

## 5. PARTS PER MILLION

**Overview:** Students experiment with dye proportions in order to understand the concept of parts per million (PPM).

**Objective:** Students will use measure and dilute a dye solution to help them understand the concept of parts per million (PPM). This activity also reinforces place value and ties in with any base ten measurement.

**Time needed:** Approximately 40 minutes.

**Group Size:** 2-4

**Age appropriateness:** 5th and up.

**Site:** anywhere in the Garden or in the classroom.

**Background:** PPM is a unit of measure which is used to express total dissolved solids in water, dust particles in the air, the amount of chemical elements in a substance, etc. This activity coordinates with any water studies and pH. Vocabulary - colorless vs. clear, million, ratio or concentration, adjectives to describe color intensities for the color of dye being used.

**Materials:**

Provided at the Garden

Provided by the classroom teacher

Clear CHEM or CEPUP trays or similar trays with depressions. White styrofoam egg cartons could be substituted.

Red or blue food coloring

Eye droppers

2 cups of water, one for **rinse** and one to stay **clean** for dilution

Student data table

**Preparation:**

**Pre Activity:** This activity would be a great follow-up activity to a study of pond or river water or any study of water quality.

**Procedure:**

1. If you have clear trays, place them over white paper.
2. Place one drop of food coloring in the first cup of your container. Rinse the eye dropper.
3. Using the eye dropper, add 9 drops of clean water to cup 1 and mix.
4. Record color intensity and ratio (concentration) of cup 1 on the data sheet (1 part per 10, or 1 drop of color for 10 total drops, or 1/10, or .1).
5. Rinse the eye dropper and remove one drop of solution from cup 1 and put it in cup 2.
6. Rinse the eye dropper and add 9 drops of clean water to cup 2. Stir and rinse eye dropper.
7. Record observations on data sheet. The ratio in cup 2 is now 1 part in 100 or 1/100 or .01.

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8. Place one drop from cup 2 into cup 3. Rinse dropper and add 9 drops of clean water.
  9. Continue in the same manner to cup 6 where the ratio is 1 part per million (1/1,000,000 or .000001)
  10. Complete the data sheet and discuss results with the whole class.

**Modifications:** Continue the process to demonstrate parts per billion.

**Extensions:**

1. Visit the water treatment facility.
2. Do "My Sweet Tooth" activity in the CHEM kit that has students taste test and compare concentrations of sugar versus Equal and Sweet 'n Low.
3. Do "Controlling Variables" activity in Science Process Skills. Students record the length of time taken for increasing amounts of salt to dissolve in water.
4. Salt crystals can be formed by dissolving rock or Kosher salt in hot water (adding food coloring intensifies the cubes for microscopic viewing) and allowing the water to evaporate.
5. Rock candy can be formed by dissolving sugar in hot water, suspending a string and allowing water to evaporate. What is the concentration level in part per (i.e. How many parts of sugar per parts of water are needed)?

**Reference List:**

CHEM

CEPUP

Charts resulting from water or air testing available from air and water quality testing facilities.

**Time of Year:** any

**\*\*This activity was adapted from CEPUP, Fruitvale.**