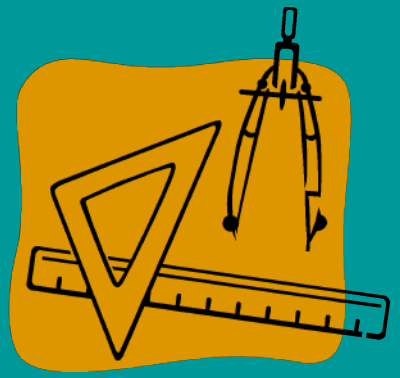
Metric System



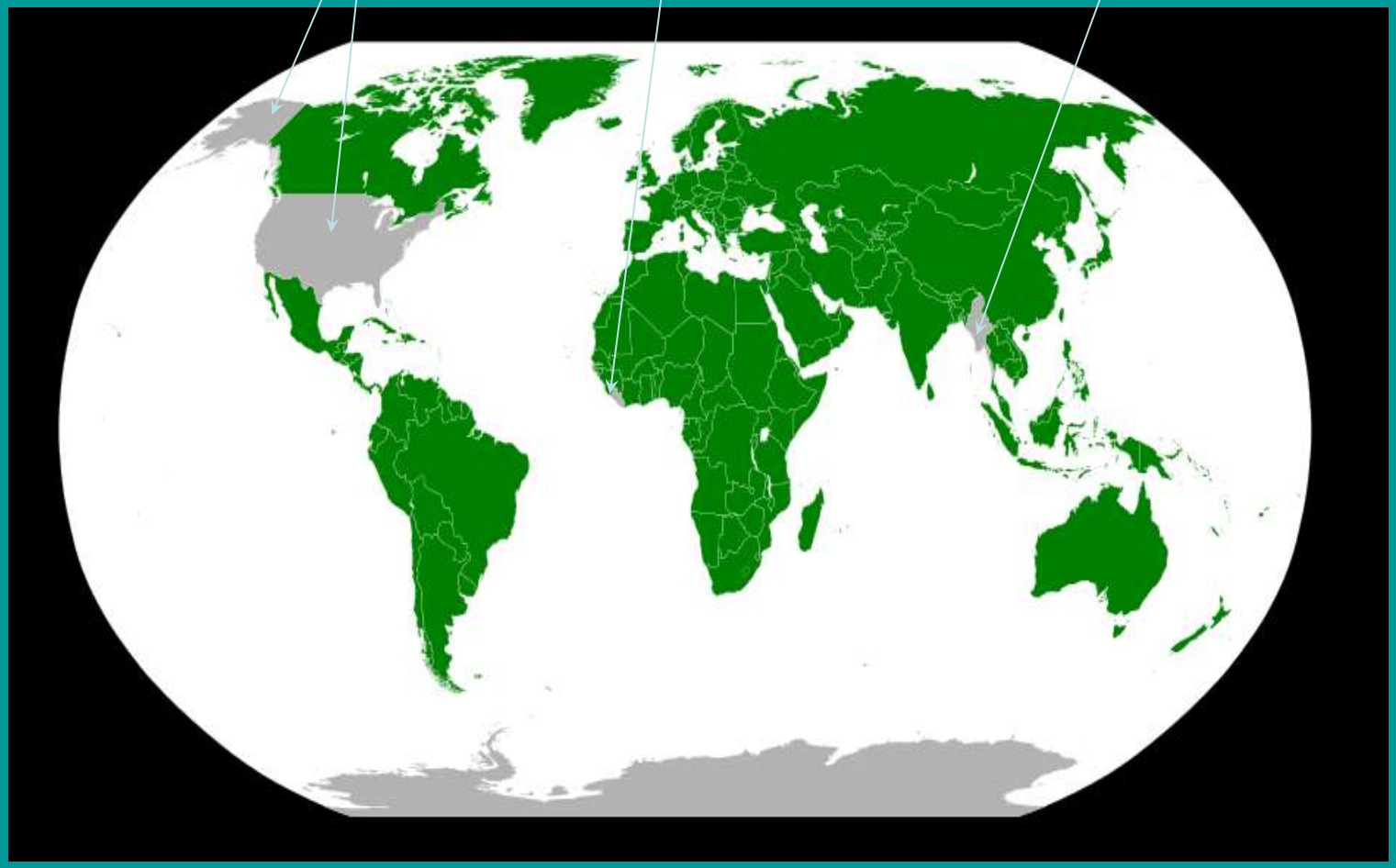
The Metric System

- **Standardized system of measurement used by all scientists worldwide**.

- **Based on units of 10**

- Similar to our monetary system:
  10 cents = dime
  100 cents = dollar
  10 dimes = dollar

The Metric System is used for everyday life in most countries except the United States, Liberia and Myanmar



"Uh oh, I measured the lumber in feet, but you measured it in metric."

Basic Units of Measurements

- **Length**
  - Meter = m
- **Volume**
  - Liter = L
- **Mass**
  - Gram = g

All multiples of "10"

Prefixes for the basic units…

- Kilo (K) = 1000
- Hecto (h) = 100
- Deka (da) = 10
- Liter/Gram/Meter = 1
- Deci (d) = .1
- Centi (c) = .01
- Milli (m) = .001

The Metric Scale

Kilo

1000

Hecto

100

Deka

10

Meter, Liter, Gram

1

Deci

1/10 or 0.1

Centi

1/100 or 0.01

Milli

1/1000 or 0.001

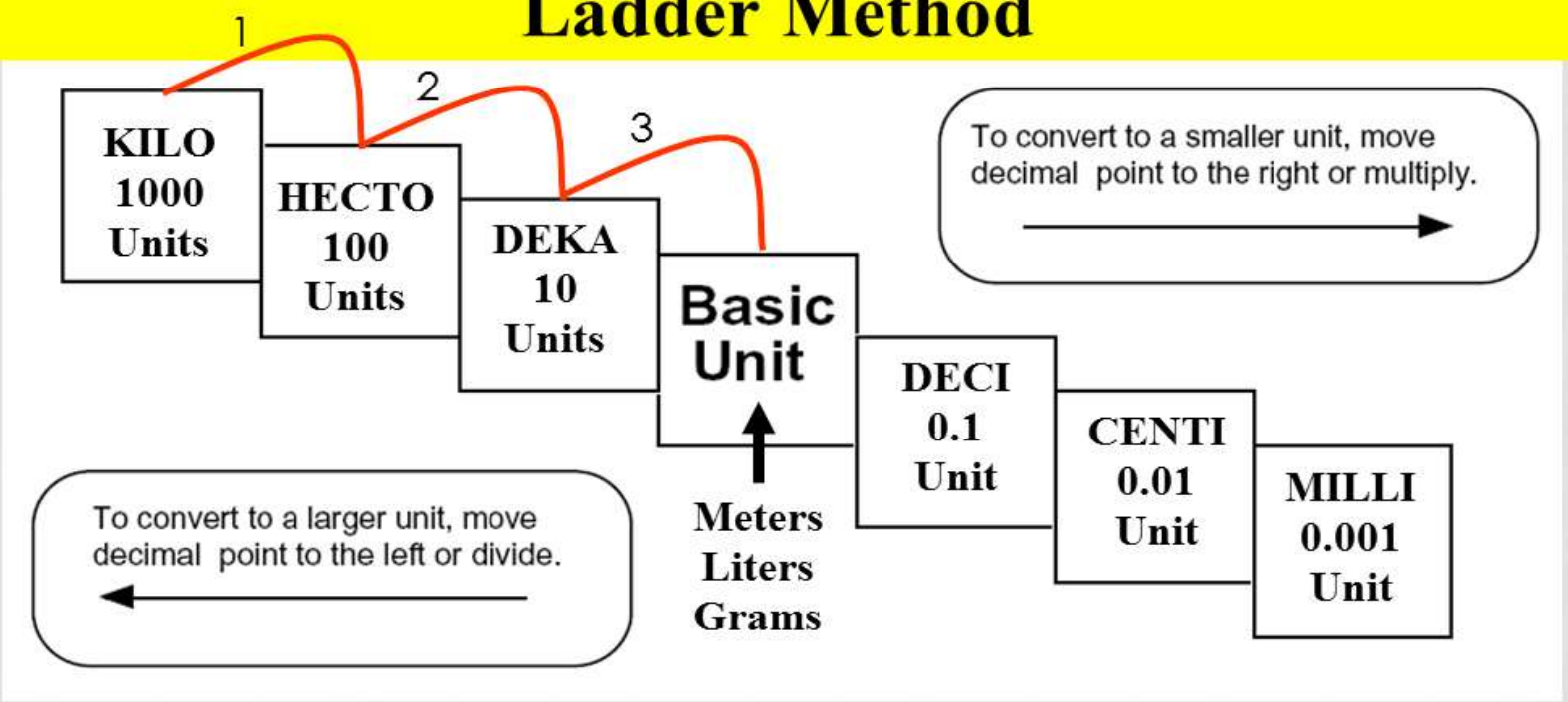
As you go **UP** the scale, move the decimal to the **LEFT**

Ex: 500 mm = 0.5 m,
3 jumps up = 3 moves left

As you go **DOWN** the scale, move the decimal to the **RIGHT**

Ex: 5 km = 5000 m,
3 jumps down = 3 moves right

Ladder Method



How do you use the "ladder" method?

1st – Determine your starting point.

2nd – Count the "jumps" to your ending point.

3rd – Move the decimal the same number of jumps in the same direction.

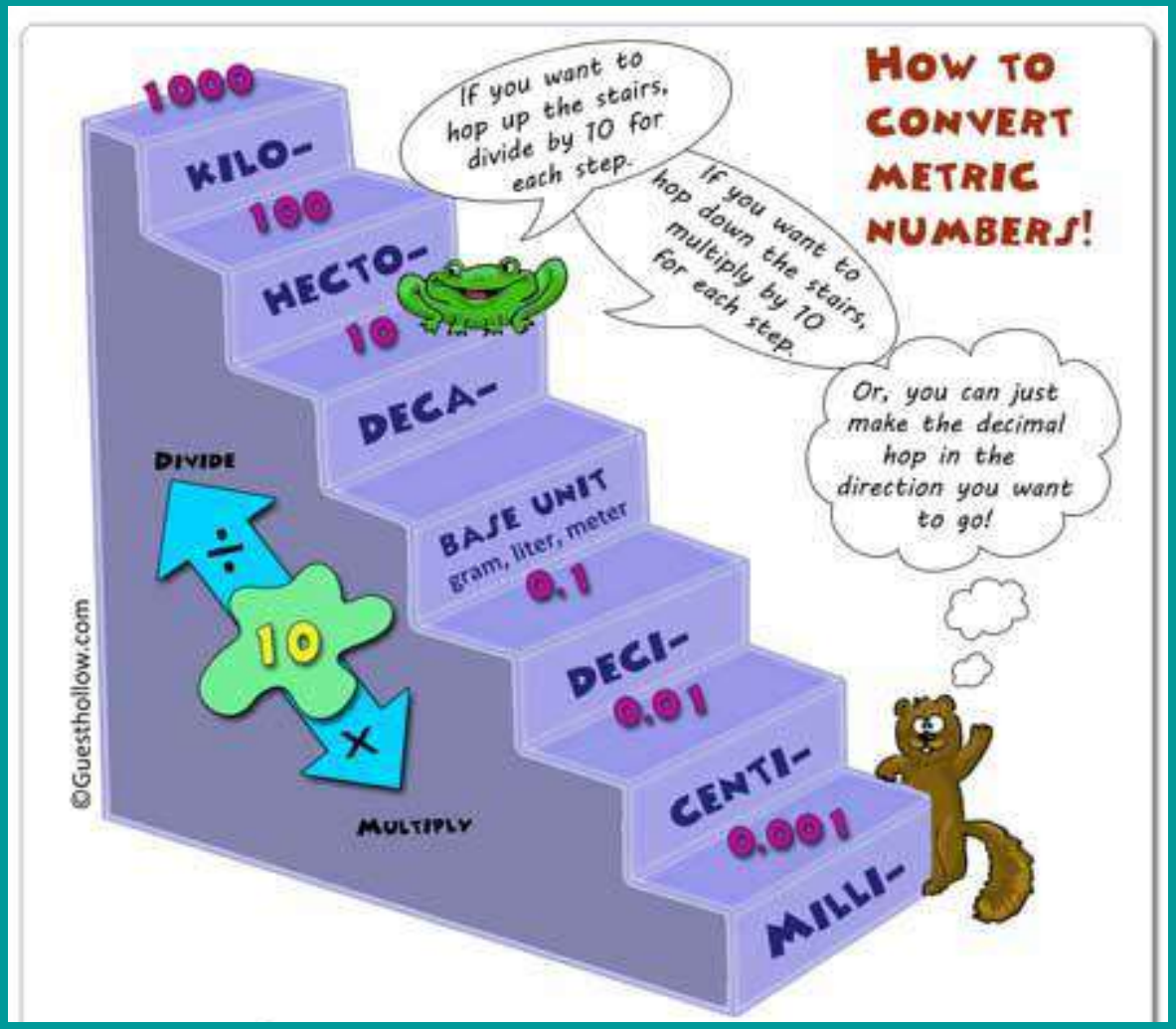
4 km = _____ m

Starting Point Ending Point

How many jumps does it take?

4. __. __. __. = 4000 m

1 2 3



Frog's way:

EXAMPLE 1

1kilometer = _____meters?

It's 3 hops down from the kilometer step to the step with the base unit: meter.

When you go down the stairs you multiply by 10 each hop, so:

1 kilometer x 10 x 10 x 10 = 1000 meters

Squirrel's way:

EXAMPLE 2

1kilometer = _____meters?

The decimal point goes right after the 1. It's 3 hops down from the kilometer step to the step with the base unit: meter. Just make the decimal hop down 3 places too and put zeros in the blank spaces:

1. 0 0 0 =1000 meters

1st hop 2nd hop 3rd hop

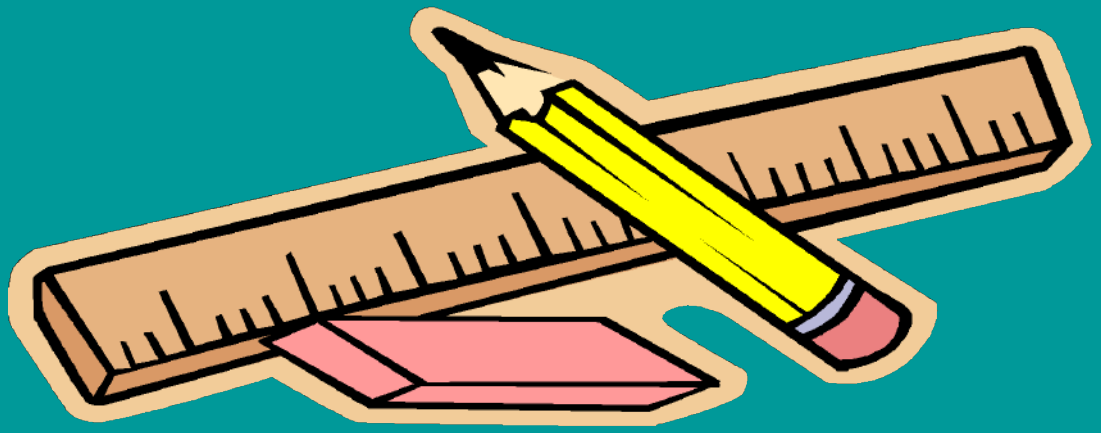
Metric Measurement: *Length*

Length is the distance between two points.

- ✓ **Does not matter if it is width, height, depth, etc. All are length measurements.**
- ✓ **The basic unit of length in the SI System is the meter.**
- ✓ **The meter is about the length of the English yard (3 feet).**
- ✓ **Area is a variation of a length measurement.**
  - ➢ **Area is length x width.**
  - ➢ **Expressed in units^2 (m^2, cm^2, mm^2 etc.)**

Using a ruler

- line up the end of the ruler with the object
- always estimate one place beyond what is given on the ruler



Metric Measurement: *Volume*

Volume is a measurement of the amount of space something takes up.

- ✓ **The basic unit used for volume is the liter. This unit is used for the volumes of liquids.**
- ✓ **Volumes of solids are figured using this formula:**

(L)ength x (W)idth x (H)eight

cm x cm x cm = cm^3

- ✓ **Objects without a definite length, width or height (a rock for example), can use water displacement to determine volume.**

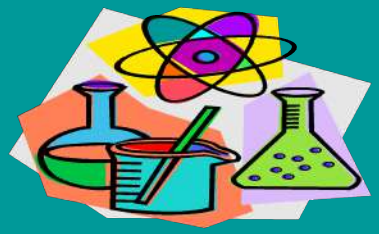
NOTE: **1 ml = 1 cm^3**

Volume Measurements

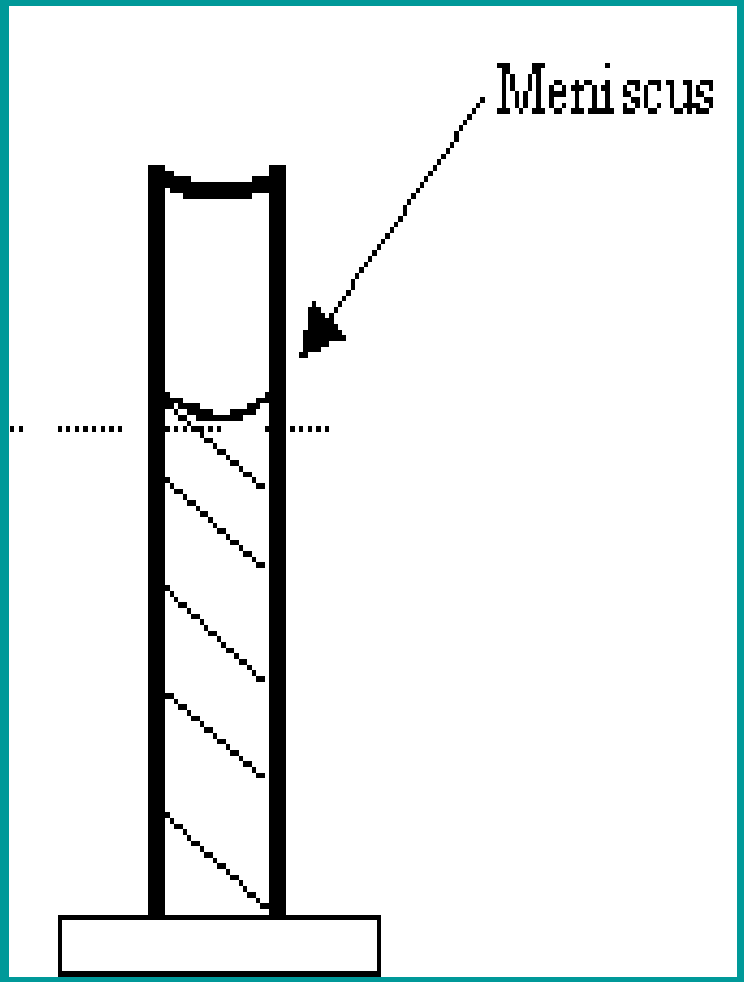
- milliliters (mL) for liquids and cm^3 for solids

  $1cm^3 = 1$ mL

  $= 1$ g H_2O



Using a Graduated Cylinder



- **Volume of Liquids**- measured in a beaker or graduated cylinder
  - measure from the **meniscus**, the bottom level of the curve in a GC
  - always measure one place beyond what is given in the GC or beaker

Water Displacement

- **Volume by Water Displacement**- the amount of water moved by the object is equal to the volume of the object when it is submerged in the water
  - *used to measure the volume of an irregular shaped objects
  - **Volume of the object =**

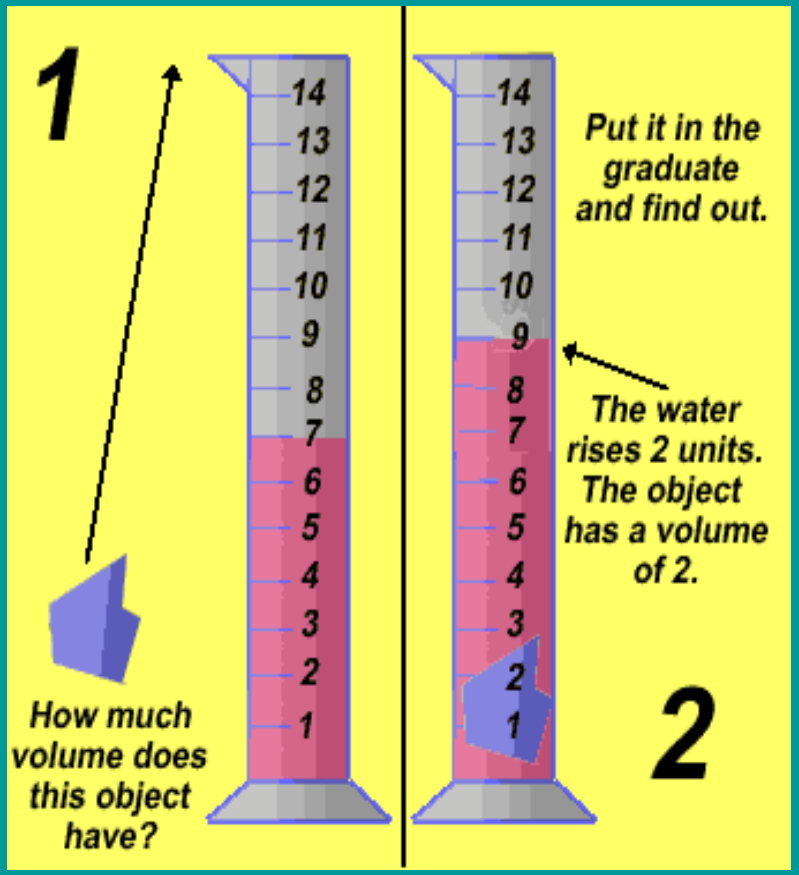
    (water plus object) – (water alone)

Example of Water Displacement

Initial reading 7 mL
Final reading 9 mL

Difference 2 mL

Use this and density of the object to solve for mass
M = DV



Metric Measurements: Mass

Weight vs. Mass

Measure of the force of gravity on an object

Measure of amount of matter in an object NOT affected by gravity

Weight vs. Mass cont…

Weight and Mass are related, but NOT the same.

- **Weight can change depending on location**
- **Mass is constant regardless of location**

- **The greater the mass, the larger the pull of gravity.**

  The larger the pull of gravity, the greater the weight

Metric Measurement: *Temperature*

Temperature is a measure of the kinetic energ of the atoms in an object.

- ✓ **Temperature is measured with a thermometer and measured in Celsius or Kelvin.**
- ✓ **Celsius ranges from 0 (freezing) to 100 (boiling).**
- ✓ **The Kelvin scale begins at absolute zero, or 0 K. At 0 Kelvin no more heat can be removed from an object.**
  - ➢ **To convert to Kelvin you add 273 degrees to the Celsius reading.**
  - ➢ **Freezing in Kelvin is 273 K, boiling is 373 K.**

Which would you prefer: the pilot of your flight is consistently accurate or precise in flight landings?

Accuracy vs. Precision

- **Accuracy**: the extent to which a measurement approaches the true value.

- **Precision:** the degree of exactness of a measurement.