

Marsh Mystery Post Activity

Program at Nature Station: Backyard Safari: Wildlife Conservation

Grade Level: 7th -12th

Program Length:

Prep time: minimal

Activity time: 1 or 2 class periods

Group size: Based on class of 25; adjust numbers to fit class size.

Setting: Classroom

Vocabulary and Concepts:

- bioaccumulation - process by which pollutants build up in the environment through the food web
- consumer - an organism that consumes food produced by other organisms
- pesticide - any chemical preparation used to control populations of organisms, including plants and animals, perceived to be injurious
- producer - an organism that produces its own food and food for others
- toxin – a metabolic product of a living organism that is poisonous to other organisms, or any substance damaging to living things

Materials:

- 25 paper plates or large paper strips for labels (can also use plastic coated name tags with attached clips), can be laminated and used again
- tape or string
- scissors
- magic markers
- 32 red construction paper tokens (2-inch squares), can be laminated and used again
- copies of The Mystery of Sandy Bottom Creek (optional, at end of activity)
- copies of Possible Solutions for New Port City and Cedarville (optional, at end of activity)

Background Information:

Bioaccumulation or biological magnification is the process by which pollutants build up in the bodies of consumers in the food web. An example: plants (primary producers) are sprayed with a pesticide. Insects (primary consumers) eat the plants and ingest the pesticide. Some die, others are eaten before the pesticide kills them. A bird or other animal (secondary consumer) eats several insects, thereby taking in the pesticide. This consumer's body now contains a quantity of pesticide equal to the amount taken in by an

insect multiplied by the number of insects and plants it ate. A predator or scavenger (tertiary consumer, or third in the chain) now eats a few of the secondary consumers, and the pesticide is further concentrated in its body.

This is how we sometimes destroy entire populations of wildlife and can endanger human health as well. For example, before the pesticide DDT was banned, bald eagles were nearly driven into extinction from its effects.

Procedure:

Ask students what happens when certain toxic substances are introduced into the food web. Read *The Mystery of Sandy Bottom Creek* to the class (you may want to give them copies so they can read along). On the board, draw a map of the situation as you read.

1. Ask students if they can solve the mystery. How did the boy become ill? Could it be from something he ate? Give the students a hint: There is a man in New Port City who earns his living by catching fish in the Johnstown River and selling them to markets throughout the region.

2. Explain that each student will represent a component of the King's Folly marsh ecosystem. Give students paper plates or strips and have them label their plates or strips as follows: four students are cattail plants, one is a muskrat, one is a mouse, one is an eagle, ten are shellfish, five are small minnows, two are large bass, and one is a person. Have the students tape their labels to their clothing or tape loops of string through them so they can be worn like a necklace. (For older students, you may want to assign animal identities and diagram the proceedings on the board.)

3. Start at the "bottom" of the food web to try to uncover clues to this mystery. Remind the group that it is known that the pesticide did get into the water that flows through King's Folly Marsh on its way to New Port City, and that the class members represent things that live in the marsh.

4. Ask the cattails what they need to survive (soil, water, sunlight, air). Tell them that as cattails take up water, they are also taking in the pesticide. Give each cattails three tokens (red squares) to represent the pesticide concentration they contain. Have them tape the squares to their plates or labels.

5. Ask which of the animals would eat cattails? Cattails that are eaten by the muskrat and should give their tokens to the muskrat; those eaten by the mouse should give their tokens to the mouse, (All the cattails should be eaten.) How many tokens do each of these animals now have? Since the mouse and muskrat ate the cattails, anything in the plant tissue was also eaten, and is now in their bloodstreams and bodies.

6. Ask who would eat these animals? Have the muskrat and mouse give all of their tokens (12) to the eagle, who now has this much of the pesticide in his body. Have the eagle tape the 12 tokens to his label. This is enough to kill him.

7. Now give each of the shellfish two tokens. Explain that shellfish feed by filtering tiny bits of plant and animal material out of the water. In this way, they also have taken in some of the pesticide.

8. Ask which of the remaining animals would eat these shellfish. Have the minnows eat two shellfish each and take in their pesticide tokens.

9. Next, have the bass eat all the minnows and take their tokens.

10. The person (perhaps someone living in New Port City who caught fish from the Johnstown River or bought fish from the fish merchant) then eats the two bass, takes in all 20 tokens and tapes them to his label. Ask if this is enough to make a person ill. Explain that this is a simplified demonstration of a natural process called bioaccumulation or biological magnification. Substances that accumulate (build up) in organisms work their way through the food web.

11. Ask the students to review the process by describing what happened in the demonstration. Read the story again. Make a list on the board of all the clues to the mystery and have the class answer the following:

- How did the people get sick?

Bioaccumulation of the pesticide caused the sickness. The sick people ate fish caught in the Johnstown River. These fish fed in the marsh, a drainage area for the Cedarville farms, before they moved downstream to the river. Some of the contaminated fish were sold in New Port City, while others were sent to a market in the state to the north.

- Why didn't the people in Cedarville get sick?

Cedarville kids fished and swam in Sandy Bottom Creek north of town, upstream from the runoff from Cedarville farms. King's Folly Marsh is downstream from the farms, and so was contaminated when the pesticide washed down and accumulated in its sediment (silt and soil), water, plants, fish. If the citizens of Cedarville had eaten the marsh fish, they would have become sick, too.

- Why didn't the water test show dangerous levels of pollutants?

The marsh filtered out some of the pollutants, so the water that flowed on to the Johnstown River was not badly contaminated. The marsh wasn't able to filter out all of the pesticide, however, so the chain of bioaccumulation began.

- When pollutants wash away, are they really away? Is the problem gone? Is the presence of the marsh part of the problem?

No! Discuss the benefits of having the marsh there (helps filter pollutants; provide food and cover for valuable animals- animals that give us food and jobs, and animals we just enjoy seeing.) If people did not pollute, problems such as the one in the story would not occur.

Assessment or Evaluation:

Ask students if this situation could ever happen in their neighborhood. Have them research their community to find potential sources of pollution that could accumulate in the environment. Have students consider possible solutions to the problems they discover. Students may ask:

- How does the local landfill/dump control leakage of chemicals? Does the community offer separate hazardous waste collection and storage?
- Do farmers in the area use buffer strips (areas of trees, shrubs, or even wetland vegetation between tilled land and waterways) or other methods to filter farm runoff?
- Are methods of filtration used on runoff from streets and parking lots? (One method uses storm water management ponds that allow sediment and attached chemicals to settle out of the water.)
- How can I work to prevent pollution? Organize a community-wide planting day to add a buffer zone (filtering area) to the edges of waterways, or even around parking lots. Plant a wetland. Encourage friends and neighbors to keep pollutants off the land and out of waterways by using and disposing of chemicals carefully and according to package directions. Some chemicals break down rapidly into harmless, common compounds. Read labels to find out about products' safety and contact the manufacturer for information if necessary. Become more aware of how certain chemicals react in the environment and purchase and use the safer ones. That is, be a wise consumer!

Source:

WOW!: The Wonders of Wetlands. 1995. "Marsh Mystery." St Michaels MD.: Environmental Concern Inc.

The Mystery of Sandy Bottom Creek

Sandy Bottom Creek, a small tributary, flows through a rural town called Cedarville. The people of Cedarville are mostly farmers who have worked the land since the area was settled in the late 1600's. Cedarville is a small community. Its residents know each other well and often work together to protect the area's resources.

In the summer the children of Cedarville swim and fish in Sandy Bottom Creek just north of town, at a spot where the water is deep. Cedarville residents say, "Many a summer supper came to our table from the idlings of our youngsters! Seems Sandy Bottom's been feedin' our families since time began."

The creek flows through a great marsh on its way out of town. The marsh is called King's Folly Marsh because, before the area was settled, the King's men (English Soldiers) took a shortcut through the marsh on their horses and got stuck in the mud! King's Folly teems with animals and is alive throughout the year with colorful insects, herons, egrets, ducks, muskrats, and many kinds of fish. Last year the Cedarville picnic was held just outside the marsh, since the scenery there is so beautiful.

This fall, the citizens of Cedarville are up in arms about an alarming and mysterious set of circumstances. It all started when a health official came from New Port City, an urban area bustling with industry and port activities that lies downstream (south) of Cedarville, where the creek joins the Johnstown River. The official said a small boy had become quite ill in New Port City, and a test showed dangerous levels of a pesticide byproduct in his blood. Cedarville farmers use this pesticide in their crops. The case is a mystery; the boy has never visited Cedarville and has never left his neighborhood in New Port City.

New Port City's drinking water was tested, and not a trace of the pesticide was found. The unfiltered water from Johnstown River was tested. A small amount of the pesticide was found, but this was expected since the runoff from Cedarville farms is known to contribute small quantities of pollutants to Sandy Bottom Creek. So how did this poison get into the boy's blood?

In the state north of Cedarville, several people have also reported mild cases of a similar disorder. Yet Cedarville is the only town in the region that uses the pesticide. The town has called a meeting to discuss the problem. The citizens are concerned about their responsibility in the matter and also worried that they won't be able to use the chemical anymore to protect their crops. They feel this pesticide is the best one ever developed. They've used it for two years and there has never been a problem. Has there been some mistake?

No illnesses were reported during the summer, when people were eating the tomatoes and corn in Cedarville, and none of the crops were shipped out of state. If the pesticide is making people ill, why haven't the people who have eaten crops grown in Cedarville been affected? No one in Cedarville had gotten sick-though one man did report finding a dead eagle near his farm south of town.

Possible Solutions for New Port City and Cedarville

1. Make the man in New Port City stop catching and selling fish there. How would this affect the man?
2. Stop all fishing in the Johnstown River and Sandy Bottom Creek. Who would this affect and in what ways?
3. Make the farmers in Cedarville stop using the pesticide. What should they use instead? Have someone play the role of the pesticide manufacturer.
4. Install good pesticide management practices on the farms. Plant wide strips of trees, shrubs, and other plants along the borders between farm fields and waterways to trap eroding soil and pollutants. Who would pay for this to be done?—the farmers or the town, state, or national government? Many of the farmers would lose a piece of their cropland for this purpose. How would they be compensated (repaid) for the cropland lost?
5. Write new or stronger laws to regulate the use of pesticides near waterways. What would the regulations say? How would each of the characters react to these new laws?
6. Have the Health Department or other government agency of New Port City test the water and the fish periodically for toxic levels of pollutants. They should then publish a notice or warning to let people know when to avoid the fish or the water. Would this cause undue alarm in the citizens? What would happen to merchants who sell fish in the city?
7. Do not let children of Cedarville fish in or near King's Folly Marsh. Make sure they continue to fish upstream from the marsh. Is this an effective means of avoiding contaminated fish? Why or why not? Is this the best approach to natural resource management? Is this treating the symptom or its cause?
8. Fill in King's Folly Marsh and make it a landfill (dump), since pollutants are going there anyway. What effects would this have on the environment and its inhabitants (people, too)?