Chapter 2
Measurement

Measurement

- A way to describe the world with numbers
- Answers questions such as, how much, how long, how far. Describes events (100 m dash)
- Exact measurements eliminate bias.

- Not all measurements are exact - some are estimations.
- Estimations are a rough measurement made of an object by using one's knowledge of the size of something familiar to estimate the size of a new object.

Measurements

- Should be precise - all trials should be close
- Accurate - how the measurement compares to the "real" or accepted value for a measurement.

Arguments pro and con

- con - industry suggest changeover would be hugely costly (changeover or conversion of machinery.
- pro - easier trade with other countries if all are using SI system of measurement
- pro - based on units of ten - all you have to do is move a decimal.

Avoid Confusion

- In 1960 it was decided that this system would be used to provide a worldwide standard of physical measurement for science, industry, and commerce.
- Scientist around the world have agreed to use the SI system of measurement.

Importance of Using Same System

- to understand each other's research
- compare your results to others results
- people can communicate their results in the same language (they can all understand a common language no matter what their native language is)

Measuring in Science

- Measurements are very important, especially in science.
- In order for measurements to be useful - must have a measurement STANDARD.
- A measurement STANDARD has a known exact quantity

Actual Measuring

- When you measure you are comparing a known quantity to an unknown quantity. (this can be length, volume, mass, etc.)
- EXAMPLE - We use a ruler (a known quantity) to measure the length, height, width of your textbook (an unknown quantity)

Why do Measurements?

- Measurements give people exact descriptions of some of the features of living and nonliving things. (height, weight,mass, length, temperature, density, volume, time, speed, etc)

Metric System or SI System

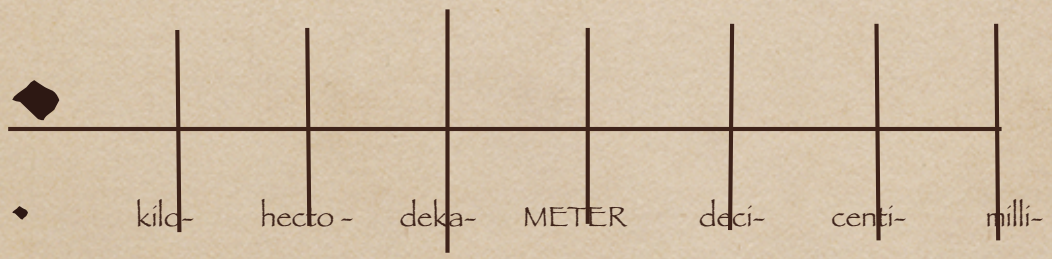
- Remember - metric system is based on units of 10 - you just have to move the decimal.

Metric Prefix	Symbol	Meaning
kilo-	K	1000
hecto-	h	100
deka	dk	10
deci-	d	0.1
centi-	c	0.01
milli	m	0.001

Root words

- meter (m)
- liter (l)
- gram (g)

Performing Metric Conversions

- The following tool is useful in performing metric conversions.
- k h dk d c m
- 
- kilo- hecto - deka- METER deci- centi- milli-
- LITER
- GRAM

Steps for using the number line:

- 1. Start at the unit you are given in the problem with a numerical value. EX. 25 cm = _____ m
- You will start at the centi- on the number line. That is your given.

2. Count the number of places you must move on the number line to get to the desired value.

EX. You are trying to get to meters, you must move 2 places. This value equals the number of times you must move the decimal. (2 places)

- 3. The direction you move on the number line (right or left) is the direction you move the decimal. (2 places - which you determined in step #2)
- EX. To go from centimeters to meters you had to move left on the number line, so you move the decimal to the left. (2 places - which you determined in step #2)

- 4. Add the proper units!!!!!

  Wrong units mean wrong answer.

- ANSWER = 25 cm = .25 m

SI Units

- Length - root word - meter (m)
- Mass - root word - gram (g)
- Volume - root word - liter (l)

Length - units used (or root word) is meter (m).

Meters are used to measure height, width, and length. Instruments used - meter stick, ruler, measuring tape, etc.

Mass is the amount of matter an object is made of.

Mass - units used (or root word) is gram (g). Instruments used to measure mass - balance, scale, spring scale, etc.

Volume - the amount of space an object occupies.

Volume - units used (or root word) is milliliter (ml) or cubic centimeter (cm3). Instruments used to measure volume - graduated cylinder, meter stick, ruler, etc.

Other Metric Units You May Need to Know

Temperature -Celsius(C) or Kelvin (K)
Speed - km/hr
Time - seconds
Mole (mol) - amount of substance
ampere (A) - electric current
candela (cd) - intensity of light

3 ways to Calculate Volume

1st way - to calculate volume of a measurable object take LxWxH . (length (cm) x width (cm) x height (cm)). Take the length in cm, the width in cm, and the height in cm. The answer will have the units cm^3.

2nd way- in order to calculate the volume of a liquid

- Use a graduated cylinder. Read the bottom of the meniscus.
- The answer will have units of ml.

3rd way - volume of an irregular shaped object

water displacement

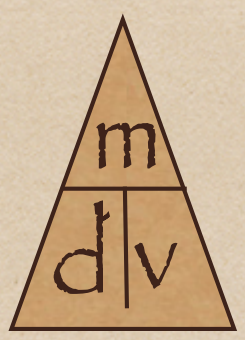
- 3a. record the volume of the water in the graduated cylinder
- 3b. carefully lower the object into the graduated cylinder
- 3c. record the new volume of the water.
- 3d. subtract the original volume from the new volume to get the volume of your object

Density - measures how much mass is packed into a certain volume. Density is how heavy something is to the amount of space it occupies.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Tool to calculate density

- Density triangle



- Steps for using the triangle to calculate mass, volume or density.
- 1. Identify what you are looking for.
- 2. Cover what you are looking for.
- 3. If the remaining two are next to each other,then you MULTIPLY.
- 4. If the remaining two are one on top of the other, then you DIVIDE the bottom value into the top value.
- 5. Be sure to use the correct units in your answer.

Units for density problems

- if you are answering VOLUME the units must be milliliter (ml) or cubic centimeter(cm3).
- if you are answering MASS the units must be in grams.
- if you are answering DENSITY the units must be grams/milliliter (g/ml) or grams/