

# Biomagnification

## HASPI Medical Biology Activity 14a

Name: \_\_\_\_\_

Period: \_\_\_\_\_ Date: \_\_\_\_\_

### Background

#### Biomagnification

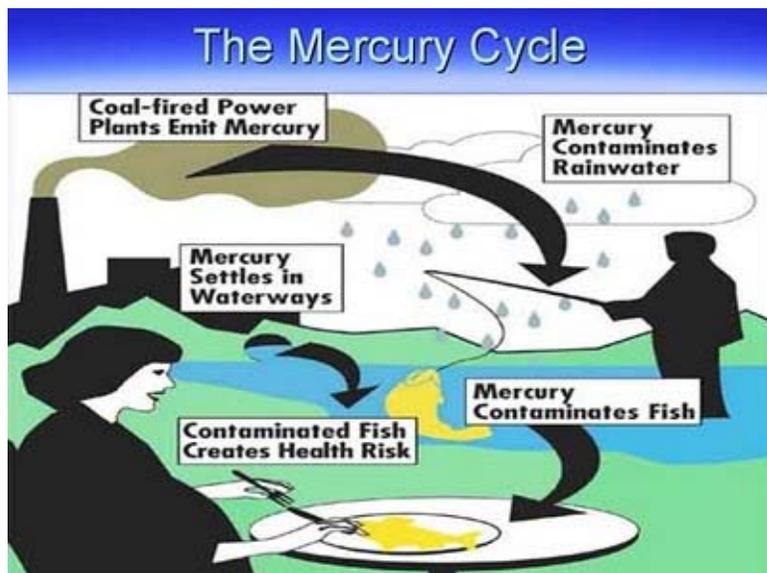
Pollutants that exist in small amounts in the environment (such as certain heavy metals and organic agents found in pesticides) become concentrated in organisms near the top of the food chain.

In an estuary, for example, microorganisms called plankton may absorb small amounts of pollutants such as PCBs (polychlorinated biphenyls); fish that eat lots of plankton might retain the pollutants in their tissues; birds or people that eat the fish might concentrate the pollutants still more. This process, called **biomagnification**, can produce health issues. Some substances that are capable of bioaccumulating include PCBs, fluoride, dioxins, boron, DDT, and mercury.

**Uptake** describes the entrance of a chemical into an organism--such as by breathing, swallowing, or absorbing it through the skin--without regard to its subsequent storage, metabolism, and excretion by that organism. **Storage**, a term sometimes confused with bioaccumulation, means the temporary deposit of a chemical in body tissue or an organ.

**Bioaccumulation** is a normal and essential process for the growth of organisms. All animals, including humans, bioaccumulate many vital nutrients daily, such as vitamins, trace minerals, essential fats, and amino acids. What concerns toxicologists is the bioaccumulation of substances to levels in the body that can cause harm.

*Extension Toxicology Network. 1993. A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, the University of Idaho, and the University of California at Davis and the Institute for Environmental Toxicology, Michigan State University. <http://extoxnet.orst.edu/tibs/bioaccum.htm>*



<http://obrien-envproject.wikispaces.com/Allen-Rabideaux>

#### Mercury Poisoning

Ocean organisms ingest a form of mercury called methyl mercury. This pollutant is produced in several industrial processes and is found in run-off into streams and rivers. These rivers eventually lead to the ocean where the mercury builds up and is ingested by small organisms.

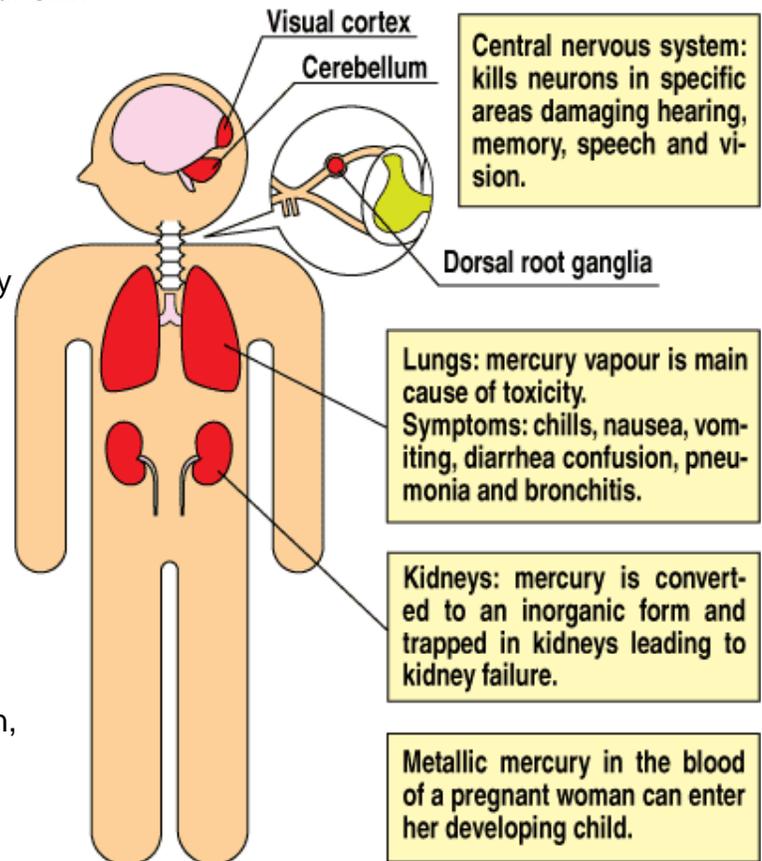
Methyl mercury can cause sickness if inhaled, eaten, or placed on the skin for long periods of time. Usually mercury causes problems over years or decades, not immediately. In other words, being exposed to small amounts of mercury every day for years will likely cause symptoms that appear later.

Long-term exposure will likely cause neurological symptoms, including: [http://www.wiregrassenergynetwork.com/uploads/1/4/9/6/1496058/6257066\\_orig.gif?198](http://www.wiregrassenergynetwork.com/uploads/1/4/9/6/1496058/6257066_orig.gif?198)

- \* Numbness or pain in certain parts of your skin
- \* Uncontrollable shake or tremor
- \* Inability to walk well
- \* Blindness and double vision
- \* Memory problems
- \* Seizures and death (large exposures)

Medical evidence suggests that being exposed to large amounts of methyl mercury while pregnant can permanently damage the baby's developing brain. Most doctors will recommend eating less fish, especially swordfish, while pregnant. These recommendations are made to be extremely cautious. Small exposures are unlikely to cause any problems.

Treatment of organic mercury exposure usually consists of medicines called chelators to remove mercury from the blood and away from the brain and kidneys. Often, these medications will have to be used for weeks to months.



NIH. 2011. Mercury. U.S. National Library of Medicine, Article 002476. <http://www.nlm.nih.gov/medlineplus/ency/article/002476.htm>

## Procedure

**Purpose:** The goal of this activity is to demonstrate how a hazardous substance, like mercury, can bioaccumulate in a food chain and eventually cause poisoning in organisms higher in the food chain.

1. Obtain a container from your teacher.
2. There are 5 different types of containers and each represent a level of the food chain.
  - Plankton are organisms located at the bottom of the food chain.
  - Krill are shrimp-like organisms that feed on plankton.
  - Small fish, like those that feed on krill.
  - Large fish, like tuna and sharks, feed on the small fish.
  - Humans normally feed on the larger fish.
3. The beads in your container represent the mercury that the organism labeled on your container has consumed. To start the activity, only the plankton feeding from the bottom levels have been contaminated with mercury. Mercury cannot be broken down so it remains in the body and is passed to the next organism that consumes it.
4. See the following page to determine what your responsibility in this activity will be, depending on the container you received.
5. Once this activity is complete, return your container and complete the analysis section.

### If you were given a **PLANKTON** container:

- When directed by your teacher the KRILL will “consume” you. When consumed, pour the contents of your container into the container of the KRILL that eats you. As soon as you are consumed, return to your seat.



### If you were given a **KRILL** container:

- When directed by your teacher you will “consume” as many PLANKTON as possible until none are left. In order to consume the PLANKTON, you will have them pour the contents of their container into your container. When directed by your teacher the second time, the SMALL FISH will “consume” you. When consumed, pour the contents of your container into the container of the SMALL FISH that eats you. As soon as you are consumed, return to your seat.



### If you were given a **SMALL FISH** container:

- When directed by your teacher you will “consume” as many KRILL as possible until none are left. In order to consume the KRILL, you will have them pour the contents of their container into your container. When directed by your teacher the second time, the LARGE FISH will “consume” you. When consumed, you will pour the contents of your container into the container of the LARGE FISH that eats you. As soon as you are consumed, return to your seat.



### If you were given a **LARGE FISH** container:

- When directed by your teacher you will “consume” as many SMALL FISH as possible until none are left. In order to consume the SMALL FISH, you will have them pour the contents of their container into your container. When directed by your teacher the second time, the HUMAN will “consume” you. When consumed, you will pour the contents of your container into the container of the HUMAN that eats you. As soon as you are consumed, return to your seat.



### If you were given the **HUMAN** container:

- When directed by your teacher you will “consume” all of the LARGE FISH. In order to consume the LARGE FISH, you will have them pour the contents of their container into your container.



**Analysis** – on a separate sheet of paper complete the following

1. What is bioaccumulation? List 2 substances that naturally bioaccumulate.
2. What is biomagnification? List 3 harmful substances that are capable of biomagnifying.
3. In terms of biomagnification, what is uptake and storage?
4. How does methyl mercury get into the environment?
5. List 3 symptoms of long-term exposure to methyl mercury.
6. Why is it risky for a pregnant woman to consume large amounts of fish?
7. How is mercury poisoning treated?
8. Summarize what occurred in each step of this activity starting with the krill eating the plankton and finishing with the human eating the large fish.
9. How did this activity demonstrate how mercury builds up in organisms at the top of the food chain?
10. Draw the food chain that was represented by this activity.
11. The following table contains the average level of mercury in parts per million (ppm) found in two contaminated environments at each trophic level. Use the table to create a bar or line graph summarizing the information (*not actual data*).

Trophic Level Tested	Environment A: Pacific Ocean near California coastline	Environment B: Atlantic Ocean near New York coastline
Producers	1 ppm	2 ppm
Herbivores	3 ppm	34 ppm
Primary Consumers	9 ppm	56 ppm
Secondary Consumers	22 ppm	112 ppm
Tertiary Consumers	48 ppm	390 ppm

12. According to the graph you created, fish from which environment would be more risky to consume? Explain your answer.
13. The World Health Organization has put the level of risk for mercury poisoning at 50 ppm. Is anyone consuming fish caught from the California or New York coastline at risk of mercury poisoning? *NOTE: The FDA does not allow fish with greater than 1 ppm to be sold to consumers so don't panic!*
14. According to **FIGURE A** below, which U.S. states have the highest level of mercury in their water systems? Why do you think this could be? Explain your answer.

**Figure A** Fish Consumption Advisories for Mercury

