

Title: <b>Trout to Die For</b>		
Overview:	At the conclusion of this lesson students will be able to <ul style="list-style-type: none"> <li>• Access and make use of Maryland fish advisory data.</li> <li>• Explain that water quality, specifically the levels of toxic chemicals, has a direct effect on human health</li> </ul>	
Grade:		
Standards	NGSS	<ul style="list-style-type: none"> <li>• MS-ESS3-1 - Apply scientific principles to design a method for monitoring and minimizing human impact on the environment</li> </ul>
	Core Idea	Earth and Human Activity
	Practices	<ul style="list-style-type: none"> <li>• Engaging in argument from evidence</li> <li>• Obtaining, evaluating, and communicating information</li> </ul>
	Cross-Cutting Concepts	<ul style="list-style-type: none"> <li>• Cause and effect</li> </ul>
	Reading, Writing and Social Studies	<ul style="list-style-type: none"> <li>• CCSS.ELA/Lit. RI.6-8.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</li> <li>• CCSS.ELA/Lit.SL.6-8.1 - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.</li> <li>• CCSS.ELA/Lit.W.6-8.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.</li> </ul> <p>Maryland State Standards - Health – Grade 6</p> <ul style="list-style-type: none"> <li>• E.1 - Evaluate media messages related to disease/disease prevention</li> <li>• E.1.a - Describe the impact of media messages on disease control.</li> </ul>
	Environmental Literacy	<ul style="list-style-type: none"> <li>• 1.A.1 - Identify an environmental issue</li> <li>• 1.B.3 – Analyze the effectiveness of the action plan in terms of achieving the desired outcomes.</li> <li>• 6.A.1 – Identify and describe natural changes in the environment that may affect the health of human populations and individuals</li> <li>• 7.C.1 – Investigate cultural perspectives and dynamics and apply their understanding in context.</li> </ul>

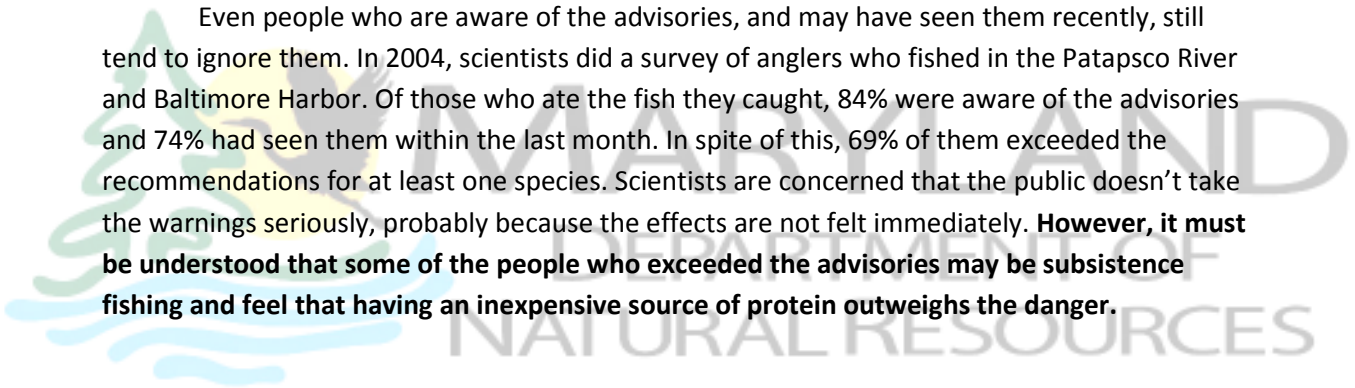
	Description	Resources
Engage	<p>Show students the fever thermometer. Ask them to notice the color of the column; do they remember what color it used to be? Why is it different now?</p> <ul style="list-style-type: none"> <li>• Ask students if they have heard or read anything about eating swordfish or tuna. <i>Some of them might say that you should not eat them because they are going extinct.</i> Is there another reason? <i>They may be aware of mercury contamination.</i></li> <li>• Tell them that the half gram of mercury contained in a mercury fever thermometer is enough to contaminate nearly 3,000 six-ounce cans of tuna with 1 ppm (parts per million) mercury, the EPA maximum.</li> </ul> <p>Ask students if any of them go fishing. Where? Do they eat what they catch?</p>	Fever thermometer
Explore	<p>Ask students if they think that Maryland fish are safe to eat? <i>Students might say it depends on where the fish were caught.</i> Where could they go to find out? Tell the students that they are going to do an investigation to answer these questions.</p> <ul style="list-style-type: none"> <li>• Divide the students into teams depending on how many computers are available.</li> <li>• Give the students a copy of the Student Background Information and Student Worksheet. <ul style="list-style-type: none"> <li>○ Tell them that the information they need to access the data will be found on the worksheet.</li> <li>○ They are to use the data and the background information to answer the questions.</li> </ul> </li> </ul>	<p>Student worksheet</p> <p>Student Background Information</p> <p>Computers with Internet access</p>
Explain	<p>Review the Student Worksheet. <i>Teacher answer page is provided</i></p> <ul style="list-style-type: none"> <li>• Have students write a paragraph answering the questions: <ul style="list-style-type: none"> <li>○ Were they surprised to find out that there are consumption advisories for trout?</li> <li>○ Were they surprised that there were advisories for fish in what would seem to be a “clean” stream?</li> </ul> </li> </ul>	
Extend	<ul style="list-style-type: none"> <li>• Give the students the Student Worksheet Part Two and have them work individually or as a group to create a sign, poster, TV commercial or newspaper article/advertisement to make anglers take the fish consumption advisories more seriously. <ul style="list-style-type: none"> <li>○ You might want to have a discussion beforehand as to which medium the students think would be most effective.</li> <li>○ Have students share their finished work</li> <li>○ They could do the project focusing on the Antietam River or if your students live near an area where there are fish advisories, they might want to consider doing this as a local community service project.</li> </ul> </li> <li>• Have students look at the fish consumption advisories to see if there are advisories for other fish in Antietam Creek.</li> <li>• Use a county map (ADC maps are great) of Washington County</li> </ul>	<p>Student Worksheet Part Two</p> <p>County ADC maps</p>

	and have the students trace the Antietam River (Note: On many maps it is called Antietam Creek). Have them hypothesize where the PCBs might be coming from. <i>They should notice that the river flows through the city of Hagerstown and past several industrial parks.</i>	
Evaluate		

### Teacher Background

People who read newspapers or watch TV may be aware of the warnings about consuming certain fish (usually large oceanic fish like swordfish and tuna) because of mercury contamination. But many of these same people are not aware that similar advisories exist for fish caught in Maryland – even trout. These advisories offer recommendations concerning safe consumption for certain fish species in certain waters. Often people who are vaguely aware of these advisories are lacking specific information.

Even people who are aware of the advisories, and may have seen them recently, still tend to ignore them. In 2004, scientists did a survey of anglers who fished in the Patapsco River and Baltimore Harbor. Of those who ate the fish they caught, 84% were aware of the advisories and 74% had seen them within the last month. In spite of this, 69% of them exceeded the recommendations for at least one species. Scientists are concerned that the public doesn't take the warnings seriously, probably because the effects are not felt immediately. **However, it must be understood that some of the people who exceeded the advisories may be subsistence fishing and feel that having an inexpensive source of protein outweighs the danger.**



## **Toxic Chemicals – Background Information for Teachers**

Contaminants such as chlordane, polychlorinated biphenyls (PCBs), and mercury have been found in various fish species in certain rivers throughout the watershed. To ensure the continued good health of the Chesapeake Bay watershed's citizenry, Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia issue fish consumption guidance for certain fish species in certain waters within their states, including portions of the Chesapeake Bay watershed. Some fish consumption advisories are issued to protect the general public while others are issued to protect the sensitive populations such as women of childbearing age, nursing mothers, pregnant women, and children.

Long-lasting contaminants, such as PCBs, DDT and mercury, build up in your body over time. Eating contaminated fish can result in the buildup of these chemicals in your body, so it is important to keep your exposure as low as possible. It may take months or years of regularly eating contaminated fish or game to build up amounts of contaminants in your body to pose a health concern.

Health problems that may result from the contaminants found in fish range from small changes in health that are hard to detect to birth defects and cancer. Mothers who eat highly contaminated fish before becoming pregnant may have children whom are slower to develop and learn. Women beyond their childbearing years and adults face fewer health risks from contaminants than children do. People in this group should follow their local or national advisory to reduce their total exposure to contaminants.

### **Where do the chemicals come from and how do they get into the fish?**

Some chemicals like PCBs are associated with industrial activity, whereas others such as chlordane are associated with residential or farming activity. Some enter the water from runoff over the land and some are deposited by the air or by a point source. Instead of degrading over time, these long-lived chemicals bind to sediment in the water. Sediment dwelling organisms can be exposed to and accumulate the contaminants in their bodies as they live and feed along the bottom. The chemicals are then passed along to the larger fish that consume them.

How much of a chemical a fish will accumulate depends on:

- Fat content of the fish- many chemicals accumulate in fat, so fish with more fat will have more chemical accumulation
- The type of fish - fish that feed along the bottom will usually have higher contamination levels than species that do not have such consistent contact with sediment
- Age of the fish - older, larger fish usually have higher contamination levels than younger, smaller fish because they have had a longer time to accumulate them.

There are many sources of mercury to the environment, both natural and human-related. Natural sources include volcanoes, natural mercury deposits, and volatilization from the ocean.

The primary human-related sources include coal combustion, waste incineration, and metal processing.

Exposure to mercury causes neurological damage which is especially severe in fetuses and young children. It can also cause kidney damage, respiratory failure and death.

Chlordane was used on corn, citrus, deciduous fruits and nuts, vegetables; for home, garden and ornamentals; lawns, turf, and roadsides. It was applied directly to soil or foliage to control a variety of insect pests including parasitic roundworms and other nematodes, termites, cutworms, chiggers, and leafhoppers. The only commercial use of chlordane products still permitted is for fire ant control in power transformers.

Short-term: EPA has found chlordane to potentially cause the following health effects when people are exposed to it at levels above the MCL (Maximum Contaminant Level – the maximum permissible level of a contaminant in water which is delivered to any user of a public water system) for relatively short periods of time: central nervous system effects - including irritability, excess salivation, labored breathing, tremors, convulsions, deep depression - and blood system effects such as anemia and certain types of leukemia. Long-term: Chlordane has the potential to cause the following effects from a lifetime exposure at levels above the MCL: damage to liver, kidneys, heart, lungs, spleen and adrenal glands; cancer.

There are no natural sources of PCBs. Because they don't burn easily and are good insulating materials, PCBs have been widely used as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in October 1977 because of evidence that PCBs build up in the environment and cause harmful effects. Consumer products that may contain PCBs are old fluorescent lighting fixtures, electrical devices or appliances containing PCB capacitors made before PCB use was stopped, old microscope oil, and hydraulic fluids.

Although PCBs are no longer made in the United States, people can still be exposed to them. Many older transformers and capacitors still contain PCBs. These transformers can be used for 30 years or more. Old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, made before PCB use was stopped may contain PCBs. When these electric devices get hot during operation, small amounts of PCBs may leak into the air and raise the level of PCBs in indoor air.

The two main sources of exposure to PCBs are from the environment and from the workplace. PCBs are found throughout the environment and remain there a very long time. Small amounts of PCBs can be found in almost all outdoor air, in indoor air, on soil surfaces, and in surface water.

Skin irritations, such as acne and rashes, can occur in people exposed to PCBs. Studies in the workplace suggest that exposure to PCBs may also cause irritation of the nose and lungs. The EPA has determined that PCBs are probable human carcinogens.



## Fish to Die For – Part One

You live in a rural area just north of the Potomac River in Western Maryland and you love to go fishing. You usually fish in a beautiful tributary of the Potomac called the Antietam River which is within walking distance of your house. You are especially proud of the fact that your family (your mom, dad and five-year-old sister) enjoys eating the fish you catch – often trout. During the summer, you may eat fresh fish several times a week.

One summer day you have a friend visiting and you suggest going down to the river to see if you can catch some trout for dinner. Your friend is from Baltimore and says there's no way he'd ever eat something that came out of Baltimore Harbor. You tell him he doesn't have anything to worry about. After all, this is a rural area and not a city and besides, you and your family have been eating fish from the river for years and nobody has ever gotten sick. But just to make him feel better, you agree to go on the Internet and see if you can find out if the fish are safe to eat.

- You decide to start with the Maryland Department of the Environment website: [http://www.mde.state.md.us/programs/Marylander/CitizensInfoCenterHome/Documents/Fish%20Consumption%20Docs/Maryland\\_Fish\\_Advisories\\_2014\\_Web\\_bluedit.pdf](http://www.mde.state.md.us/programs/Marylander/CitizensInfoCenterHome/Documents/Fish%20Consumption%20Docs/Maryland_Fish_Advisories_2014_Web_bluedit.pdf)
- You can also use a search engine and enter “Maryland fish consumption advisories”

Either way, check out the chart. Which one of you was right? Explain your answer.

Using the chart and background information, answer the following questions.

- Your family consists of you, your dad and mom and your five-year-old sister. If your entire family eats the fish you catch, how does this affect the number of trout that are safe to eat?
- What are the contaminants in the Antietam River? What possible health risks are you facing if you continue to eat the fish?
- Your family has been eating trout from the Antietam River for years and none of you has gotten sick. Should you continue to eat the fish even though no one has gotten sick?

## **Fish to Die For – Part Two**

Scientists did a survey of anglers who caught and ate fish and found that more than 75% were aware of the advisories. In spite of this, many people continued to eat more than the recommended number of meals. **However, for some people, having an inexpensive source of protein outweighs the danger. This is called subsistence fishing.**

Your job – create a sign to be posted at fishing spots, a newspaper/magazine advertisement or article, or a television commercial that will get people's attention and will be effective in getting the message across.





## **Fish to Die For – Student Background Information**

Fish are not the only things that have to deal with water quality issues; people who eat the fish may also be affected. For humans, the water quality issue that is most important is the presence of toxic chemicals. In Maryland, these chemicals are most likely to be mercury, PCBs and pesticides. Unfortunately, these chemicals do not break down; once they enter the water, they bind to the sediments. Bottom dwelling organisms are exposed to these chemicals and accumulate them in their bodies; the chemicals are then passed on up the food chain. How much of a chemical a fish will accumulate depends on:

- The age of the fish – older, larger fish usually have higher contamination levels because they have a longer time for the chemical to build up in their bodies and because they often are higher up on the food chain.
- The type of fish – fish that feed on the bottom, like catfish, usually have higher contamination levels because they are exposed to the sediments.

Mercury gets into the environment from both natural sources, such as volcanoes and natural mercury deposits, and from man-made sources, such as the burning of coal, waste incineration, and metal processing. Exposure to mercury causes severe damage to the central nervous system, especially in fetuses, infants and young children. It can also cause kidney damage and respiratory failure.

Pesticides, especially chlordane, were applied to soil or plants to control a number of pests, such as roundworms, termites and chiggers. Exposure to chlordane, even for short periods of time, causes damage to the central nervous system (trembling, irritability, and depression), and blood system (anemia and leukemia – a type of cancer). Long term exposure causes damage to the liver, kidneys, heart, lungs and spleen, and may cause cancer. Because of the serious health effects, chlordane has been banned for most uses.

PCBs, or polychlorinated biphenyls, are chemicals that are strictly man-made. They were widely used to cool or lubricate electrical equipment. They are no longer made in the US, but can still be found in old fluorescent light fixtures and old appliances like refrigerators and TVs. Small amounts of PCBs can be found in almost all air, water and soil samples. Scientists agree that PCBs probably cause cancer.

Many fish worldwide have been found to contain varying amounts of these toxic chemicals. In order to protect human health, Maryland issues fish advisories, telling people what species of fish from certain areas are safe to eat and which ones to avoid. They also give advice on how many meals of certain fish species should be eaten over the course of a year.

## Teacher's answers

Using the chart and background information, answer the following questions.

- Your family consists of you, your dad and mom and your five-year-old sister. If your entire family eats the fish you catch, how does this affect the number of trout that are safe to eat?

*You and your dad can eat more meals of trout than your mom or sister should. But since your entire family eats the same thing, your family should eat the number of meals that are recommended for children, until your sister is six years old. Then you should eat the number of meals recommended for women.*

- What are the contaminants in the Antietam River? What possible health risks are you facing if you continue to eat the fish?

*The contaminants in the Antietam River are PCBs. Long term exposure to PCBs may cause cancer.*

- Your family has been eating trout from the Antietam River for years and none of you has gotten sick. Should you continue to eat the fish even though no one has gotten sick?

*You should definitely start to follow the fish consumption advisories. It may take years for enough PCBs to build up in your body to cause cancer.*

