

WHAT IS A PART PER MILLION?

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Objectives: Use the laboratory supplies in front of you (M&M's and rice) to:

- 1) become familiar with the term "part per million"
- 2) understand what this term means
- 3) learn to convert to other units

A. "PART PER TEN"

Count out colored M&M's to show what one part in ten (a "part per ten") would look like. (Hint: If you want to show that one part in ten is different from the rest, how would you go about doing this? How many total M&M's would you use?) Make a note of how you created a "part per ten" using M&M's.

B. "PART PER HUNDRED"

Now use the rice grains at your station to show what a "part per hundred" would look like. You may color one grain black to show it is different from the rest. (Hint: One part per hundred can also be thought of as one percent.) Make a note of how you created a "part per hundred."

C. "PART PER THOUSAND"

Suggest a procedure for measuring "one part per thousand."

Write out your calculation for determining a "part per thousand."

D. "PART PER HUNDRED-THOUSAND"

Before you begin this part, guess as to how much rice you might need to make a "part per hundred-thousand."

How much rice did it take to make a part per hundred thousand?

E. "PART PER MILLION"

How much rice will it take to make a part per million?

F. "PART PER BILLION"

How much more rice would you need to make a “part per billion”?

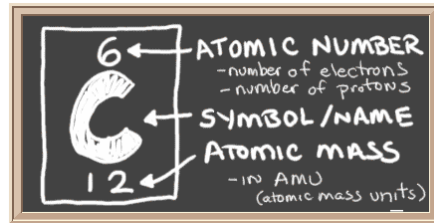
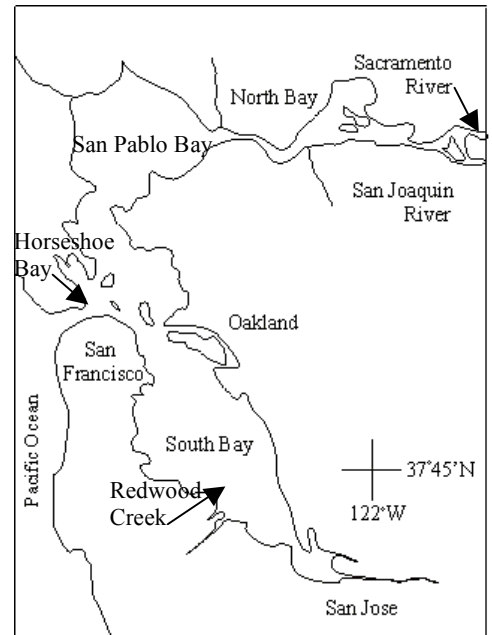
Can a part per million really be toxic?

The EPA Maximum Contaminant Levels (MCLs) for nitrate and nitrite in drinking water are 10 and 1 ppm, respectively (http://www.epa.gov/safewater/contaminants/dw_contamfs/nitrates.html). Nitrate is converted to nitrite in infant’s blood. Nitrite causes “blue baby syndrome” by preventing the infant’s blood from carrying oxygen. Some of the largest releases of nitrate are in California.

G. Convert 10 ppm nitrate to ppb. Should you multiply or divide?

H. “1 mg/g”. Units are often also given in mg/L, $\mu\text{g/L}$, $\mu\text{g/g}$, etc. Make a mg/g. Hint: if your black grain of rice is 1 mg, you could add 999 mg of regular rice, and that would be 1 mg/g. How much does your black grain of rice really weigh? Describe how you made 1 mg/g. What other unit is equivalent to 1 mg/g?

I. In South San Francisco Bay (see figure), concentrations of dissolved inorganic nitrogen can reach $0.060 \mu\text{mol/mL}$. In chemistry, moles (mol) are a standard measurement for the number of atoms. You need a periodic table to determine the atomic weight, or the number of grams of each element that make up a mole. Given that nitrogen’s atomic weight is 14.01 g/mol, how can you convert to $0.060 \mu\text{mol/mL}$ to $\mu\text{g/mL}$? What is $0.060 \mu\text{mol/L}$ in ppm?



J. Who cares about nitrogen inputs to bays? Phytoplankton are the tiny, floating plants at the base of the food chain. High nutrient concentrations can contribute to growth of phytoplankton, such as in Chesapeake Bay (Cloern, 2001). In San Francisco Bay, the effects of nutrients are more subtle, but can include changes in the magnitude, timing, and cycling of metals by phytoplankton blooms (Cloern, 2001).