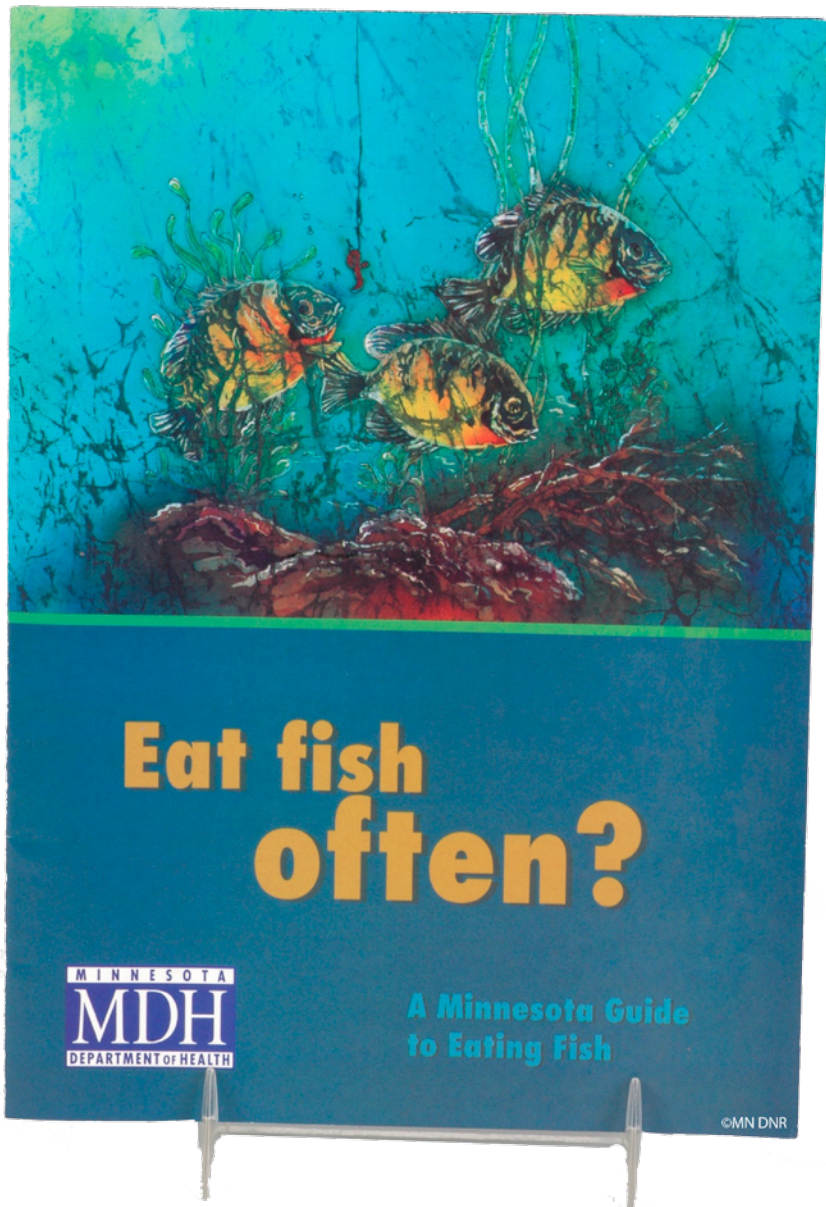


Eating Fish

Fish: good food for your brain



Minnesota Department of Health fish consumption guidelines brochure.

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Please note: Academic Standards are updated regularly and our alignments will be updated on the DNR Academic Standards Website at: www.mndnr.gov/education/teachers/edstandards_intro.html

Eating Fish

Minnesota Academic Standards

- 👁 Lesson *introduces* this Benchmark.
- 👁 Lesson *partially* addresses this Benchmark.
- 👁 Lesson *fully* addresses this Benchmark.

Language Arts

Grades 3, 4, 5

I. Reading and Literature

B. Vocabulary Expansion:

Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading. 👁 (Fully addresses Benchmark if computer research is completed, otherwise partially addresses Benchmark.)

History and Social Studies

Grade 4-8

V. Geography

D. Interconnections

Benchmark 2—Students will analyze how the physical environment influences human activities. 👁

Science

Grade 3

IV. Life Science

C. Interdependence of Life

Benchmark 2—The student will know that changes in a habitat can be beneficial or harmful to an organism. 👁

Grade 4

III. Earth and Space Science

A. Earth Structure and Processes:

Benchmark 1—The student will identify and investigate environmental issues and potential solutions. 👁

Grade 5

IV. Life Science

F. Flow of Matter and Energy:

Benchmark 2—The student will use food webs to describe the relationships among producers, consumers, and decomposers in an ecosystem in Minnesota. 👁

Environmental Literacy Scope and Sequence

Benchmarks

- Social and natural systems are made of parts. (PreK-2)
- Social and natural systems may not continue to function if some of their parts are missing. (PreK-2)
- When the parts of social and natural systems are put together, they can do things they couldn't do by themselves. (PreK-2)
- In social and natural systems that consist of many parts, the parts usually influence one another. (3-5)
- Social and natural systems may not function as well if parts are missing, damaged, mismatched or misconnected. (3-5)
- For the full Environmental Literacy Scope and Sequence, see:
www.seek.state.mn.us/eemn_c.cfm

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Chapter 6 • Lesson 5

Eating Fish

Grade Level: 3-5

Activity Duration: Part 1: 15 minutes

Part 2: 15 minutes

Part 3: 60 minutes

Group Size: any

Subject Areas: Health and Safety, Language Arts, Social Studies, Science

Academic Skills: application, comparison, drawing conclusions, listening, measuring, observation, researching, simulation

Setting: Part 1: indoor or outdoor gathering area

Part 2: computer lab

Part 3: kitchen with stove

Vocabulary: bioaccumulation, biomagnification, fish advisory, mercury, omega-3s, parts per billion (ppb), PCBs, risk

Internet Search Words: eating fish, Minnesota Department of Health Fish Consumption Advice, nutrition and fish, omega-3s, protein; on the Minnesota DNR website: search on Lake Finder and then by individual lake

Instructor's Background Information

In China, some people believe that eating fish makes wishes come true. In Celtic mythology, eating fish bestows infinite knowledge. What are the myths and facts about eating fish?

The foods we eat do influence our health. The October 18, 2006 issue of *Journal of the American Medical Association (JAMA)* includes an important article about the benefits of eating fish. It states that fish is an excellent source of protein that is low in saturated fats, and that fish is also rich in other nutrients such as minerals and vitamins. Fish is not only packed with protein, healthful vitamins such as Vitamin D, and minerals such as selenium, but it is a major source of omega-3 fatty acids.

The Power of Protein

Neil Osterweil, an award-winning medical writer and Senior Associate Editor of *MedPage Today* in his article, "The Benefits of Protein," (see (www.webmd.com/content/article/85/98824.htm)) reports that: "protein is an important component of every cell in the body. Hair and nails are mostly made of protein. Your body uses protein to build and repair tissues. You also use protein to make enzymes, hormones, and other body chemicals. Protein is an important building block of bones, muscles, cartilage, skin, and blood. Along with fat and carbohydrates, protein is a 'macronutrient,' meaning that the body needs relatively

Summary

The American Heart Association recommends two servings of fish per week. Fish are a nutritious source of low-fat protein and omega-3s and provide many health benefits. Pollution in lakes, rivers, and streams can impact fish. Fish containing pollutants may pose some risk to people, but we make choices about balancing risks and benefits every day. What should you do? Gather information and assess it effectively. Studies show that the benefits of eating fish outweigh the risks as long as the fish are low in contaminants. In this lesson, the instructor demonstrates using a recipe and cooking fish. Students will taste the fish.

Student Objectives

The students will:

- 1 List three nutritional benefits of eating fish.
- 2 List two pollutants that can impact fish, explain how each gets into water and can impact fish, and state a reason for each to explain how this can pose a risk for people.
- 3 Define risk, understand that hazards and risks occur daily in our lives, and identify three ways to reduce some risks associated with eating contaminated fish, including gathering and assessing information.
- 4 State the American Heart Association's recommended amount of fish to include in a healthful diet for the general population.
- 5 Observe a filleting demonstration that also

highlights removal of fat, participate in a cooking demonstration, and taste fish!

Materials

Part 1: Bioaccumulation

- Six name tags
- Six one-gallon sized ziplocking bags
- One large bag of popcorn
- Permanent marker, for writing on name tags and plastic bags

Part 2: Fish Advisory

- **Fish Consumption Report for Sleepy Eye Lake**, one per student or group
- **Safe Eating Guidelines** Sheet or “Eat Fish Often?” brochures from the Minnesota Department of Health
- Computer with Internet access

Part 3: Filletting, Cooking, and Tasting

- Video, *Landing and Caring for the Catch* (15:22), optional (available through the MinnAqua Program)
- **Basic Filletting Sheet**, one per student
- Whole fish (fresh is best, thawed okay)
- Sharp fillet knife
- Cutting board
- Table covering
- Fabric butcher gloves—helps with gripping and holding fish while filletting (optional)
- Plastic bag for garbage
- Paper towels
- Cooking pans, waxed paper, aluminum foil
- Ingredients for fish strips (6 fish fillets, 2 eggs, 1 cup bread or cracker crumbs, ½ cup butter or margarine)
- **Fish Recipes Sheet**, one per group
- Crackers and napkins (for serving fish)

large amounts of it. (Vitamins and minerals, which are needed in only small quantities, are called ‘micronutrients.’) Unlike fat and carbohydrates, the body does not store protein, and therefore has no reservoir to draw on when it needs a new supply.” (The body needs a continuous supply of protein.)

We should also be aware of some myths about protein. Osterweil continues, “We’ve all heard the myth that extra protein builds more muscle. In fact, the only way to build muscle is through exercise. Bodies need a modest amount of protein to function well. Extra protein doesn’t give you extra strength.”

And according to the U.S. Department of Health and Human Services:

- Teenage boys and active men can get all the protein they need from three daily servings for a total of seven ounces.
- For children age two to six, most women, and some older people, the government recommends two daily servings for a total of five ounces.
- For older children, teen girls, active women, and most men, the guidelines give the nod to two daily servings for a total of six ounces.

Osterweil also notes that, “Everyone who eats an eight-ounce steak typically served in restaurants is getting more protein than their bodies need.”

Fish, on the other hand, provides a healthy low-fat source of protein:

“Fish are proven to offer multiple nutritional benefits—they are high in protein, low in saturated fat and they contain many other nutrients that are important for proper growth and development.”

—Lester M. Crawford, DVM, PhD,

Acting Commissioner, U.S. Food and Drug Administration

www.fda.gov/oc/opacom/hottopics/mercury/mercuryop-ed.html

Omega-3s

Omega-3s are a group of polyunsaturated (good) fats found in foods such as flaxseed, walnuts, canola oil, and fish native to cold waters, such as salmon and trout. Omega-3s are important components of cell membranes, particularly in the brain and eyes.

A flood of recent studies have shown that eating fish routinely (once a week) can reduce the chance of death from a heart attack, heart disease, diabetes, and other chronic illnesses. This is not a myth. Omega-3s are good for healthy brain development and they can reduce the chance of heart attack. Other benefits may include: reduction in blood pressure and heart rate, warding off dementia and stroke in the elderly, and possibly guarding against dry-eye syndrome. Researchers from the Harvard School of Public Health completed a comprehensive analysis of fish and health (which appears in the October 18, 2006, issue of

The Journal of the American Medical Association). This was the first comprehensive summary of levels of omega-3 fatty acids, mercury, PCBs, and dioxins in various species of fish and other foods, including chicken, beef, pork, butter, and eggs. This research was supported by the National Institutes of Health.

The results show that the benefits of eating a modest amount of fish per week—about three ounces of farmed salmon or six ounces of mackerel—reduced the risk of death from coronary heart disease by 36 percent. Notably, by combining results of randomized clinical trials, the investigators also demonstrated that intake of fish or fish oil reduces total mortality—deaths from any causes—by seventeen percent.

Fish is one of a few foods that contains the omega-3 fatty acids needed for proper development of the brain and nervous system. For pregnant women, mothers who are breastfeeding, and women of childbearing age, fish intake is important because it supplies DHA, a specific omega-3 fatty acid product that is beneficial for the brain development of infants.

Eating fish can also boost intelligence. A Harvard University study appearing as a series of five articles in the November 2005 *American Journal of Preventive Medicine* (Joshua Cohen, lead author) showed that women who ate fish every week had children with higher intelligence scores than the children of women who did not do so. And eating fish regularly may reduce rates of Alzheimer's disease in the elderly. A 1995 study, "Fish Consumption and Cardiovascular Disease in the Physicians' Health Study: A Prospective Study," by Martha Clare Morris, JoAnn E. Manson, Bernard Rosner, Julie E. Buring, Walter C. Willett, and Charles H. Hennekens, which appeared in the *American Journal of Epidemiology* found that seniors who ate fish twice a week had a seventeen percent lower rate of mental decline than those who didn't eat fish.

So perhaps the Celtic myths about eating fish to increase knowledge aren't so very far off base! And, if you wish for good health and a longer life, Chinese tradition suggests that you eat fish to fulfill this wish.



©MN DNR, C. Iverson

Fish—particularly oily fish, such as salmon, trout, catfish and herring—is rich in omega-3 polyunsaturated fatty acids. Some potential health benefits of consuming omega-3s include:

- preventing heart disease
- reducing the effects of depression
- supporting bone growth
- reducing the risk of cancers, including breast, prostate, and colon cancers
- reducing symptoms of inflammatory and autoimmune disorders such as asthma, rheumatoid arthritis, lupus, and inflammatory bowel disease
- decreasing insulin resistance in diabetics
- warding off dementia and stroke in the elderly
- guarding against dry-eye syndrome

In the latest studies of fish-related health benefits, published in the *Archives of Ophthalmology*, researchers found that eating fish rich in omega-3s also reduces the risk of macular degeneration, the leading cause of age-related blindness. This research supports earlier findings. The strongest evidence is for benefits related to neurodevelopment and heart disease. The other benefits listed above are less certain.



Other food sources of omega-3s include flaxseed and flaxseed oil, canola oil, soybean oil, soybeans, walnuts, walnut oil, and purselane, a green leafy plant. Eggs high in omega-3s are also available in grocery stores—they come from flaxseed-fed hens. These are sources of ALA (alpha-linolenic acid). Fish contain DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid). ALA may be converted into DHA and EPA when ingested from food sources, but the process is inefficient.

Is There a Catch?

You may have seen news reports about fish containing high levels of contaminants such as mercury, PCBs, and other substances. In a world where we increasingly know more and more about what we eat, it can be hard to decipher what's good for you and what you should avoid—and many people want to know if eating fish poses health risks.

Most people understand that risk is a normal part of everyday life. For starters, driving, storms, swimming, bungee jumping, mowing the lawn, walking to school, stepping into the shower, skateboarding, snowboarding, and biking involve risk. Is anything 100 percent risk-free? It makes sense to develop assessment and decision-making skills to help determine whether the risks associated with an activity or event outweigh any benefits or pose a serious concern.

What is risk? **Risk** is the likelihood or probability that a harmful consequence will occur as a result of exposure to a health or safety hazard. We make decisions every day that weigh the possible negative or harmful consequences against positive consequences or benefits.

In order to evaluate risk in an effective way, it's necessary to be well informed, know how to find as many facts as possible, analyze information critically, and make choices.

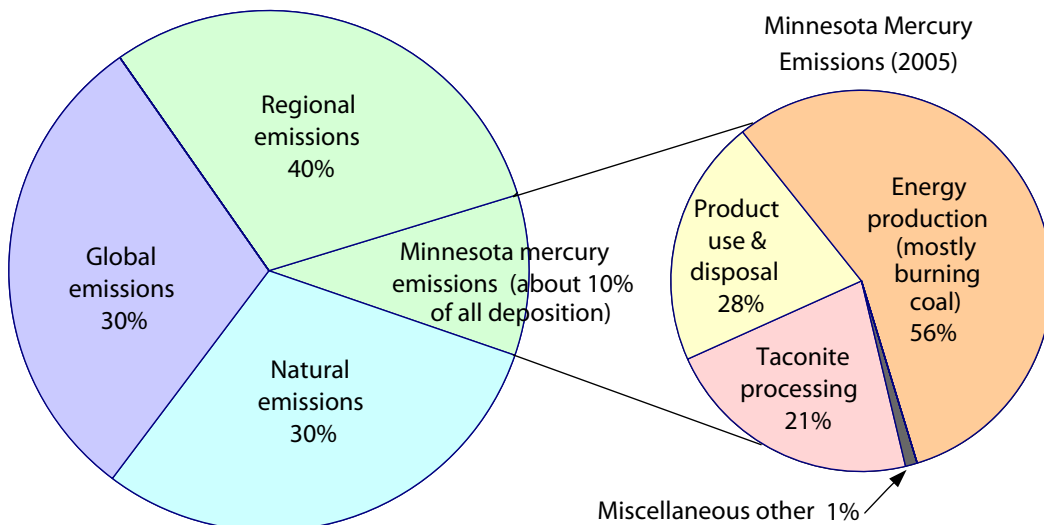
Fish acquire contaminants from their surroundings. Contaminants or pollution can reach rivers and lakes from local sources such as improperly stored wastes and abandoned dumps. If a local source of pollution is identified, it may be possible to clean it up and decrease the contamination of the lake or river. Contaminants, however, reach remote and pristine lakes from the atmosphere. Fish bought from markets and grocery stores also contain contaminants from the waters where they were caught. So it's recommended that people follow Department of Health fish consumption advisories and guidelines to reduce risk, regardless of immediate, identifiable, or potential sources of pollutants.

Minnesota fish are low in most contaminants tested, but mercury warrants some closer attention. Generally, most people do not eat enough fish for mercury to be an issue. The risk is somewhat greater for pregnant women, nursing mothers, and young children but, although there is a greater risk in those demographics, the health benefits of eating fish are not to be neglected, either. To weigh the benefits and risks of eating fish, become informed by gathering facts—then manage the risk. Managing risk involves finding ways to prevent or reduce harmful consequences and deciding whether or not it is worthwhile to do so. By choosing to eat fish low in mercury you can get the benefits of eating fish and reduce the risks from exposure to mercury.

Mercury

How does mercury get into fish? **Mercury** is a naturally occurring metal in the earth's crust and it's found in coal and many other rocks. Although some mercury occurs naturally in the environment, most of the mercury that enters Minnesota waters is first released into the air as a result of burning coal and other fossil fuels. Mercury is also released from wastes containing household and industrial mercury. Released mercury travels and cycles between soil, water, and air. When it rains, mercury enters water and soil, often far from its original source.

Sources of Atmospheric Mercury Deposition to Minnesota



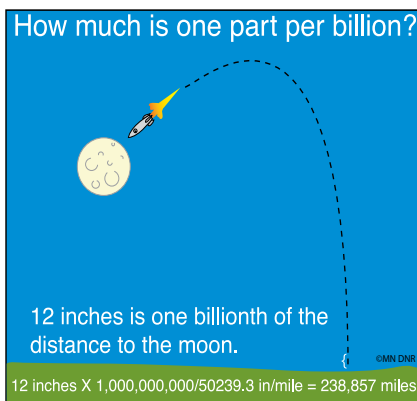
©Minnesota Pollution Control Agency

Once in the water, bacteria convert mercury to methylmercury. This is the form of mercury that enters the tissue of fish and shellfish. Large amounts of mercury may harm the human nervous system. As people absorb or ingest toxic levels of mercury, and the levels of the contaminant increase, the ability to walk, speak, see, and hear can also be affected in subtle ways. Too much exposure to mercury may affect a child's ability to learn and process information. The fish consumption guidelines and advisories issued by the Minnesota Department of Health are intended to keep the quantity of mercury in the human body below levels that damage the nervous system.

Methylmercury gets into fish through the food they eat. The longer a fish lives and the larger it grows, the more contaminants it ingests. **Bioaccumulation** occurs when a chemical builds up in the body and the concentration is higher inside the body than in the environment outside of the body.

Another reason why larger fish accumulate more contaminants than smaller fish is due to **biomagnification**, when the chemical accumulates in animals higher up in the food chain that have eaten animals with

high concentrations of the chemical in their bodies. Biomagnification can be illustrated by a food chain. Small organisms in the water filter plankton for food from the water, and through this process they also take in very low concentrations of methylmercury. Larger organisms in the aquatic food web eat these small organisms with their accumulated methylmercury. Small fish eat the small organisms, too, and larger fish eat smaller fish. Once ingested, methylmercury is tightly bound to proteins in the cells of all fish tissue, including muscle, where it continues to accumulate. This means that, with each step up the food chain, the amount of methylmercury increases. The tiny organisms are eaten by smaller fish, which are eaten by medium-sized fish, which are then eaten by larger fish, and the amount of mercury is biologically amplified in increasing concentrations higher up the food chain. This phenomenon is called biomagnification.



Mercury levels are measured in parts per billion (ppb).

In his book *How Much is a Million?* David M. Schwartz says: “How big is a billion? If a billion kids made a human tower, they would stand up past the moon. If you sat down to count from one to one billion, you would be counting for 95 years. If you found a goldfish bowl large enough to hold a billion goldfish, it would be as big as a stadium.”

Managing Risk

Mercury is found in all fish tested from Minnesota lakes, most often at a level safe for human consumption. It may take months or years of frequent fish eating for people to accumulate levels that are a health concern. You can reduce your risk levels further by eating smaller fish. Larger, older, and predatory fish pose the highest risk levels. Smaller fish (and younger fish) and those species lower on the food chain don't have an opportunity to accumulate as much mercury in their bodies as larger predatory fish. Eating a variety of types of fish also further reduces risk.

Government guidelines advise eating a balanced diet that includes a variety of fish, and smaller fish, but there are no specific U. S. Food and Drug Administration (FDA) recommendations on limits for older children and other adults. Mercury levels in fish are typically measured in **parts per million** or **ppm**. Certain people, such as children (under age 15), and women who are or may become pregnant are more sensitive to mercury and should take some precautions and limit the quantity and types of fish that they eat.

The U. S. Environmental Protection Agency and the FDA have advised that it is, in fact, prudent for pregnant women, nursing mothers, women who may become pregnant, and young children to continue eating fish—but to simply to avoid those fish that contain higher levels of mercury.

There is good news concerning mercury emissions in Minnesota. Human-caused emissions of mercury have dropped more than 45 percent since 1990. Government regulations now limit the amount of mercury used in batteries and paint, and require increased pollution controls for municipal waste combustion and medical waste incineration. A further step, taken in March 2005, was to reduce emissions from coal-fired electric power plants. Under a compromise agreement, legislation passed into law in May 2006 requires Minnesota's largest coal-fired power plants to cut mercury emissions by 90 percent by 2015. This legislation exceeds the federal

government requirement of a 70 percent reduction by 2018. Reducing mercury emissions that come from burning fossil fuels is a step in the right direction in decreasing levels of mercury contaminants in lakes and rivers—although 90 percent of the mercury that accumulates in Minnesota fish comes from sources outside the state.

Although the levels of mercury released into our atmosphere in the U.S. has been reduced, the levels of mercury found in fish has shows an increase in the past decade. A recent study published by the Minnesota Pollution Control Agency describes this trend: “Regression analysis of the 25-year record of mercury concentrations in standardized length predator fish has shown a trend reversal, from downward to upward, in the early to mid-1990s. Furthermore, a pairwise comparison of years within lakes indicates 60% of the lakes had decreasing SPFHg (mercury levels) before 1995 and 60% were increasing after 1995. Despite the plausible mechanisms for increased bioavailability caused by changing climate, there is no evidence of an explicit trend shift in the factors associated with changing climate that, by themselves, could explain the trend reversal of SPFHg. Causes of the trend reversal may include delayed responses and additive effects from multiple factors. Changes in mercury deposition and climate could combine to give the observed trend reversal of mercury concentrations in fish.”

—**Trend Reversal of Mercury Concentrations in Piscivorous Fish from Minnesota Lakes: 1982#2006**

Bruce A. Monson

Environ. Sci. Technol., Article ASAP • DOI: 10.1021/es8027378 Publication

Date (Web): 09 February 2010

Downloaded from <http://pubs.acs.org> on February 10, 2010

Even as we reduce our mercury emissions locally and eventually globally, mercury never goes away, the amount of mercury already on the planet will continue to cycle forever.

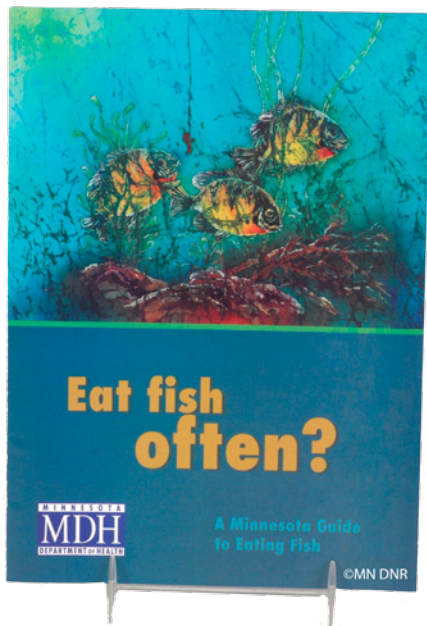
The ABCs of PCBs

Polychlorinated biphenyls, or **PCBs**, are found mainly in Lake Superior and major rivers such as the Mississippi River. These synthetic oils once had many industrial uses and are still found in electrical transformers, cutting oils, and carbonless paper. Although banned in 1976, they don't decompose easily and remain in the water and lake sediments for many years. PCB levels in Minnesota waters are slowly decreasing.

Why are PCBs a concern? PCBs bioaccumulate, just as methylmercury does, but rather than accumulating throughout all fish tissues, PCBs are soluble in fat, so they accumulate in the fatty tissues of fish. Consumption advice for PCBs is meant to protect children from developmental problems linked to high levels of PCB exposure. High exposure to PCBs also cause changes in the blood, liver, and immune functions of adults. They've been shown to cause cancer in laboratory animals and may cause cancer in humans.

“It makes sense to be concerned about mercury in our environment and to reduce human-caused emissions. But it makes just as much sense to continue eating fish.”

—Patrick Moore,
co-founder of Greenpeace and
environmental movement leader,
PhD (Ecology);
B.S. (Forest Biology)



Managing Risk

Fish absorb fat-soluble chemicals like PCBs from water, suspended sediments, and food. And again, because PCBs concentrate in the fat tissue of fish, they accumulate in greater amounts in fatty fish such as carp and catfish. To reduce risks posed by PCBs, it is recommended that you remove the fat when you clean or fillet your fish. Larger, older fish and fish that eat other fish accumulate more contaminants than smaller, younger fish that have eaten fewer contaminated prey. Eating smaller fish also reduces risks posed by PCBs and other types of contaminants. In Minnesota, the levels of these chemicals (including PCBs and dioxins) in fish, including farmed fish, are significantly lower than safety guidelines and similar to levels in meats and dairy products. When compared with the health benefits of eating fish, the health risks posed by these chemical levels are very low, and shouldn't deter people from eating a healthful diet that includes fish. Consult the Minnesota Department of Health fish consumption advice for eating guidelines for fish caught in the lakes where you fish.

Staying Informed

Overall, the health benefits of eating fish greatly outweigh the potential risks—especially when up-to-date research information and recommended consumption guidelines are used to further reduce the probability (likelihood of occurrence) of being affected by these risks.

The Minnesota Department of Health publishes a **fish consumption advice** report, which provides guidelines on choosing fish people can safely consume with minimal risks from contaminants. Fish consumption advice is available online at www.health.state.mn.us or in *Eat Fish Often?* a brochure issued by the Minnesota Department of Health at 651-201-4911 or 1-800-657-3908. The Minnesota Department of Health provides two types of advice on how often fish can safely be eaten:

- **Statewide Safe Eating Guidelines**—General guidelines for the entire state to help you decide if you and your family need to make changes in your fish-eating habits.
- **Site-Specific Advice**—Detailed consumption guidelines for lakes and rivers where fish have been tested for contaminants can be found by accessing the DNR Lake Finder at <http://www.mdnr.gov/lakefind/fca/index.html>. The information found on Lake Finder provides site-specific advice and consumption guidelines for lakes and rivers where fish have been tested for contaminants, and is compiled directly from the Minnesota Department of Health Fish Consumption Advice.

These consumption guidelines are also searchable by lake on the Lake Finder feature of the Minnesota DNR website.

Fish consumption advice is published so people can reduce risks, make informed decisions about where they get their fish, find out which

species, sizes, and quantities to eat, and find consumer advice on how to select fish to maximize its benefits. They explain how certain pollutants can affect animals and people, and underline the importance of preventing pollution. Informed citizens have access to facts that enable them to make better decisions for themselves and the environment.

For further information on good nutrition and the benefits of eating fish, see:

- Food and Drug Administration
Food Safety Information Line
888-SAFE-FOOD
www.fda.gov
- American Heart Association
www.americanheart.org
- American Dietetic Association
www.eatright.org

Look for fish consumption information from the Minnesota Department of Health and the American Heart Association to best assess your risk. With good information, you can make good decisions. The consumption guidelines are based on the contaminant level measured in fillets of particular species of fish taken from particular lakes for your risk category.

Fish—particularly fatty or oily fish—is nutritious and healthful for the general population. As experts say, eating fish once or twice a week is good for our health as long as the fish are low in contaminants.

Do eat fish—but eat smaller fish and a variety of fish. Become aware of nutrition and fish consumption advice, and eat what’s most healthful for you!

Although eating fish may not make all your wishes come true, as in Chinese tradition, or give you the infinite knowledge promised by the Celtic myth, there’s no question that fish is good for you—and for your brain! Including fish as a recommended part of a nutritious diet will help you to live healthier and longer, too.

Filleting Your Catch

Cleaning and filleting is a skill. Here are some instructions to help you practice filleting.

1. Raise the pectoral fin. Lay the knife just behind the head and cut through the body cavity to the backbone.
2. Hold the fish firmly. Turn the blade nearly parallel to the backbone, and with a sawing motion, cut through the rib section toward the tail.

Filleting Tips



- Use a very sharp fillet knife. A dull knife will rip and tear the flesh. A dull knife is also a safety hazard because you will use more force and the potential for slipping is greater.
- Use a big fish at first. It’s more difficult to fillet a small fish.
- Removing the fillet from the rib cage is the most difficult step. Be very careful and go slowly.
- The fillet may not look perfect the first time you try this. Like anything else, filleting improves with practice.
- Always cut in a motion that takes the knife away from your body—and your other hand—in case the knife slips.

3. Stop at the base of the tail. It isn't necessary to cut the fillet all the way off.
4. To skin the fillet, hold the tail firmly with your fingertips and work the flat of the blade forward between the flesh and skin using a sawing motion.
5. The fillet will now have only rib bones remaining.
6. Remove rib bones by sliding the knife along ribcage.
7. Turn the fish over and repeat this procedure on the other side of the fish.
8. Cut away the dark area running the length of the fillet. (This may not be very evident on some fish species.) This is where the vein that takes blood to the tail is located—it's an area of fatty tissue. Cut a V-shaped trough around the length of the dark line and remove it.
9. Cut off any fat along the fish's back or belly.
10. Rinse the fillets in cold water. Pat them dry.
11. Put the carcasses into a plastic garbage bag and seal. Discard in the trash or bury in your garden to fertilize your flowers or vegetable crops.

Cooking Fish the Healthful Way

Fish is a tasty food favored by people from almost every culture and background. There are about a half dozen basic ways to cook fish, and once you learn them, you can cook almost any type of fish dish. Sauté, grill, bake, braise, or poach fish. Try marinating fish or sprinkling it with your favorite herbs and spices to complement and enhance its flavor. There are many good recipes for simple, delicious fish dishes.

Unhealthful or improper preparation of fish can be a health risk, though. Avoid commercially fried fish and don't choose cream sauces to serve with fish. Deep frying or serving fish with heavy fat and calorie-laden sauces can make healthful food unhealthful. Prepare fish without added saturated and trans fats. Another potential problem is undercooked fish, which can lead to parasite infections. Unless you're skilled at making sushi, make sure you cook your fish until it's flaky and tender, with no sign of translucency to the meat. To test for doneness, poke the fish with a fork at its thickest point, and check all the way through the fish. (You can poke the piece of fish that you plan to serve to yourself—or garnish it well to hide the poking!)

When it's done, enjoy!

Procedure

Preparation

Part 1

Make six name tags (three bluegills, two bass, one eagle) and collect other materials.

Part 2

- 1 Reserve the computer lab.
- 2 List one nearby lake for each pair of students.
- 3 Make one copy per student of the **Fish Consumption Report for Sleepy Eye Lake** and the **Safe Eating Guidelines Sheets**.

Part 3

- 1 Reserve the kitchen or set up a grill outdoors and collect the cooking materials and ingredients.
- 2 Make one copy per student of the **Basic Filleting Sheet** and the **Fish Recipes Sheet**.

Activity

Warm-up

The Benefits of Eating Fish and Managing Risk

- 1 Ask students if they ever go fishing. Do you eat fish? Why do we eat fish? Does your family have any traditions about eating fish? (Such as cooking fish a special way or fish dishes or meals associated with holidays.) Fish has traditionally been an important part of a healthy diet for many people around the world.
- 2 Discuss with your students the health benefits of eating fish.
- 3 Define risk for your students. (The likelihood or probability that a harmful consequence will occur as a result of exposure to a health or safety hazard.)
- 4 We make decisions every day to balance negative or harmful consequences and positive consequences or benefits. Ask the students to list everyday activities or situations that could pose a risk. Discuss the probability or likelihood for harmful consequences for each. When might you decide to take a risk? When would you decide not to take a risk?
- 5 Discuss with students that, to balance the benefits and risks of eating fish, it's important to know how to gather facts, become informed, and then manage the risk. Managing risk involves finding ways to prevent or reduce harmful consequences, as well as deciding whether or not to do so.

Lesson

Part 1: Bioaccumulation and Biomagnification

- 1 Ask students if eating fish can ever be risky. How? Brainstorm a list of reasons. There are many health benefits of eating fish. Review the



American Medical Association's recommendation for eating fish. (Two meals per week, as part of a healthy diet.)

- 2** Tell your students that, as with just about everything we do each day, there are also potential risks for eating some fish. Discuss contaminants. You may wish to discuss it in this way:
 - Sometimes, pollution in the water can get into fish. Usually, the pollution that could be in fish would not be enough to hurt us. But there is information available to help us to learn more about the risks and be aware of the pollutants that can get into fish.
 - The pollutant most often present in Minnesota fish is called mercury. Mercury is released from burning fossil fuels, such as coal, to make electricity and heat our homes. The mercury rises into the atmosphere with the smoke and then falls back to the earth when it rains. These raindrops may fall far from where they first began to develop, so sometimes mercury in Minnesota arrives from a faraway state or country. If people ingest too much mercury, it can have some harmful effects on the way that the brain and the nervous system work. Rain containing mercury can fall into lakes and rivers. It gets into the flesh of fish from the food they eat.
 - Other pollutants called PCBs are sometimes present in Minnesota fish, although they are less common than mercury. PCBs came from synthetic or manufactured oils once used as an insulator in electrical transformers. Sometimes, PCBs would end up in the environment because they leaked from old transformers or other electrical equipment and traveled with rain and snowmelt over the ground to lakes, rivers, and streams. PCBs have been banned and can no longer be used. But PCBs are still in the environment, and still end up in some fish through the food they eat. PCBs are known to hurt the development of babies and they may cause cancer in adults. PCBs collect in the fat of a fish so, unlike mercury, much of the PCB contamination can be cut away when the fish is cleaned and filleted prior to cooking and eating.
- 3** What kind of information can help reduce our risk of eating fish with contaminants? Larger fish may contain more toxins than smaller fish. Larger fish have eaten more contaminated fish than little fish have, so more contaminants may have accumulated in the bodies of larger fish. This is called biomagnification. How might this information help us reduce our risk of eating contaminated fish?
- 4** Try the following demonstration to illustrate the concept of biomagnification (you can do this outdoors or indoors):
 - Choose six volunteers from the group. Give each a name tag and a clear plastic bag. (Name tags: three bluegills, two bass, one eagle)
 - Arrange the students in the order of a food chain. (Or let the students do this themselves.)
 - Spread the popcorn on the floor or on the ground.
 - Tell the students that when you say, "Start feeding!" the

bluegills should begin picking up popcorn and putting it in their bags. When you say, “Stop,” they have to stop.

- Say, “Start!” Let the bluegills feed for 20 seconds or so. Say, “Stop!”
 - Draw a “fill line” on each bluegill’s bag—this is where the popcorn ends.
 - Now tell the bass that it’s their turn to feed. Have one bluegill pour their popcorn into a bass’s bag. Have the other two pour their popcorn into the other bass’s bag. Draw lines on the bags of the two bass.
 - Next, tell the eagle that it’s its turn to feed. Have the bass pour their popcorn into the eagle’s bag.
 - Compare the bag levels. Notice that the eagle’s bag has much more food in it than the bass’ or bluegills’ bags. If the food was contaminated with toxins like mercury, the eagle’s body would contain more contamination than the bass’ or bluegills.’ This process is called biomagnification. (You can point out that the concentration of pollutants in the water is less than the concentrations in the bluegills and eagle.)
 - Thank the volunteers and put away the props.
- 5** Managing risk (or reducing risk): Discuss with students that there are steps they can take to reduce their risk of eating fish that contain contaminants.
- Eat smaller fish. A small walleye hasn’t eaten as many fish as a bigger walleye, so it hasn’t had the chance to collect as many contaminants in its body.
 - Eat fish lower on the food chain, such as like bluegills, crappies, and perch, instead of larger predators such as walleyes and northern pike, which can accumulate larger concentrations of contaminants.
 - Trim fat from fish before you cook and eat it. Some contaminants, like PCBs, are stored in the fat. The fat on a fish is located on the back and belly, and along the dark strip through the fillet where the vein that carries blood to the tail is located. The fat looks white, like the fat on a pork chop. (If you are doing a filleting demonstration, you can show the students what the fat looks like, and demonstrate how to remove it.)
- 6** Review the health benefits of eating fish. Ask students to list at least three benefits of eating fish.

Part 2: More Ways to Reduce Risk—Finding Fish Advisory Information

- 1** Ask your students how they could find more information about the fish that they might catch on a fishing trip. Tell students about fish advisory information on the Internet, the Minnesota Department of Health website, and the Minnesota DNR website.
- 2** Hand out the **Fish Consumption Report for Sleepy Eye Lake**. Go through the symbols in the key with your class.
- 3** Have the students find partners and sit at a computer. Go to the



If computers aren’t available to your class, you can just do Steps 1 and 2.

- Minnesota DNR website: mndnr.gov
- 4 Click on Lake Finder.
 - 5 Under Find a Lake, type in a lake name and its county. You may wish to assign a lake to each group, or have them pick their own. Click on Get Lake Data.
 - 6 Click on the checkmark under Fish Consumption Advisory [MDH]. The fish advisory for that lake should appear.
 - 7 Note how the chart is broken into two sections: one for pregnant women and children and another for everyone else. Explain that fetuses and growing children are more susceptible to toxins than adults.
 - 8 Then ask the students:
 - Are there any contaminants that they might want to be aware of in their lake?
 - What are these contaminants?
 - Which fish species contain these contaminants?
 - What sizes of fish have more contaminants?
 - What is the suggested consumption limit for each type of fish?
 - 9 Ask students to discuss how this information can help them reduce risks associated with eating fish from lakes that contain contaminants. Can they list three ways to reduce risks?
 - 10 Ask students to try to locate the Fish Consumption Advice on the Minnesota Department of Health website. Then, using the Internet, locate information about the health benefits of eating fish.

Part 3: Filleting, Cooking, and Tasting

- 1 Watch the (optional) video, *Landing and Caring for the Catch* (15:22).
- 2 Tell the students you will do a filleting and cooking demonstration for the class.
- 3 Hand out the **Basic Filleting Sheet** to the students so they can follow along if they wish.
- 4 Remember to point out the steps in which you are removing fat from the fish. (PCBs accumulate in the fat deposits of the fish.)
- 5 If you have a large class, consider using a camera (such as a Scopacam) that captures a small demonstration area and projects the image to a television or large screen so that the students can see a larger projected view of the filleting demonstration.

Cooking

(You may wish to ask students to bring favorite recipes from home to use for the cooking demonstration. You can also compile a class cookbook using recipes that the students bring from home. Highlight those prepared for cultural events, holidays, or other family traditions.)

- 1 Use the fish you filleted and two others that you've filleted ahead of time.
- 2 From the **Fish Recipes Sheet**, use the Fish Strips recipe or Captain Nelson's Charcoal Broiled Salmon or Lake Trout recipe to demonstrate how to follow directions to prepare the fish according to the recipe, or use the recipes that the students have brought from home.

Or divide the students into small groups of four or five; have each try a different recipe with one fillet. (One fillet is one side of a fish.)

- 3 In a school kitchen facility, on a portable cook stove set up in the classroom or outdoors, or on a charcoal grill outdoors, demonstrate cooking the prepared fish according to directions in the recipe(s).
- 4 Hand out the **Fish Recipe Sheet** for the students to take home.

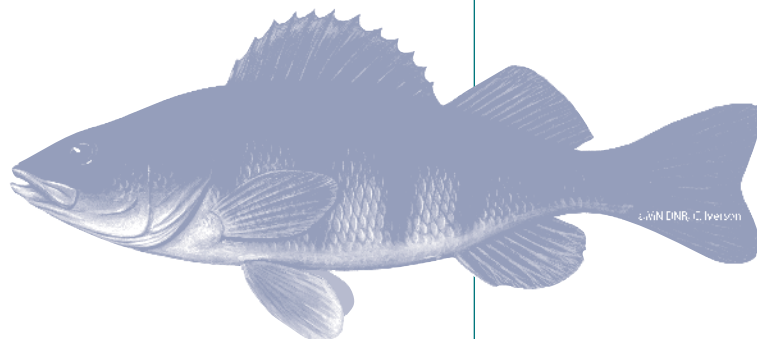
Tasting

(Have napkins and crackers available for serving fish.)

- 1 Distribute cooked fish to the students so they can taste it.
- 2 Enjoy the health benefits of eating fish!

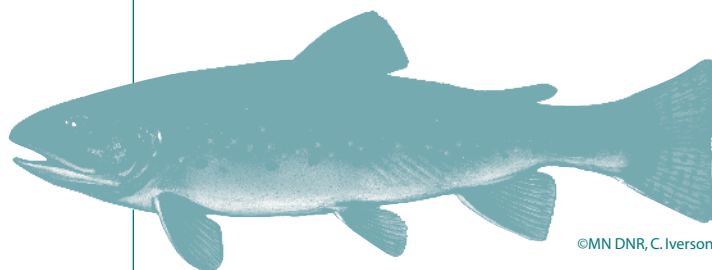
Wrap-up

- 1 Remind students that fish is a healthful food. List the health benefits of eating fish. Everyday activities present risks. Review the definition of risk. We can follow the guidelines for safe eating, just in case the fish we eat contains contaminants. This reduces risks. Send the Safe Eating Guidelines Sheet home with the students to share with their families.
- 2 Discuss the importance of reducing pollution and keeping our waters clean. What is the meaning of the saying, “Everything is connected?” Remind the students that pollution enters the water from various locations, including the air. Reducing air pollution reduces water pollution and contamination levels in fish. What does this mean for people?
- 3 How can students reduce air pollution? Students can help by using less electricity at home, by switching off unneeded lights, for example. Using less energy at home helps reduce the amount of mercury produced by power plants.
- 4 What are some other ways to reduce the amount of energy that we use? What benefits does energy provide? What are the risks of using different types of energy sources (such as coal, natural gas, hydroelectric, nuclear, oil, biofuels, and wind energy)? Can the students think of additional ways that conserving energy reduces health risks for people? Have students pledge to try one of the ideas to reduce energy use for one week, and report back to the class on how they did, the changes they made, and the impacts of those changes.
- 5 Ask students how they liked the fish. Fish tastes good—and is good for you, too!



Assessment Options

- 1** Have students name three nutritional benefits of eating fish, and identify a source of information on nutritional benefits of fish. Ask students to state the American Heart Association's recommendation for how much fish to eat as part of a healthy diet.
- 2** Locate a source for Minnesota fish consumption advisory information for a local lake (the Minnesota Department of Health website or the Lake Finder area of the Minnesota DNR website). Ask students to determine how often, in general, children under fifteen are advised to eat fish from that lake, and how often pregnant women are advised to eat fish from the lake.
- 3** Have each student write a report on mercury and PCB contaminants found in Minnesota lakes, including where contaminants come from, how they get into lakes and fish, how these contaminants pose risks to people, and three ways to reduce risks from eating fish that may be contaminated.
- 4** Have students create an informational brochure about fish consumption advisory information for three local lakes. Ask them to include nutritional benefits of eating fish, three suggestions for reducing risks of eating fish that may be contaminated, and list further sources of information. Make copies of the brochure to distribute and display (with permission) at a local bait shop, doctor's office, or lakeshore resort.
- 5** Assessment options include the Checklist and Rubric on the following pages.



Eating Fish Checklist

Possible Points	Points Earned	Points Earned	
	Student	Instructor	
3	_____	_____	Lists three healthful nutrients found in fish.
3	_____	_____	Lists three health benefits of eating fish.
1	_____	_____	Defines <i>risk</i> .
2	_____	_____	Explains how mercury and PCBs get into water.
2	_____	_____	Explains how fish get toxins such as mercury and PCBs from the food they eat, and that fish get more in of these things in their tissues as they eat more food and grow.
2	_____	_____	Explains why fish higher in a food chain can have higher levels of toxins in their tissues.
4	_____	_____	Lists two types of harmful toxins found in fish, and states one reason why each toxin is harmful to humans.
2	_____	_____	Knows that a fish consumption advisory chart tells how often it is safe to eat a meal of fish from a lake or river.
3	_____	_____	Lists three ways to further reduce health risks from eating fish contaminated with toxins (including gathering and assessing information to balance benefits and risks).
2	_____	_____	Explains that PCBs accumulate in the fatty tissues of fish, and that some fatty parts can be removed before you cook a fish.
2	_____	_____	Makes the connection that we're exposed to risks every day, and that we can evaluate risks and benefits to make decisions that are good for our health.
Total Points			
26	_____	_____	Score _____

Checklists are tools for students and instructors. Checklists involve students in managing their own learning. They help students understand and set learning goals before the lesson begins, and help them monitor their progress during the lesson, ensuring that they meet learning goals and objectives by the end of the lesson. Students can also use checklists to discover areas that may need improvement. Checklists help instructors monitor each student's progress throughout the lesson, facilitating appropriate adjustment of instruction to ensure learning by the end of the lesson. The instructor may wish to have students add several of their own learning goals to the checklist to personalize it, and to accommodate varied learning needs and styles.

Grade

24-26 points = A

Excellent. Work is above expectations.

21-23 points = B

Good. Work meets expectations.

17-20 points = C

Work is generally good. Some areas are better developed than others.

13-16 points = D

Work does not meet expectations; it isn't clear that student understands objectives.

0-12 points = F

Work is unacceptable.

Eating Fish Scoring Rubric

Eating Fish Criteria	3 Excellent	2 Good	1 Fair	0 Unacceptable
Fish nutrition: benefits of eating fish	Lists three nutritional benefits of eating fish, including: source of protein, importance of omega-3s from some fish, fish are low in fat, and reduce risk of some diseases.	Lists two nutritional benefits of eating fish, including: source of protein, importance of omega-3s from some fish, fish are low in fat, and reduce risk of some diseases.	Lists one benefit of eating fish.	Can't list nutritional benefits of eating fish.
Accumulation of toxins in fish	Defines risk and explains how mercury and PCBs get into water, how fish accumulate toxins in their tissues from the food they eat over time, and that larger fish and fish higher in a food chain can have higher levels of toxins.	Defines risk and explain show mercury and PCBs get into water, that fish get toxins from the food they eat, and that larger fish can have higher levels of toxins that smaller fish.	Explains that fish get toxins from the food they eat, and that larger fish can have higher levels of toxins than smaller fish. Or can define risk.	Can't define risk or state that fish get toxins from the food they eat, or that larger fish can have higher levels of toxins.
Reducing risks of eating fish	Lists at least three ways to reduce risks associated with eating fish, including: gathering and assessing information from nutrition data and fish consumption advisories, eating smaller fish, eating fish lower on the food chain, trimming away fat when filleting fish, cooking fish thoroughly before eating, avoiding commercially fried fish, and not using trans fats when cooking fish.	Lists at least two ways to reduce risks associated with eating fish, including: gathering and assessing information from nutrition data and fish consumption advisories, eating smaller fish, eating fish lower on the food chain, trimming away fat when filleting fish, cooking fish thoroughly before eating, avoiding commercially fried fish, and not using trans fats when cooking fish.	Lists one way to reduce risks associated with eating fish.	Can't name a single way to reduce risks associated with eating fish.
Fish consumption advisory report—gathering information	Reads a fish consumption advisory chart and identifies fish species found in the lake, whether the lake has been tested for contaminants, and deciphers consumption guidelines.	Reads a fish consumption advisory chart and identifies fish species found in the lake and whether the lake has been tested for contaminants.	Can read a fish consumption advisory chart.	Can't read or understand a fish consumption advisory chart.
Fish filleting and cooking	Observes a filleting demonstration, or participates in filleting discussion and can explain why removing fat helps reduce levels of PCBs in the fillets. Makes the connection that very small amounts and limited amounts of toxins are not as big of a health risk as not eating nutritional food.	Observes a filleting demonstration, participates in discussion and understands that removing fat helps reduce levels of PCBs in the fillets. Understands two ways to prepare fish to reduce health risks.	Observes a filleting demonstration and participates in discussion, but can't state that PCBs are absorbed into the fatty tissue of the fish. Understands one way to prepare a fish fillet to reduce health risks.	Doesn't make a connection between preparing fish and reducing health risks for some toxins.

Score _____ (Calculate score by dividing total points by number of criteria.)

Diving Deeper

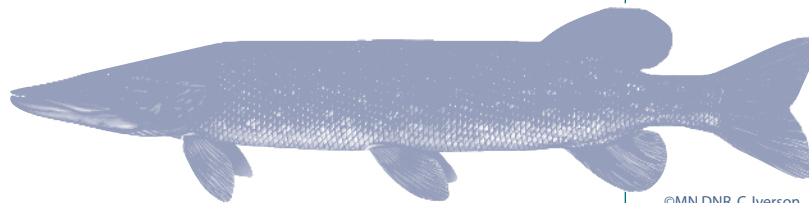
Extensions

- 1 After researching and reporting on contaminants found in fish, such as mercury and PCBs, have students compose a Jeopardy game to reinforce what they've learned.
- 2 Ask students to bring their favorite fish recipe from home. Compile a cookbook of these recipes. Highlight recipes used on special family occasions and traditional or cultural fare. Send a copy home with each member of the class.
- 3 Before your filleting demonstration, discuss the external parts of a fish (fins, eyes, mouth, scales, gill cover, and so forth) with your students. You may also wish to look up fish dissection on the Internet, and explore the internal parts of a fish, too. The **Anatomy of a Fish Sheet** at the end of this lesson will aid in identifying the internal parts of fish.
- 4 Have your students go fishing and cook their own catch. (See Chapter 5 for angling skills development as well as **Lesson 6:1—Safety & Fishing at the Water's Edge** or **Lesson 6:2—Ice Fishing & Winter Safety**.)

For the Small Fry

K-2 Option

Nutritional benefits of fish, cooking, and tasting can be completed with younger children. Do the Warm-up and Part 3 of the Activity.



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Fish Consumption Advisory Report for Sleepy Eye Lake

Fish consumption guidelines

These **fish consumption guidelines** help people make choices about which fish to eat and how often. Following the guidelines enables people to reduce their exposure to contaminants while still enjoying the many benefits from fish.

Pregnant Women, Women who may become pregnant and Children under age 15

LAKE NAME County, DOWID	Species	Meal Advice				Contaminants
		Unrestricted	1 meal/week	1 meal/month	Do not eat	
SLEEPY EYE Brown Co., 08004500	Northern Pike		All sizes			Mercury
	Yellow Perch		All sizes			Mercury

General Population

LAKE NAME County, DOWID	Species	Meal Advice				Contaminants
		Unrestricted	1 meal/week	1 meal/month	Do not eat	
SLEEPY EYE Brown Co., 08004500	Northern Pike	All sizes				
	Yellow Perch	All sizes				

DOWID - MN DNR, Division of Waters' lake ID number.

Contaminants listed were measured at levels high enough to warrant a recommendation to limit consumption.

Listing of consumption guidelines do not imply the fish are legal to keep, MN DNR **fishing regulations** should be consulted.

Dioxin

Mercury

PCBS - Polychlorinated biphenyls

PFOS - Perfluorooctane sulfanate

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Safe Eating Guidelines Sheet

Safe Eating Guidelines* for Pregnant Women, Women who may become pregnant, and Children under age 15

Kind of fish	How often can you eat it?	
EAT		
Catfish (farm-raised), cod, crab, flatfish, herring, oysters, pollock, salmon**, sardines, scallops, shrimp, tilapia, and other purchased fish low in mercury	→	2 meals per week
OR		
Canned "light" tuna Minnesota caught: Sunfish, crappie, yellow perch, bullheads	→	1 meal per week (see exceptions)*
**salmon-farm-raised or wild, Pacific and Atlantic - not Great Lakes		
AND		
Canned "white" tuna, chilean seabass, grouper, halibut, marlin, orange roughy, tuna steak Minnesota caught: bass, catfish, walleye shorter than 20 inches, northern pike shorter than 30 inches, and other MN gamefish	→	1 meal per month (see exceptions)*
DON'T EAT		
Shark, Swordfish, tile fish, king mackerel Minnesota caught: walleye larger than 20 inches, northern pike longer than 30 inches, muskellunge	→	Do not eat
*Fish from some Minnesota Lakes and rivers have been found to have higher levels of mercury or PCBs. If you eat certain fish from these waters, you should eat it less often than these guidelines. See exceptions tables (above) for further information on restrictions for eating fish from the specific Minnesota lakes and rivers.		
There is no change in these guidelines for eating fish just during vacation or one season.		

Safe Eating Guidelines for Men and Women not planning to be pregnant

Kind of fish	How often can you eat it?	
EAT		
Minnesota caught: Sunfish, crappie, yellow perch, bullheads	→	unrestricted
Minnesota caught: Walleyes, northern pike, smallmouth bass, largemouth bass, channel catfish, flathead catfish, white sucker, drum, burbot, sauger, carp, lake trout, white bass, rock bass, white fish, other species	→	1 meal a week
AND		
Limit the following species: shark, swordfish, tile fish, king mackerel	→	1 meal a month
In general, adults who eat fish just during vacation or one season can eat fish twice as often as recommended in these guidelines.		



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Basic Filleting Sheet



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1.



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2.



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3.



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4.



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5.



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6.



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7.

STUDENT COPY*Fish Recipes Sheet***Fish Strips**

6 fish fillets

2 eggs, cracked into a bowl and mixed with a fork

1 cup bread or cracker crumbs, spread on a plate or waxed paper

½ cup butter or margarine, melted in a microwave or on the stove

1. Cut the fillets into long strips, about one inch wide.
2. Dip the strips into the eggs, and then into the bread or cracker crumbs.
3. Place them on a pan lined with aluminum foil.
4. Pour the melted butter or margarine over the strips.
5. Bake at 400 degrees for 15 to 20 minutes.
6. Poke the fish to check for doneness.
Enjoy!

Captain Nelson's Charcoal Broiled Salmon or Lake Trout

2 pounds salmon or lake trout fillets

¼ cup butter, melted

¼ cup soy sauce

¼ cup brown sugar

1. Melt the butter. Add soy sauce and brown sugar and mix.
2. Place fillets, skin side down, on a grill over a moderate charcoal fire and cover them with foil.
3. Baste fillets with the mixture occasionally during cooking. Do not turn fish.
4. When the fish flesh flakes easily—in approximately twelve minutes, depending on grill temperature and fillet thickness—lift the fillets off skin with a spatula and serve. (Serves 4.)

(This recipe comes from Dexter Nelson, Lake Superior Charter Captain, First Mate Charters.)

