



Title: Fish and Pollution

Subject: Science

Grades: 3–5

Concept: Students learn about the ways in which pollution affects fish in aquatic ecosystems.

Learning Objectives:

- Explain the factors that support the survival of fish
- Describe the ways in which pollution harms fish
- Develop and list steps that humans can take to minimize pollution and ensure the health of fish

Teacher Background:

Human activity can change aquatic ecosystems in ways that can harm fish and other organisms. For example, thermal pollution from factories raises the temperature of water. This can kill fish that are adapted to lower water temperatures and can also decrease the amount of oxygen dissolved in the water, which aquatic animals need to survive. The removal of plants from the land allows silt (fine soil) to be carried from fields and construction sites to cover fish spawning areas. Fertilizer runoff from farms and lawns adds excess nutrients to waterways, which can cause harmful algae growth. Algae can be toxic to fish and can decrease the amount of dissolved oxygen in the water. Storm runoff can also carry solid pollution into aquatic ecosystems. Aquatic ecosystems can be harmed by air pollution that causes acid rain. Some fish require a narrow pH range in order to survive and may be killed by the acidity. Acidic waters also leach more aluminum from the surrounding environment. Aluminum is toxic to many fish. In this lesson, students identify what fish need to survive and learn about how human activity can change aquatic environments in ways that are detrimental to survival of fish and other aquatic animals.

Materials:

- For each group:
 - 500 mL beaker or pint jar
 - 5 pH strips
 - 25 or 50 mL graduated cylinder, oral syringe, or measuring spoon
 - Vinegar

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- Distilled water
- Stirring rod or clean spoon
- 3 small plastic containers for water samples
- Permanent marker
- Masking tape
- A photograph of a freshwater fish in its natural environment

Vocabulary:

- Oxygen
- Gills
- Acidity

Timing:

- Approximately two 45-minute class periods
 - Lesson: 45 minutes
 - Activity: 25 minutes
 - Wrap-up: 20 minutes

Lesson:

1. Post a photograph of a freshwater fish in its natural environment. In the center of a board or chart paper. Write and circle “Fish Needs” in green. Lead students in creating a concept map describing fish needs. Ask: What does a fish need in order to survive? Call on students to share ideas. Link main ideas, such as water and food, to the central concept. Add details by linking sub-concepts to the main ideas. (See the sample concept map in Appendix A). Use green ink for all text related to fish needs. Be sure to cover all of the following concepts, encouraging students to look on the internet and in books for ideas if necessary:
 - a. Fish need clean water in which to live. Ask students where fish live; they should be able to identify oceans, ponds, lakes, and rivers as common aquatic environments that support fish. Ask students where the water in a fish’s environment comes from. Guide the class in a review of the water cycle, prompting responses about the role of precipitation and runoff, for example, in fresh water environments. Tell students that water may pick up pollutants on its way into an aquatic environment.
 - b. Fish need food. Ask students what types of foods different fish eat. If you have learned about carnivores, herbivores, and omnivores, review these terms. Common sources of food for fish include algae, aquatic plants, insects, and other aquatic animals— including other fish.
 - c. Fish need **oxygen**. Explain that fish take in oxygen that is dissolved in the water through their **gills**. Have students describe what they know about gills. If necessary, explain that gills are a special structure that fish have to remove dissolved oxygen from water.

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Ask students where the oxygen in the water comes from. Some comes from aquatic plants that take in carbon dioxide and release oxygen during the process of photosynthesis; some is mixed into the water from the air.

- d. Fish need a certain temperature. Ask students to think of some adaptations that help land animals survive changes in temperature (fur, hibernation, building shelters, migration). Help students understand that fish do not have these adaptations and therefore can be sensitive to changes in temperature. Fish eggs and juveniles (young fish) are particularly vulnerable and may be killed by waters that are too warm. Warmer water also hold less dissolved oxygen than cooler water.
 - e. Fish can only live in a certain water pH, or **acidity**. Certain types of fish are susceptible to changes in the acidity of the water surrounding them. Acidic waters may kill fish or disrupt their ability to reproduce.
2. Write “Sources and Effects of Pollution” in red near the existing concept map. For each main idea about fish needs, add a concept describing the effect of pollution. (See sample concept map in Appendix A). Ask: Where does water pollution come from and what effects can it have on aquatic organisms? Call on students to share ideas. Use red ink for all text related to effects of pollution. Be sure to cover the following concepts:
- a. Storm runoff can carry solid and liquid pollutants from the land into natural waterways.
 - b. Some pollutants can poison algae, plants, and insects that fish depend on for food. Others poison the fish directly.
 - c. The amount of dissolved oxygen in the water decreases as water temperatures increase. Power plants release hot water, and cause thermal pollution. Removing trees and other plants along streams can also raise water temperatures. Warm water can also harm fish in other ways.
 - d. Excess algae growth caused by fertilizers from farms or yards in runoff can be directly toxic to fish and can also decrease the amount of dissolved oxygen in the water.
 - e. Acid rain can lower the pH of aquatic ecosystems, causing them to become more acidic.

Activity:

1. Divide the class into groups of three. Distribute the activity materials to each group.
2. Students should use the following procedure to investigate the acidity of water:
 - a. Fill a 500-ml beaker or pint jar with distilled water.
 - b. Test the pH of the distilled water using a pH strip. (The strip should read neutral, indicated by a yellow color.)

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- c. Measure 10 milliliters (2 teaspoons) of vinegar.
 - d. Add the vinegar to the water and stir.
 - e. Test the pH of the water using a fresh pH strip. (The strip should read acidic, indicated by a red or orange color.)
3. When students have finished their investigation, have them summarize the results.
4. Take students outside and have each group collect three water samples from local bodies of water. If the location of the school does not allow for this, collect or prepare water samples prior to beginning the activity. Streams, puddles, ponds, rivers, lakes, reservoirs, and water collection containers are all good sources of water. Students should label their samples with the masking tape and the marker. When students are finished, return to the classroom with the water samples.
5. Have students test the pH of each of their samples of water using the pH strips, and record their results. (Note – high levels of calcium carbonate in some soils will buffer the effects of acid precipitation, so waters tend to be somewhat basic.) In areas where the soil buffers acidity, collect rainwater. Rain is normally slightly acidic, but substances in the air can make it more so.

Wrap-up:

1. Using the data from their experiment, have each group answer the following questions:
 - a) What does the pH strip indicate?
 - b) How did adding a small amount of acidic substance (vinegar) to water affect the pH of the water?
 - c) How did the pH of the water samples from the environment compare to the pH of the water samples you created in class? Explain your results using what you know about pollution in ecosystems.
 - d) How can changing the acidity of an aquatic ecosystem affect the health of fish?
2. When students are finished, discuss their answers to the questions. Have each group prepare a report on the effects of acid rain on fish survival, including suggestions for minimizing the effects of acid rain.

Extensions:

- Science: Students can experiment with plant samples from local waterways (or from the classroom aquarium) and different forms of pollution (detergent, thermal pollution, fertilizer, oil) to see how pollution affects plant health.
- Science: Students research types of pollution present in bodies of water around the school, including puddles, ponds, rivers, and streams, and discuss how these types of pollution affect local organisms.

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- English/Language Arts: Students read and respond to *The Lorax* by Dr. Seuss, tying the experiences of the organisms in *The Lorax* to what they learn about pollution during class and what they see in their local environment.

Standards:

Life Science

- Organisms and Environments: Humans depend on their natural and constructed environments. Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms.
- The Characteristics of Organisms: Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.

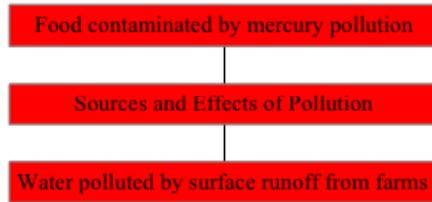
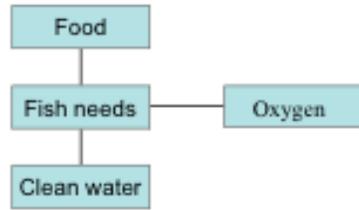
Science in Personal and Social Perspective

- Changes in Environments: Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad. Pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans.

Association of Fish and Wildlife Agencies (AFWA)

- The health and well-being of fish, wildlife, and humans depend on the quality of their environment.
- All living things depend on habitat that includes adequate and suitably arranged food, water, shelter, and space.
- Everyone impacts fish and wildlife and their habitats, and as human populations grow, impacts on natural resources increase.

Appendix A - Sample concept map



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