

# Where Do All the Toxins Go? (External View)

*Bioaccumulation* is the build-up of chemicals in an organism’s body – the longer an organism lives, the more it absorbs. When an older, large lake trout is caught, the concentration of toxins in its body could be a million times that of the original concentrations in the water. *Biomagnification* results when toxins become increasingly concentrated as they pass through the food chain. When a fish feeds on zooplankton, for example, the fish takes up toxins in all of the plankton it eats. In the fish, many of the toxins accumulate in its fatty tissues. When a gull or an eagle feeds on the fish, the bird takes up all of the toxins the fish has accumulated from all the contaminated organisms it has ever eaten. Therefore, the higher up an organism is in the food chain, the greater the amount of toxins it is likely to consume.

### Earth Systems Understandings

This activity addresses ESU 2 (stewardship), 3 (science processes), and 4 (interactions).

### Materials

Each group will need:

- Copy of Table 1.
- Copy of *human activities and industry* cards (1 page).
- 1 *toxin* card.
- Copy of *food chain cards* (3 pages).
- Copy of *effects of toxin* cards (1 page).
- Scissors.
- Posterboard or butcher paper.
- Glue.

### OBJECTIVES

When you have completed this activity, you should be able to describe how bioaccumulation and biomagnification of toxins in the food chain cause health disorders in humans and animals.

### PROCEDURE

1. The teacher has prepared cards for the teams. Each of the eight themes (fish, mammals, etc.) is on a different color.
2. Work in groups of three to four people to make a poster. First assemble a reasonable food chain from the cards you have.
3. Each group will be given one toxin card and all of the other cards in order to trace the toxin from its origin to its effects in humans and/or other animals. Table 1 will provide source and effect information on the toxins.
4. Have each group show its food chain poster to the class, and explain the interactions they have linked together.

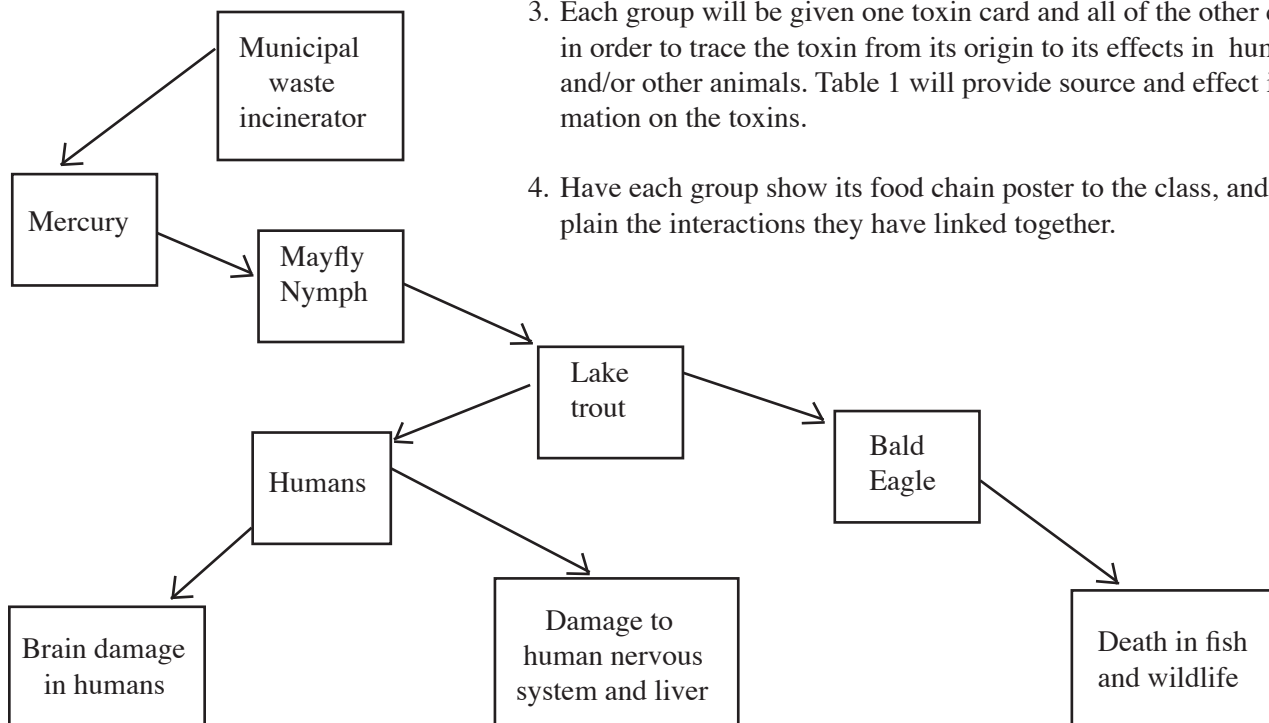


Table 1. Toxins Source and Effect Information.

Name of Toxin	Uses	Source of Toxin	Effects of Toxin
<b>Lead</b>	Used in gasoline, paints, glazes, pipes, and roofing materials	Burning leaded fuels, incinerator emissions, boilers	Toxic effects on humans, fish and wildlife; can cause brain damage
<b>Arsenic</b>	Used in pesticides, smelters, glass production	Pesticide use, coal combustion, primary copper smelters	Poisonous to humans, fish and wildlife
<b>Mercury</b>	Used in batteries, paints, industrial instruments, and pulp and paper mills	Natural, coal combustion, municipal waste incineration, copper smelting, sewage incineration	Affects the nervous system and permanent damage can result; the brain may also be damaged
<b>Benzopyrene (BaP)</b>	Not used alone but is found as a by-product of burning fossil fuels	Combustion processes, such as wood burning, cigarette smoke, and coke oven emissions	Believed to be cause of high incidence of tumors in fish; carcinogen
<b>Hexachlorobenzene</b>	Used to control insects	Pesticide use, manufacture of chlorinated solvents	Linked to nerve and liver damage; suspected to cause birth defects
<b><i>Additional Airborne Toxins No Longer Produced in the USA:</i></b>			
<b>PCBs</b>	Once used in industrial products- paints, plastics, electrical transformers	Existing landfills, spills, leaking transformers	Illness develops in humans; fatally toxic to fish and wildlife
<b>DDT, dieldrin</b>	To control insects, fungus, rodents, and weeds	Banned in USA, but still used in Mexico, Central and South America	Will accumulate in humans, fish and wildlife; can cause cancer in humans; toxic to fish and wildlife
<b>Toxaphene</b>	Pesticide used on cotton crops	Was used in southern states, including Texas, Georgia, Alabama and Louisiana	Extremely toxic to fish
<b>Dioxin</b>	Not used alone but is found as a by-product of manufacturing herbicides	Improper incineration of herbicides and leaching from land disposal	Human illness, livestock mortality, extremely toxic

Sources: Hilleman, 1988; EPA, 1987

## REVIEW QUESTIONS

1. With the use of the constructed food chain, explain what bioaccumulation and magnification are and how these factors cause health disorders in humans and animals.
2. List and explain different types of human activities that produce airborne toxins and what effects these toxins have on humans and animals.

## EXTENSIONS

1. Look up information on the percentages of toxins found in the Great Lakes that probably reached there on air currents. Use your maps to determine where these toxins may be originating.
2. Do a study on how incinerators work and how they are regulated.
3. Choose a city and discuss the human health effects that might be found in its residents as a result of the airborne pollutants.

## Answers to Review Questions

1. Varies by choice of toxin.
2. Refer to Chart 1 in Activity A of this section and Table 1 of Activity C, which is on this page.

## Teacher's Note

A public health advisory chart, which indicates the fish that are considered dangerous to eat, is included with the activity "Which fish can we eat?" These restrictions are a reflection of the bioaccumulation of toxins in those fish.

## REFERENCES

- Eisenreich, Steven J. 1987. Toxic Fallout in the Great Lakes. *Issues in Science and Technology*. Fall 1987.
- Fortner, Rosanne W. and Victor Mayer, eds. *The Great Lake Erie*. 1993. Columbus: Ohio Sea Grant College Program. pp. 136-140.
- Hall, Bob and Mary Lee Kerr. 1991-1992 *Green Index: A State-By-State Guide to the Nation's Environmental Health*. Washington D.C.: Island Press. pp. 22-24.
- Hilleman, B. 1988. The Great Lakes cleanup effort. *Chemical and Engineering News* 66(6):22-39.
- Michigan Department of Natural Resources *1992 Michigan Fishing Guide*.
- Ohio Sea Grant College Program, 1989. *PCBs: Their history and our health*. Fact Sheet #007.
- Sierra Club, 1988. *Sweet Water, Bitter Rain: Toxic Air Pollution in the Great Lakes Basin*. A 1988 Update, Lake Michigan Federation.

<i>Toxins</i>	<b>DDT</b>	<b>PCBs</b>
<i>Toxins</i>	<b>Dioxins</b>	<b>Toxaphene</b>
<i>Toxins</i>	<b>Mercury</b>	<b>Lead</b>
<i>Toxins</i>	<b>Arsenic</b>	<b>Benzopyrene</b>
<i>Toxins</i>	<b>Hexachloro- benzene</b>	<b>Dieldrin</b>
<i>Effects of Toxins</i>	<b>Human Cancers</b>	<b>Brain Damage in Humans</b>

<i>Effects of Toxins</i>	<b>Tumors in Fish</b>	<b>Birth Defects in Humans</b>
<i>Effects of Toxins</i>	<b>Death in Fish and Wildlife</b>	<b>Damage to Human Nervous System &amp; Liver</b>
<i>Effects of Toxins</i>	<b>Human Illness</b>	<b>Livestock Mortality</b>
<i>Plants &amp; Phytoplankton</i>	<b>Cattails</b>	<b>Blue-Green Algae</b>
<i>Plants &amp; Phytoplankton</i>	<b>Water Lilies</b>	<b>Duckweed</b>
<i>Plants &amp; Phytoplankton</i>	<b>Rice Cutgrass</b>	<b>Purple Loosestrife</b>

<i>Food Chain: Birds</i>	<b>Mallard Duck</b>	<b>Bald Eagle</b>
<i>Food Chain: Birds</i>	<b>Seagull</b>	<b>Blue Heron</b>
<i>Food Chain: Birds</i>	<b>Red-Tailed Hawk</b>	<b>Blue-Winged Teal Duck</b>
<i>Food Chain: Fish</i>	<b>Lake Trout</b>	<b>Yellow Perch</b>
<i>Food Chain: Fish</i>	<b>Coho Salmon</b>	<b>Walleye</b>
<i>Food Chain: Fish</i>	<b>Catfish</b>	<b>Alewives</b>

Food Chain: Mollusks, Insect Larvae and Zooplankton	<b>Caddisfly</b>	<b>Snails</b>
Food Chain: Mollusks, Insect Larvae and Zooplankton	<b>Zebra Mussels</b>	<b>Daphnia (Zooplankton)</b>
Food Chain: Mollusks, Insect Larvae and Zooplankton	<b>Mayfly Nymph</b>	<b>Freshwater Clams</b>
Food Chain: Mammals	<b>Mice</b>	<b>Beaver</b>
Food Chain: Mammals	<b>Red Fox</b>	<b>Raccoon</b>
Food Chain: Mammals	<b>Rabbit</b>	<b>Muskrat</b>

<i>Food Chain: Mammals</i>	<b>Human</b>	
<i>Human Activity &amp; Industries</i>	<b>Incinerators and Boilers</b>	<b>Copper Smelters</b>
<i>Human Activity &amp; Industries</i>	<b>Sewage Incineration</b>	<b>Manufacture of Chlorinated Solvents</b>
<i>Human Activity &amp; Industries</i>	<b>Pulp and Paper Mills</b>	<b>Production of Glass</b>
<i>Human Activity &amp; Industries</i>	<b>Cigarette Smoking</b>	<b>Use of Leaded Fuels</b>
<i>Human Activity &amp; Industries</i>	<b>Application of Agricultural Pesticides</b>	<b>Coal Combustion</b>