Lesson Title: N, T & B: Pollutants Three

Ohio Standards Connection:

Standard(s): Earth Science

Benchmark(s): (grades 3-5) C. Describe Earth's resources including rocks, soil, water, air animals and plants and the ways in which they can be conserved.

Indicator(s):

Grade(5) 6. Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained.

Benchmark(s): (grades 6-8)

Indicator(s): C. Describe the interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g. water cycle, weather and pollution).

Grade(7) 2. Explain that Earth's capacity to absorb and recycle materials naturally (e.g., smoke, smog and sewage) change the environmental quality depending on the length of time involved (e.g., global warming).

Lesson Summary: The student will do list and describe three types of surface water pollution (nutrient, bacterial, toxic); observe the effects of various water pollutants on algae growth and illustrate a cause of each of the three types of pollution.

Estimated Duration: class period

Background: Nutrients from fertilizer have been major water pollutants since the 1940's. Although plants and animals need these for growth, if there is too much phosphorus and nitrogen in water, algae and other aquatic plants grow too rapidly. Rapidly growing plants in water also means more plants die and decay, and in the process they use up the oxygen dissolved in the water. As a result, fish and other aquatic life die.

Another major water pollutant is human and animal wastes. Lakes and beaches are often closed to swimmers and anglers because of high counts of fecal coliform bacteria from raw sewage (human waste) and feedlot runoff that makes its way into rivers and streams then empties into the lakes and oceans. Although coliform bacteria are not harmful themselves, they usually indicate that pathogens, disease-causing organisms, are present.

The third major type of water pollutant is toxic, or poisonous, chemicals. Toxic pollution is most often from pinpointable sources, such as industrial discharges or accidents in transportation (such as oil spills). It can also come from less identifiable sources, including runoff from both urban and rural areas, and fallout from the atmosphere.

The sources of pollutants that cause water pollution vary. In some cases, pollutants may come from a pipe discharging into a river, a boat, irrigation ditch, underground storage tank, or other single source, called a "point source" of pollution. But frequently they are varied sources,

collectively called a “non-point source,” that could include industries, agriculture, and other human activities.
Point source problems are the easiest to correct. Their cause—wastewater emptied into the lake through a pipe—can be dealt with directly. Non-point source problems are more difficult to fix. Fixing non-point source problems usually requires a lot of cooperation by every part of society.

Instructional Procedures:
ADVANCE PREPARATION
A. Cut the tops off the five 3-liter bottles. (Scissors work fine. Just cut the top section off each, and recycle.) You may use large, clear jars as long as all of them are exactly the same.
B. Take five 2-liter bottles to a pond, lake, or river, and fill each with water.
C. Gather the other jars, bottles, and so forth, and the “pollutants.”
D. Run a jar (approximately a pint, or 500 mL) of tap water and let it set overnight so the chlorine will dissipate.
E. Copy the student sheet for distribution.

I. Setting the stage
A. Ask students to guess how much water they use each day. Then tell them that each person in the United States uses about 150 gallons (570 L) of water each day for drinking, bathing, cleaning, flushing the toilet, watering lawns, and so on. Provide a gallon (4 L) milk jug and a 2-liter soft drink bottle of water to show gallons and liters of water.

B. Point out to the students that while we progressed as a nation we became very careless with our water. Farmers used chemicals to help crops grow and kill insects, and later the rain and snow washed these chemicals into streams and lakes. Factories made many useful products from chemicals, such as medicine, clothes, automobile lubricants, and household goods. Water was always used in the process, and wastewater was discharged into streams. People added pollutants to water when they used it in their homes. They added soap, toothpaste, shampoo, bleach, detergent, fertilizers, insect spray, human wastes, paint, oil, grease, plus many more. Tell the students many of these activities continue today.

C. Emphasize to the students that people thought that because rivers and lakes had so much water, they could clean themselves. We now know that a little here and a little there can eventually add up to a lot. In the '60s, lakes and streams were overnourished with phosphorus that came from detergents; they became choked with algae. Nutrients from fertilizers and untreated sewage added to the problem. Fecal coliform bacteria from raw sewage flowing into the lakes and streams caused a lot of beaches and lakes to be closed. Now we know that we must clean water before it can be used again; we pollute bodies of water too much for them to clean themselves.

II. Activity
A. Have the students list sources of each of the three categories of pollutants (nutrient, bacterial, toxic).
1. Write the three categories on the board. (These are the “N, B, & T” pollutants to which the title refers.) Make them headings for columns.

2. Ask the students to identify the kinds of substances causing each kind of pollution. Lead them to summarize: nutrient - fertilizer, bacterial - human waste, toxic - chemicals. Write these terms beside the headings.
3. Have the students list as many sources as possible for each of the three kinds of pollution.
4. Write their answers in the columns.

B. Do this activity to show that a little pollution here and there can do harm.

1. Prepare "pollutants" to mix with the pond water. Have the students help you measure, mix, and label them. Use the tap water you have let set to dechlorinate. Mix the following in small jars (e.g., baby food jars).
    a. Pour 1/4 cup (60 mL) of plain water into the first jar. You will not add a pollutant to this jar.
    b. Mix a scant half-teaspoon (2-3 mL) soap or detergent and water (1/4 cup or 60 mL).
    c. Mix a solution of vinegar (1-1/2 ounces or 45 mL) and water (1/4 cup or 60 mL).
    d. Mix a scant half-teaspoon (2-3 mL) of flea powder and water (1/4 cup or 60 mL).
    e. e. Mix a scant half-teaspoon (2-3 mL) food scraps and water (1/4 cup or 60 mL). (NOTE: You may want to avoid using any meat scraps because they will become very smelly.)
2. Use five 3-liter plastic bottles (with the tops cut off) or other clear containers. Fill each "pond model" with pond water. They will be identical; then add one of the following to each. As you do this, point out to the students that the models are just alike except for the pollutants added to them. This is very important in an experiment. Identify each as to its pollution category.
    a. Add the plain water.
    b. Add the mixture of soap and water. This represents nutrient pollution.
    c. Add the solution of vinegar and water. This represents toxic pollution.
    d. Add the mixture of flea powder and water. This represents toxic pollution. The powder is similar to the chemicals used to kill pests on crops.
    e. Add the food scraps and water. This represents bacterial pollution; the bacteria will break the food down.
3. Label the models with treatment type and the date and time of the treatment.
4. Have the students predict what will happen to each.

C. Ask the students what a "monitor" is. (someone who keeps a check on something) Ask them to give examples. Tell them they will be "monitoring" the progress of the models. Tell them scientists monitor our water for water pollutants. This helps keep us safe from polluted water.

D. Have the students observe daily and record any differences in growth and development of the algae for about 10 days to two weeks. (NOTE: If the smell becomes too unpleasant in the food scraps pond, you may have to discard it.). Discuss their observations. (The model plain water was added to should look the same, the vinegar and flea powder should show no growth [toxic], the detergent should have extensive growth of algae [nutrient], and the food scraps should be smelly [bacteria].)
Can the students explain these results in light of what was added? (Algae and algae spores were present in the pond water that was collected for the experiment.)

E. When you are through observing the pond models, the algae and water (with the additives) may be safely flushed down the toilet.

III. Follow-Up

A. Have students complete the sheet "A Little Here and There is Too Much."
B. Have students write a poem or a song about the N, B, & T Pollutants (Nutrients, Bacteria, Toxics)

IV. Extension

A. Have the students imagine they are each the governor of a state. They are having three major problems: 1) Businesses are discharging hazardous wastes into the lakes; 2) Farmers are using chemical fertilizers that run off into the rivers; and 3) The sewage treatment plant leaks raw sewage into the rivers. Have the students write ways they would take care of these concerns. (NOTE: Younger students might act out their solutions to these problems.)

B. Have the students examine local newspapers to find out what their community's major water pollutants are.

RESOURCES

Elick, C., "Water," Tennessee Conservationist -Student Edition, Nashville, Tennessee, January/February,1988.

Gay, K., Water Pollution, Franklin Watts, New York, 1990.
Holmes, N. J., et al., Gateways to Science: Grade 5, Webster Division, McGraw-Hill, New York, New York, 1985.

"Your Lake Is Unique," RiverPulse, Tennessee Valley Authority, Water Resources Division, July 1992.

Materials and Resources:

- 5 baby food jars with lids
- six 2-liter plastic bottles
- gallon (4 L) milk jug
- water
- soap or detergent
- vinegar
- flea powder
- food scraps
- five 3-liter plastic bottles (clear, not tinted)
- pond water
- teaspoon
- crayons or markers
- student sheet (included)

Vocabulary:

bacterial water pollution: the introduction of unwanted bacteria to a water body.
conservation: preserving from loss, waste, or harm.
erosion: the wearing away of the earth's surface by running water, wind, ice, or other geological agents; processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material
is removed from the earth's surface.
fertilizer: any one of a large number of natural or synthetic materials, including manure and nitrogen, phosphorous, and potassium compounds, spread or worked into the soil to increase its fertility.
nonpoint source pollution (NPS): pollution that cannot be traced to a single point, because it comes from many individual places or a widespread area (e.g., urban and agricultural runoff).
nutrient pollution: a nourishing contamination that causes unwanted plant growth in water.
point source pollution: pollution that can be traced to a single point, such as a pipe or culvert (e.g., industrial and wastewater treatment plant discharges).
pollutant: an impurity (contaminant) that causes an undesirable change in the physical, chemical, or biological characteristics of the air, water, or land that may be harmful to or affect the health, survival, or activities of humans or other living organisms.
pollution: contaminants in the air, water, or soil that cause harm to human health or the environment.
sewage: human waste.
toxic pollution: harmful, chemical contamination in water.

A LITTLE HERE AND THERE IS TOO MUCH

Draw a picture to illustrate a cause for each kind of pollution.

NUTRIENT POLLUTION

F
E
R
T
I
L
I
Z
E
R
S

BACTERIAL POLLUTION

S
E
W
A
G
E

TOXIC POLLUTION

C
H
E
M
I
C
A
L