Duration: 55 minutes

MATERIALS

Graph Paper
Pollutant information sheets (one per student)
10 different colors of construction paper (2 sheets each)
Scotch tape or glue
Paper cutter or Hole punch
1.25 ml (¼ teaspoon) measure
15 ml (1 tablespoon) measure

RESOURCES

Deadly Waters Activity
Project Wild, Canadian Wildlife Federation – Wild Education

Blueprint For Life/Work Designs – The Quick Reference Guide

INSTRUCTIONAL METHODS

Group Discussion
Inquiry Method
Cooperative Learning

LESSON OBJECTIVES

- ✓ Students will understand how career choice allows people to engage in work experiences that satisfy one's needs as well as contribute to society
- ✓ Students will understand the role of an Environmental Engineer in the sustainability of ecosystems
- ✓ Students will carry out an activity to simulate the work of an Environmental Engineer in determining the quality of water from a particular source
- ✓ Students will be asked to make value judgments while discussing the dichotomy between necessary effluent production from industry versus its impact on the environment.

BACKGROUND INFORMATION

The expectations of society and direct pressure from industry have led to demand for unique technical abilities. Environmental engineers solve a range of environmental problems in urban and remote areas.

Environmental engineers plan, design, and evaluate solutions for waste management, air quality management, automobile emissions and alternative fuels, as well as the development of energy alternatives and energy conservation, transportation, and water resources supply and treatment.

MOTIVATIONAL SET

A sample of tap water (or water from another source) is brought into the classroom. The teacher displays the water and asks the students how they would know if the water sample is safe for human consumption. Students are asked to act as environmental engineers to study the quality of water within a particular environment.

PROCEDURE / TIMELINE

Over 70% of our Earth's surface is covered by water. 97.5% of all water on Earth is salt water, leaving only 2.5% as fresh water. Nearly 70% of that fresh water is frozen in the icecaps of Antarctica and Greenland; most of the remainder is present as soil moisture, or lies in deep underground aquifers as groundwater not accessible for human use.

Less than 1% of the world's fresh water (~0.007% of all water on earth) is accessible for direct human uses. This is the water found in lakes, rivers, reservoirs and those underground sources that are shallow enough to be tapped at an affordable cost. Only this amount is regularly renewed by rain and snowfall, and is therefore available on a sustainable basis.

Pollutants pose a great threat to our watersheds, and to the long-term sustainability of this precious ecosystem. There are four major categories of pollution:

- Chemical Pollution – the introduction of toxic substances into an ecosystem (e.g. acid rain, contamination of water supplies by pesticides)
- Organic Pollution – oversupplying an ecosystem with nutrients (e.g. fertilizers)
- Thermal Pollution – varying temperatures above or below the normal conditions (e.g. elevated temperatures of cooling water for power plants circulated back into water supplies)
- Ecological Pollution – adding a substance that is not a naturally occurring substance in the ecosystem (e.g. extreme tides introduce salt water into habitats ordinarily protected from sea water), or increasing the amount of a naturally occurring substance (e.g. abnormal increase in sediments in run-off water to produce salt).

Most pollution is caused through human activity. Chemical pollution through the introduction of toxic substances is clearly human-caused. Organic pollution in lakes and rivers typically results when organisms living there are affected by chemical fertilizers used in agriculture. Thermal pollution is predominantly human-caused by electrical power production and other industrial plants.

To understand the causes of pollution, and its effect on our vital ecosystems, prepares us to be able to take action now and into the future to sustain a healthy environment.

Deadly Waters Activity

Students are asked to become environmental engineers for this activity. Through this activity, students will be able to:

a. Identify the major sources of aquatic pollution
b. Make inferences about the potential effects of a variety of aquatic pollutants on wildlife and wildlife habitats
c. Identify the impact that pollution has on the environment and the immediate society.

Students analyze the pollutants found in a hypothetical river. They graph the quantities of pollutants and make recommendations about actions that could be taken to improve the habitat.

1. Before the activity begins, make 100 tokens of **each** of the ten colours of construction paper. Either cut the construction paper into one-centimetre squares using a paper cutter, or punch out construction paper tokens with a hole punch. Put all the tokens in a container and stir them so the colors are thoroughly mixed.

   Make one copy of the Pollutant Information Sheet for each student (included with the lesson plan that can be downloaded from the APEGS website, at www.apegs.sk.ca).

2. List the four major categories of pollution on the chalkboard and discuss each. They are: chemical, thermal, organic, and ecological.

3. Pass out the Pollutant Information Sheets. Review each kind of pollution with the students. Talk about how some of these can fit into more than one of the four categories of pollution. Color-code each with a different color of the construction paper (some teachers have simply copied the Pollution Information Sheets, cut out each of the descriptions, and pasted them on the appropriate sheets of colored construction paper). Post each sheet with its corresponding description of the kind of pollution it represents in a row in a convenient place.

4. Once all the kinds of pollution have been discussed, and the students understand that each kind of pollution will be represented in this activity by one color of paper, tell the students that they are to divide into teams of three. These will be research teams; each team will analyze the pollution content of a hypothetical river. Distribute the colored paper tokens that have been cut or punched from the construction paper. Provide 1.25 ml (¼ teaspoon) of the paper-punched tokens, or 15 ml (one tablespoon) of the cut one-centimeter square tokens, to each research team. Also provide each team with a piece of graph paper.

5. Teams separate their colored tokens into piles, and using the color key, identify each type of pollutant. Once this is done, count the number of each kind of pollutant and use the graph paper to construct a simple bar graph showing the whole array of pollutants. Arrange the pollutants in the same order as they are displayed in the color key that is posted in the classroom. This makes it easy to compare each team's findings. Remind students that each team has a different river. Their results are not likely to be the same!

6. When all bar graphs are completed, compare the results of each team. Any quantity above two units of any kind of pollutant is considered damaging to wildlife habitat. In their hypothetical rivers, what pollutants would be likely to cause the most damage to wildlife and wildlife habitat? Give examples and discuss the kinds of damage that could be caused.

7. Have students list five things they can do in their own lives, starting today, to reduce the number of pollutants they add to the environment.

DEBRIEF

Students should be prepared to have conversations about their understanding of the role of environmental engineers in determining the health a particular environment. Students should be aware of the dichotomy that often exists between industry (or human activity) and the environment. It is the role of the environmental engineer to monitor the impact of human activity and suggests ways in which the human footprint could be minimized, without losing the effectiveness of that activity.

ASSESSMENT / INDICATORS

The Learner will be able to:

1. Describe the role of an environmental engineer.
2. Describe what skill set and education is required in order for someone to become an environmental engineer.
3. Describe the role of an environmental engineer in promoting the concept of sustainable development.

This lesson plan is available for download at www.apegs.sk.ca (click "About Us", "Youth Programs").

Photo Credits (Poster Front: Left-to-Right, Top-to-Bottom)

Laying the blacktop on the Trans-Canada Highway west of Swift Current. (Saskatchewan Archives Board R-B63000-1); The Patience Lake potash mine as it appears today. (Photo courtesy PotashCorp); Interior view of the Canadian Light Source in Saskatoon. (Photo courtesy Canadian Light Source Inc., University of Saskatchewan); Anvils and other equipment await agricultural engineering students inside the U of S Engineering Building in 1913. (University of Saskatchewan Archives A-398) ; Regina's NewGrade heavy oil upgrader, at night. (Photo Courtesy Saskatchewan Industry and Resources); An aerial view of the Island Falls hydroelectric plant as it appears today. (©[2005]SaskPower); SaskPower Coorporation; Wagons cross Saskatoon's Traffic Bridge (later known as the Victoria Bridge) in 1912 under the watchful eye of a police officer. (Photograph LH5080 by Leonard A.J. Hillyard courtesy Saskatoon Public Library – Local History Room); Wascana; Drilling Shell Big Muddy No. 1 (Saskatchewan Archives Board R-A3207-1); Giant Steel rings beams await installation in the Gardiner Dam diversion tunnels, October 1961. (Agriculture and Agri-Food Canada #61-10-069); Fibre Optics Networks transmit data digitally as pulses of light along hair-thin threads of glass. (Photo courtesy Graham Bradley); An earthmover rumbles past the Gardiner Dam shaft superstructures in 1964. (Saskatchewan Archives R-B4476-2); The Boundary Dam Generating Station as it appears today. (©[2005]SaskPower); Dr. Amy Veawab, an Associate Professor of Environmental Systems Engineering at the University of Regina, conducts research in a U of R lab. (Audio Visual Services, University of Regina);