

Science Lessons for Grades 9-12

“River of Shame”

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Discipline: Environmental Science, Chemistry, Biology

Grade: 9 to 10, 11 to 12

Standards

Content Standard A – Science as Inquiry

- Identify questions and concepts that guide scientific investigations
- Design and conduct scientific investigations
- Use technology and mathematics to improve investigations and communications
- Formulate and revise scientific explanations and models using logic and evidence
- Recognize and analyze alternative explanations and models
- Communicate and defend a scientific argument
- Understandings about scientific inquiry

Content Standard E – Science and Technology

- Abilities of Technological Design
 - o Identify a problem or design an opportunity
 - o Evaluate the solution and its consequences
 - o Communicate the problem, process and solution

Content Standard F – Science in Personal and Social Perspectives

- Personal and community health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Context

Students will be introduced to the concept of the water pollution. Businesses, industries, and community services contribute different pollutants (chemical, sedimentary, thermal, impervious pulse) and create cumulative contamination of the water body impacting the watershed ecosystem. Students will learn the concepts of pollutant origins (point source vs. non-point source & inorganic vs. organic), and the role of impervious surfaces. Students do not realize that all businesses and community services directly or indirectly contribute contaminants to the watershed. Students should understand all categories of contamination, flow of water bodies, water cycle, and have a basic understanding of businesses, industries, and services in their communities. Organic waste originates from animal or plant sources and wastes, petroleum products, and byproducts of the industries such as dairy industry. Inorganic wastes include a wide range of particles originating from soil, naturally occurring minerals and depositions from industries (sand quarry, still industries). The origin of both organic and inorganic wastes can be point or nonpoint source pollution. Point source pollution can be identified and has a particular discharge location (factory outflow, waste water plant discharge, storm sewer pipes). Nonpoint source pollution is contributed over an extended area and cannot be traced to a single point (farm field, lawn, parking lots, run off). This lesson can be part of a variety units, including water pollution, human impacts, natural resources, and sustainability.

Preparation/Websites

Supplies:

White bulletin board paper 20 – 25 feet

Blue marker – for river path

Black marker – for roads

Colored stickers (or construction paper, coloring utensils, etc.) - 8 different colors, one for each pollutant. If construction paper, cut 300 square pieces (size ½”).

Colored pencils – drawing the community pollution contributors

Worksheet "River of Shame" - one per student
Worksheet "Types of businesses" - one per class
Scissors (only for cutting construction paper)
Glue (only for applying construction paper)

Using the blue marker, draw a river from the beginning to the end of the bulletin board paper. The down stream should have a delta that opens into a larger body of water such as an ocean or lake. Along the river include tributaries and ponds. Draw arrows representing water flow in all water bodies. Using a black marker draw in roads on each side of the river. Create a River of Shame worksheet in advance. This worksheet lists the types of pollutants and provides a description of each. (An example worksheet is available at http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html.) Set up a Pollutant Color Coded Key in advance where each color corresponds to a particular group of pollutants. This can be made by using the River of Shame worksheet and assigning a color to each pollutant. This key contains the types of pollutants and a description of each. (An example key is available at http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html.) Make a sheet of Types of Businesses. Student pairs will choose a type and pick a specific operation, e.g., agriculture - dairy farm, factory - steel mill, etc. (An example worksheet is available at http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html.)

Types of businesses may include:

CAFO (Concentrated Animal Farming Operations)
Waste Water Treatment Plan
High School
Restaurant/Fast Food
Shopping center/strip Mall
Park/Playground
Hospital
Gas Station
Electric Company
Factory
Farm
Housing Development

http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html

Motivation

Reflective discussion of our student watershed water quality results, to illustrate community impacts. Discuss point source/non-point source and organic/inorganic pollution, the levels of waste water treatment, where fertilizer, etc. ends up when it runs off into the water.

Description

1. Students choose partners (works best in pairs).
2. Student partners choose a type of business, industry, or service from the list.
3. Students choose location along the "river".
4. Students choose the specific operation of their business, industry, or community service and draw the aerial view with all infrastructure (adding labeling when appropriate). The more detail, the better. Include driveways, walkways, parking lots, landscaping, bathrooms, sewer lines, water lines, plant operations details, bathrooms, and dumpsters.
5. Using "River of Shame" worksheet and colored stickers (or other material e.g., construction paper, coloring utensils, etc.) for pollutant colors, students create their own Pollutant Color Coded Key sheet by filling in the assigned color for each pollutant.
6. Working together students will decide the amount of each pollutant that their business creates (low, medium, or high). Adjust low, medium and high values according to class size. The river should be full, not overflowing with pollution. For a class size of 10 pairs, values of 5 for low, 10 for medium and 15 for high are sufficient.
7. Student teams tally/collect number of pollutants based on the amount of business pollution circled on the River of Shame Worksheet sheet.
8. Students will make a reference key on the bulletin board paper in front of their drawing, that summarizes their pollution by applying one appropriately colored sticker for each pollutant that their business, industry, or

community service creates. Next to each sticker (pollutant), students write down the total number of that pollutant. For example, if the green stickers represent fertilizers and the business/service pollutes a large number of pesticides, that group would stick a green sticker in front of their site and write high = 15 next to the sticker.

9. When all groups are ready directions to “pollute” are given. All students will deposit “pollutants” into the river and down stream of their business or service location by sticking the colored dots onto the bulletin board paper. One-third of each color is applied directly in front of the business; the other two-thirds are distributed downstream.

Assessment

1. Participation in the group activity.
2. Amount of detail and ideas exhibited in the business or service design.
3. Checking accuracy of the pollutant value based on their company or service.
4. Oral explanation of their business or service’s impact on the water body.
5. Worksheet/Questionnaire (available at http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html).

Follow-Up Activities

Do water quality sampling to see what is in the local watersheds.