



Lesson Plan

Title
To Drink or not to Drink
Primary Subject Area
Environmental Science
Grade Level
AP
Overview
Using PBL framework to determine potability of water samples employing both standard (microbiological) and novel (light based) methodologies.
Approximate Duration
2-3 lab periods occurring within a one week period
MA Framework
The exercise is fully supportive of the MA Frameworks four scientific inquiry skills (SIS1-SIS4). It is also supportive of the Introductory Physics guidelines, specifically section 6.2 involving the electromagnetic spectrum. It is also consistent with Engineering Design Principles as so elucidated by the state frameworks. The state frameworks also recommend that during grades 11 and 12 students pursue additional science course work including Advanced Placement offerings. The exercise is fully supportive of the AP Environmental Science course outline (I. C. Global Water Resources and Use, including surface and groundwater issues; VI. A.3. Water pollution, including types, sources, causes, and effects). Further, the exercise supports the AP Physics topics outlines involving waves and optics.
Interdisciplinary Connections
Includes a range of biological (microbiology), chemical (reactions) and physical (optics) topics.
Lesson Objectives
To have students examine the utility, as well as the limitations, of existing approaches to assessing water quality. Given those limitations and a rapidly growing need for clean water sources globally, the students then examine new approaches for better determining water quality such as the use of optics-based methodologies.
Lesson Materials and Resources
A series of readings including primary sources (research papers). Most of the readings will be web-based.
Technology Tools and Materials
The first component of the investigation involves the determination of standard microbiological contamination of water supplies. This unit requires materials to properly culture coliform bacteria (coliform growth media and the tools used to plate and score the trials). The second unit introduces an optics based approach using laser light sources and light sensors coupled with a vernier data collection system to measure the degree of light absorption due to contamination in the water sample.
Background Information
According to the global non-profit, Water.org, almost a billion people currently lack access to clean drinking water with most living in the developing world. Further, this number is rapidly growing with the burden disproportionately borne by children. For example, it is estimated that 1.4 million children succumb to waterborne diseases annually. Historically, the assessment of drinking water quality has largely rested on an indirect assay in which the number of coliform bacteria present in a given water sample is used as an indicator of water quality. Although relatively easy to perform, such an assay suffers from several limitations. First, coliform bacteria are associated with the guts of warm-blooded organisms and not therefore just limited to humans. Secondly, most coliform bacteria themselves are not necessarily pathogenic, but simply serve as an indicator of potential contamination of the water by fecal matter. Ideally, biological water assessment would be based on the detection and quantification of specific

waterborne pathogens. A variety of emerging methodologies hold great potential promise to serve in such a capacity. These approaches include optic based systems such as the ones under development at research institutions such as Boston University.

Lesson Procedures

Assessment Procedures

At the end of the class prior to the start of the investigation, pre-assessment is conducted both to see what prior knowledge student have of water quality determination,as well as to get them ready for that night's reading

Accommodations/Modifications

Reproducible Materials

Explorations and Extensions

Lesson Development Resources

Reflections

Contact Information