Science Lessons for Grades 6-8

"What is in that water? Bacterial load and Water Quality Experiment"

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Discipline: Life Sciences
Grade: 6 to 8

Standards
Benchmarks of NAS Science Standards that fit the lesson:
1)The global environment is affected by national and international policies and practices relating to energy use, waste disposal, ecological management, manufacturing, and population. 7G/M5*
2)Viruses, bacteria, fungi, and parasites may infect the human body and interfere with normal body functions. A person can catch a cold many times because there are many varieties of cold viruses that cause similar symptoms. 6E/M3
3)The environment may contain dangerous levels of substances that are harmful to human beings. Therefore, the good health of individuals requires monitoring the soil, air, and water and taking steps to make them safe. 6E/M5
4)Specific kinds of germs cause specific diseases. 6E/M6** (BSL)
5) All living things are composed of cells, from just one to many millions, whose details usually are visible only through a microscope. 5C/M1a

Purpose/Goals
1) Students will recognize some organisms are too small to see.
2) Students will recognize that bacteria may help or harm other organisms.
3)Students will describe how bacteria in the water can affect human health.
4)Students will design an experiment for testing bacterial levels in the water.
5)Students will observe the colony growth of bacteria from four different water samples.
6)Students will analyze and graph the total bacterial growth before and after sanitation using UV light.

Context
In this lesson plan of a class lab experiment "What is in that water?" students will learn about bacteria and its helpful and harmful influence in the lives of humans. This experiment presented as part of the lesson plan can show that life in water extends to the world of bacteria. The major objectives covered through this experiment include not only learning about water sanitation and public health, but also about the biological function of bacteria normally present in the aquatic environment. This lesson also contains applicable extensions to learning about the current state of water sanitation in the developing world. This lesson was also used as an introduction to cell theory, the interdependence of organisms, and the aquatic science fields in general. This lesson is part of a module called "Water for Life" created for the NSF SPICE GK12 program.

Preparation
1) Sets of Bugcheck Bacterial Test Kit or equivalent environmental bacterial media growth strip (Each kit comes with 10 nutrient agar/fungal media strips).
2)Class water samples from four different locations (total collected number can vary depending upon group size and class number for from each location).
3) Location with access to full sun (up to 9 hours).
4) Composition Notebook
5)Optional-UV Light water sanitation device from camping store.

Websites:
http://esa.un.org/iys/water_quality.shtml
http://www.wateryear2003.org/en/ev.php-URL_ID=1600&URL_DO=DO_TOPIC&URL_SECTION=201.html
http://www.water.org/waterpartners.aspx?pgID=916

Motivation
A short activity is conducted to explore the concept of global water quality, water use, and water sanitation and compare to average American family. This exploration was accomplished with a webquest and subsequent discussion of findings with the students. This created a sense of overall purpose and set the stage for the lesson plan and "What is in that water?" experiment. Students then understood the need and purpose of exploring water sanitation.

Description
One of the ways we can increase knowledge and awareness of aquatic ecosystem resource use is to develop curricula that can be infused into a wide variety of courses. I believe integration of different aquatic science activities to existing agriculture or science curricula may be an effective tool to facilitate knowledge gain in science and increase awareness of natural resource use and its sustainability.
The context of this lesson is that students will do guided research experiment based on the issues and associated concepts of water sanitation, waterborne disease, microorganisms, and the importance of water to human health. Through an experiment called " What is in that water? Bacterial load and Water Quality Experiment" students will also learn the processes of science through the scientific method. In this lesson plan students conduct an experiment in which they measure, through a self contained system, the bacterial load (amount of bacteria) in 4 different types of water and examine the effect of UV disinfection on the water samples' bacterial populations. Provided below is the basic schematic for conducting the experiment with the students.

Experimental Procedure for Lesson Plan:
Purpose: To examine the total bacterial load in different types of water and how the numbers of bacteria are affected by exposure to UV rays.
Question:
1) How is the amount of bacteria in different types of water affected by solar disinfection process?
Suggested types of water include Tap water, Toilet water, aquaculture tank water, and pond water.
Hypothesis: If I change the type of water used in the sanitation process then the _____water with the greatest amount of bacteria will show the greatest reduction in bacterial growth after UV sanitation.
Independent Variable:
Water samples to be used in the disinfectant process: toilet water, tap water, fish (sturgeon) tank water, and pond water.
Control: Store bought Deionized water is clear water that has been sterilized and so it has no bacteria.
Dependent Variable: Amount or number of bacteria present (colony forming units) in each sample.

Assessment
Students were assessed on their participation in the lab, their ability to complete a final data chart, and an overall procedural write up with their conclusions of the lab in a lab notebook.

Follow-Up Activities
Several ideas exist for further exploration, such as expanding on the water samples collected from different sites and comparisons of other sanitation methods for waterborne pathogens such as chlorine, filtration, and ion exchange.