Third Grade
Water Quality

Test, Test, Is This Water Safe?

LEARNING OBJECTIVES

The students will begin to understand how pollution enters surface water. The students will conduct chemical and physical testing of water samples. The students will begin to understand how they can affect water pollution.

STUDENT PERFORMANCE OBJECTIVES

* The student will understand the difference between point and nonpoint pollution.
* The student will begin to understand Limnology.
* The student will conduct temperature, dissolved oxygen, pH, nitrogen, and phosphate testing of water.

BACKGROUND

All living things need water to survive. Different bodies of water require different levels of purity based on the purpose of the body of water. Water in a pond that supports aquatic life requires a different level of purity than water that is removed and purified for human consumption.

The human body is approximately 70% water. It is recommended that each person drink eight 8-oz glasses of water per day. Safe, drinkable water is an important resource. Water that is contaminated with pollution or hazardous wastes is dangerous for human or animal consumption. Controlling pollution or hazardous waste before it enters water supplies benefits all of us.

Pollution sources are divided into 2 types: point and nonpoint source pollution. Point pollution is pollution that enters a stream at a specific, detectable source, such as industrial or sewage treatment plants. Nonpoint source (NPS) pollution is caused when rainfall or snowmelt moves over and through the ground. This runoff picks up and carries away natural and man-made pollutants. The polluted runoff enters surface and groundwater. NPS pollutants include:

*excess fertilizers

*oil or grease

*sediments from improperly managed construction sites, crop and forest lands, and sediments from eroding stream banks

*salt from irrigation practices

*bacteria from livestock, pet wastes, and faulty septic systems

According to the Environmental Protection Agency (EPA), as reported in the Environmental Pointer Number 10 (EPA841-F-96-004J), NPS pollution is the leading cause of water quality problems.

Individuals can prevent NPS pollution. Using alternatives to chemical fertilizers and pesticides, or using chemicals sparingly can help reduce pollutants. Disposing of oil, antifreeze, paint, and other household chemicals properly is another way people can prevent NPS pollution. Oil can be recycled at many automotive stores. Check the product labels for disposal information. Contact your solid waste facility for additional disposal directions. Chose detergents that are phosphate free. Avoid hosing oil, antifreeze, or grease down driveways into street gutters; instead, sprinkle kitty litter or sand across the spilled liquid. The litter or sand will soak up much of the spill. It can then be swept up and thrown into the trash. Plant ground cover to stabilize areas prone to erosion.

According to Encarta? Encyclopedia, limnology is the study of the physical, geographical, chemical, and biological aspects of inland freshwater systems. The physical properties of water are temperature, turbidity (suspended matter in the water creates a murky look), color, taste, and odor. Chemical aspects of water include pH (acidity of water), dissolved minerals, such as, phosphates, calcium, magnesium, and gasses like, oxygen, nitrogen, hydrogen sulfide, carbon dioxide, and methane. Limnologists use tests to discover the presence and amount of these chemicals.

Temperature of natural waters is an important factor for aquatic life. Each creature is adapted to particular temperatures. Trees and brush provide shade for natural waters such as creeks, ponds, and lakes. When these areas are cleared for construction, the temperature of the water may be raised due to the increase in sunlight on the once shaded area. Changes in water temperature can affect aquatic habitats. This may result in the death aquatic creatures.

An important gas in water is oxygen. It is referred to as dissolved oxygen or DO. Oxygen is necessary for aquatic life. DO is found in cold water at higher levels than warm waters because oxygen is more soluble in cold waters. Cold waters have a DO measurement of 5.0 milligrams per liter or higher. Oxygen is found in warm water at not less than 4.0 mg/L. Oxygen can also indicate the

corrosiveness of water. When DO is found with carbon dioxide and slightly acidic water it will corrode metal pollutants in the water.

The pH indicates the amount of hydrogen ion concentration. The acid, neutral, or alkaline nature of materials can be determined by using a pH test. Natural bodies of freshwater should have a pH of 5.0 to 8.5. Seawater has a pH content of 8.1. An acid level of less than 5.0 indicates that mine drainage or acid industrial waste may have polluted the water. Industrial alkaline wastes are indicated when the pH is 8.5 to 9.0. A neutral pH of 7.0 is considered best for human consumption.

Nitrogen (nitrate) is naturally found in bodies of water at low levels. It is essential for plant growth. Pollution is present when nitrates are found at excessive levels. Nitrates are found in fertilizer, sewage, industrial, and livestock wastes. Methemoglobinemia (hemoglobin is abnormal and cannot transport oxygen) can be found in infants less than six months of age when exposed to high levels of nitrates. High levels of nitrates when paired with phosphates can stimulate the growth of algae causing fish kills. For safe drinking water, the nitrates should not exceed 10 ppm.

Phosphorus (phosphate) is found naturally in bodies of water. It is a nutrient for aquatic plants and is generally found at 0.1 ppm in natural waters. When phosphorus levels increase, it is a sign that agricultural wastes or wastewater has polluted the body of water. Several detergents include phosphates (dishwashing and clothes washing products). The phosphorus increases algal growth which increases oxygen levels from photosynthesis. Several cloudy days in a row can result in the algae dying. Oxygen is used in the decomposition of the algae resulting in fish kills due to a lack of oxygen.

See other lessons on: water, properties of water, and water changes

<for more>

MATERIALS

* 1 clear beaker labeled A and filled with 3 cups of tap water
* 1 clear beaker labeled B and filled with 3 cups of water and ¼ teaspoon of Miracle-Gro? stirred until it dissolves
* 1 clear beaker labeled C and filled with 2 cups of water and 1 cup of vinegar
* Water Quality Datasheet [WQlty/3-1] (copy a class set)
* Masking tape

* Watering can (1 per salt dough map)
* Cake decorations: multi-colored balls, multi colored confetti bars, chocolate confetti bars, snowflakes, red sugar crystals
* Ward's Water Quality Snap Test Kits (dissolved oxygen, pH, nitrate, phosphate) 1-800-962-2660
* Thermometer
* www.ecoplex.unt.edu
* Salt dough relief map **TEACHER PREPARATION – *Several days prior*** to the opening activity create a salt dough map. Make 3 batches for the relief map. (For the best results, do not double the recipe. One map per small group of students is suggested.)

  Foil lasagna pan
  Food coloring
  1 cup flour
  ½ cup salt
  1 cup water
  1 tablespoon cooking oil
  2 teaspoons cream of tartar
  Paintbrush
  Waterproof paint

Mix ingredients until a ball forms. Food coloring may be added. Place dough into a foil lasagna pan. Press dough out to the edges of the pan. On one end create 2 depressions that will join in the middle of the pan in the shape of a "V". On the opposite end of the pan create another depression that will join the "V" creating a "Y". These depressions will serve as rivers. Create a depression where all the rivers join. This will create a lake. Use a paintbrush to "paint" the model with food coloring (land - green, rivers - blue). Allow the model to dry for 3 days. Paint the dough with clear, waterproof paint so that it can be reused. (Students can make group maps on a Friday, spray with waterproof paint on Monday morning, and be ready for the lesson Monday afternoon. The salt dough map will also be used in the surface water lesson.)

OPENING

Ask students:

What do humans need to live? (water, food, shelter etc.)

Where does the water come from that you drink?

Would you drink water from a creek?

Show the students the three beakers of water. **Without tasting** the water in the beakers, using only your observation skills, ask the students to pick beaker A, B, or C as the water they would prefer to drink. Distribute the Water Quality Datasheet. Students record their answers on the datasheet. (Move the beakers aside and explain that the class will come back to the beakers and datasheets at the end of the lesson.)

PROCEDURE

1. Place the salt dough model in front of the class. (Distribute student group models if appropriate.) Explain to the students that they are looking at the city of Salt Dough. In and around the city, there are farms, factories, schools, shopping, and residential neighborhoods. In the center of the city, is a lake where the people get water for drinking.

2. Using masking tape, divide the salt dough map into sections. Label the sections farmland, Sudsy Soap Detergent factory (place close to one of the rivers), 3 or 4 residential sections. (If students have group maps, ask them to label their maps in the same way as the teacher map.)

3. Explain to the students that the farmland has been sprayed with a fertilizer to promote crop growth. Sprinkle cake-decorating balls on the farm section to represent the fertilizer.

4. In the Sudsy Soap Detergent factory, excess detergent is washed down the drain. Sprinkle the multi-colored cake decorating confetti bars to represent the excess detergent. Make a thin line of the bars to show how it would move through a pipe into the river.

5. In all of the residential sections, a neighbor is changing his automobile's oil. He collects it in a bucket, then dumps it in the drainage ditch behind his house. Sprinkle chocolate cake decorating confetti bars around the residential sections. The bars represent the oil. Another neighbor pours gasoline on fire ant nests. Use snowflake cake decorations to symbolize the gas. Pesticides are being used to keep the neighborhood grass from being eaten by bugs. Use red sugar crystals to symbolize pesticides. Fertilizer is sprayed on neighborhood yards to promote a thick, dark green grass. Sprinkle cake-decorating balls in the residential area to symbolize the fertilizer.

6. Discuss what the students think will happen if it rains.

7. Using a watering can filled with water, "rain" on the salt dough map. Discuss what happens to the pollutants (cake decorating items).

8. Explain to the students that the oil, fertilizer, and gas are nonpoint pollutants. These pollutants enter rivers as runoff. Water that is not absorbed by the earth moves across the land towards rivers, lakes, etc. (You may choose to repeat the

demonstration.)

9. Explain that limnology is the study of the physical, geographical, chemical, and biological properties of water. It is this type of scientist that tests water for contamination by pollutants. Today we will become limnologists to determine which beaker of water (displayed at the beginning of the lesson) is safe to drink. (Ask students to check their datasheet for their hypothesis). Each test result will be compared to the list of safe chemical levels as mandated by the Texas Department of Health and the Safe Drinking Water Act.

10. Focus the student's attention back to the beakers. Explain that the student's will conduct water testing to determine which sample would be the best to drink. (Remind students that tasting the water is not an option. Determine the best way to divide the students and materials to complete the pH, nitrate, phosphate, DO, and temperature test for your class.)

11. Conduct the pH water quality test according to the test instructions (litmus paper or a pH meter can be used). Record the results on the worksheet. Compare pH results to the safe levels for drinking water. Beaker C should show a low pH because of the vinegar. Explain to the students that this means the water is acidic. Small amounts of acidic water would not be life threatening for humans because of the human digestive system, however it is not recommended. If the water were found in a river, it's high acidic levels would cause any metal that might be in the river to break down and release secondary pollution. High acid levels damage the gills of aquatic creatures. This water is harmful to a river environment.

12. Test each water sample for nitrates (nitrogen). Record the results on the datatsheet. Compare the results to the list of safe levels. This water would be dangerous to humans and the river environment.

13. Test the water samples for phosphates. Record the results on the datasheet. Compare the results to the list of safe levels. Sample B should show a high level of phosphorus. This is dangerous to river environments because it is a nutrient for algae. The algae will grow quickly and produce and use a great amount of oxygen. It is possible for the algae to require such great amounts of oxygen that it depletes the oxygen supply and some aquatic creatures may die.

14. Test the water samples for dissolved oxygen. Record the results on the datasheet.

15. Using thermometers, measure the temperature of each water sample. Record the temperature of each sample.

16. Complete the datasheet.

17. Ask students which sample is the safest to drink. Compare the test results to the hypothesis of each student. How many students chose the "safest" sample?

18. Take students to a computer lab. Ask students to locate www.ecoplex.unt.edu. Compare the class water test results to those on the web site for Lake Lewisville.

19. Referring to the salt dough map, remind students of the difference between NPS and point source pollution. Ask students to think about what part of the map would be the source of pollutants found in the beakers of water. (Beaker B may have been the results of agricultural wastes from the farmland). Explain ways to prevent NPS and point source pollution.

SO WHAT?
(LIFE APPLICATION)

Water is necessary for life. More and more the quality of drinking water and natural bodies of water is in question. Each of us can actively play a role in the quality of our water by practicing proper disposal of household chemicals and educating others about nonpoint and point source pollution. Create a slogan and poster explaining one of the ways to prevent NPS pollution. Display your posters at a PTA meeting.

CURRICULUM EXTENSIONS

Science

Allow students to bring swimming pool, creek or lake water samples from home to test purity.

Create bar graphs from the water testing data.

Math

Compare the Fahrenheit boiling point, freezing point, body temperature, and the day's Fahrenheit temperature to the Celsius temperature.

Social Studies

Use the internet to research the Safe Drinking Water Act. A suggested site for research is www.epa.gov/safewater/sdwa25/25years.html.

Invite a guest from the EPA or water treatment plant to speak to the class.

Language Arts

Write thank you notes to EPA or other water protection service employees.

TEKS

Science: 3.1A,B, 3.2A,B,C,D,E, 3.3C, 3.4A, 3.7A, 3.8A,B,C

RESOURCES