

Sources & Solutions

Background:

Land-based marine pollution can either be from a “point source” or a “nonpoint source.” Point source pollution originates from a specific place such as an oil refinery or a paper mill. Nonpoint source pollution, on the other hand, is contaminated runoff originating from an indefinite or undefined place, often a variety of places (e.g., farms, city streets and parking lots, yards and landscaping, construction sites, and logging operations). The soot, dust, oil, animal wastes, litter, sand, salt, pesticides and other chemicals that constitute nonpoint source pollution often come from everyday activities such as fertilizing lawns, walking pets, changing motor oil, and driving. With each rainfall, pollutants from these activities are washed from lawns and streets into storm drains that often lead directly to nearby bodies of water such as streams, rivers, and oceans.

While rarely visible, nonpoint source pollution is a chronic and ubiquitous form of water contamination. The U.S. Environmental Protection Agency estimates that the primary cause of the pollutants in the ocean is not from point sources, but from various forms of contaminated runoff. The table provided in this guide outlines examples of nonpoint source pollutants, their sources, and their effects. Finding solutions to nonpoint source pollution is difficult, even if the sources can be identified and located. Often solutions involve major changes in land-use practices at the local level and expensive methods to minimize runoff. However, nonpoint source pollution does offer individual citizens an ideal opportunity for combating water pollution. There are actions we can take every day that can help—by changing some of our habits, we can help reduce nonpoint source pollution. The first step is understanding what some of the common types of pollutants are that we let drain into our water bodies every day. The next step is to look for alternatives to use in place of those pollutants. Using these alternatives, we can still have clean houses and luxuriant yards—and clean water!

Grade: 7-12

Objectives: Part 1 - Students will identify nonpoint source pollution and how it affects both water quality and water organisms. Students will understand how consumer choices can reduce nonpoint source pollution.

Part 2 - Students will be able to utilize a cooperative problem solving process designed to reduce marine debris. Students will implement their solution.

Time Needed to Complete: Part 1 - 50 minutes; Part 2 – 60 minutes

Materials Needed:

- Local map of the community, photocopied for each student
- Map of community’s storm drain system from the local Department of Public Works (optional)
- “Nonpoint Source Pollution” and “Safe Substitutes” handouts
- Overhead transparency of “Brainstorming Tips”



Procedure:

Part 1: Identifying the Source

1. Ask students what they know about nonpoint source pollution, and write their answers on the board. Have they heard of the term? Do they know what it means? What are some examples? (*Nonpoint source pollution is contaminated runoff originating from an indefinite or undefined place, often a variety of places, see list in the "Background" section above.*)
2. Next, ask students what types of nonpoint source pollution they think could be originating from their school and their community. Write this on the board.
3. Pass out the "Nonpoint Source Pollutants" and "Safe Substitutes" handout. Go over the list as a group.
4. Pass out a copy of a map of your community. Each student will now study the map and locate possible sources of nonpoint source pollution in your community. Some examples could include:

Schools

- Playground, football field (trash, fertilizers, pesticides)
- Sewage system, including restrooms, cafeteria, science classes (trash, excess nutrients, detergents, chemicals, pathogens)
- Parking lot (trash, heavy metals, dripping oil)
- Sidewalks and outdoor hallways (trash)

Community

- Farmland (sediments, excess nutrients, fertilizers, pesticides)
- Construction sites (trash, sediments)
- Residential areas (trash, fertilizers, pesticides, detergents from car washing)
- Parking lots (trash, heavy metals, dripping oil)
- Parks (trash, fertilizers, pesticides, animal waste)

5. Brainstorm with students about actions they *or their parents and caregivers* can take to reduce pollutants entering the marine environment. (*Note: Many of these are activities that adults would likely undertake; students would need to advocate these suggestions to their parents. Brainstorm with your students how they can approach adults in a helpful manner.*) Ideas could include:
 - Properly dispose of trash in garbage cans. Storm drains empty into local waterways and can carry litter.
 - Never dump chemicals on the ground or down storm drains because they may end up in the local stream, river, or bay.
 - Walk pets in grassy areas or parks. Pet wastes on pavement can be carried into streams by storm water. Pick up after your pets.
 - Do not pour chemicals down drains or toilets because they may not be removed in sewage treatment and can end up contaminating water bodies. Use non-hazardous alternatives whenever possible (see "Safe Substitutes").
 - Keep cars well maintained and free of leaks. Recycle used motor oil (contact local public works department or call (800) CLEANUP, for how to store and where to take waste oil).
 - Don't dispose of leaves or grass clippings in your storm drain (this clogs the drain, preventing rain water from being able to flow through and can flood your street. Additionally, storm drains usually lead to a body of water, and excess nutrients are a type of pollution. Instead, try composting yard waste.)
 - Landscape your yard to prevent runoff. Use as few pesticides as possible. Try "natural" (non-toxic) approaches to pest control wherever possible and use organic gardening techniques.



6. Students locate their homes or neighborhoods on the maps. Then, draw on maps with a colored pencil or crayon the nonpoint source pollution originating from their homes and community, and track where it may go. Does it empty into a nearby waterway? Does it enter the lake, or ocean?
7. On the other side of the paper, students will list some possible solutions to reducing nonpoint source pollution from their homes and community.

Nonpoint source pollution presents a significant challenge to address on a large scale, as it is pervasive and difficult to control. However there is much we can do to reduce nonpoint source pollution at its source, beginning at home, extending to our schools, and out in our community.

Part 2: Developing Solutions

1. Hold a class discussion on the problem solving process.
2. Tell students that they are now going to use the problem solving process to address the issue of plastic pollution and other water pollution. Write on the board the different steps and explain them:
 - a. Understand and define the problem(s)
 - b. Brainstorm solutions
 - c. Analyze the solution suggestions
 - d. Evaluate which solutions would be most effective and select the best solution.
3. Divide students into small groups (3-4 students). In the groups, assign roles or have students choose a role: recorder, discussion leader, spokesperson.
4. Display “Brainstorming Tips” on the overhead projector for students to refer to in their groups. Tell students they will now use the problem solving process discussed earlier to create solutions to problems associated with water pollution.
5. Each group presents their problem definition and solution plan to the class. Ask for questions and comments. Ask that students note the ways their proposal could be improved.
6. The class selects the best plan by voting.
7. Elaborate on the best solution—describe it clearly. Would graphs, charts, or time lines help? Help the students design a graphic presentation of the classes’ chosen solution. Then, have students create an action plan with timeline for implementation of their class solution.
8. Help students implement the action plan or send the recommendation to the appropriate city, county, or state agency. Consider the following for implementation: Which groups need to know about the proposal?
9. Which groups will initially oppose it and how can their concerns be satisfied? What persuasive and educational techniques will be needed?
10. Who will perform each task? Depending upon the age of your class, you may need to have suggestions ready for them to choose (e.g., local Department of Public Works, EPA, California Coastal Commission, Harbormaster, etc.). Assist students in defining tasks and draw up a plan of action with names, tasks, and dates.



Extensions:

1. Using the maps and information from this activity, create a nonpoint source pollution display for your school and/or community.
2. Find out what types of pollutants your school is generating (detergents, pesticides, fertilizers) and make a list. Discuss with school staff nonpoint source pollution, and suggest alternative products.
3. Conduct a storm drain stenciling activity around your school to alert people about the hazards of nonpoint source pollution. Contact your local public works department to see if they have a stenciling program.
4. Write to local or state representatives to find out what measures are being taken (or considered) to reduce nonpoint source pollution in your community.
5. Invite an administrator from the school to evaluate students' proposals and presentations developed in Part 2.

Adapted from "Searching Out Non-Point Sources of Pollution", from Waves, Wetlands, and Watershed, a curriculum guide developed by the California Coastal Commission

Non Point Source Pollutants

Pollutant Types	Sources	Effects
Plastic Pollution	Runoff from roads, landfills, and parking lots into storm drains; sewer systems, shoreline and boating activities.	Can harm wildlife by entanglement or ingestion
Sediments	Construction sites; agricultural lands; logging areas	Clouds water, decreases plant productivity; suffocates bottom-dwelling organisms
Excess nutrients (e.g. fertilizers, animal wastes, sewage, yard waste)	Livestock; gardens; lawns; sewage treatment systems; runoff from streets	Prompts phytoplankton or algal blooms; causes eutrophication (depleted oxygen) and odor
Acids, salts, heavy metals	Runoff from roads, landfills, and parking lots; salt from roadway snow dumping sites	Toxic to wildlife and can be taken up by organisms and bioaccumulate in their tissues
Organize chemicals e.g. pesticides, oil, detergents)	Forests and farmlands; anti-fouling boat paints; homes (lawns); golf courses; sewage treatment systems; street runoff	Chronic and toxic effects on wildlife and humans, possibly carcinogenic (cancer causing)
Pathogens (e.g. coliform bacteria)	Municipal and boat sewage; animal wastes; leaking septic/sewer systems	Causes typhoid, hepatitis, cholera, dysentery



Safe Substitutes: Reduce Nonpoint Source Pollution

At Home

Air Fresheners

- For sink disposal odors, grind up used lemons.
- For surface odors on utensils and chopping blocks, add a few drops of white vinegar to soapy water.

Deodorizers

- For carpets, mix 1 part borax with 2 parts cornmeal; spread liberally and vacuum after an hour.
- Sprinkle baking soda in the bottom of cat boxes and garbage cans.

Dish Detergents

- Use mild, biodegradable, vegetable oil-based soap or detergent.
- For dishwashers, choose a detergent with the lowest phosphate content.

Disinfectants

- For disinfecting tasks, use ½ cup borax in 1 gallon hot water.

Drain openers

- Pour boiling water down the drain once a week.
- For clogs, add a handful of baking soda and ½ cup white vinegar to your drain, cover tightly and let sit 15 minutes while carbon dioxide bubbles work on clog. Finish with 2 quarts boiling water, follow with a plunger.

Floor cleaners

- For plain wood floors, use a damp mop with mild vegetable oil soap and dry immediately.
- For painted or varnished wood floors, combine 1 teaspoon of washing soda with 1 gallon of hot water. Rinse and dry immediately.
- For vinyl floors, combine ¼ cup white vinegar and ¼ cup washing soda with 1 gallon of warm water, and mop.
- For scuff marks on linoleum, scrub with toothpaste.

Furniture polish

- For finished wood, clean with mild vegetable oil soap.
- For unvarnished wood, polish with almond, walnut, or olive oil; be sure to remove excess oil.
- Revitalize old furniture with linseed oil.

Glass cleaner

- Combine 1 quart water with ¼ cup white vinegar.

Laundry detergent

- Avoid products containing phosphates and fabric softeners.

Bathrooms

- Combine ½ cup borax in 1 gallon of water for cleaning and disinfecting toilets.
- Clean toilets frequently with baking soda.
- Tub and sink cleaners: Use baking soda or a non-chlorinating scouring powder.

For the Garden

Garden fertilizers

- Use organic materials such as compost, either from your own compost pile or purchased from the store.

Garden weed and fungus control

- Use less-toxic soap solutions for weed killers.
- For fungus, use less-toxic sulfur-based fungicides.
- To control powdery mildew on roses, spray both sides of rose leaves (in the morning, weekly) with a mixture of 2 tablespoons mild liquid soap, 2/3 teaspoon baking soda, and 1 gallon water.

Pest control

- For outdoor ants, place boric acid in problem areas.
- For indoor ants and roaches, caulk entry points. Apply boric acid dust in cracks and insect walkways. Be sure it's inaccessible to children and pets (it's a mild poison to mammals).
- For garden aphids and mites, mix 1 tablespoon of liquid soap and 1 cup of vegetable oil. Add 1 teaspoon of mixture to a cup of water and spray. (Oil may harm vegetable plants in the cabbage family.)
- For caterpillars in the garden, apply products containing *Bacillus thuringiensis* to the leaves when caterpillars are eating.
- For mosquitoes in the yard, burn citronella candles.

Source: *Take Me Shopping: A Consumers Guide to Safer Alternatives for Household Hazardous Products.* Published by the Santa Clara County Hazardous Waste Management Program.



Brainstorming Tips

1. Don't Criticize Others' Ideas
They will lose their train of thought and stop generating ideas.
 2. More is Better
Write down as many ideas as you can. At this stage, don't worry about spelling, repetition, etc.
 3. Connect Ideas When Possible
If something someone says sparks a thought, say your idea. Connect parts of your ideas with theirs when possible.
 4. Be Free Wheeling and Don't Be Afraid to Express Crazy Ideas
A crazy idea now may seem plausible and original after more thought and research.
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The Problem Solving Process

(Format for a class discussion)

Why is it important to understand and define the problem(s) before beginning to explore solutions? The more accurately and specifically a problem is defined, the easier it is to come up with effective solutions.

What are some examples of how different problem definitions might lead to different solutions? One problem definition might focus on the large numbers of cigarette butts found on beaches; another might focus on a lack of trash receptacles in public area. If your students have participated in a shoreline or beach cleanup, remind them about the data they gathered and analyzed during the cleanup, and the problems they identified. Is there anything else you observed at the shoreline that could help define the problems? If your students did not do a shoreline cleanup, discuss the problems identified in Part 1 of this lesson above.

As a group, identify some examples of problem definitions for which the students will explore solutions. Discuss some possible solutions. The solutions could be as simple as initiating a letter writing campaign or as complex as working to get a law passed. For example, students in Massachusetts helped pass a law banning mass balloon releases.

