Serial Dilution

Scientists and water monitors use several different tools to determine the concentration of substances in water. Chemicals may be present in dangerously high concentrations and yet may not be detectable by sight, taste or smell. Water contains dissolved oxygen, minerals, salts and possibly pollutants or contaminants.

A unit (of measure) of concentration when measuring levels is "*part per million*" (ppm). For example: if you were one person in a population of one million people, you would represent one part per million. A similar relationship holds for a "*part per billion"* (ppb).

Expressing PPM, PPB and PPT (trillion) in plain English and Numbers:

- The average distance to the moon is 239,000 miles or about 1.2 billion feet. So, if you jump only 1.2 feet (almost 15 inches) in the air, you have jumped one part per billion (ppb) of the distance of the moon.
- The average distance from the sun is 93,000,000 miles. When you drive 93 miles you have driven one part per million (ppm) of the distance to the sun.
- Ten drops of a solution in the Rose Bowl (in Pasadena) filled with water is one part per trillion (1:1,000,000,000,000) (ppt).

Materials Needed:

- Serial dilution plate (i.e. paint well tray or anything with ten wells or depressions, labeled 0-9)
- Food coloring (to represent contaminant)
- Two pipettes (eyedroppers)(one for transferring contaminant and one for diluting)
- Glass of tap water for rinsing pipette or eyedropper
- Glass of water for dilution

Procedure:

1. Place 10 drops of food coloring in well #**0**
2. Using one pipette or eyedropper take food coloring (contaminant) from well #**0** and place one drop into well #**1** (rinse pipette).

3. With the other pipette add nine (9) drops of clean water to well #**1**. (you should have a total of 10 drops in well #1).
4. Place one drop of solution from well #**1** and place into well #**2** (rinse pipette). Add nine (9) drops of clean water to well #**2**. **[What do you observe about the contaminant in the three wells?]**
5. Place one drop of solution from well #**2** and place into well #**3** (rinse pipette). Add nine (9) drops of clean water to well #**3**.
6. Place one drop of solution from well #**3** and place into well #**4** (rinse pipette). Add nine (9) drops of clean water to well #**4**.
7. Place one drop of solution from well #**4** and place into well #**5** (rinse pipette). Add nine (9) drops of clean water to well #**5**.
8. Place one drop of solution from well #**5** and place into well #**6** (rinse pipette). Add nine (9) drops of clean water to well #**6**. **[What do you observe about the contaminant in the well #6?]**
9. Place one drop of solution from well #**6** and place into well #**7** (rinse pipette). Add nine (9) drops of clean water to well #**7**.
10. Place one drop of solution from well #**7** and place into well #**8** (rinse pipette). Add nine (9) drops of clean water to well #**8**.
11. Place one drop of solution from well #**8** and place into well #**9** (rinse pipette). Add nine (9) drops of clean water to well #**9**.
12. Place one drop of solution from well #**9** and place into well #**10** (rinse pipette). Add nine (9) drops of clean water to well #**10**. **[What do you see? Is there contaminant in the water? How could you detect if any contaminant remained?]**