 Amphipods).

3. Each Amphipod is given an envelope, to represent the Amphipod's "stomach" in which to collect its food (detritus/straws). The Mangrove Snappers and the Ospreys are given different-coloured bibs or hats so they can be easily identified.

4. Have the students close their eyes while you spread the food (detritus, represented by the straws) around a playing field, an open area, or a large floor area in the class room.

5. Give instructions (times indicated are for classroom space; make it a little longer if played outside):

- The amphipods will go out looking for food, which they each place in their stomach (envelope). The Osprey and Mangrove Snappers remain quietly on the sidelines, acting as predators do when watching their prey. After 20 seconds, signal (or whistle) for the Amphipods to stop feeding.
- The Mangrove Snappers are now allowed to hunt the Amphipods. Osprey still remain on the sidelines. When a Mangrove Snapper catches an Amphipod by tagging, the Amphipod must give up its food envelope to the Mangrove Snapper and move to “Amphipod heaven” at the side. Allow 15 to 20 seconds, enough time for each Mangrove Snapper to catch one or more Amphipods. Give another signal (two whistles).
- The Osprey are now introduced and given 15 to 20 seconds to hunt the Mangrove Snappers. When the Osprey tag the Mangrove Snappers and retrieve the food envelopes, the Mangrove Snappers go to “Mangrove Snapper heaven” at the side.

Note: Any Mangrove Snappers still alive may continue to hunt Amphipods, and Amphipods still alive may continue to eat detritus.

6. Give a signal (three whistles) to end all the action. Have the remaining “live” Ospreys, Mangrove Snappers, and Amphipods stand in view, with the “consumed” wildlife sitting on the floor a few feet away. Ask the “consumed” students who they were and who consumed them. Have the “live” Osprey, Mangrove Snappers, and Amphipods count the number of food pieces (straws) in their envelopes, putting them on the floor as they do (don’t let the students mix their straws with those of other students).

7. Inform the students that the following contaminants have been introduced into the food chain by farmers and gardeners to improve their crop, or by government agencies to destroy pests like mosquitoes. Insecticides—red straws Herbicides—yellow straws
All of the Amphipods who were not eaten by the Mangrove Snappers may now be considered dead if they have any yellow or red straws in their food supply. Any Mangrove Snappers that have more than half their food supply contaminated—yellow or red straws—are now dead. The Osprey with the highest quantity of yellow and red straws will not die at this time; however, it has accumulated so many pesticides in its body that the eggs produced by it and its mate during the next season will not hatch successfully. The other Osprey is not visibly affected at this time.

8. Try the activity again, choosing other colours of straws and different toxins—e.g., blue straws for fungicides and green straws for rodenticides.

Discussion/Reflection

- Ask the students the following questions:
    - Are these toxins or chemicals harmful to ecosystems and wildlife? How? Do they affect humans?
    - What are the advantages and disadvantages to the farmer, golf-course manager, and gardener of using pesticides?
    - What are some real or imaginative alternatives to the use of toxins? (For example, some farmers successfully use organic or non-toxic substances along with crop rotation, companion planting, biological controls, and genetic approaches in efforts to minimize damage to their crops).
    - What other species that you know of were or are affected by the use of pesticides?
    - What are other possible sources of toxic chemicals that could enter the food chain?

Extensions: The following page contain two case study examples, one documented, one anecdotal, of declines in bird populations in the Cayman Islands due to the ingestion of toxins that have gotten into the food chain.

Have students interview family members, particularly grandparents, and document similar declines in your area. Ask them, for example, if they remember more of a particular species when they were children than they see now.

References

- Mangrove Action Project, Marvellous Mangroves - A Wetlands Education Resource Book for the West Indies

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Case Study #1

The Osprey (also known as the Fish Hawk) is a common winter visiting bird throughout the Caribbean including the Cayman Islands. It can often be seen hunting throughout the region. Its prey is mostly fish, though it occasionally hunts egrets at local airports. Not too many years ago (the 1950s and 1960s), the Osprey was almost extinct because its prey had absorbed DDT from agricultural run-off. The Osprey also absorbed the DDT, and this affected its ability to reproduce—the eggs often had thin shells that cracked before the baby bird was ready to hatch. Osprey also suffered from illegal shooting (because people thought it caught too many fish) and habitat loss. However, the 1972 ban on the use of DDT, plus other factors, have enabled this magnificent bird to make a comeback.

Case Study #2

There has been a drastic decline in the number of Barn Owls in the Cayman Islands. While there is no accurate count of the number of Barn Owls, there are many reports of a significant decline in numbers in recent years. The owls' primary food is rats and mice, which in turn feed on plants, fruits, and nuts. The owls also eat lizards, bats, and other, smaller bird species like bananaquits. The decline in numbers is being attributed to the increase in the number of multi-dose poisons that are being used to bait and kill rats and mice. These poisons are then absorbed by the owls, and a build-up of the toxins eventually kills the birds.

Barn Owl

Bioconcentration Factor