Ozone

Does It Affect Me?

MEASURING PARTS PER MILLION

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Measuring Parts per Million of a Room

Name: _____

Date: _____

Period: _____

OBJECTIVES

You will calculate how many 1 milliliter blocks are needed in a room to total the equivalent of 3 parts per million.

You will practice and assess an identified interpersonal skill.

You will design a spreadsheet that will enable them to quickly solve the problem for any size room.

MATERIALS

- balance
- meter sticks
- 1 mililiter cubes
- computer and spreadsheet

1) Choose a group of three other students (that's a total of four) and assign the following roles:

a) Leader - This person is responsible for the functioning of the group and keeping everyone on task.

b) Planner/Recorder - This person is responsible for developing the overall strategy and recording what is actually done in sentence form.

c) Technician This person is responsible for carrying out the plan developed by the group for solving the problem.

d) Mathematician - This person is responsible for doing and recording any calculations that are needed to solve the problem.

2) Now that you have picked your group role, record names here:

a) Leader _____

b) Planner/Recorder _____

c) Technician _____

d) Mathematician _____

3) The problem you are to solve is the following:

How many blocks each with a volume of 1 milliliter would be needed to have a concentration of 3 parts per million in our classroom? The purpose of this problem is to allow us to visualize parts per million.

4) Record your procedure here: (if you need to revise it as you go along, feel free to do so)

5) Record you calculations here in a clear and concise form.

6) Record the number of 1 ml blocks needed to represent a concentration of 3 ppm in our classroom.

7) Design a computer spreadsheet that will calculate for you the number of 1 ml blocks needed to represent a concentration of 3 ppm for any room.

8) Any comments or evaluation of how your group functioned:

The Metric System

In the metric system, a basic unit of length, mass, volume, or other property is selected, and then prefixes are used to indicate the power of ten by which the basic unit is to be multiplied to form larger or smaller units. These prefixes are summarized in the table below. The four prefixes most widely used are *mega-, kilo-, centi-, and milli-.*

Very large and very small numbers are more easily handled by converting them to *exponential notation*. The exponential form of 1,000 is 10^3 (or 10 x 10 x 10), where the superscript 3 is called the *exponent*. The exponential number 10^{-6} is equivalent to $1/10^6$, or 1/1,000,000, or .000001.

Prefixes and multipliers for the metric system of units

Prefix	Abbreviation	Factor by which the unit is multiplied		
tera	T	10^{12}	or	1,000,000,000,000 (1 trillion)
giga	G	10^9	or	1,000,000,000 (1 billion)
mega	M	10^6	or	1,000,000 (1 million)
kilo	k	10^3	or	1,000
hecto	h	10^2	or	100
deca	da	10^1	or	10
deci	d	10^{-1}	or	0.1
centi	c	10^{-2}	or	0.01
milli	m	10^{-3}	or	0.001
micro	μ	10^{-6}	or	0.000001
nano	n	10^{-9}	or	0.000000001
pico	p	10^{-12}	or	0.000000000001

Some Common Units

Some basic units in the metric system are the *meter* (m) for length or distance, the *cubic meter* (m^3) for volume, the *kilogram* (kg) for mass, the *second* for time, and the *joule* (J) (pronounced jool) for energy, heat, or work. Other common units of length are the kilometer (km) equal to 10^3 m, the centimeter (cm) equal to 10^{-2} m, and the millimeter (mm) equal to 10^{-3} m.

Volume is the amount of space an object occupies. To compute the volume of a rectangular solid you simply multiply its length times its width times its height. Thus, the volume of a rectangular solid with sides of 2 m, 5 m, and 6 m, is

2 m x 5 m x 6 m = 60 m^3. Another common unit for volume is the cubic centimeter (cm^3 or cc), which is also known as a milliliter (ml). Thus, 1 ml = 1cc = 1 cm^3. Another widely used volume unit is the liter, which is a cubic decimeter (dm^3), or 1,000 cm^3. Thus 1 liter = 10^3 ml = 1 dm^3 = 10^3 cc = 10^3 cm^3.

Mass is a measure of the amount of matter in a substance. On earth mass and weight are used interchangeably, but technically the two are different. Mass is independent of gravitational force, while *weight* is a measure of the gravitational force acting on an object. A person who weights 56 kilograms (or 123 pounds) on earth would have zero weight in space and a weight of about 9.3 kilograms (21 pounds) on the moon, where the pull of gravity is one-sixth that of earth. The mass of the person is the same in all three situations. Common mass units are the gram (g), the kilogram (kg) equal to 1,000 or 10^3 g, and the milligram (mg) equal to 1/1,000 or 10^{-3} g.

Measuring Parts Per Million Of A Room

TEACHER BACKGROUND

OBJECTIVES

Students calculate how many 1 milliliter blocks are needed in a room to total the equivalent of 3 parts per million.

Students practice and assess an identified interpersonal skill.

Students design a spreadsheet that will enable them to quickly solve the problem for any size room.

MATERIALS

balance
meter sticks
1 mililiter cubes
computer and spreadsheet

SCIENCE SKILLS

Data Analysis
Systems Modeling

Notes and Expected Outcomes:

To calculate the total number of milliliters in a room, the students can measure the height, width, and length of the room with meter sticks. They can use the resulting measurements in some variation of the following formula:

height (meters) x width (meters) x length (meters) x 10 liters/m^3 x 1,000 ml/liter = total number of milliliters in the room.

To calculate how many 1 milliliter blocks are needed in a room to total the equivalent of 3 parts per million, students can multiply the total number of milliliters in the room times 3 and divide by 1,000,000.

To design a computer spreadsheet, students can identify the following spreadsheet columns: (More or less columns may be used, depending on how students think through the problem.)

Column A = Room length (meters)
Column B = Room width (meters)
Column C = Room height (meters)
Column D = Room volume (liters) = A x B x C x 10
Column E = Room volume (milliliters) = D x 1,000
Column F = Number of milliliters that equals 3 ppm = E * 3/1,000,000

Entering different variables into the spreadsheet for the length, width, and height of a room will result in different figures appearing in column F, the number of 1 millimeter blocks that are needed in a room to total the equivalent of 3 parts per million.