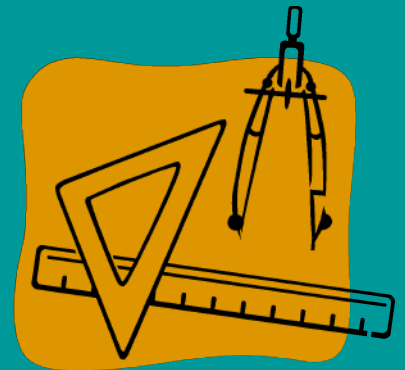


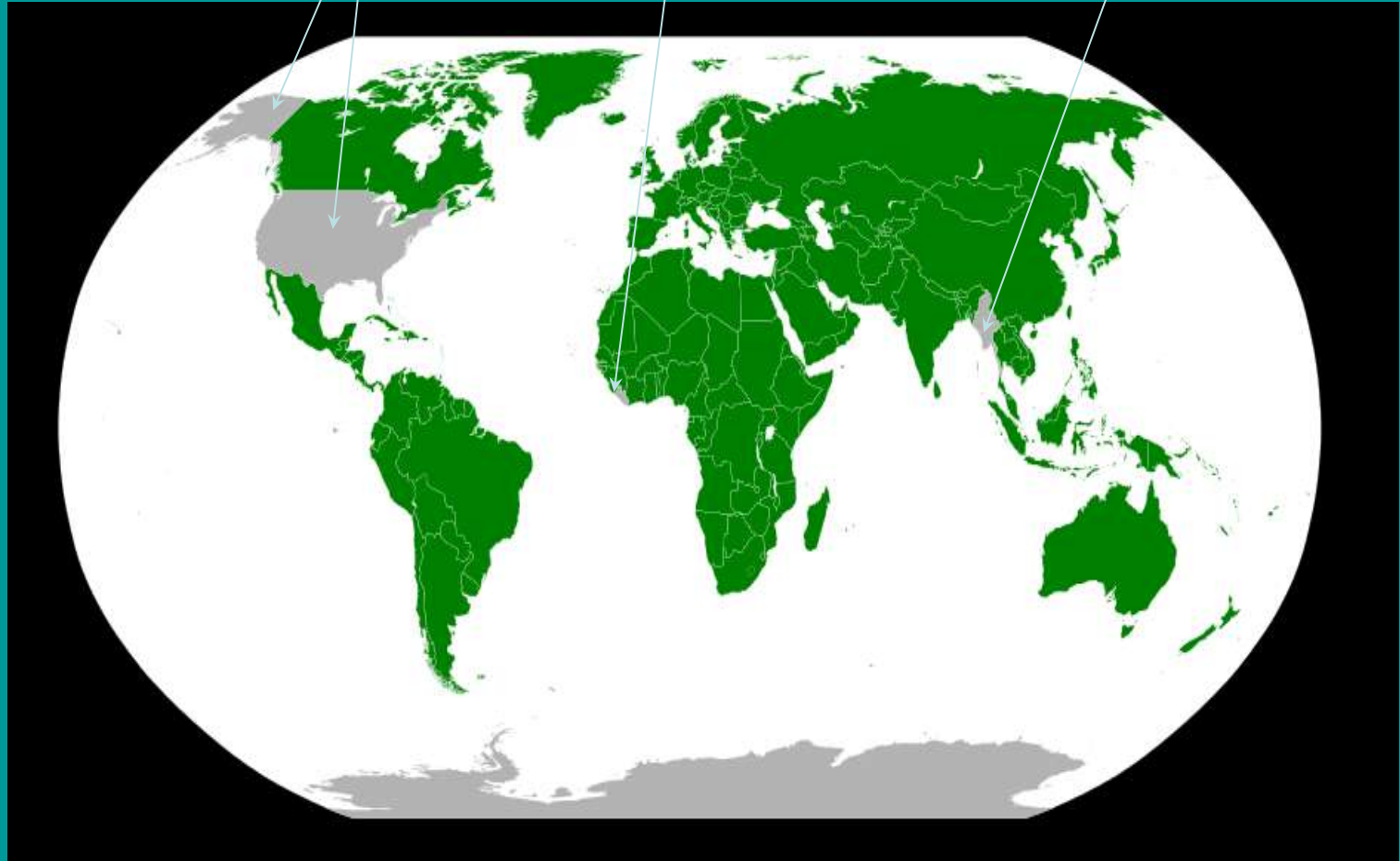
Metric System



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



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

SEARCH ID: UMCN2708

Basic Units of Measurements

- **Length**
 - Meter = m

- **Volume**
 - Liter = L

- **Mass**
 - Gram = g

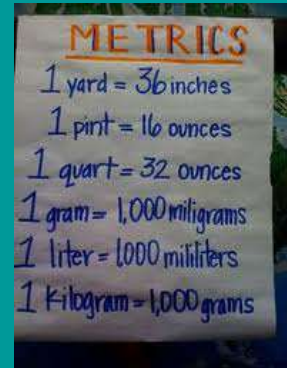
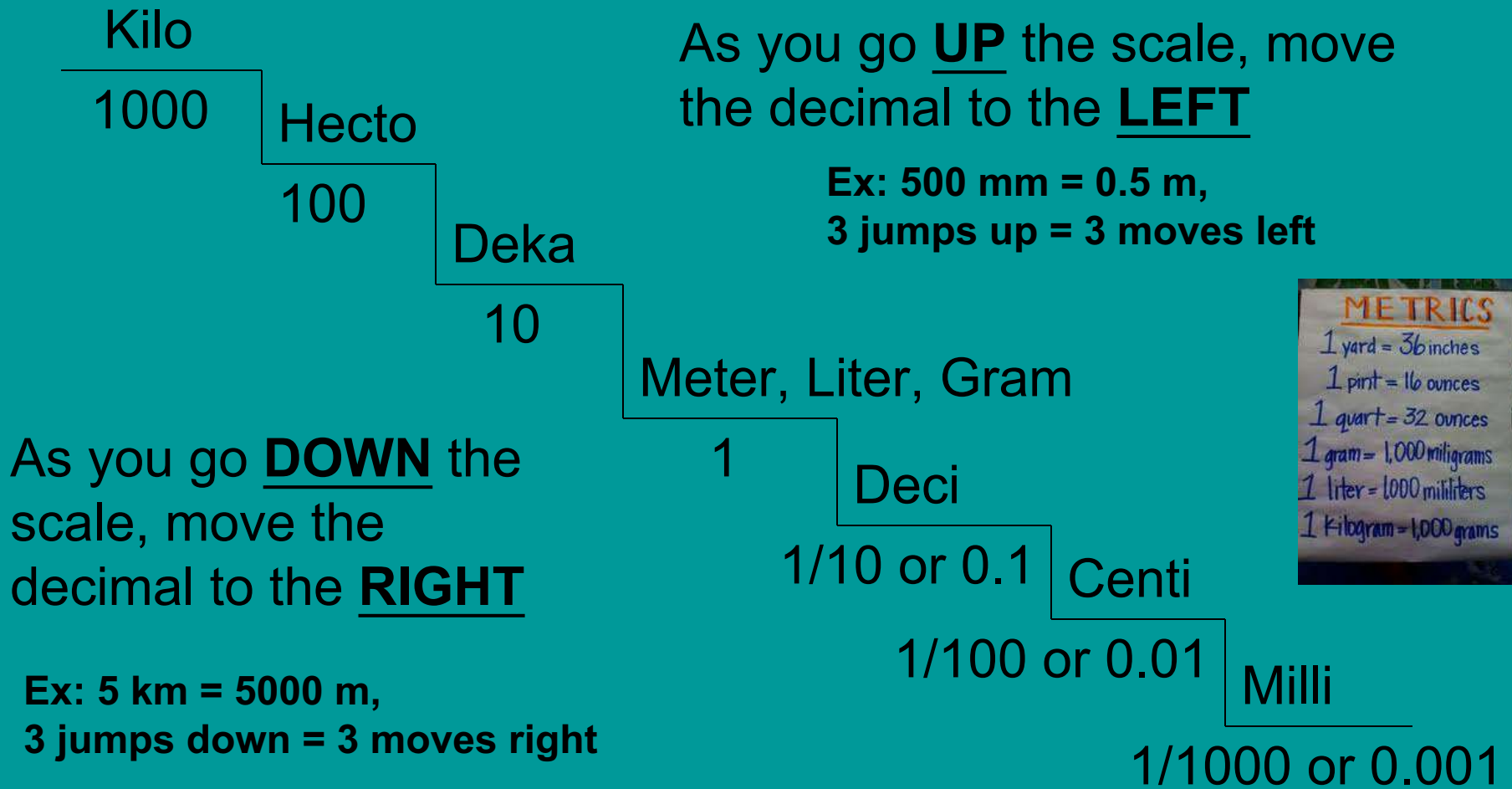


All multiples of “10”

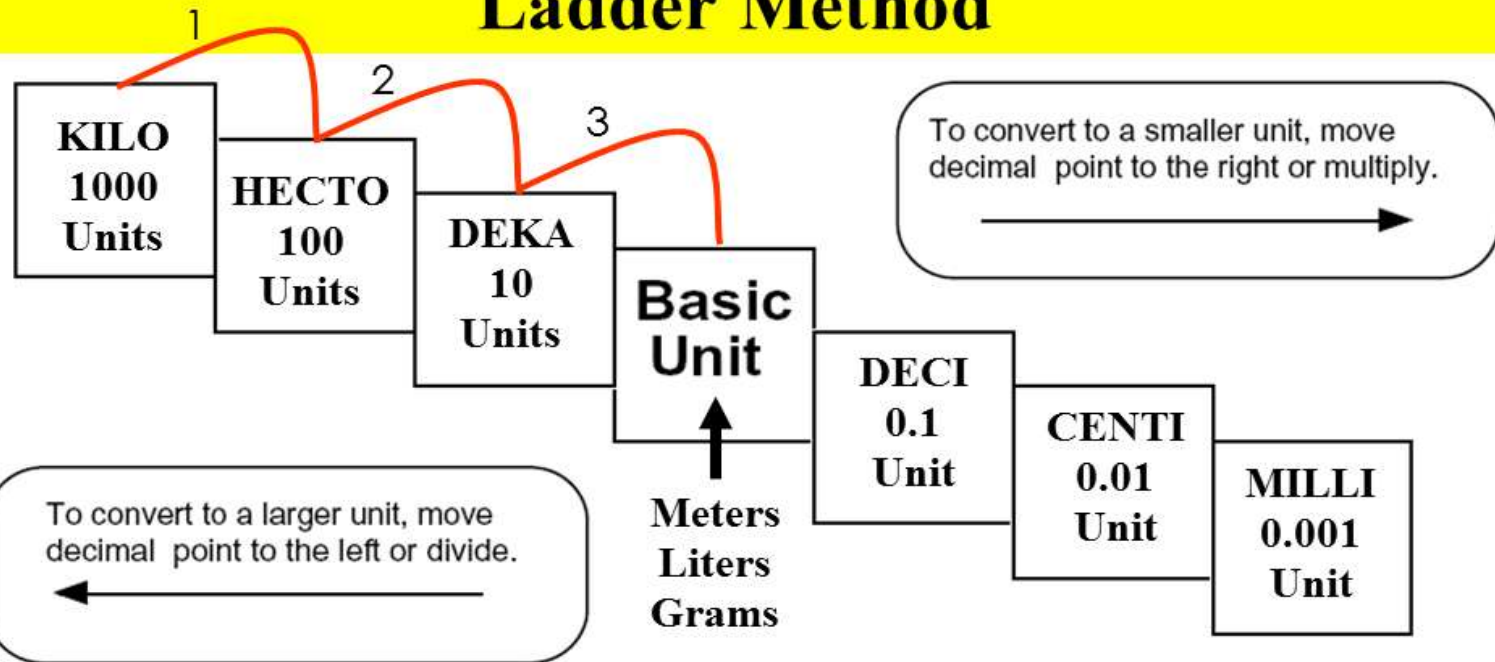
Prefixes for the basic units...

- 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



Ladder Method



How do you use the “ladder” method?

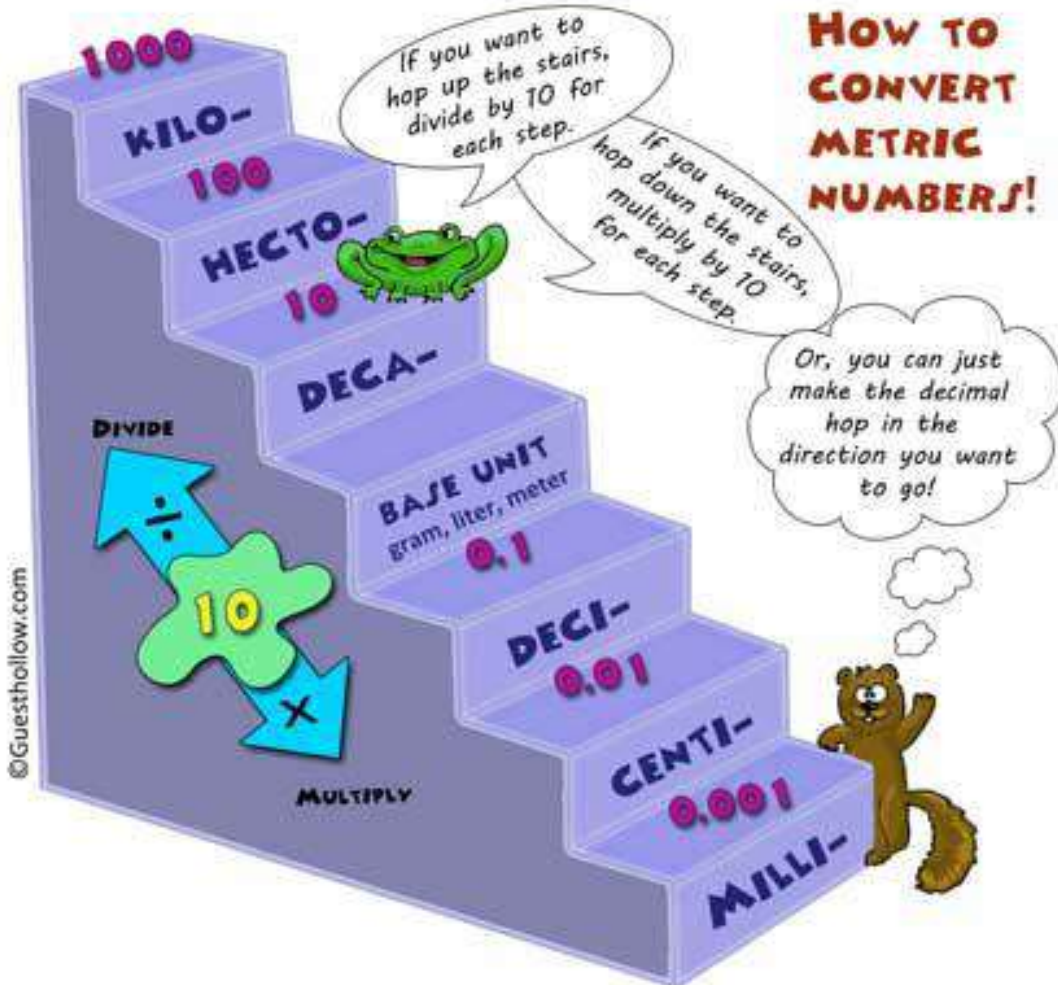
- 1st – Determine your starting point.
- 2nd – Count the “jumps” to your ending point.
- 3rd – Move the decimal the same number of jumps in the same direction.

$$4 \text{ km} = \underline{\hspace{2cm}} \text{ m}$$

↑
Starting Point
↑
Ending Point

How many jumps does it take?

$$4.\overset{\cdot}{\underset{1}{\text{---}}}\overset{\cdot}{\underset{2}{\text{---}}}\overset{\cdot}{\underset{3}{\text{---}}} = 4000 \text{ m}$$



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:

$$1 \text{ kilometer} \times 10 \times 10 \times 10 = \underline{1000} \text{ meters}$$

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:

$$1.\overset{0}{\text{ }}\overset{0}{\text{ }}\overset{0}{\text{ }} = \underline{1000} \text{ meters}$$

1st hop 2nd hop 3rd hop

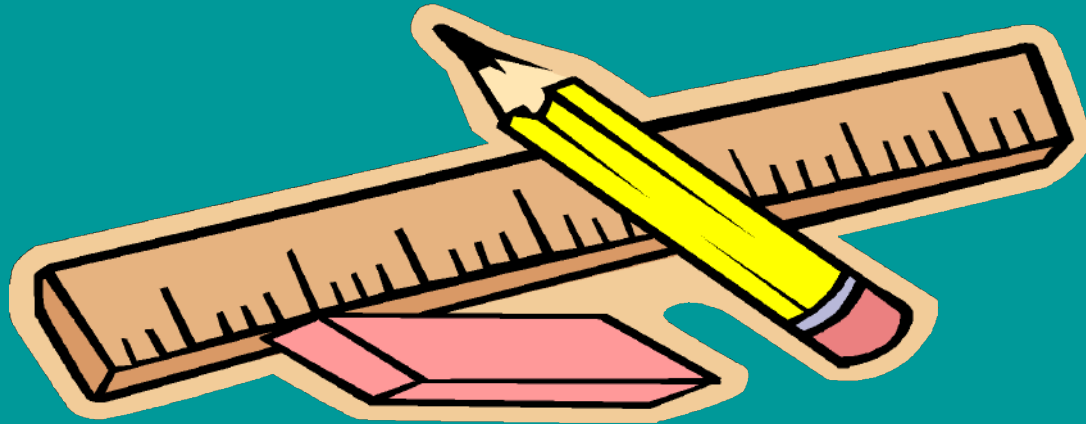
Metric Measurement: *Length*

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 units² (m², cm², mm² 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:

$$\begin{aligned} & \text{(L)ength} \times \text{(W)idth} \times \text{(H)eight} \\ & \text{cm} \times \text{cm} \times \text{cm} = \text{cm}^3 \end{aligned}$$

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

NOTE: 1 ml = 1 cm³

Volume Measurements

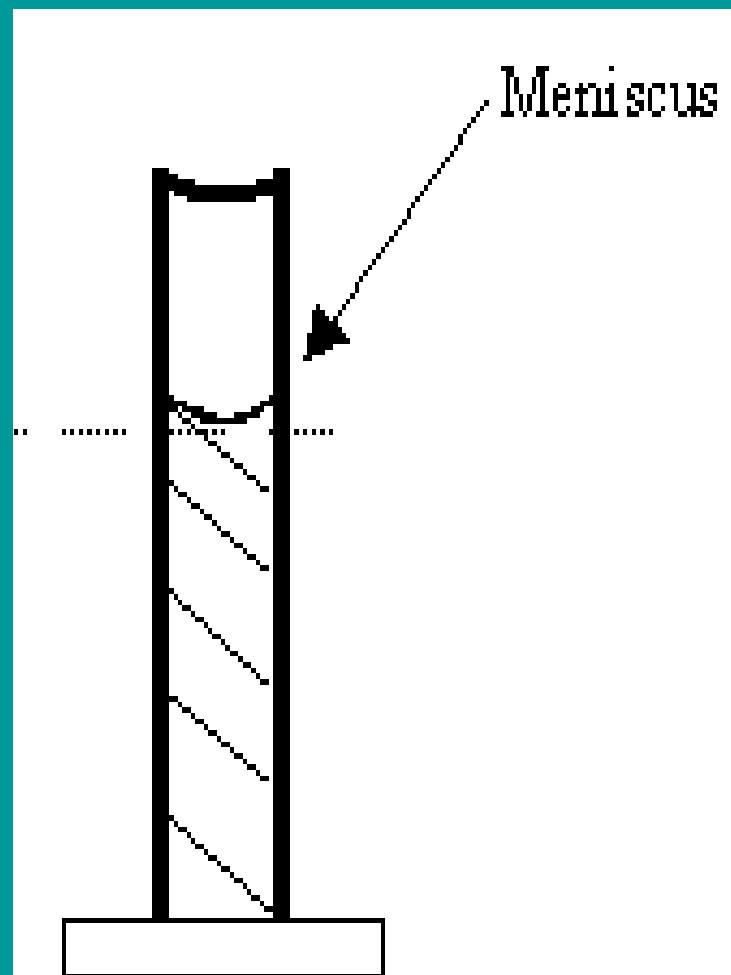
- milliliters (mL) for liquids and cm^3 for solids

$$1\text{cm}^3 = 1\text{ mL} \\ = 1\text{ g H}_2\text{O}$$



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

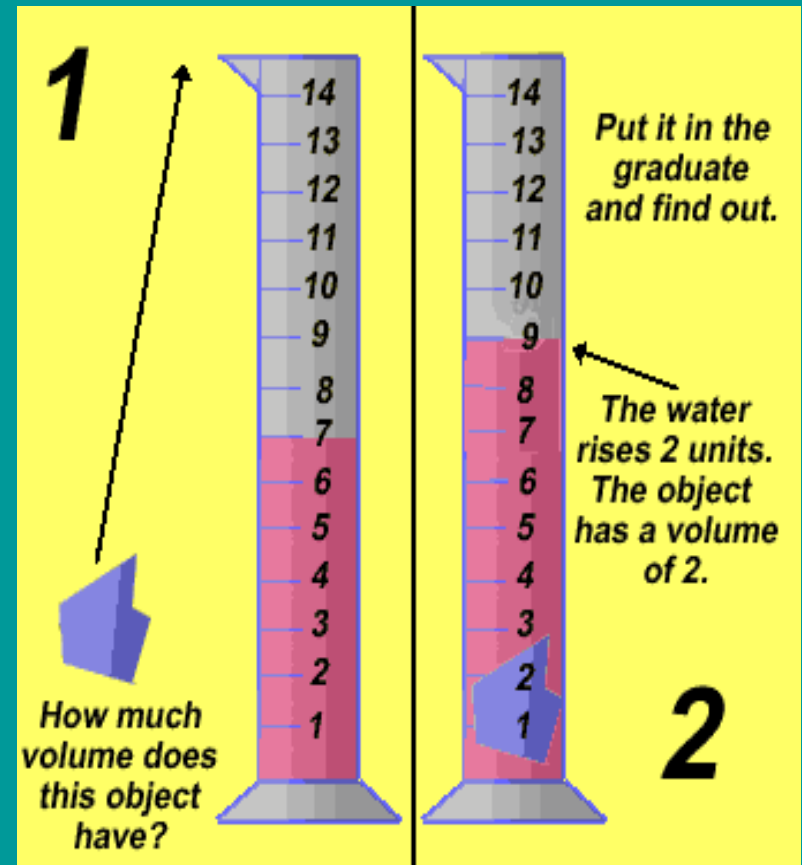
Initial reading 7 mL

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



My **WEIGHT** on Earth is around 560N



My **WEIGHT** on the moon is around 90N



My **MASS** is always 56kg!!

Weight vs. Mass

cont...

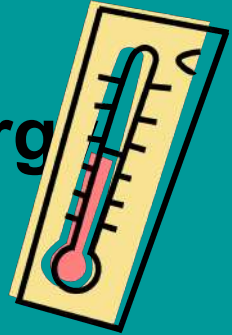
Weight and Mass are related, but NOT the same.

- 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 energy 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.

