Activity #4:

Chemical Concentrations in Water

Social Studies
Lesson
#2

Concentrations of chemicals in water are often expressed as units of "parts per million" (ppm) or "parts per billion" (ppb). For example, chemical fertilizers contain nitrates, chemicals that have been found to be dangerous to pregnant women even in quantities as small as 10 ppm. Trichloroethylene (TCE), a common industrial solvent, is more dangerous than nitrates and has been found to cause cancer in humans at quantities as small as 5 ppm. When analyzing the amount of certain chemicals in water supplies, it is often important to determine "how much is too much." Although it is not possible to determine such amounts by sight, taste or smell, they may still be harmful to people who regularly drink the water.

Objective: Students will be able to explain the concept of parts per million and parts per billion as these units are used to express concentrations of certain chemicals in water.

NEVADA SCIENCE STANDARD 16:8

Time: One class period

Materials: (per group) nine clear containers (glass or plastic, 50 ml), medicine dropper, solid coffee stirrers or toothpicks, red food coloring, clean water for rinsing dropper and for diluting, white paper

Procedure:

1. Line up the containers side by side and place a piece of white paper under each one. Starting left to right, number the containers #1 through #9.

2. Using the dropper, place ten drops of food coloring into container #1. (Food dye is already diluted 1:10.)

3. Using the dropper, place one drop of food coloring into container #2. Rinse the dropper. Add nine drops of clean water to this container. Stir the solution. Rinse the dropper.

4. Use the medicine dropper to transfer one drop of the solution in container #2 into container #3. Rinse the dropper. Add nine drops of clean water to container #3. Stir the solution. Rinse the dropper.

5. Use the medicine dropper to transfer one drop of the solution in container #3 into container #4. Rinse the dropper. Add nine drops of clean water to container #4. Stir the solution. Rinse the dropper.

6. Use the medicine dropper to transfer one drop of the solution in container #4 into container #5. Rinse the dropper. Add nine drops of clean water to container #5. Stir the solution. Rinse the dropper.

7. Continue this same process until all nine containers contain successively more dilute solutions.

8. When finished making the dilutions, answer the questions below.

<u>Questions</u>:

A. The food coloring in container #1 is a food coloring solution that is one part "color" per 10 total parts of liquid. What is the concentration for each of the other successive dilutions? Use the table below to show the concentrations.

Container No.	#1	#2	#3	#4	#5	#6	#7	#8	#9
Concentration	1:10	1:	1:	1:	1:	1:	1:	1:	1:

B. What is the concentration of the solution when the diluted solution first appeared to be colorless?

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C. Do you think there is any of the colored solution present in the diluted solution identified in Question B above even though it is colorless? Explain.

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D. What would remain in the containers if all the water were to be removed?

E. Explain the relationship between ppm and ppb and the conversion of these units to milligrams per liter or micrograms per liter. (Example: 1 ppm = 1000 ppb)

F. Extension: Let the containers sit for a few days until all the water in the containers evaporates. Does anything remain? In which containers?
