

**SPECIAL VOCABULARY:**

- Ppm (parts per million)
- Concentration
- Ratio

# Mini-Lesson Measurement— Understanding PPM as a Ratio

**STATE STANDARDS:**

- 5MDA.1, 6RPA.1&2,  
7RPA.2,

**INTRODUCTION (2 MINUTES)**

- Science research and data often refer to the amount of pollutants or substances in air or water in a measurement such as ppm = parts per million. What does that actually mean?
- **For Older students:** Pollutants or substances in air or water are often referred to as %. In Latin, % means “for every 100”. So, 1 part per 100 = 1%. Ppm and ppb are ways of talking about concentration that are much smaller than 1%

**INSTRUCTION (5 MINUTES)**

- Discuss with students the term “1 part per”... by showing them a jar with 1 red ball and 10 white balls. Clarify how this is “1 per 10 parts” Continue with a jar that has 1 red ball and 100 white ones. Clarify how this is “1 per 100 parts”. You can add a jar that is 1 per 1,000 too.
- Explain that this is a ratio and demonstrate the ways to write it on the board 1:100, 1/100 or 1 to 100.

**INTERACTION (7 MINUTES)**

- Write 1: 1,000,000,000 and ask what ratio this is. Can they think of a way to describe, visualize, represent or draw it?
- Share a few illustrations:
  - 1 inch in about 16 miles
  - 1 second in 11 days
  - 1 minute in 2 years
- Explain that ppm (parts per million) or ppb (parts per billion) are a measurement of concentration often used for substances dissolved in water or diffused in air.
- As a class, in pairs or individually, practice equivalent ways of expressing the same concentration
  - 1 part per 10 = 10 parts per 100 = 10,000 parts per 100,000
  - 1 part per 100 = .1 per 10 = .01 part per 1,000...

**CLOSURE (1 MINUTE) - CHOOSE ONE**

- Give students a written or verbal measurement and ask them to write it as a ratio.
- Have students share their visual, description or representation with a desk partner
- Have students make a visual representation for the changing ratio 1/10, 1/100. 1/1000

**MATERIALS NEEDED:**

- 1 – 3 JARS WITH THE DIFFERENT RATIOS OF LIKE OBJECTS (1/10, 1/100. 1/1000)
- OBJECTS COULD BE LEGOS, MARBLES, SKITTLES, MINI-BALLS OR MINI POMPOMS....
- PAPER AND WRITING IMPLEMENTS TO PRACTICE WRITING EQUIVALENT EXPRESSIONS

**TEACHER NOTES:**

1. Students will need to spin the jars around to find the one red object... They will likely get pretty caught up in this.
2. You will likely need the 3 different jars for younger grades to demonstrate the progression. Older grades could make a larger leap.
3. Older students could try working the equivalent ratios on their own or in partner pairs.
4. Important to provide a variety of ratio examples for students with different learning styles.

**EXTENSIONS:**

5. **MS/HS:** Have students compare ppm to mg/L and address the ratio quantities here. Now you are dealing with a metric measure of volume or capacity. A liter of water weighs 1 kilogram = 1,000 grams. Flush this out to milligrams and mg/L.
6. Have students read an article or watch a video that includes data on a substance relating to air or water quality in your area. Have them visually represent the measurements from the article in a visual manner.
7. Use this lesson as a starter activity to move into water quality unit and measuring DO, pH and turbidity or an air quality unit measuring particulate matter.