# Metric Measurement

Tools of a Scientist

10/6/09

## The Metric System

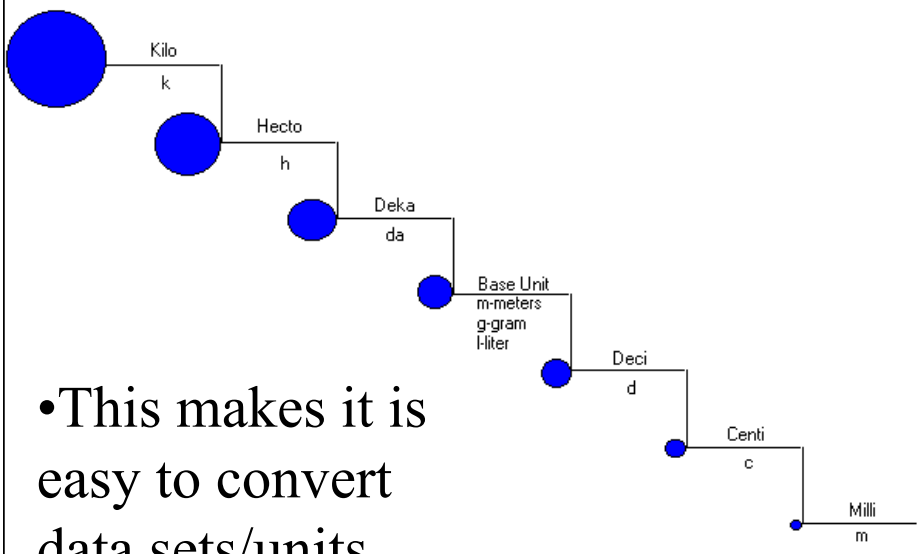
- Mass = grams
- Length = meter
- Volume = Litre or $m^3$ (1ml =1 $cm^3$)
- Temperature = Celsius or Kelvin

## Common SI Units

| | | |
|---|---|---|
| **Length**  | **meter (m)**<br>kilometer (km)<br>decimeter (dm)<br>centimeter (cm)<br>millimeter (mm)<br>micrometer (μm)<br>nanometer (nm) | 1 km = 1,000 m<br>1 dm = 0.1 m<br>1 cm = 0.01 m<br>1 mm = 0.001 m<br>1 μm = 0.000001 m<br>1 nm = 0.000000001 m |
| **Volume**  | **cubic meter ($m^3$)**<br>cubic centimeter ($cm^3$)<br>liter (L)<br>milliliter (mL) | 1 $cm^3$ = 0.000001 $m^3$<br>1 L = 1 $dm^3$ = 0.001 $m^3$<br>1 mL = 0.001 L = 1 $cm^3$ |
| **Mass**  | **kilogram (kg)**<br>gram (g)<br>milligram (mg) | 1 g = 0.001 kg<br>1 mg = 0.000001 kg |
| **Temperature**  | **Kelvin (K)**<br>Celsius (°C) | 0°C = 273 K<br>100°C = 373 K |



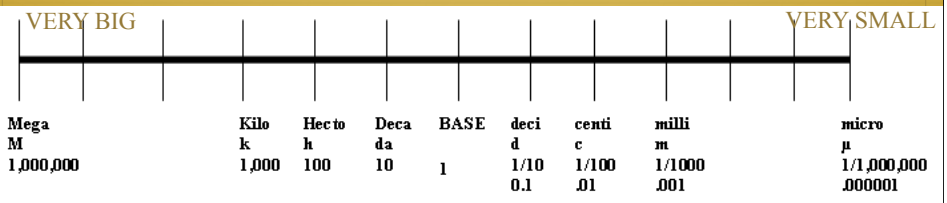
# The metric system is a

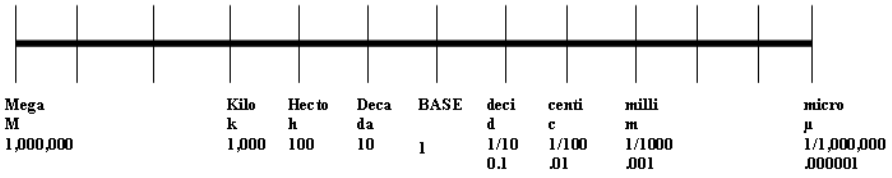



- This makes it is easy to convert data sets/units

# Converting Metric System Units

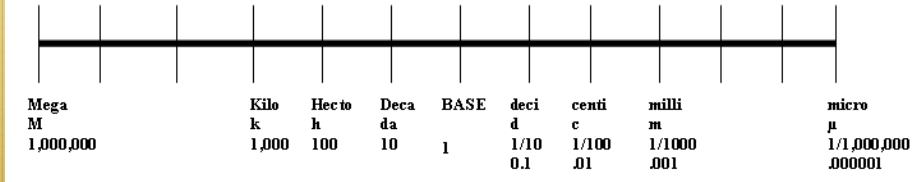
- Sometimes it is necessary to convert from one metric unit to another.
- Start by counting the number of steps from where you are at to where you want to go
- Then move the decimal the same number of steps in the same direction




- Convert 104 decimeters to kilometers.
- To do this you must count over four (4) lines to the left.
- So move the decimal four (4) places to the left.
- ANSWER: 0.0104 kilometers

# Let's try another one




- Convert 3.3 meters to centimeters.
- To do this you must count over two (2) lines to the right.
- So move the decimal two (2) places to the right.
- ANSWER: 330 centimeters



**Try these:**

**10 cm = 0.1 m**

**12 km = 12,000 m**

**87 g = 87,000 mg**

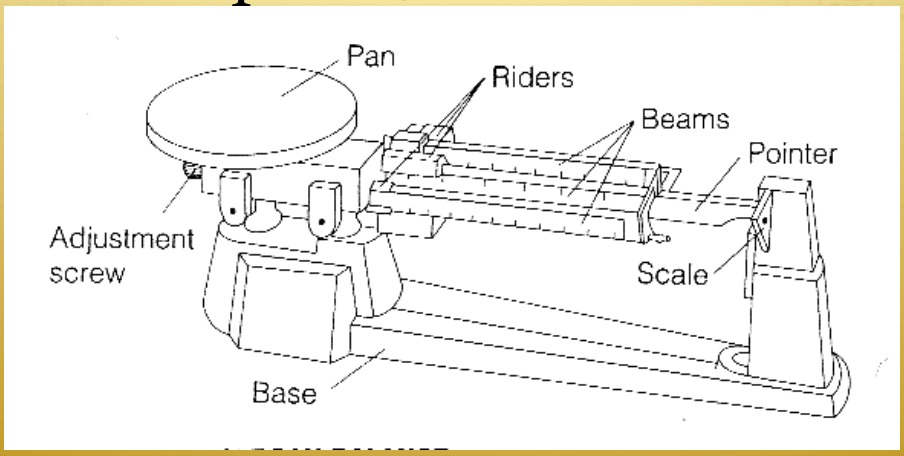
**2500m = 2.5 km**

# Measuring Mass

- Remember that mass is the amount of matter contained within an object.
- The method used to measure mass is by comparing it to a known amount of matter on a balance.
- The balance we will use is the **triple beam balance**

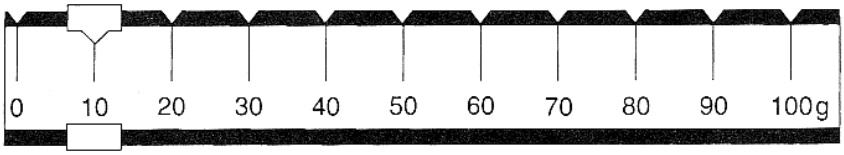


# Triple-Beam Balance

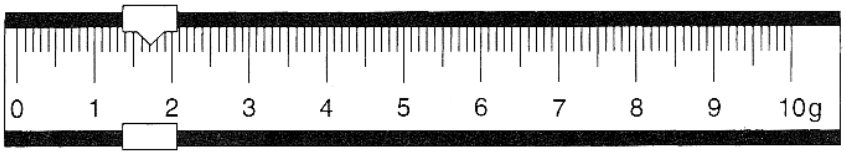



•When measuring mass, you must always **zero out the scale** - please watch as I demonstrate

# Measure to the nearest 0.1grams

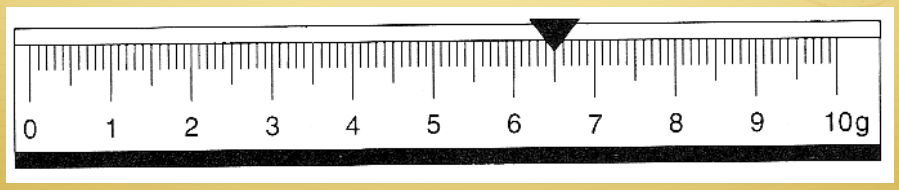


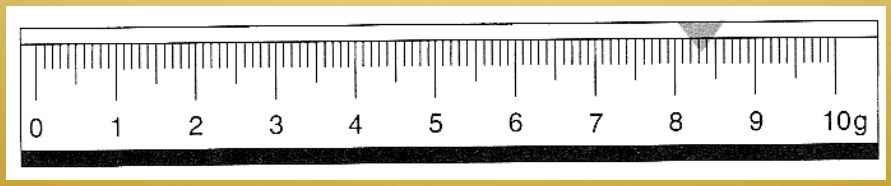

Beam 1

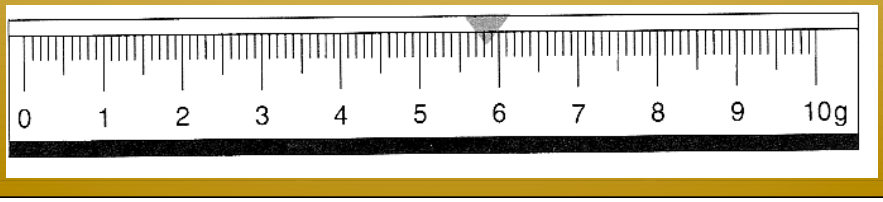



Beam 2

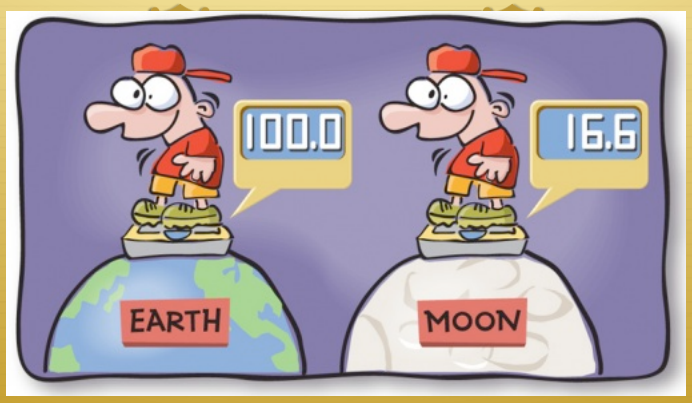
# More Practice



# Mass vs. Weight

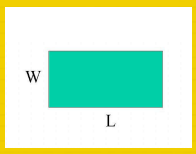





# Measuring Distance

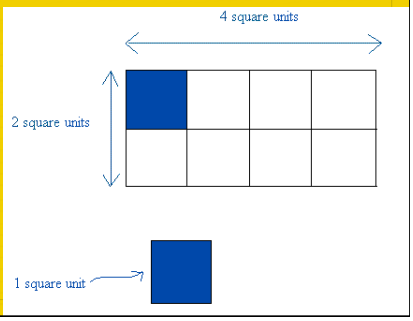
-Use the best unit for measuring.

## Measuring Area




Measures the surface area in square units ($cm^2$ or $m^2$)

For rectangles the area is the area = length x width



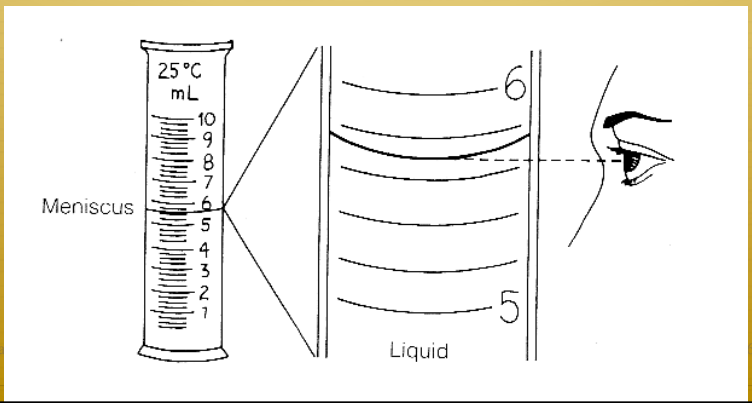
# Measuring Volume

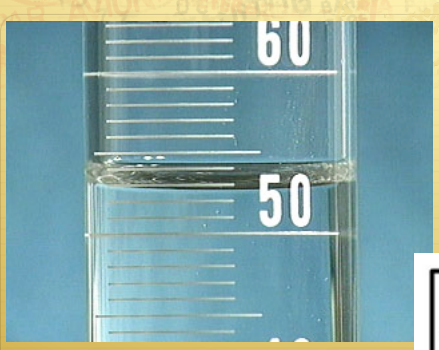
- **Volume** is the amount of space an object occupies (takes up)
- Three types of objects:
  - Liquids
  - Regular shaped solids (square or rectangle)
  - Irregular shaped solids



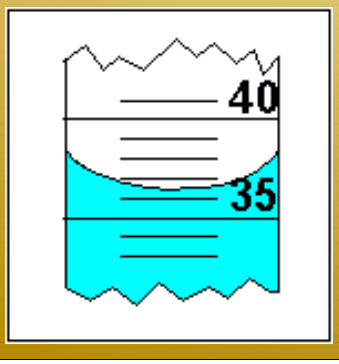
# Measuring Volume of a liquid

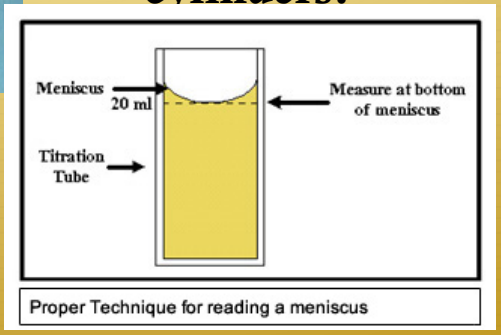
- Pour liquid into a graduated cylinder
- In order to read a graduated cylinder accurately you
- must get your eyes to the level of the liquid.
- Read the meniscus (the bottom of the arc).






## What volume of liquid is in each of these graduated cylinders?




Proper Technique for reading a meniscus

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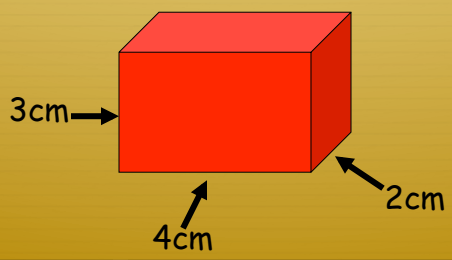
## Calculating Volume of Regular Solids

- **multiply the length and width and height of an object**
- **Example = 2 cm X 3 cm X 4 cm = 24cm$^3$**




Mrs. Bauman

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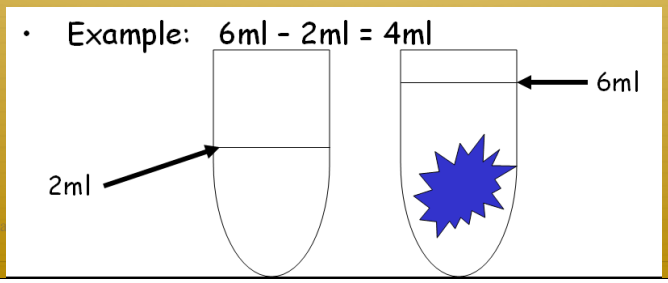
## Finding the volume for irregular shaped objects

- Displacement method
- Fill a graduated cylinder to a certain level. Record that level.
- Put the object in the water and record the new water level.
- Subtract the original water level from the new water level and you have the volume of the object in ml.

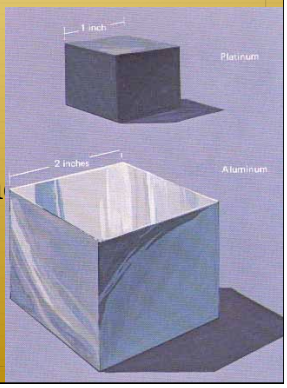





## Measuring Density

- Density is a measure of how much matter is contained in a given space (volume).
- You can calculate density using the following formula:

$$D = \frac{M}{V}$$




- This will give you units of mass/volum
  - For example: grams/milliliter or g/ml

# CHALLENGE

- Using what you now know, which of the following has a greater density:
  - A cube with a mass of 50g and volume of 10cm3
  - OR
  - A liquid with a mass of 75g and volume of 25ml