

Mercury Pollution: Source to System

By: Lisa Olenderski (April 1, 2011)



Summary: Lectures and activities will focus on mercury as a pollutant in aquatic ecosystems and the dangers of its bioaccumulation in marine food webs.

Grade: 9-12

Time Required: 2-3 class periods

Keywords: Mercury, Methylation, Bioaccumulation, Food Web, Trophic Level, Pollution

Georgia Performance Standards (9-12):

• Habits of Mind

SCSh1 – Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh6 – Students will communicate scientific investigations and information clearly.

• The Nature of Science

SCSh8 – Students will understand important features of the process of scientific inquiry

SCSh9 – Students will enhance reading in all curriculum areas

• Biology

SB4 – Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems

• Ecology

SEC4 – Students will analyze biogeochemical cycles and the flow of energy in ecosystems

SEC5 – Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.

• Oceanography

SO2 – Students will relate how the oceans are integral to all life on earth and how biogeochemical processes in the oceans influence the entire planet

SO5 – Students will analyze how the unique attributes of seawater determine the types of marine organisms and the ecology of marine food webs.

SO6 – Students will identify how humans use the ocean for food, commerce and energy and will evaluate the potential for abuse in the absence of responsible stewardship.

National Science Education Standards:

• Unifying Concepts and Processes Standard

-Evidence, Models and Investigation

• Life Science Standard

-Interdependence of Organisms

-Behavior of Organisms

-Biological Evolution

• Personal and Social Perspectives Standard

-Personal and Community Health

-Environmental Quality

-Nature and Human-Induced Hazards

-Science and Technology in Local, National and Global Challenges

• Science and Technology Standard

-Understanding about Science and Technology K-12

Ocean Literacy Standards:

- #1 – The Earth has one big ocean with many features.
- #5 – The ocean supports a great diversity of life and ecosystems.
- #6 – The ocean and humans are inextricably interconnected.
- #7 – The ocean is largely unexplored.

Objectives:

Students will be able to recall basic information about mercury and how it pollutes our environment.
Students will be able to define bioaccumulation and apply it to marine food webs.
Students will be able to recognize the dangers of mercury pollution to both wildlife and humans.
Students will be able to evaluate fish consumption advisories in their state as well as the U.S.

Materials: 42 oz Bag of M&Ms, ziploc bags, stopwatch, calculators, student game instructions, activity #4 handouts, activity #5 handout, Microsoft PowerPoint

Procedure:

Activity 1: (20 min) PowerPoint Presentation

“Movin’ On Up: Bioaccumulation in Marine Food Webs” contains an introduction to the following: marine food webs, trophic levels, energy transfer, trophic pyramids, bioaccumulation, and pollutants. Refer to the notes portion on each slide.

Activity 2: (30 min) Bioaccumulation in Georgia Waters

Materials - 42 oz bag of M&Ms, ziploc bags, stopwatch, calculators, student instructions, and pencils
The following game was modified from a CoSEE (Centers for Ocean Sciences Education Excellence) activity.

The day before...

1. Assign student roles as follows:
 - copepods (16+ students) mackerel (2-3 students)
 - menhaden (5-8 students) shark (1 student)
2. Print the introduction sheet for the game (page 7) and cut the pages in half so each student receives a half sheet. Print individual instruction cards (pages 8-9) and cut out the corresponding number of each according to the number of students (see step 1).

The day of...

1. Students will be equipped with a pencil and calculator. Pass out game introduction sheet and instruction card to each student. Students read their game handouts and write their name on the instruction card.
2. Choose a student to draw the following data table on the board with enough rows to be used by each student:

Name	#Blue	#Brown	#Yellow	#Green	#Red	#Orange	Total	%

3. Simultaneously, clear floor space in part of the classroom for students to move around. Push desks together to form a table and spread the M&Ms out on top.
4. Gather copepods around the desks with the M&Ms. Review the copepod instructions listed on the instruction card. Start the stopwatch and let the copepods begin. Stop play after one minute.
5. Copepods fill in the data table on their instruction card and the board. Discuss the following questions as a class (answers in italics):

What is the first level of the food chain in this scenario?

NOT the copepods. It is the phytoplankton – they are the primary producers. These autotrophs act as food for zooplankton.

How much energy is transferred from the phytoplankton to the zooplankton (copepods)?

10% of the energy from the phytoplankton is transferred to the copepods. 90% of the phytoplankton's energy is used for metabolic processes and 10% is transferred to the next trophic level – zooplankton, which includes the copepods.

6. Instruct copepods to now remove all **brown** M&Ms from their bag. This symbolizes energy used for metabolic processes. Tell the students that this is not the exact ratio of energy used to energy transferred, but merely a representation! Copepods **clearly** cross out the brown column on their instruction card **only** and seal the card in the bag with the M&Ms.
7. Invite menhaden to join copepods. Review the menhaden instructions listed on the student instruction card. Start the stopwatch and let menhaden begin. Stop play after 30 seconds.
8. Menhaden fill in the table on their instruction card and the board. Discuss the following questions as a class (answers in italics):

Menhaden are important links between plankton and the rest of the food web. What is the menhaden's feeding strategy and what are some other Georgia species employing the same strategy?

Filter feeding – specialized mouth parts filter plankton from sea water

Other filter feeders – bivalves (oysters, mussels, clams), other invertebrates like tunicates and sponges

What are the pros and cons of being a filter feeder like the menhaden?

Pros: filter feeding expends less energy than hunting prey, menhaden don't have the need to discriminate between prey items (plankton)

Cons: drop in nutrient availability means plankton are sparse, range is restricted to areas where plankton are found, must consume immense quantities of prey since plankton are so tiny

9. Instruct menhaden to now remove all **yellow** M&Ms from their bag. This symbolizes energy used for metabolic processes. Tell the students that this is not the exact ratio of energy used to energy transferred, but merely a representation! Menhaden **clearly** cross out the **yellow** column on their instruction card **only** and seal their card in the bag with the M&Ms.
10. Invite mackerel to join menhaden. Review the mackerel instructions listed on the student instruction card. Start the stopwatch and let mackerel begin. Stop play after 30 seconds.
11. Mackerel fill in the table on their instruction card and the board. Discuss the following questions as a class (answers in italics):

What other large, predatory fish would play roughly the same role as mackerel do in the oceans off the coast of Georgia?

Tuna, jack, mahi mahi, marlin, sailfish, etc

What are the pros and cons of being a mackerel living off the coast of Georgia?

Pros: High on the food chain so not as many predators

Cons: Popular sport fish for recreational fishermen, being larger requires more energy intake, higher levels of bioaccumulative toxins

12. Instruct mackerel to now remove all **red** M&Ms from their bag. This symbolizes energy used for metabolic processes. Tell the students that this is not the exact ratio of energy used to energy transferred, but merely a representation! Mackerel **clearly** cross out the **red** column on their instruction card **only** and seal their card in the bag with the M&Ms.
13. Invite the shark to join the mackerel. Review the shark instructions listed on the student instruction card. Start the stopwatch and let mackerel begin. Stop play after 30 seconds.
14. Reveal that the phytoplankton bloom in the beginning of the scenario was polluted with methyl mercury! The orange M&Ms signify units of methyl mercury that have moved through the food chain. Using the M&M tallies on the board (not on the cards), instruct students to calculate their individual percent of orange M&Ms (out of their total number in their bag) and write that percent on the board in the column next to their previous data.

Using the tallied class data, relay the following information:

<20% contamination = ability to function normally

20-30% contamination = sick with mercury poisoning

>30% contamination = potential death of the organism

15. Post-game discussion questions:

- What percent of methyl mercury contamination did your body have (even if you were eaten)?
- Consider the food chain from the game. If you could choose to be one of these animals from the food chain, which would you choose and why?
- What are the pros and cons of being this animal?
- Do you think there is any way to stop bioaccumulation from happening?
- Which levels of the food chain are most affected by this natural phenomenon? (*Highest levels*)
- What other predators in the ocean are adversely affected by bioaccumulation?
Dolphins, killer whales, tuna, seals, sea lions
- What are some possible effects on the food chain if top predator populations diminish?

Hints!

- It may help to make sure all the students are aware of what a single round of Rock, Paper, Scissors consists of. For example... 1, 2, 3, "shoot" OR rock, paper, scissors, "shoot"
- The idea of Rock, Paper, Scissors can always be exchanged for a different method of feeding!
- Students WILL be inclined to eat their M&Ms! (Who wouldn't?!)
- Gloves for the students to wear may be a good idea when handling the M&Ms.
- In a large group, more students should be added to the bottom of the food chain (more copepods and menhaden) rather than the top of the food chain.

Photo Credit for Instruction Cards:

Copepod and atlantic menhaden – UGA MAREX

King mackerel – South Carolina DNR (<http://www.dnr.sc.gov/marine/species/kingmackerel.html>)

Bull shark – NOAA (<http://www.photolib.noaa.gov/brs/fsind61.htm>)

Activity 3: (20 min) PowerPoint Presentation – “Mercury: Source to System”

Ask students to volunteer information they already know about mercury/mercury pollution and write it on the board. Begin the second PowerPoint, called “Mercury: Source to System”, which gives an introduction to the basic facts of mercury, the path it takes as it moves through our environment, and the dangers it poses to marine food webs as well as humans. Again, refer to the notes portion of each slide to gain more insight on information to cover.

Activity 4: (30 – 45 min) Consumption Advisories

Materials – internet access, Consumption Advisories Fact Sheet, State Advisory activity, A Closer Look at Consumption Advisories worksheet and answer key, pencils

1. Prior to the class period, print handouts for each student (pages 10-12 of this document) and the answer key (pages 13).
2. After the PowerPoint “Mercury: Source to System”, move to a computer lab. Students read the consumption advisory fact sheet.
3. Follow instructions on the second page of the lab packet as a class until all students reach the “Advisory Report Output” page that shows all consumption advisories for Georgia.
4. Students individually answer questions from the questions titled “Consumption Advisories: A Closer Look”.

Activity 5: (5 min) Project Introduction – “Pick a State... Any State!”

Prior to the class period, print a project handout for each student (page 14 of this document). Distribute the papers and introduce the homework project called “Pick a State... Any State!” and assign due dates to be filled in on the provided blank space in the document. Students are responsible for a written report, poster, and short presentation to the class.

Classroom Extensions:

- Assign students to further research on other bioaccumulative pollutants such as PCBs and DDT. These chemicals come from different sources and have unique effects on our environment.
- Organize a debate or mock town hall meeting on the pros and cons of coal power plants. Divide the students into two groups. One side acts as supporters of a coal power plant and the other side acts as environmentalists against the plant’s operation.
- Have students create their own brochure about mercury pollution, the dangers of mercury in our environment, seafood safety guidelines, etc.

Additional Resources:

Mercury:

U.S. Environmental Protection Agency: www.epa.gov/mercury

Food & Drug Administration: www.fda.gov

U.S. Geological Survey: www.usgs.gov
<http://pubs.usgs.gov/fs/1995/fs216-95/>

“Mercury Matters” report by the Hubbard Brook Research Foundation

National Resources Defense Council: <http://www.nrdc.org/health/effects/mercury/effects.asp>

Mercury Deposition Network: <http://nadp.sws.uiuc.edu/mdn/>

Food Webs & Bioaccumulation:

U.S. Geological Survey: <http://toxics.usgs.gov/definitions/bioaccumulation.html>

Utah Dept. Of Environmental Quality: <http://www.mercury.utah.gov/bioaccumulation.htm>

Rhode Island Sea Grant Fact Sheet: <http://seagrant.gso.uri.edu/factsheets/foodweb.html>

Sources for this Project:

Websites:

Environmental Health Perspectives: <http://ehp.niehs.nih.gov/docs/2001/109-10/focus.html>
(Tarnishing the Earth: Gold Mining's Dirty Secret)

North Dakota Department of Health:

<http://www.ndhealth.gov/wm/Mercury/MercuryContainingDevicesProducts.htm>

S.C. Department of Health and Environmental Control: www.scdhec.gov/mercury

U.S. Environmental Protection Agency: www.epa.gov/mercury

- 2008 Biennial National Listing of Fish Advisories

http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/upload/2009_09_16_fish_advisories_tech2008.pdf

U.S. Food & Drug Administration: www.fda.gov

U.S. Geological Survey: www.usgs.gov

Fact Sheets:

Argonne National Laboratory Human Health Fact Sheet: <http://www.ead.anl.gov/pub/doc/mercury.pdf>

Rhode Island Sea Grant Fact Sheet: <http://seagrant.gso.uri.edu/factsheets/foodweb.html>

Journal Articles:

Driscoll, C.T. et al., Mercury Matters: Linking Mercury Science with Public Policy in the Northeastern United States. Hubbard Brook Research Foundation. 2007. Science Links Publication. Vol.1, no.3.

Dufault, Renee et al. Mercury from chlor-alkali plants: measured concentrations in product sugar. *Environmental Health*. 2009; Vol.8.

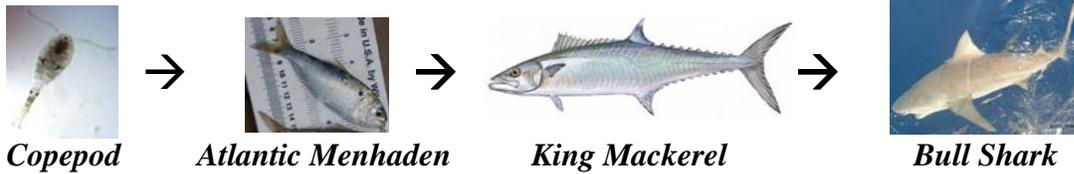
Mahaffey K.R., Mercury Exposure: Medical and Public Health Issues. *Transactions of the American Clinical and Climatological Association*. 2005; Vol.116:127–154.

Books:

Sverdrup, Keith A. et al., 2004, *An Introduction to the World's Oceans*, 8th ed., McGraw-Hill, New York, pp 383-387.

Bioaccumulation in Georgia Waters

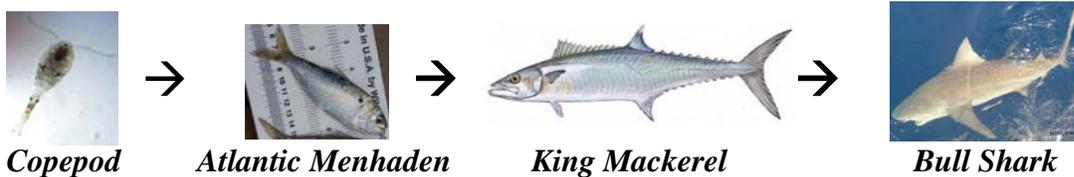
You are now a member of the following food chain along the coast of Georgia:



- Each of you will act as a specific organism in the food chain above, with specific feeding strategies.
- Energy is the key to survival, and survival is the name of the game. All four of these species are heterotrophic and must find their own food to gain the energy needed for survival. During the game, feed on lower members of the food chain if you want to make it!

Bioaccumulation in Georgia Waters

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Copepod

You drift into a bloom of phytoplankton!

In **1** minute, collect as many M&Ms as possible.

Using only **one** hand, pick up **one** M&M at a time.

Tally each color below and determine your total M&M count.



Blue	Brown	Yellow	Green	Red	Orange	Total

Fill in your data on the board, but leave the % column on the board blank for now.

In the next round, if you are eaten by a menhaden, pour your bag contents into the menhaden's bag and return to your seat.

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Using only **one** hand, pick up **one** M&M at a time.

Tally each color below and determine your total M&M count.



Blue	Brown	Yellow	Green	Red	Orange	Total

Fill in your data on the board, but leave the % column on the board blank for now.

In the next round, if you are eaten by a menhaden, pour your bag contents into the menhaden's bag and return to your seat.

Atlantic Menhaden

In **30** seconds, eat as many copepods as you can!

Challenge copepods to a single round of Rock, Paper, Scissors.

If you **win**, the copepod pours their bag contents into **your** bag.

If you **tie**, try another round -OR- If you **lose**, find another copepod!

Add the individual color tallies on the copepod cards to get your **own** color tallies and total number of M&Ms.



Blue	Brown	Yellow	Green	Red	Orange	Total

Fill in your data on the board, but leave the % column on the board blank for now.

In the next round, if you are eaten by a mackerel, pour your bag contents into the mackerel's bag and return to your seat.

King Mackerel

In **30** seconds, eat as many menhaden as you can!

Challenge menhaden to a single round of Rock, Paper, Scissors.

If you **win**, the menhaden pours their bag contents into **your** bag.

If you **tie**, try another round -OR- If you **lose**, find another menhaden!

Sum the individual color tallies on the menhaden cards to get your **own** color tallies and total number of M&Ms.



Blue	Brown	Yellow	Green	Red	Orange	Total

Fill in your data on the board, but leave the % column on the board blank for now.

In the next round, if you are eaten by a shark, pour your bag contents into the shark's bag and return to your seat.

King Mackerel

In **30** seconds, eat as many menhaden as you can!

Challenge menhaden to a single round of Rock, Paper, Scissors.

If you **win**, the menhaden pours their bag contents into **your** bag.

If you **tie**, try another round -OR- If you **lose**, find another menhaden!

Sum the individual color tallies on the menhaden cards to get your **own** color tallies and total number of M&Ms.



Blue	Brown	Yellow	Green	Red	Orange	Total

Fill in your data on the board, but leave the % column on the board blank for now.

In the next round, if you are eaten by a mackerel, pour your bag contents into the mackerel's bag and return to your seat.

Bull Shark

You're the top predator! In **30** seconds, eat all the mackerel you can.

Challenge mackerel to a single round of Rock, Paper, Scissors.

If you **win**, the mackerel pours their bag contents into **your** bag.

If you **tie**, try another round -OR- If you **lose**, find another mackerel!

Sum the individual color tallies on the mackerel cards to get your **own** color tallies and total number of M&Ms.



Blue	Brown	Yellow	Green	Red	Orange	Total

Fill in your data on the board, but leave the % column on the board blank for now.

Activity 4: Consumption Advisories Fact Sheet

Low in saturated fat and high in omega-3 fatty acids, fish provide a source of high-quality protein that is essential to a healthy diet. Consider the following before you begin your meal.

Do you know where your fish are coming from?

All U.S. states post consumption advisories. A consumption advisory is created when a certain area (lake, river, coastal waters, etc) has species whose tissues are contaminated with a certain pollutant, making them unsafe for human consumption. Advisories are not laws or even regulations; only recommendations. Some advisories make suggestions to merely limit the consumption of certain species, while other advisories urge the public to avoid a species altogether. Similarly, some consumption advisories are intended for commercial fishermen while others are meant to aid recreational fishermen and the general public about the safety of the local catch.

Think big...

Chemical contaminants can include anything from PCBs to furan to arsenic. Mercury, however, is the major contaminant of concern. According to the 2008 National Listing of Fish Advisories published by the U.S. Environmental Protection Agency (EPA), 80% of all consumption advisories issued in the U.S. during 2008 concerned mercury. Consider the following:

- All 50 states have fish advisories on mercury
- 16.8 million acres of lake are under mercury advisories
- 1.3 million miles of river are under mercury advisories
- Idaho, Wyoming and Oregon have issued STATEWIDE mercury advisories

Mercury is a significant issue for aquatic systems. Visit the EPA's website (www.epa.gov) to view their 2008 Biennial National Listing of Fish Advisories.

Who is at risk?

Pregnant women and small children are at the biggest risk of mercury poisoning. The nervous system of a developing fetus is particularly vulnerable to the harsh effects of mercury. Pregnant women and women who may become pregnant should follow guidelines to avoid the possibility of mercury poisoning in an unborn child. In 2004, the U.S. Food & Drug Administration (FDA) collaborated with the U.S. EPA to target women with information about mercury fish and shellfish. Mercury is removed through the body over time, but it takes a year or more for mercury levels to decrease significantly.

What can YOU do?

Be educated and aware. Familiarize yourself with advisories in your local area, state, and region. Acquaint yourself with the areas that have consumption advisories, the species of concern, and what the recommendations are for those species. Furthermore, for recreational fishermen who consume their catch, be sure to correctly identify the species before you eat it. Consult websites for your state's Department of Natural Resources or Fish & Wildlife Service for further information. Knowing about consumption advisories is the only way to avoid the negative effects of mercury. Do a favor for those you care about and educate them about the dangers of mercury.

Activity 4: State Advisories

To check advisories in your state:

Option 1...

Go to: http://oaspub.epa.gov/nlfa/nlfa.bld_qry?p_type=advrpt&p_loc=on

Option 2...

Go to: www.epa.gov

In the search box, type in: national listing of advisories

Click on the search result: Fish Advisories / Fish Advisories / US EPA

In the “Highlights” box, click on “*National Listing of Advisories*”

Under the “Database” section, click on “*State Advisories*”

Then, your page should look something like this...

Map Display Functions	2x	2x				Full Extent
Map Query Functions		Name Query		Name Search (e.g. Ontar for Lake Ontario)	Limit By State	Begin Search
Mapping & Reporting Functions	Map Advisories	Map Advisory Counts	Advisory Report	Fish Tissue Report	Commercial Advice	Format To Print



In the row of grey buttons, click on the “Advisory Report” button

To view ALL advisories in your state:

Select Pollutants – Choose Mercury as your pollutant

Select Fish Species – Choose Any Species

Select Population – Choose Any

Select Meal Advice – Choose Any Meal Advice

Select States/Provinces – Choose GA

Select EPA Regions – Choose Any

Select Advisory Types – Choose Any

Results should be ordered by *Advisory Type*

Click the “Advisory Report” button to view all advisory information for your state. On the ‘Advisory Report Output’ page, each set of information will include an advisory number. However, each individual row in the tables represents ONE individual advisory record.

Activity 4: A Closer Look at Consumption Advisories

1. Georgia currently has _____ active mercury advisories.
*Hint: Scrolling to the bottom of the page allows you to see the total number of records!
2. Look at the first advisory on the page (Adv. # _____)
How large is the advisory?

What general areas does it include?

Why might some mackerel have a recommendation of *No Consumption* while some have no restriction on consumption?
3. Go back to the 'Advisory Report Query' page and choose the *Rescinded* button on the left side of the page. Compare the number of rescinded (withdrawn) advisories to active ones.

What are two ways to reduce the amount of mercury pollution that would help work toward the withdraw of consumption advisories?
4. PCBs are another bioaccumulative pollutant found in seafood. Change the 'Advisory Report Query' to read *Active* again, and choose PCBs as the pollutant. How many advisories are there for Georgia?
5. Spend a few minutes investigating on your own. Go back to the 'Advisory Report Query' page. Leave the pollutant as mercury, but change the other dropdown boxes to search different combinations of species, meal advice, etc. In the space below write 3 things you learned that were of interest to you.
*Example: There are 2 states with advisories for the bayou – AR and LA.
6. What are your thoughts on eating seafood? Have they changed at all? How?

Activity 4: A Closer Look at Consumption Advisories ANSWER KEY
Information is current as of February 2011. Answers are subject to change

1. Georgia currently has 300 active mercury advisories.
*Hint: Scrolling to the bottom of the page allows you to see the total number of records!

2. Look at the first advisory on the page (Adv. #1042331)
How large is the advisory? 255.18 miles

What general areas does it include? *Statewide: Covers all coastal and estuarine waters*

Why might some mackerel have a recommendation of *No Consumption* while some have no restriction on consumption?

The smallest mackerel (24–33”) have no restriction on consumption while the largest mackerel (>39”) are not to be consumed. This is because as the mackerel grow in size, they accumulate more mercury in their system. Smaller mackerel have less mercury and are safe to eat. Larger mackerel contain too much mercury to be considered safe for consumption.

3. Go back to the ‘Advisory Report Query’ page and choose the *Rescinded* button on the left side of the page. Compare the number of rescinded (withdrawn) advisories to active ones.
Active: 300 vs. Rescinded: 34

What are two ways to reduce the amount of mercury pollution that would help work toward the withdraw of consumption advisories?

Any of the following:

Reduce harmful power plant emissions

Replace coal power plants with more eco-friendly power suppliers

Proper recycling of compact fluorescent light bulbs (CFLs)

Proper disposal of medical supplies and waste containing mercury (ex: thermostats, auto scrap, thermometers, etc)

Establish further regulations and laws on the use of mercury

4. PCBs are another bioaccumulative pollutant found in seafood. Change the ‘Advisory Report Query’ to read *Active* again, and choose PCBs as the pollutant. How many advisories are there for Georgia?
PCBs: 136 advisories
5. Spend a few minutes investigating on your own... go back to the ‘Advisory Report Query’ page again. Leave the pollutant as mercury, but change the other dropdown boxes to search different combinations of species, meal advice, etc. In the space below write 3 things you learned that were of interest to you.
*Example: There are 2 states with advisories for the bayou – AR and LA.
6. What are your thoughts on eating seafood? Have they changed at all? How?

Activity 5: Pick a State... Any State!

The Problem: Mercury pollution is a problem in aquatic ecosystems nationwide. It is not only detrimental to wildlife, but is a dangerous problem for humans as well.

Your Task: Act as a representative of one of the 50 U.S. states. Start by choosing a state of interest to you (other than your own). Become an expert on mercury issues within that state and be prepared to educate your fellow classmates.

The Finished Product:

1. Compile all information into a written report due on: _____

Make sure to cover the following information:

- Possible sources of mercury pollution (be specific when possible)
- Details and a general overview on consumption advisories
- Impacts on the food chain as well as certain species
- Impacts on humans as consumers
- Laws, regulations, other advisories particular to that state
- Possible steps YOU would choose to take to decrease mercury pollution (don't forget the small stuff!)
- Any personal opinions on the issue of mercury pollution and its impacts on our aquatic environments

****Don't limit yourself to JUST these questions!!!****

2. Design a poster to illustrate what you would like to convey to others about the mercury issues in your state. Include facts, pictures, graphs, etc.
3. Use your poster as a guide for a short presentation to your classmates about what you learned. Come prepared to share your information to the class on the following date: _____.

Helpful Hints:

You may find the following websites to be very helpful in your research:

- United States Environmental Protection Agency - www.epa.gov
- U.S. Geological Survey - www.usgs.gov
- U.S. Food and Drug Administration - www.fda.gov
- National Resources Defense Council - www.nrdc.org
- U.S. Fish and Wildlife Service - www.fws.gov
- Fish and Wildlife Service (state)
- Department of Natural Resources (state)

Pick a State... Any State!
Sign-Up Sheet

Alabama _____
Alaska _____
Arizona _____
Arkansas _____
California _____
Colorado _____
Connecticut _____
Delaware _____
Florida _____
Georgia _____
Hawaii _____
Idaho _____
Illinois _____
Indiana _____
Iowa _____
Kansas _____
Kentucky _____
Louisiana _____
Maine _____
Maryland _____
Mass. _____
Michigan _____
Minnesota _____
Mississippi _____
Missouri _____
Montana _____
Nebraska _____
Nevada _____
New Hamp. _____
New Jersey _____
New Mexico _____

New York _____
N. Carolina _____
N. Dakota _____
Ohio _____
Oklahoma _____
Oregon _____
S. Carolina _____
S. Dakota _____
Tennessee _____
Texas _____
Utah _____
Vermont _____
Virginia _____
Washington _____
W. Virginia _____
Wisconsin _____
Wyoming _____