7-2012

Be the Solution to Water Pollution

Alexa Cavalli
The College at Brockport, acava1@brockport.edu

Jeremiah Johnson
The College at Brockport, jjohn10@brockport.edu

Follow this and additional works at: http://digitalcommons.brockport.edu/cmst_lessonplans

Part of the Physical Sciences and Mathematics Commons, and the Science and Mathematics Education Commons

Alexa Cavalli & Jeremiah Johnson
CMST Summer Institute
Summer 2012

Be the Solution, To Water Pollution!

Summary:

For our Noyce Scholarship Project we have chosen to apply our newly acquired modeling techniques to create a several day long exploration-based lesson on water pollution. We choose this topic because the study of pollution is relevant both to the Living Environment and Earth Science curriculum as dictated by the New York State Standards. We have integrated many activities in order to create a lesson that will effectively educate all students on the subject of water pollution, regardless of their background knowledge or learning style. We first created a basic model for water pollution using Agents Sheets™; this model simulates the spread of pollution from an industrial source, as well as the effect of the diffusion of pollution on aquatic life within the lake. This model would serve as an introduction to water pollution and would allow students to explore factors relevant to pollution such as: lake size, and shape, pollution diffusion rate, and fish resiliency. The students would receive a worksheet that would accompany the simulation to guide their exploration.

After using the model we created students would move on to using a more established simulation (http://www.awqa.ca/media/AWQA%20Game.swf) where students would be able to gain knowledge of the process of testing water for environmental pollution. Using this simulation the students would gain procedural knowledge, as well as knowledge of the type of chemicals that contaminate water.

At this point students would receive real data about lake pollution in Saranac Lake including factors like temperature, pH, precipitation, sulfate, and nitrate concentration over the last 35+ years. The students will analyze this data by creating scatter plots and regression lines using Excel. This activity would build graphing and analysis skills which are important in conducting and understanding scientific research.

Our multiday exploration would conclude with the students creating a model of water pollution and pollution filtration in a laboratory setting. Hands-On exploration and laboratory activities are at the center of science classroom, and are what separates science from other disciplines. By concluding our lesson with a hands-on activity students will be able to apply the knowledge they have built throughout the lesson, which is a gratifying feeling for developing learners.

New York State Science Standards:

Living Environment

Preformance Indictator 1.1
Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent oneÕs thinking.
Major Understandings
1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.
1.1b Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.
1.1c Science provides knowledge, but values are also essential to

7.1c Human beings are part of the Earth's ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems. Humans modify ecosystems as a result of population growth, consumption, and technology. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems may be irreversibly affected.

7.2a Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water.

7.2c Industrialization brings an increased demand for and use of energy and other resources including fossil and nuclear fuels. This usage can have positive and negative effects on humans and ecosystems.

Earth Science

Key Idea 2:
Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.
For example:
- draw a simple contour map of a model landform
- design a 3-D landscape model from a contour map
- construct and interpret a profile based on an isoline map
- use flowcharts to identify rocks and minerals

Key Idea 6:
In order to arrive at the best solution that meets criteria within constraints, it is often necessary to make trade-offs.
For example:
- debate the effect of human activities as they relate to quality of life on Earth systems (global warming, land use, preservation of natural resources, pollution)

Agent Sheets Worksheet

Name:_____

Agent Sheets Activity Worksheet

1. How many fish did you place in your lake? (Small, medium, and giant fish)
    a. Small-
    b. Medium-
    c. Giant-

2. Using the original settings, which fish tends to die first? Which one lasts the longest?

3. Change the number and position of factories, what happens to the overall fish population?

4. What happens as you increase/decrease the death rate of your fish?

5. Does the proximity of the fish to the pollution plume effect the death rate? How?

Excel Worksheet

Name:_____

Saranac Lake Data Analysis

1. Create scatterplots for each of the pollution variables vs. time (year). Are there any noticeable positive or negative trends?

2. To confirm any of the trends fit your data with a trend line and linear equation. What do the equation and R^2 value tell you about the relationships?

3. Now try creating scatterplots amongst the variables. For instance plot Nitrate Concentration v.s pH, or precipitation vs. temperature.

4. Which variables are most strongly related?

5. Which variables are least strongly related?

   Save all your scatterplots and send them to my email address!

Lesson 5 – Make Your Own Water Pollution

Grade 5-8 (Science and Social studies)
Grade 9-12 (Science and Social studies)

Topic: water pollution and cleaning up polluted water.

Time: 60 minutes

Space Requirement: Regular classroom or lab set up

Methodology: Group lab, cooperative learning

Materials: 1 2L pop clear pop bottle per group, 1 500-mL pop bottle (with lid) per group, 1 cup of fine sand per group, 1 cup coarse sand per group, 1 cup fine gravel per group, 1 cup coarse gravel per group, 1 cup activated carbon (charcoal) per group, 1 cotton ball per group, 1 clear cup per group, 1 small piece (about 10 cm^3) of cheese cloth per group, 1 rubber band per group, 1 funnel per group, TDS meter, pH meter, pollutants as brought by students, 1 designated waste container for the water rinsed from the pop bottles, 1 permanent marker, blank paper (1 per group).

Objectives: Students will experiment with different types of water pollution to see first hand how pollution affects water. Students will begin to develop an understanding of the economic impact of water pollution. Students will develop a water filter diagram to demonstrate the difficulties associated with cleaning polluted water.

Directions/Procedure:
   1. Stir up the container of dirty water from the previous lesson and remind the students about the types of pollution discussed the day before. (2
   min)
   2. Explain the activity for the day using Exercise in creating water pollution sheet (see Resources) and explain the following duties then divide the class into groups of five. (5 min)
      a. Reader: reads the procedure for the whole group
      b. Materials: gets what is needed from the materials list
      c. Chemist: mix the pollutants together one at a time
      d. Recorder: records all observations

      e. Banker: look useful for now

         f. Remind students that all questions must be answered by the end of class time.

3. Divide students into groups and begin the activity (25 min)

         a. While the groups are working on their pollutants, set up the filter materials on a separate table.

4. Hand out Exercise in filtering water pollution (see Resources) to each group.

      5. After 25 minutes bring the class together and explain the second part of the activity. (5 min)

         a. Point out the table with the filter materials. Remind the groups that ONLY the material gatherer and the recorder are to go to the table and make a note of what is on the table to build a water filter. The groups are NOT to begin building the filters today.

         b. The task is to design a filter that will remove as many or all the pollutants your group has using the materials on the table.

      6. Groups work together to design a water filter. They must draw the filter in a fully labelled diagram on a separate sheet of paper to be handed in at the end of the class. (20 min)

7. Remind the students to fill in their water bottle charts.

Evaluation: Students must hand in one completed question sheet and one filter diagram per group.

For the Teacher: This lesson is adapted from two sources: Carmen Hood from the SEER water Project and Tracy Webb a teacher from Nova Scotia and a Board member for the Safe Drinking Water Foundation.

The goal for this lesson is to have students begin to think more deeply about pollution and the effect it has on the environment and the economy. It is advisable to have some assistance during this lesson either from an EA or another teacher to assist the younger grades with filtering their samples.

There are a number of materials needed for the lesson. Most materials can be gathered at little or no cost (for example: pop bottles, cotton balls and cheese cloth from home, sand and gravel from play ground). The sand and gravel should be cleaned prior to use. It is easily cleaned by putting the sand in a colander or strainer and running water through the sand until the water runs clear. The activated carbon is the same material that is used in filters for aquariums; your local pet store will stock it.
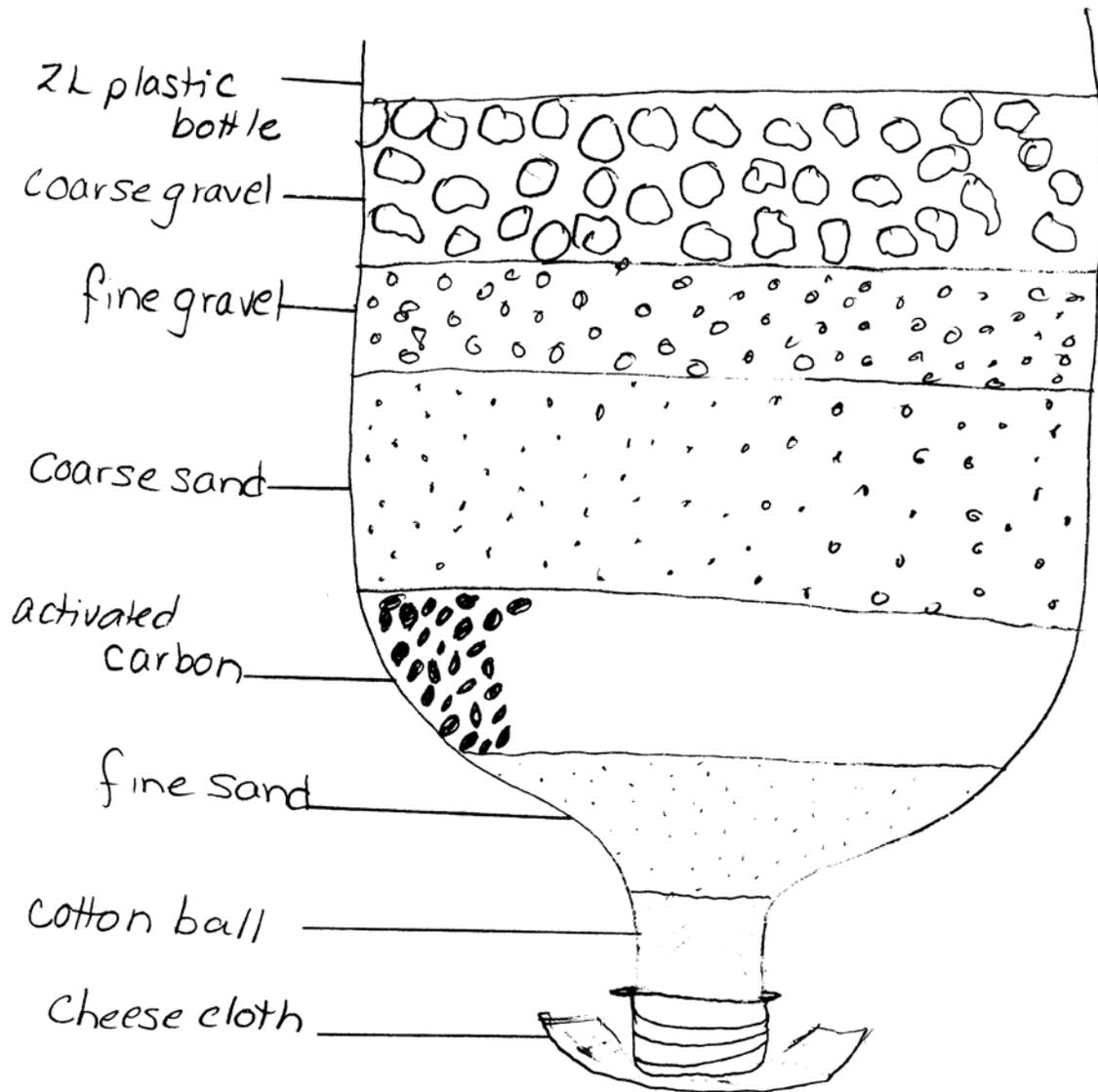
www.safewater.org

A water filter diagram is available through a link in the resources section. This diagram can be used as a template for assessing how effective the students' filters will be.

Resources: The Procedure sheets and Questions sheet for this activity can be found at the following links: Exercise in creating water pollution, Exercise in filtering water pollution, Questions. The sample diagram is available through the Filter Diagram link.

Extension Activity: The Safe Drinking Water Foundation has other educational programs that can be taught with this set of lessons. Operation Water Drop looks at what chemical contaminants there are in water and is designed for a science class. Operation Water Flow looks at how water is used and where it comes from and is designed for a Social studies and Math collaboration. Operation Water Spirit presents a First Nations perspective of water and water issues and is designed for a Native Studies class. Operation Water Health looks at common health issues surrounding drinking water in Canada and around the world and is designed for a Health, Science and Social Studies collaboration. To access more information on these and other educational activities visit the Safe Drinking Water Foundation website at www.safewater.org.

www.safewater.org

Sample Water Filter ~ Lesson 5 Operation l
Pollu

2L plastic bottle

Coarse gravel

fine gravel

Coarse sand

activated carbon

fine sand

cotton ball

Cheese cloth