Activity: Pollution Observation

Summary: In this activity, students will conduct an experiment to observe the effects of nonpoint source pollution on water environments.

California State Content Standards

SCIENCE

Chemistry
- **Acids and Bases 5a.** Students know the observable properties of acids, bases, and salt solutions.

Biology/Life Sciences
- **Ecology 6b.** Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- **Ecology 6d.** Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.

Earth Sciences
- **Biogeochemical Cycles 7a.** Students know the carbon cycle of photosynthesis and respiration and the nitrogen cycle.

Investigation and Experimentation
- **1c.** Students will identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
- **1d.** Students will formulate explanations by using logic and evidence.
- **1g.** Students will recognize the usefulness and limitations of models and theories as scientific representations of reality.
- **1j.** Students will recognize the issues of statistical variability and the need for controlled tests.

Objectives:

Students will be able to:
- Record and interpret observations of the effects different types of nonpoint source pollution have on water environments
- List possible effects of pollution on wildlife in Upper Newport Bay

Materials:

- 5 clear 1-quart or larger containers (plastic soda bottles or canning jars)
- Water that contains algae from a freshwater aquarium or a pond, or pond water purchased from a biological supply company (at least 5 quarts)
- Good light source (direct sunlight or strong artificial light)
- Plant fertilizer (7 teaspoons)
- Motor oil (2 teaspoons)
- Vinegar (1/2 cup)
- Dish detergent (2 tablespoons)
- Masking tape or blank labels
- Markers
- Handout
  - *Observation Sheet*

Preparation:

- Two weeks before the lesson, set up the five bottles or jars. Fill each jar with aquarium or pond water, add one teaspoon of plant fertilizer, and stir thoroughly. To improve the quality of the model, try adding a bit of soil from the bottom of a pond or gravel from an aquarium tank along with the water. Put the jars without lids near a window where they will get direct light or give them a strong incandescent or fluorescent light. Do not put them where they will get cold. Let the jars sit for 2 weeks.
- The day of the lesson, set up 4 testing stations. Each station should have a jar, tape and marker for labeling, measured amount of one of the pollutants (2 teaspoons of motor oil, 1/2 cup of vinegar, 2 tablespoons of detergent, 2 teaspoons of fertilizer), and an *Observation Sheet*.

Time Required:

- 1 hour for initial lesson
- 5 minutes twice a week for 4 weeks for observations
- 1 hour for final lesson

Adapted from "Recipe for Trouble" in *WOW! The Wonders Of Wetlands,* co-published by International Project WET and Environmental Concern

Procedures:

1. Tell students that they will be conducting an experiment to see how pollution affects water environments such as Upper Newport Bay. Show students the five jars. Explain that each contains water and some added nutrients, in the form of fertilizer, to feed the plants in the water.

2. Explain that one jar will be the control, and the other four will each have a "pollutant" added to them. Point out each pollutant and ask students how that pollutant might get into the Bay.
   Motor oil – from cars and car repair shops; washes off streets and parking lots and runs into storm drains or creeks
   Detergent – from car washing, dog washing, patio washing; runs off into storm drains or creeks
   Vinegar – represents acid rain or acidic runoff from manufacturing
   Fertilizer – from agriculture, gardens, pet waste, parks, golf courses; runs off into storm drains or creeks.

3. Divide students into four groups and direct each group to a different station. Direct students to label their jar with the name of the pollutant they will be adding, and to record what they observe in the jar before adding the pollutant. Have students predict what will happen to the jar of water, both immediately and over time, and record their predictions on the sheet.

4. Ask students to carefully add the pollutant to their sample and to record their immediate observations of changes. Ask students to cover the jars lightly (covering tightly might lead to the growth of some undesirable bacteria). Put the jars in the light as before.

5. Twice a week for the next four weeks, have students check their jars and record notes on their *Observation Sheet*. *(OPTION: Use a camera to take pictures of the samples each week.)* At the end of week 4, have each group give a brief report to the class on their observations.

Follow-up:

Ask students the following questions:

1. Why is the fertilizer, which is a nutrient and promotes plant growth, considered a "pollutant"?
   (The algae grow too quickly, disrupting the balance of organisms. When the algae die and decompose, the oxygen in the water is depleted because of microbial activity—called eutrophication. The lack of oxygen can harm plants and animals living in the water. Many plants and other organisms that can't move, such as clams, will suffocate.)

2. Why did the vinegar make the water so clear?
   (The water became clear because the acid in the vinegar killed everything in the water.)

3. Why can some organisms survive under a layer of oil?
   (If the algae can get enough sunlight, they can produce enough oxygen to keep themselves—and other organisms that live below the oxygen-impervious oil layer—alive.)

4. What wildlife can be harmed by oil in the water?
   (Animals that come into contact with oil are harmed. Aquatic birds and mammals that get coated with oil are unable to fly or stay warm. Fish gills can be clogged.)

5. How can wetlands help lessen the effects of pollutants?
   (Because they are able to process excess nutrients and toxins, wetland plants can filter out many pollutants before they have a chance to enter larger water bodies. Too many pollutants, however, can begin to kill wetland plants and animals.)

6. What can you do to decrease the amount of these pollutants that reach the water?
   (For example, properly maintain cars, pick up pet waste, use commercial car washes.)

Extensions:

1. Have students devise methods to reverse or improve the water quality in their model polluted systems. For example:
   — Add baking soda to the acid test to neutralize the acid. (This is similar to adding lime or limestone rocks to lakes or streams to neutralize the effects of acid rain.)
   — Mop up the oil spill with straw, feathers, or cotton. Can students skim the oil off of their models to let the oxygen through again?

2. Have students research and write a report on what is being done to keep pollutants off the street. For example:
   — sweeping streets
   — mailing information sheets
   — providing pet-waste bags in parks
   — stenciling storm drains with "Leads to Ocean"
   — setting "Total Maximum Daily Load" (TMDL) requirements for pollutants

Adapted from "Recipe for Trouble" in *WOW! The Wonders Of Wetlands,*
co-published by International Project WET and Environmental Concern

Observation Sheet

Pollutant: _____

Appearance before adding pollutant: _____

_____

Predictions: _____

_____

_____

Appearance immediately after adding pollutant: _____

_____

Week 1: _____

_____

Week 2: _____

_____

Week 3: _____

_____

Week 4: _____

_____

Possible Sources of Error: _____

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Conclusions: _____

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