Name ____ Date ____________
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AP Environmental Science

PPM and PPB
HAGD and MTFBWY

Introduction:

Sometimes people are concerned with materials in very small amounts or concentrations. An environmental scientist might have to analyze water, air, or soil to determine what substances are present, but the amount of the substance is so small that a special unit is required to express it. Well, a unit does exist; just as "per cent" means "out of a hundred", **parts per million** (**ppm)** means out of a million and **parts per billion** (**ppb)** means out of a billion.

A concentration of 1 ppm corresponds to one part substance per one million parts of the gas, liquid, or solid medium it is found in. If you have any understanding of metric system units: 1 ppm = 1mg/L (not sure if that really helps ...). But, just because these amounts are numerically small, it does not mean that they are insignificant. For example, fish have specific requirements for dissolved oxygen (DO)in water to be able to survive. The DO level must be in the range of 2 and 9 ppm and can be disturbed by environmental activities. When testing groundwater, benzene levels (a carcinogen found in gasoline), are analyzed. The maximum allowable concentration of benzene in groundwater is 1 ppb.

As technology develops, people are able to use more sensitive equipment and testing techniques to detect tiny concentrations of contaminants. The smallest amount that can be detected with the analytical tools available (in this case, your eyes) is known as the *detection limit*.

Procedure to Conduct a Successive Serial Dilution:

____ 1. Place a Chemplate on top of a clean white piece of paper. This will give you a clearer view and better contrast.

_____ 2. Holding a bottle of food coloring vertically in order to obtain drops more uniform in size, add 10 drops of food coloring into cavity 1 of the Chemplate. This first cavity has a 1/1 concentration a.k.a. "*1 part per 1*".

_____ 3. Using the dropper, transfer 1 drop of the food coloring from cavity 1 into cavity 2. Return any excess back to cavity 1 and then thoroughly clean the dropper with water.

_____ 4. Using the clean dropper, add 9 drops of clean water to cavity 2. Use the tip of the dropper to gently mix the solution and then rinse off the dropper.

_____ 5. Once again, using the clean dropper, transfer 1 drop of the newly created solution from cavity 2 to cavity 3. Return any excess back to cavity 2 and then thoroughly clean the dropper with water.

______ 6. Using the clean dropper, add 9 drops of clean water to cavity 3. Use the tip of the dropper to gently mix the solution and then rinse off the dropper once again.

______ 7. Continue the process of moving 1 drop of each newly created solution, returning excess to previous cavity, and then adding 9 drops of clean water followed by a gentle mixing until cavity 10 (1 ppb) is filled.

____ 8. Construct a neat Data Chart with the following headings and fill it in based on experimental findings.

Example portion of data table:

Cavity #	Concentration	Concentration	Color Observed
1	1/1	1 part per 1	Very Dark Red

Conclusions (Answer on the Back of this Page):

1. At what concentration did you notice that the color of the dye was no longer visible? (1)
2. Based on your answer to question #1, what concentration was your detection limit for colored food dye? (1)
3. Which cavity has a concentration of 1 ppm? (1)
4. How many ppm of salt are found in a 3.5% salt solution? Show set up and work (1)
5. If you were the manager of a sewage treatment plant, you might be responsible for diluting treated sewage to safe levels in order to discharge them legally. If a one liter sample of the treated sewage had a concentration of 5000ppm, what would be the volume of the solution when diluted to an acceptable concentration of 5 ppm?
   Formula: Concentration 1 x Volume 1 = Concentration 2 x Volume 2 ($C_1V_1 = C_2V_2$) Show all work. (1)

Grading: Participation (2 points) Data Chart (3 points) Conclusion Questions (5 points)