(post-tour)

WATER ON THE ROAD

CONCEPTS:

Students will learn:

- what a watershed is
- sources of point and nonpoint pollution
- the causes and effects of various water pollution

Activity Overview:

Students will:

- make watershed models
- survey their own watershed
- perform water quality tests

Vocabulary:

- acid
- algae
- alkaline
- basic
- carcinogenic
- nonpoint source pollution
- point source pollution
- toxic
- watershed

Time Requirement:

- Approximately 60 minutes

Materials:

- ☐ "River In A Concrete Box" poster
- ☐ "Pollution Sources in a Watershed" handout
- ☐ Small aquarium
- ☐ Gravel
- ☐ Soil
- ☐ Small plants
- ☐ Plastic wrap
- ☐ Several "pollutants" (salt, pepper, red or blue Kool-Aid, etc.)
- ☐ Sprayer
- ☐ Water
- ☐ Solutions for water testing (tap water, vinegar, dishwasher soap, pond water; might also include lemon juice, window cleaner)
- ☐ pH indicator paper

Preparation:

- ☐ Read the "Background Information" at the end of this lesson.
- ☐ Make a copy for each student of the "Pollution Sources in a Watershed" handout
- ☐ Prepare and label sample solutions for testing:
  1. tap water
  2. vinegar
  3. 50% vinegar and 50% tap water
  4. 25% vinegar and 75% tap water
  5. liquid dishwasher soap
  6. 50% dishwasher soap and 50% tap water
  7. 25% dishwasher soap and 75% tap water
  8. pond water

PROCEDURES

I. DEMONSTRATE A WATERSHED

(approximately 20 minutes)

(Note: If you created a water cycle model in Lesson 1, the same model can be used for this demonstration.)

A. Have students half fill the aquarium with gravel and build up the ground slightly higher on one side than the other. Cover the high ground with a layer of soil and some little plants. Create a couple trenches in the dirt from the high ground to the lower ground.

B. Slowly spray or sprinkle water into the aquarium to simulate rain. Have students note where the "rain" water is going. *(Some water is underground, in the spaces between the gravel. Some water may run into the trenches to form streams and then a lake at the low end.)*

C. Cover some of the ground with plastic wrap to simulate roads, parking lots, and other areas covered with concrete. Spray or sprinkle more water on the model and have students note what happens to the "rain." *(The water runs quickly off the plastic either into the streams or the lake.)*

D. Place some pollutants – salt, pepper, blue or red Kool-Aid, oil – throughout the model on both the soil and the plastic. Sprinkle more water on the model and have students note what happens. *(On the plastic, the pollutants run off immediately onto the ground or into the streams and lake. On the soil, some of the pollutants run off, some soak into the ground.)*

E. Discuss the demonstration. Explain to students that this model represents a watershed, an area usually marked by the surrounding highest points from which surface water drains. Ask students:

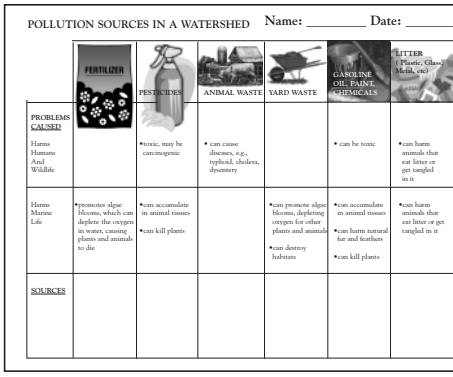
1. **Where does water go that runs down our streets?** *(It runs into storm drains.)*
2. **Where do storm drains lead?** *(In Los Angeles County, most storm drains lead directly to the ocean. They do not go to wastewater treatment plants.)*
3. **What kinds of things get carried along with water runoff?** *(Examples include soil, soap, fertilizer, pet waste, leaves, all kinds of litter, oil, gasoline.)*
4. **What kinds of problems can be created by these things in the runoff?** *(They can harm or kill marine life; they can contaminate groundwater; they can cause disease; they can block waterways; they can destroy habitats; they can create bad odors.)*

II. SURVEY YOUR WATERSHED

(approximately 20 minutes)

A. Ask students if they know what the difference is between "point" and "nonpoint" sources of pollution. *(**Point sources** of pollution come from a specific place, such as a manufacturing plant or a refinery. **Nonpoint sources** of pollution come from indefinite, various places – homes, farms, construction sites, highways, gas stations, junk yards, golf courses. These are the pollutants that get washed into storm drains and into bodies of water.)*

B. Give each student a copy of the handout **"Pollution Sources in a Watershed."** Tell students that this handout lists across the top some common pollutants that are picked up and carried by surface runoff.



POLLUTION SOURCES IN A WATERSHED Name: _____ Date: _____

	FERTILIZER	PESTICIDES	ANIMAL WASTE	YARD WASTE	GASOLINE, OIL, PAINT, CHEMICALS	LITTER (Plastic, Glass, Metal, etc)
PROBLEMS CAUSED Harms Humans And Wildlife		•toxic, may be carcinogenic	• can cause diseases, e.g., typhoid, cholera, dysentery		• can be toxic	•can harm animals that eat litter or get tangled in it
Harms Marine Life	•promotes algae blooms, which can deplete the oxygen in water, causing plants and animals to die	•can accumulate in animal tissues •can kill plants		•can promote algae blooms, depleting oxygen for other plants and animals •can destroy habitats	•can accumulate in animal tissues •can harm natural fur and feathers •can kill plants	•can harm animals that eat litter or get tangled in it
SOURCES						

C. Discuss, as shown on the handout, how each of these pollutants can harm humans and wildlife or harm marine plants and animals as the water runs into the ocean. As each pollutant is discussed, have students list possible sources of that pollutant on the handout. *(See answer key at end of lesson.)*

D. Tell students that as they go home from school today and as they come to school tomorrow, they are to look for water pollutants *(e.g., litter, oil leaking from cars)* and possible sources of water pollution *(e.g., gas station, dog park)*. Ask them to also note where the storm drains are and how close pollution sources are to them.
*(**Note:** Alternatively, take students on a short walk around the school's neighborhood.)*

E. After students have completed their "pollution patrol," discuss their findings and brainstorm what they and others can do to reduce sources of nonpoint pollution. Ideas include:

- Do not litter.
- Pick up pet waste.
- Clean up leaks and spills of oil, coolant, etc.
- Do not overwater fertilized areas to prevent runoff.
- Recycle motor oil.
- Take hazardous waste to drop-off sites.
- Use non-toxic pest control.
- Keep lawn clippings, leaves, and branches out of the street.
- Sweep up rather than hose off paved surfaces.
- Reduce areas of pavement to allow runoff to soak into the ground.
- Do not dump chemicals (e.g., paint remover, cleaning fluids) into the gutter.

III. PERFORM WATER QUALITY TEST

(approximately 20 minutes)

A. Tell students that they are going to do a simple experiment to test water quality. Explain that the results of tests like this one – along with many others – help water managers determine where pollution sources might be and help wastewater treatment plants make sure water is clean.

B. Tell students that they are going to test the pH of various solutions (see Preparation). Explain the following according to the level of your class:

The acidity or alkalinity of a solution is measured on a ***pH*** *scale from 0 to 14. A reading of 7 is neutral. Tap water usually has a pH of about 7 to 8. Readings below 7 indicate more and more* ***acidity****; for example, lemons have a pH of about 5. Readings above 7 indicate more and more* ***alkalinity****; bleach has a pH of around 12. Often, solutions with very high or very low pH numbers are hazardous, usually corrosive.*

0 . . . . . 7 14
acid neutral alkaline

The scale is a base-10 logarithmic progression, which means that a solution with a pH of 4 is ten times as acidic as a solution with a pH of 5, and 100 times as acidic as a solution with a pH of 6.

The pH of water is important. First, a pH of between 6.7 and 8.6 has been found to be best for fish. Also water that is too acidic or too alkaline – called basic – can damage pipes, medical equipment, and manufacturing processes.

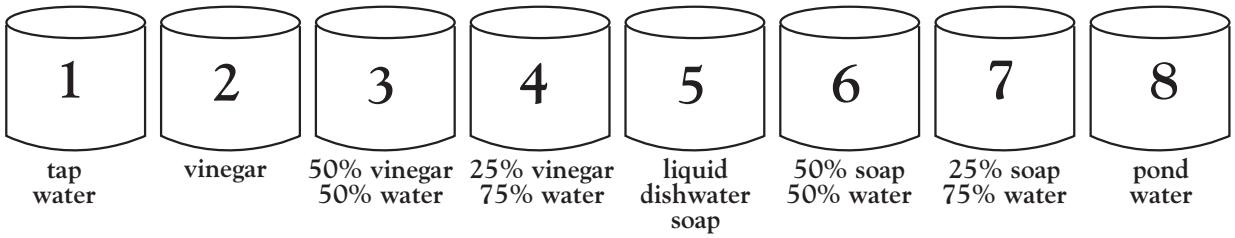
Rain water is usually acidic – how acidic depends on how much carbon dioxide and sulphur dioxide gases the rain picks up as it falls to earth. Water becomes more basic as it runs off the land, picking up minerals – such as lime (CaO) – and chemicals, often from industrial and agricultural wastes.

C. Give each student group enough pH indicator paper to test each sample. Explain how the pH test paper is used. Tell students that they are to test the pH of each solution following these procedures:

1. Record the number and contents of each sample.
2. Shake or stir each sample a little to mix the contents.
3. Dip a pH test strip into the solution.
4. Record the pH for each sample.

D. When all groups have finished testing and recording each sample, share results, determining whether each sample was acid or basic. Ask students the following questions:

1. Which substance showed the most change in pH when diluted?
   (vinegar)
2. Which substance showed little or no change?
   (dishwasher soap)
3. Even though vinegar has a low pH, meaning it is quite acidic, why is it not hazardous?
   (It is not hazardous because it is easily diluted and is quickly metabolized by tissues and cells in our bodies. This is unlike the dishwasher soap, which remains strong even in low concentrations.)
4. Why are most cleaners and detergents alkaline?
   (Alkaline chemicals "cut through" grease and oil, thus cleaning faster and easier.)
5. How can we use fewer hazardous cleaners?
   (We can choose ones that are made from less harmful chemicals, such as vinegar and water.)



EXTENSIONS

- **Demonstrate parts per million.** Explain to students that it is not practical or even possible to remove all substances from water, so the government sets standards indicating how much of various substances are allowed in water. Tell students that these standards are stated as "parts per million" or "parts per billion." To help students understand the concept, ask them to picture a million of something all black – cars, cats, marbles. Tell them if one of those objects were changed to orange, that would represent one part per million; if three were changed to orange, that would represent three parts per million. To demonstrate this concept with water, perform the following demonstration:
  1. Display a glass with 10 ounces of water mixed with red food coloring. Tell students that this substance represents a pollutant.
  2. Remove one ounce (2 tablespoons) of the red water and put it into another glass. Pour 9 ounces of water into the glass. Label the glass "1 part per 10."
  3. Remove one ounce of the diluted solution and put it into another glass. Pour 9 ounces of water into that glass. Label the glass "1 part per 100."
  4. Do this process again – "1 part per 1,000."
  5. And again – "1 part per 10,000."
  6. And again – "1 part per 100,000."
  7. And again – "1 part per 1,000,000."

- **Research environmental clean water regulations.** Determine what laws regulate water quality. What criteria are set for drinking water? For reclaimed water? Why have these criteria been established.

- **Do a storm drain survey.** On a map of your community, indicate all the storm drains. Determine what pollution sources are near the drains and how pollutants can be kept from running into the drains.

- **Make a model of local watershed.** Use a topographic map of your area to determine the high points, the low points, the "green" areas, and the water drainage patterns. Using paper maché, plaster, clay, or other materials, build a model of your area. Demonstrate the watershed by "raining" on the model. Then alter the model (e.g., add "green" areas, add "pollutants") and test again.

- **Perform other water quality tests.** Test water for the following qualities and determine why each of the tests are important. *(**Note:** TesTabs can be obtained from most scientific supply catalogs.)*
  - ■ Temperature
  - ■ Dissolved oxygen (use Dissolved Oxygen TesTabs)
  - ■ Nitrate (use Nitrate Wide Range CTA TesTabs)
  - ■ Phosphate (use Phosphorus TesTabs)

BACKGROUND INFORMATION

The water that runs off the land drains into creeks, streams, rivers, or the ocean, or it runs into storm drains, which empty directly into the ocean. The land area from which surface runoff drains into a particular body of water is called a watershed. Watersheds are separated from each other by ridge lines or mountains. Water falling on each side of a divide drains into different watersheds and collects at different sites.

As the water runs off the land, it picks up whatever might be in its path – litter, animal waste, oil droppings, leaves, fertilizer, pesticides. Most of this water does **not** go to a wastewater treatment plant; that means these pollutants end up in rivers and in the ocean, often contaminating the water and causing harm to people, plants, and animals.

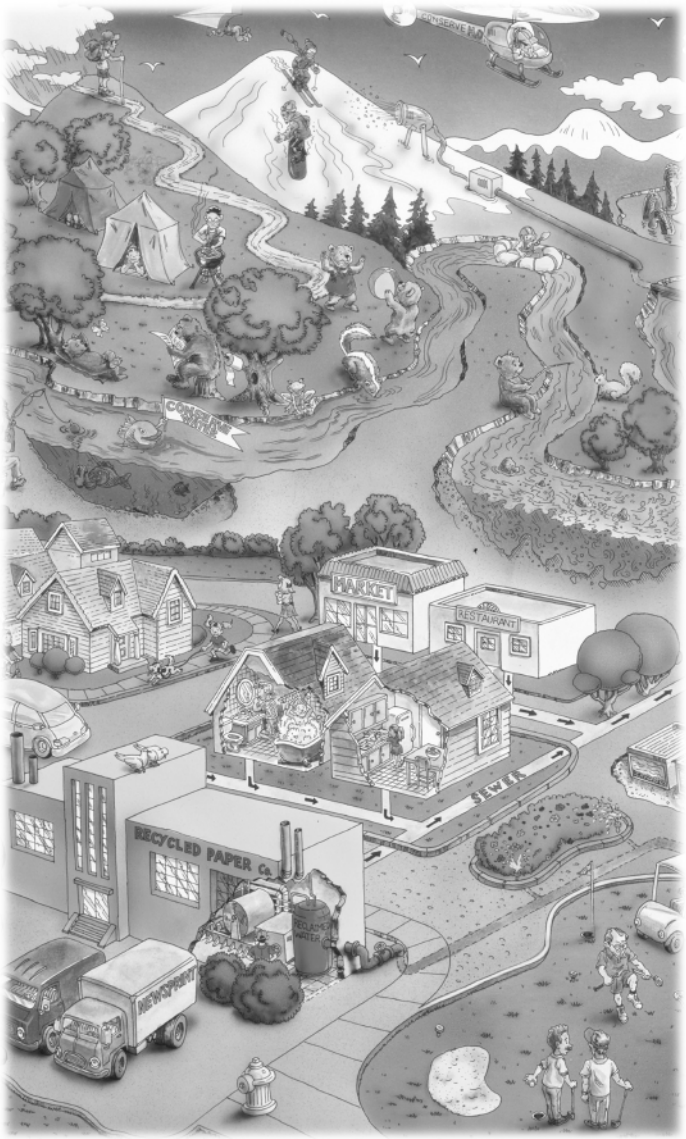
Pollutants

There are two general sources of pollutants: point and nonpoint.

Point source pollution is discharged from, and can be traced back to, an identifiable point or source, such as a factory's discharge pipe. Nonpoint source pollution is contaminated runoff that originates from an indefinite or unidentifiable place, often from a variety of places. Examples of nonpoint source pollution include fertilizers and pesticides from both agricultural fields and residential lawns and gardens, motor oil from streets and parking lots, and litter from community parks.

These pollutants can cause many problems. As they runoff with the water, they can soak into the ground contaminating groundwater. When they enter bodies of water – rivers, lakes, ocean – they can harm humans and wildlife.

- Nutrient-rich fertilizer promotes the overgrowth of algae on the surface of the water, called eutrophication. As the algae decomposes after it dies, it uses up the oxygen in the water, which affects the plant and animal populations in the water. In extreme cases, fish may die because of lack of oxygen.
- Pesticides and other chemicals can be toxic to humans and wildlife.
- Animal waste can cause diseases.
- Litter can harm marine life that either get tangled in it or eat it, thinking it is food.
- Sediment can harm marine plants and animals by burying them or destroying their habitats.



Water Quality

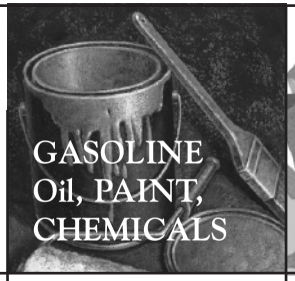
The quality of our water is constantly being tested, with physical, chemical, and biological tests. Water that comes into our homes is monitored to make sure it does not contain organisms that can transmit disease and to make sure it tastes, smells, and looks good. Wastewater is tested to determine how it should be treated or if it is safe to discharge back into the environment. And water in our oceans and lakes is tested to be sure that it is safe for humans; otherwise, the beaches are closed to the public.

Every day, water quality tests look for pollutants, both chemical and biological. Many of these tests involve the use of equipment found only in highly specialized laboratories. Other tests, however, such as testing the pH of water to determine its acidity or alkalinity, can be done in classroom labs. The pH of water is important because if water is too acidic or too alkaline, it can damage plumbing, pipes, and medical equipment, and it can be inhospitable for fish populations.

Everyone is responsible for the health of a watershed. Individuals can help by carefully following directions for using pesticides and fertilizers, by cleaning up pet wastes, by not disposing of household waste in the street, by fixing leaks in vehicles, and by using non-hazardous products when possible. Communities can help by sweeping roadways to remove waste and by planting grass and greenbelts to help filter runoff from streets and parking lots. All of our actions, both negative and positive, add up.

POLLUTION SOURCES IN A WATERSHED

Name: _____ Date: _____

		 PESTICIDES	 ANIMAL WASTE	 YARD WASTE		
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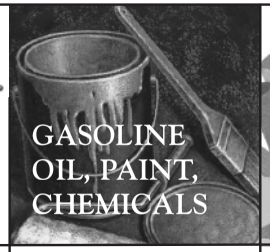
		 PESTICIDES	 ANIMAL WASTE	 YARD WASTE	 GASOLINE OIL, PAINT, CHEMICALS	 LITTER (plastic, glass, metal, etc.)
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SOURCES	• *gardens* • *lawns* • *farms* • *golf courses* • *parks*	• *gardens* • *farms* • *golf courses* • *parks*	• *farms* • *ranches* • *homes* • *animal shelters* • *animal hospitals*	• *lawns* • *gardens* • *greenbelts* • *construction sites* • *logging areas*	• *roads* • *driveways* • *parking lots* • *gas stations* • *auto shops* • *boat yards* • *airports* • *junk yards* • *paint shops* • *cleaners* • *printers*	• *fast food restaurants* • *parks* • *schools* • *anywhere there are people*