



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.

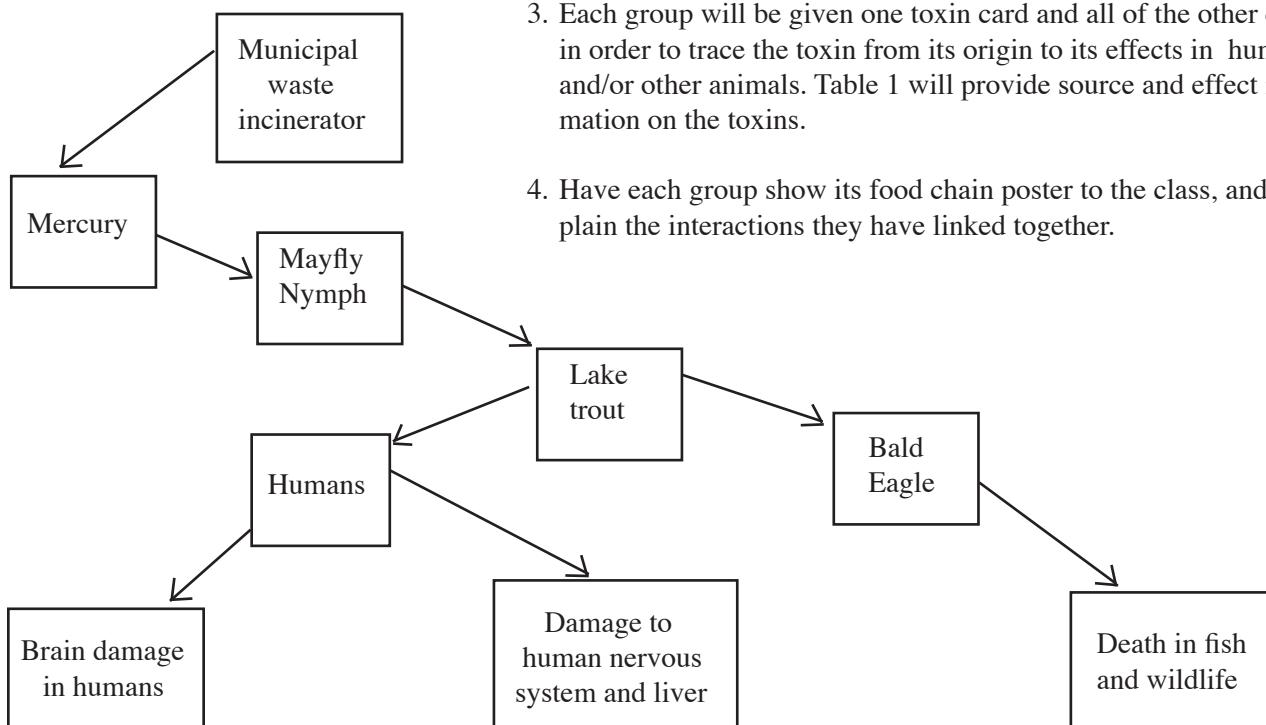
Earth Systems Understandings

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
Lead	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
Arsenic	Used in pesticides, smelters, glass production	Pesticide use, coal combustion, primary copper smelters	Poisonous to humans, fish and wildlife
Mercury	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
Benzopyrene (BaP)	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
Hexachlorobenzene	Used to control insects	Pesticide use, manufacture of chlorinated solvents	Linked to nerve and liver damage; suspected to cause birth defects

<i>Additional Airborne Toxins No Longer Produced in the USA:</i>			
PCBs	Once used in industrial products-paints, plastics, electrical transformers	Existing landfills, spills, leaking transformers	Illness develops in humans; fatally toxic to fish and wildlife
DDT, dieldrin	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
Toxaphene	Pesticide used on cotton crops	Was used in southern states, including Texas, Georgia, Alabama and Louisiana	Extremely toxic to fish
Dioxin	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

- 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.
- List and explain different types of human activities that produce airborne toxins and what effects these toxins have on humans and animals.

EXTENSIONS

- 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.
- Do a study on how incinerators work and how they are regulated.
- 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

- Varies by choice of toxin.
- 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.

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

**Tumors
in Fish**

**Birth Defects
in Humans**

**Death in Fish
and Wildlife**

**Damage to Human
Nervous System
& Liver**

**Human
Illness**

**Livestock
Mortality**

Cattails

**Blue-Green
Algae**

Water Lilies

Duckweed

**Rice
Cutgrass**

**Purple
Loosestrife**

**Mallard
Duck**

Seagull

Bald Eagle

**Red-Tailed
Hawk**

**Blue-Winged
Teal Duck**

Lake Trout

Yellow Perch

Coho Salmon

Walleye

Catfish

Alewives

*Food Chain: Mollusks,
Insect Larvae and
Zooplankton*

Caddisfly

Snails

*Food Chain: Mollusks,
Insect Larvae and
Zooplankton*

**Zebra
Mussels**

**Daphnia
(Zooplankton)**

*Food Chain: Mollusks,
Insect Larvae and
Zooplankton*

**Mayfly
Nymph**

**Freshwater
Clams**

Food Chain: Mammals

Mice

Beaver

Food Chain: Mammals

Red Fox

Raccoon

Food Chain: Mammals

Rabbit

Muskrat

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