Date: _____

Your Name: _____

New England Common Assessment Program

Released Science Inquiry Task

Mercury in Fish

2012

Grade 11

Science

Directions:

You will be analyzing the results of an investigation described in a short story called "Mercury in Fish" and applying what you learn to answer a set of questions. Thoroughly explain all of your answers. You may include drawings or labeled diagrams to help you answer the questions.

This inquiry task presents information and data found by students doing library research. You will form a hypothesis based on their research question; organize, analyze, and present data; and evaluate your hypothesis and the research results.

The Word Bank below provides definitions for words used in the investigation. You may refer back to this page throughout the session.

Word Bank

Food web	a series of interrelated food chains in an ecological community
Mercury (Hg)	a silvery white, poisonous metallic element
ppm	parts per million; a unit of concentration
Predatory	a word used to describe animals that naturally prey on other animals
Trophic level	the position that an organism occupies in a food chain

GO ON

Mercury in Fish

Students in a science class are learning how environmental factors affect human health. They know that mercury (Hg) is a dangerous environmental pollutant. High concentrations of mercury can damage human body systems.

The science teacher invited Ms. Weston, a biologist, to talk to the students about mercury. Ms. Weston told the students that mercury pollution comes mostly from human sources. Burning coal and making certain kinds of chemicals produce mercury vapor. Mercury vapor travels through the atmosphere and ends up in soil or water. Bacteria convert the mercury into an organic form that is easily absorbed by organisms.

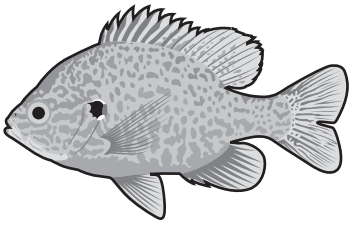
One student asked Ms. Weston how mercury gets into the human body. Ms. Weston explained that mercury moves from the environment to organisms through food webs. For example, mercury from a fish eaten by a human will pass into the human body. Pregnant or nursing mothers can also pass mercury to their children. Mercury may harm the developing nervous system of a child. Mercury often stays in body tissues for a long time. However, Ms. Weston said that mercury storage in the body is not permanent. Mercury will leave body tissues over time if organisms reduce their mercury intake.

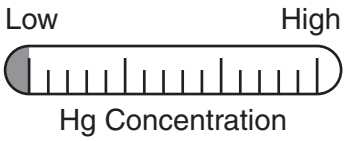
Before leaving, Ms. Weston gave each student a brochure (Figure 1) showing the relative concentrations of mercury found in some common fish.

GO ON

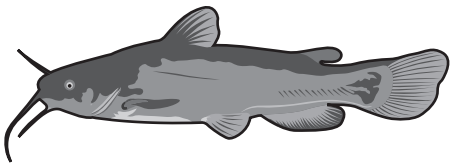
Figure 1: Mercury Concentrations in Fish

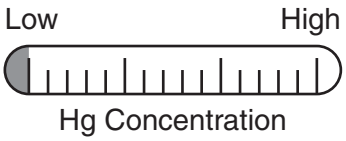
Pumpkinseed



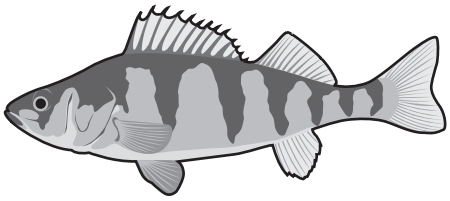


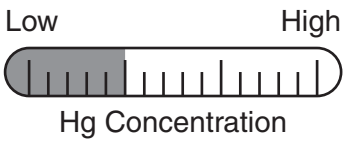
Brown Bullhead



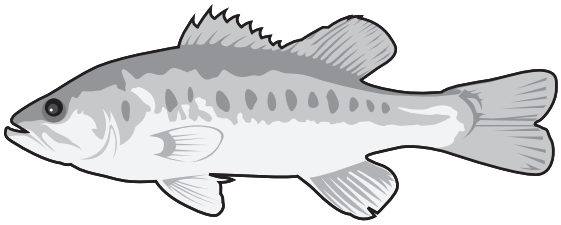


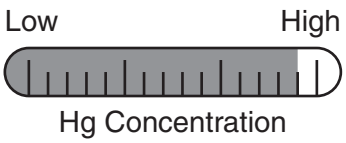
Yellow Perch



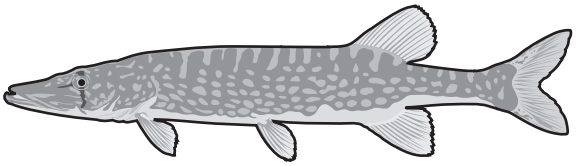


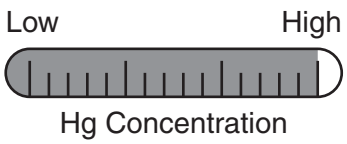
Largemouth Bass





Pickerel





fish not drawn to scale

(Adapted from a brochure titled *Eat Fish Low in Mercury* from the Vermont Department of Conservation, www.mercvt.org)

GO ON

The students noticed that some fish species in the brochure have high mercury concentrations, while other species do not. The students wondered why the mercury concentrations are so different. One student noticed that pickerel contain a lot of mercury. He said, "When I go pickerel fishing, I use a lure that looks like a small fish. So, pickerel must eat small fish." Another student added, "They do! One time I saw a pickerel with a bass stuck in its mouth. The bass was too big for the pickerel to swallow."

One student suggested that predatory fish may have higher mercury concentrations than fish that eat mostly plants. Another student suggested that large fish may have higher mercury concentrations than small fish. A third student suggested that fish living in polluted water probably have higher mercury concentrations than fish living in clean water.

The teacher assigned the students a research project to learn more about how mercury affects organisms. The students decided to focus their research on fish. They decided to answer the following research question:

Research Question:

What causes some fish to have higher mercury concentrations than other fish?

In order to answer their research question, the students used the Internet to find data about mercury concentrations in organisms living in two Massachusetts freshwater ponds. The students also found data about the relationship between fish length and mercury concentration.

Forming a Hypothesis

Answer question 1 on page 1 in your Student Answer Booklet.

1 Write a hypothesis about what causes some fish to have higher mercury concentrations than other fish. Explain your reasoning.

GO ON

The students read a research study about mercury concentrations in organisms living in two Massachusetts ponds. Figure 2 presents data from this study.

Figure 2: Mercury Concentrations in Pond Organisms

Trophic Level	Organisms	Average Mercury Concentration (mg/kg)*
Primary producers	Plant Plankton	0.019
Primary consumers	Dragonfly Damselfly Tadpole	0.028
Secondary consumers	Bluegill Redbreast sunfish Golden shiner Tess darter Snail Pumpkinseed Frog	0.110
Tertiary consumers	Yellow perch Black crappie Brown bullhead White crappie American eel Largemouth bass Pickerel	0.124

*The unit of concentration is milligrams of mercury per kilogram of tissue sample.

(Data from *Mercury Bioaccumulation in the Food Webs of Two Northeastern Massachusetts Freshwater Ponds*, April 2003, Massachusetts Department of Environmental Protection, Office of Research and Standards)

GO ON

Organizing, Analyzing, and Presenting Data

Answer question 2 on page 2 in your Student Answer Booklet.

❷ Use the data in Figure 2 to graph the mercury concentration of the organisms in each **trophic level.** Be sure to include all the required elements of a graph.

Answer questions 3 and 4 on page 3 in your Student Answer Booklet.

❸ Based on the data in Figure 2 and your graph, describe the **pattern of mercury concentration** among the organisms in the ponds. Support your description with specific examples from the data.

❹ Find data in Figure 1 that do **not** agree with the data in Figure 2.

a. Describe a different procedure for recording the data in Figure 2 that would provide a better understanding of mercury concentrations in the organisms.

b. Explain why this procedure might improve the agreement of the data in Figure 1 and Figure 2.

GO ON

The students found additional data about yellow perch from the same study of the two Massachusetts ponds. Figure 3 shows mercury concentrations in nine individual yellow perch.

Figure 3: Mercury Concentrations in Yellow Perch

Yellow Perch	Concentration of Mercury (mg/kg)*
1	0.097
2	0.120
3	0.120
4	0.120
5	0.130
6	0.092
7	0.110
8	0.100
9	0.062
Average	**0.106**

*The unit of concentration is milligrams of mercury per kilogram of tissue sample.

(Data from *Mercury Bioaccumulation in the Food Webs of Two Northeastern Massachusetts Freshwater Ponds*, April 2003, Massachusetts Department of Environmental Protection, Office of Research and Standards)

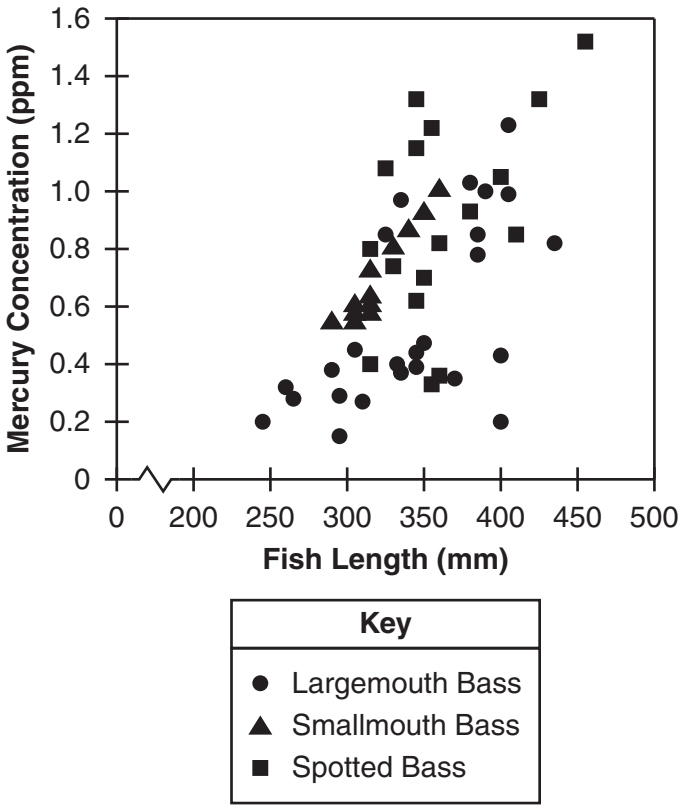
Answer question 5 on page 4 in your Student Answer Booklet.

5 Analyze the data in Figure 2 and Figure 3. Based on the data in Figure 3, describe one advantage and one disadvantage of presenting the **average mercury concentration** of each trophic level in Figure 2.

GO ON

As the students continued their research, they learned that scientists in California studied the relationship between fish length and mercury concentration in 2005. To display their data, the scientists published the scatter plot shown in Figure 4.

Figure 4: Fish Length and Mercury Concentration



(Adapted from Alpers, C.N., Hunerlach, M.P., May, J.T., and Hothem, R.L. "Mercury Contamination from Historical Gold Mining in California," USGS Fact Sheet 2005-3014 Version 1.1, Revised October 2005, http://pubs.usgs.gov/fs/2005/3014/fs2005_3014_v1.1.pdf)

Take into consideration the research question below when answering question 6.

Research Question:
What causes some fish to have higher mercury concentrations than other fish?

Answer question 6 on page 4 in your Student Answer Booklet.

6 Identify the **pattern** of the data shown in Figure 4. Explain how this pattern provides information to help answer the research question.

GO ON

Evaluating Your Hypothesis and the Research Results

Answer question 7 on page 5 in your Student Answer Booklet.

7 Based on the data in Figures 1, 2, 3, and 4, explain whether the evidence **supports or refutes** the hypothesis you proposed in question 1. Include **two** specific examples to support your reasoning.

STOP