Is It Safe To Go In?
Water Quality of Bathing Areas in the EU

Grades: ***6-8***

Time: ***Minimum 1 hour (may extend over a week depending on how in-depth or interdisciplinary the unit may become)***

Because of increasing population, industrial use, and agricultural use (irrigation mainly), clean water cannot be taken for granted in the European Union (EU) or the US. What are acceptable levels of toxins in bathing (swimming) areas?

Step 1: Defining ppm (parts per million) and threshold level.

For each group of 4 students, label six 8-ounce cups 1 – 6. Give each group 10 grams of salt (or sugar may be substituted for salt) and four 4-ounce cups. Start each group with 90 ml of clean drinking water in Cup #1. Add the salt to Cup #1 and swirl to mix. Discuss with group that you now have a 1/10 or 1 part per 10 solution.
Have students measure 10 ml of their 10% in a clean graduated cylinder. Transfer this solution and 90 ml of clean drinking water into Cup #2. Discuss how solution is now 1/100 parts sugar or salt and that the solution may be considered as 1 part per 100.
Have students continue to dilute salt solution through Cup #6 which will give a 1 part per 1,000,000 (ppm) solution.
Each student will begin with Cup #6 and add a small amount of solution in their individual 4- ounce cup. Directing students not to speak out loud, have students taste the liquid on their tongue. After they have tasted the liquid, have students rinse mouths with clean water or soda. Continue with tasting/cleansing process until each student has tested all seven cups. After tasting sessions, record on board the number of students that **first** tasted the salt solution at Cup 6, 5, 4, etc.

Step 2: Identifying local area environmental toxins.

Obtain a copy of your area's local "Water Consumer Confidence Report" from local officials or obtain a rating of your community's environmental standing at http://scorecard.org . This report should give a breakdown of ppb (parts per billion) of possible contaminants in your area's drinking water. Depending upon your locale, the following naturally occurring substances may exceed the threshold level (lowest level at which certain materials exert an effect on living organisms) for drinking water in the area. Discuss with students how difficult it was to determine the taste of sugar in Step 1 and how important that it is that water be tested regularly for safe consumption by living organisms. A sample of current EPA threshold limits is found below.

Simple list of sample substances and their threshold level that may be found locally (Note: these numbers are changed frequently by the EPA):

Chlorite	.01 ppb	Byproduct of drinking water disinfection
Nitrates	.01 ppb	Runoff from fertilizer use Leaching from septic tanks, sewage
Nitrite	.001 ppb	Runoff from fertilizer use Leaching from septic tanks, sewage
Cyanide	.0002 ppb	Discharge from plastic and fertilizer Factories
Cadmium	.000005 ppb	Corrosion of galvanized pipes Runoff from waste batteries and paint
Trihalomethanes	.001 ppb	Byproduct of drinking water disinfection
Fluoride	.04	Water additive which promotes strong teeth Discharge from fertilizer factories

Assessment:
Having completed the lab work in which students have determined the difficulty of determining the quality of water by taste (or scent), allow them the opportunity to review EEA's (European Environmental Association's) Directives 76/160/EEC and Directive 2006/7/EC (obtained at http://ec.europa.eu/water/water-bathing/index_en.html). In class, discuss the classifications – excellent, good, and poor as used to describe the quality of the EU's bathing water. Give reasons why a fourth category – "sufficient," was considered necessary as an additional indicator of bathing water quality. Although 19 pollutants were originally monitored on a regular basis, only two microbiological indicators of fecal contamination are monitored under the new directive.

Upon completion of review and discussion, students should prepare a 1-page written response to the questions below. In the final paragraph of the paper, request students to express their personal opinion on how they feel local (US) swimming area/pools should be monitored.

Why would only two pollutants be of such concern for bathing water quality?

Why would the EEA determine that a 3-years study instead of a 1-year plan be more relevant to accuracy of water quality results?

Extensions:
Students may do similar research on air toxins (substitute 10 ml of mint-flavored mouth wash for sugar/salt). Do not taste; use "wave" method to safely smell the scent in the 6 cups.

Research the EEA (European Environmental Agency) the EU version of the American EPA (Environmental Protection Agency. Determine if they maintain a type of online "scorecard" for European communities.

Research river basins found in the EU (Thames, Rhine or Danube Rivers are easily found on the Internet). Determine if EU river systems have watershed projects similar to those found in our country.

Exceptional Children's program teachers may want to prepare solutions ahead of time and monitor students closely so that they do not do more than **taste** on their tongue.

Visit your local waste-treatment facility.

Design and build water-treatment facilities from everyday materials (Hints: strainers, colanders, aquarium carbon filters, sponges, gravel.) Do not taste water but judge system by the clearest water produced by the system!

Create power-point presentations related to research or results of water quality, relationship between the EEA and EPA, water-treatment facilities, watershed/river basins of America/Europe

Online Resources:
http://ec.europa.eu/environment/water/
http://ec.europa.eu/water-bathing/index_en.htm
http://www.epa.gov/safewater/mcl.html
http://www.unc.edu/euce/education.htm

Standard Course of Study:

National Standards –
Math – 5-8.1 Problem Solving; 5-8.2 Communication; 5-8.3 Reasoning: 5-8.4 Connections; 5-8.5 Number Relationships; 5-8.7 Computation and Estimation;
3-8.8 Patterns and Function; 5-8.10 Statistics; 5-8.13 Measurement
Science – 5-8.1 Science as Inquiry; 5-8.3 Life Science; 5-8.5 Science and Technology; 5-8.6 Personal and Social Perspectives
Technology – K-12 Social, Ethical and Human Issues; K-12.3 Technology Productivity Tools: K-12.5 Technology Research Tools; K-12.6 Technology Problem-Solving and Decision-Making Tools
Social Studies/Geography – K-12.5 Environment and Society; K-12.6 The Uses of Geography

North Carolina Standards –
Grade 6 Math – 1.02; 1.06; 5.04
Grade 6 Science – 1.02; 1.03; 1.06; 1.07; 1.09; 2.02; 2.03; 2.04; 7.03; 7.04; 7.05
Grade 6 Technology – 1.05; 3.03; 3.04; 3.12; 3.13
Grade 6 Social Studies – 3.02; 6.01; 13.03

Grade 7 Math – 1.01; 1.01; 4.01
Grade 7 Science – 1.01; 1.03; 1.06; 1.07; 1.09; 2.02; 2.03; 2.04; 3.02; 3.03; 3.04; 3.06
Grade 7 Technology – 1.01; 1.06; 1.07; 1.08; 1.12; 3.01; 3.04; 3.11

Grade 8 Math – 4.01; 4.03
Grade 8 Science – 1.01; 1.03; 1.05; 1.06; 1.07; 1.09; 2.02; 2.03; 2.04; 3.01; 3.02; 3.05; 3.06; 3.07; 3.08; 4.02; 4.04; 4.08; 4.09; 4.10; 5.05; 7.02; 7.05
Grade 8 Technology – 1.01; 1.02; 1.12; 1.13; 1.14; 1.15; 1.16; 2.02; 2.06; 3.01; 3.02; 3.07; 3.08; 3.09; 3.10

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