Science Unit: *Water*
Lesson 3: *Water Pollution*

School year:	2004/2005
Developed for:	Queen Alexandra Elementary School, Vancouver School District
Developed by:	Paige Axelrood (scientist), Trevor Wright and Jenny Lau (teachers)
Grade level:	Presented to grades 4 - 5; appropriate for grades 2 – 6 with age appropriate modifications.
Duration of lesson:	1 hour and 20 minutes
Notes:	Complete the experiment on the following day if required.

Objectives

1. Learn about different sources and types of water pollution.
2. Learn why water pollution is harmful.
3. Investigate Earth's natural filters using beach sand as an example.
4. Learn how we can prevent water pollution.

Background Information

Water pollution occurs when waste or harmful substances enter bodies of water such as oceans, lakes, ponds, ditches, and rivers. Types of harmful or toxic substances include chemicals, pesticides, fertilizers, antibiotics and medicines, organic substances (such animal and human waste), microbial pathogens from human and animal waste, dead animals in surface water, and physical objects that don't decompose (such as plastic objects). Acid rain can also cause water pollution. Acid rain forms when sulfur dioxides and nitrogen oxides (produced from various sources including burning of coal, power plants and from automobile exhaust) mix with rainwater and oxygen in the atmosphere to form acidic compounds such as sulfuric acid and nitric acid.

There are many sources of water pollution, including factories, mines, refineries, garbage, sewage, automobiles, farming, household products, and burning of fuels such as coal, wood, and oil. Point source water pollution occurs when the pollutant directly enters a body of water such as an oil spill in the ocean. One of the worst oil spills was in 1989 from the Exxon Valdez. Approximately 11 millions gallons of oil contaminated Prince William Sound, Alaska. Oil spills kill organisms and poison food chains. Non-point source pollution is indirect water pollution, such as run-off of animal waste or pesticides from agricultural land into ditches and streams. Water pollution is harmful to living organisms on Earth.

Vocabulary

Water:	A colorless, odorless liquid with no taste or smell and of neutral pH.; water is comprised of 2 atoms of hydrogen and 1 atom of oxygen; water can exist as a solid, liquid and gas.
Pollution:	Contamination of the environment with a harmful substance.
Contaminate:	To pollute something or make it impure by adding a foreign or harmful substance.
Filtration:	Passage of liquid through a porous material to remove solid particles or other matter.

Materials

- 2-L plastic pop bottles
- beach sand
- beakers
- transparent plastic cups
- vegetable oil
- rubber bands
- panty hose
- scissors
- glass jars with screw cap lids
- container of water
- marking pens
- tape

In the Classroom

Introductory Discussion

1. Show pictures of different types of pollution. Discuss water pollution.
    - What is pollution?
    - Where does pollution come from?
    - What types of pollution contaminate surface water such as our oceans, lakes, and rivers?
    - How does pollution contaminate ground water?
2. Discuss oil spills in oceans including accidental oil spills from tankers and offshore drilling rigs.
3. Review the water pollution experiment.
4. Demonstrate point source pollution.
    - Pour water into a 9x11 inch glass baking dish until it is half-full and place the dish on a low table at the front of the class. Tell students not to touch the dish or table.
    - Ask a student volunteer to come to the front of the class and add 3 drops of blue food coloring to the water near a corner of the baking dish. Ask another student to add 3 drops of red food coloring to the water near the opposite corner of the baking dish.
    - Have the students line up, walk past the baking dish, observe the food coloring in the water, and go to their desks to begin their science experiment.
    - Have the students examine the dispersion of the food coloring in the water in the baking dish after setting up their science experiment, and at other times during the day. Follow up the demonstration by discussing how pollutants travel through water.

Science Activity/Experiment

Experiment Title: Water Pollution Experiment: Does beach sand filter pollution from water?

Purpose of Experiment: The purpose of this experiment is to investigate Earth's natural filters.

Experimental Treatments: There will be 5 groups of students. Each group will set up two treatments.

Control treatment	Tap water
Test treatment	Tap water mixed with vegetable oil

Before making your hypothesis, it helps to start with a question, or make observations and then ask a question. Use your prior knowledge of water/oil mixtures and water passing through materials to predict what you think will happen when water polluted with oil passes through beach sand. Record your

hypothesis based on the following question: How will the water polluted with vegetable oil look after it percolates through beach sand?

Methods:

Set-up prior to experiment:

Each group of students will need two 2-L pop bottles, a container of beach sand, a square of nylon panty hose to cover the open end of each bottle, rubber bands, a transparent jar that can hold at least 150 mL, two 250-mL beakers, a permanent marker, and labels. Cut pop bottles in half. Note: beach sand will contain particulate matter and it will make water cloudy after it passes through the filter. It is best to rinse the beach sand with water prior to the experiment.

1. Cover each bottle opening (the top of the bottle) with a piece of pantyhose and secure the pantyhose to the bottle with a rubber band.
2. Invert the top section of each bottle (bottle opening facing down) over the bottom section of the bottle (or a large beaker) and tape the sections together. It may be necessary to support the bottles so that they don't tip over during the experiment. Label the collection vessels (water; water+oil).
3. Pour 200 cc of beach sand into the top cut-off end of each of two pop bottles.
4. Measure 100 mL of tap water and pour the water over the sand surface in one of the pop bottles. Record the amount of time it takes for the liquid to pass through the sand filter. Record observations of the appearance of the water that passes through the beach sand filter. Does the water that passes through the filter look different than water from the tap? If so, how is it different? Measure the volume of water that passed through the sand and compare it with the starting volume of 100 mL.
5. Pour 50 mL of tap water and 50 mL of vegetable oil into a glass jar and screw the lid on securely. Record observations of the water/oil mixture, shake the water/oil mixture vigorously, observe, and record observation of the mixture again.
6. Shake the water/oil mixture again and immediately pour it over the sand surface in the other inverted bottle. Record the amount of time it takes for the liquid to pass through the sand filter. Record observations of the appearance of the water/oil mixture that passes through the beach sand filter. Draw observations. Measure the volume of the water/oil mixture that passes through the sand and compare it with the starting volume of 100 mL. Did oil pass through the sand filter? Are the volumes of water and oil that passed through the filter equal?
7. Compare the surface of the sand of both treatments and record results. Feel the sand in the water treatment with one hand and the water/oil treatment with the other hand. Does the sand feel the same? Record results.
8. Record conclusions.

Closure Discussion

1. What did you discover from your filtration experiment?
2. How did your results compare with your hypothesis?
3. Why is water pollution harmful?
4. How can we prevent water pollution?

References

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2. http://www.epa.gov/airmarkets/acidrain/#what United States Environmental Protection Agency, [Information about acid rain].

3. http://www.epa/gov/safewater/kids/wsb The Water Sourcebook, A Series of Classroom Activities for Grades 3-5. 1994. The Water Sourcebook was produced for Legacy, Inc. Partners in Environmental Education, in cooperation with US Environmental Protection Agency and prepared by Tennessee Valley Authority, Environmental Education Section.

4. http://www.epa.gov/safewater/kids/grades_4-8_water_filtration.html United States Environmental Protection Agency, [Water filtration experiment using 2 liter bottles, a soil/water mixture, and construction of sand/pebble filters].

5. http://ga.water.usgs.gov/edu/ United States Geological Service, Water Science for Schools.

Extension of Lesson Plan

Students can be given various supplies to design their own water filtration experiments using various materials to build filters (coarse and fine sand, pebbles, fabric, cotton, paper filters, etc.), and various materials to simulate different types of water pollution (water, soil, food coloring, vegetable oil, dishwashing detergent, or other types of liquids).

Water Pollution Experiment
Does beach sand filter pollution from water?

Name of Scientist: _____

Purpose: to investigate the Earth's natural filters

Materials:

- clear plastic cups
- water
- beach sand
- containers to hold water
- vegetable oil
- pop bottles (2 L)
- beakers
- transparent jar with lid to hold at least 150 mL
- panty hose
- rubber bands
- paper towels
- permanent markers and labels

Treatments:

1. Tap water (sample A)

2. Oil + tap water (sample B)

Hypothesis:

Before making your hypothesis, it helps to start with a question or make observations and then ask a question. Use your prior knowledge of water passing through materials to predict what you think will happen when water polluted with oil passes through beach sand.

How will the water polluted with oil look after it percolates through the beach sand?

Hypothesis:

Methods:

1. Cover each bottle opening (the top of the bottle) with a piece of pantyhose and secure the pantyhose to the bottle with a rubber band.
2. Invert the top section of each bottle (bottle opening facing down) over the bottom section of the bottle and tape the sections together. It may be necessary to support the bottles so that they don't tip over during the experiment. Label the collection vessels (water; water+oil).
3. Pour 200 cc of beach sand into the top cut-off end of each of two pop bottles.
4. Measure 100 mL of tap water and pour the water over the sand surface in one of the pop bottles. Record the amount of time it takes for the liquid to pass through the sand filter. Record observations of the appearance of the water that passes through the beach sand filter. Does the water that passes through the filter look different than water from the tap? If so, how is it different? Measure the volume of

water that passed through the sand and compare it with the starting volume of 100 mL.

5. Pour 50 mL of tap water and 50 mL of vegetable oil into a glass jar and screw the lid on securely. Record observations of the water/oil mixture, shake the water/oil mixture vigorously, observe, and record observation of the mixture again.
6. Shake the water/oil mixture again and immediately pour it over the sand surface in the other inverted bottle. Record the amount of time it takes for the liquid to pass through the sand filter. Record observations of the appearance of the water/oil mixture that passes through the beach sand filter. Draw observations. Measure the volume of the water/oil mixture that passes through the sand and compare it with the starting volume of 100 mL. Did oil pass through the sand filter? Are the volumes of water and oil that passed through the filter equal?
7. Compare the surface of the sand of both treatments and record results. Feel the sand in the water treatment with one hand and the water/oil treatment with the other hand. Does the sand feel the same? Record results.
8. Record conclusions.

Observations:

Observations of the tap water (sample A) before and after passage through the beach sand:
The amount of time for sample A to pass through the beach sand:
The volume of sample A that passed through the beach sand:

Observations of the oil + tap water (sample B) before and after passage through the beach sand:
The amount of time for the sample B to pass through the beach sand:
The volume of sample B that passed through the beach sand:

Diagram of each sample after passing through the beach sand filter

Sample A: Tap Water (after passing through the beach sand)	**Sample B: Oil + Tap Water** (after passing through the beach sand)

Conclusions:

What happens to water polluted with oil when it passes through beach sand?

Does the passage of oil through beach sand change the sand?

Key vocabulary words: pollution, pollutants, filters, percolate