The Measurement Process:

1. **Select an object and an attribute of the object to measure, such as its length, area, volume, weight, temperature,….**

2. **Select an appropriate unit to measure the attribute.**

3. **Determine the number of units needed to measure the attribute. (This may require a measurement device.)**

Non-standard Units:

For length, you could use a hand. For liquid volume, you could use some container. For cooking, you could use a pinch or dash.

Non-standard units are not necessarily convenient or consistent.

Standard Units:

The English System:

Length:

Unit	Abbreviation	Relation to a foot
Inch	**in.**	$\frac{1}{12}\ ft$
Foot	**ft**	$1\,ft$
Yard	**yd**	$3\,ft$
Mile	**mi**	$5{,}280\ ft$

Conversions:

1) Convert 48 inches into feet.

$$48in \cdot \left(\frac{1\,ft}{12in} \right) =$$

2) Convert 66 inches into feet.

$$66in \cdot \left(\frac{1\,ft}{12in} \right) =$$

3) Convert 2 miles into yards.

$$2mi \cdot \left(\frac{5{,}280\,ft}{1mi} \right) \cdot \left(\frac{1yd}{3\,ft} \right) =$$

4) Convert 11,440 yards into miles.

$$11{,}440\,yd \cdot \left(\frac{3\,ft}{1yd} \right) \cdot \left(\frac{1mi}{5{,}280\,ft} \right) =$$

"Claims she's 40 but that must be her waist measurement!"

Area:

Unit	Relation to a square foot
Square inch	$\frac{1}{144}\ ft^2$
Square foot	$1\ ft^2$
Square yard	$9\ ft^2$

Conversions:

1) Convert 48 square inches into square feet. $48in^2 \cdot \left(\frac{1\ ft^2}{144in^2}\right) =$

2) Convert 6 square feet into square inches. $6\ ft^2 \cdot \left(\frac{144in^2}{1\ ft^2}\right) =$

3) Convert 48.6 square feet into square yards. $48.6\ ft^2 \cdot \left(\frac{1yd^2}{9\ ft^2}\right) =$

4) Convert 3 square yards into square inches.

Volume:

Unit	Relation to a cubic foot
Cubic inch	$\frac{1}{1728}\ ft^3$
Cubic foot	$1\,ft^3$
Cubic yard	$27\ ft^3$

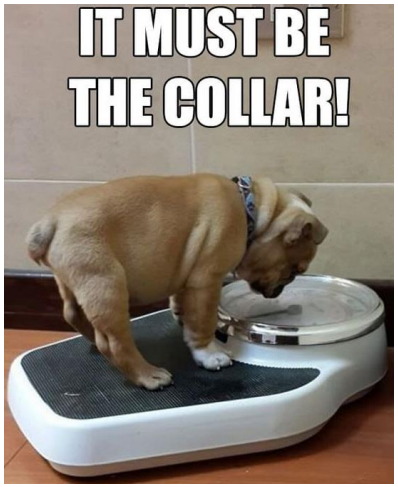
Conversions:

1) Convert 4,320 cubic inches into cubic feet. $4{,}320in^3 \cdot \left(\frac{1\,ft^3}{1{,}728in^3}\right) =$

2) Convert 3.5 cubic feet into cubic inches. $3.5\,ft^3 \cdot \left(\frac{1{,}728in^3}{1\,ft^3}\right) =$

3) Convert 197.1 cubic feet into cubic yards.

4) Convert 3 cubic yards into cubic inches. $3yd^3 \cdot \left(\frac{27\,ft^3}{1yd^3}\right) \cdot \left(\frac{1{,}728in^3}{1\,ft^3}\right) =$



Weight:

Unit	Relation to a pound
Ounce	$\frac{1}{16} lb$
Pound	$1 lb$
Ton	$2{,}000 lbs$

Conversions:

1) Convert 176 ounces into pounds. $176 ounces \cdot \left(\frac{1 lb}{16 ounces} \right) =$

2) Convert 4.5 pounds into ounces. $4.5 lb \cdot \left(\frac{16 ounces}{1 lb} \right) =$

3) Convert 3 tons into ounces. $3 tons \cdot \left(\frac{2{,}000 lbs}{1 ton} \right) \cdot \left(\frac{16 ounces}{1 lb} \right) =$

4) Convert 30,000 ounces into tons.

Temperature:

Fahrenheit scale with water freezing at $32°F$ and boiling at $212°F$ --- a range of $180°F$.

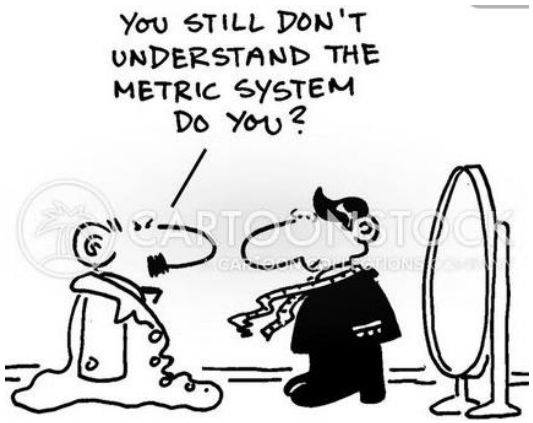
The Metric System:

The metric system is an example of an ideal system of units.

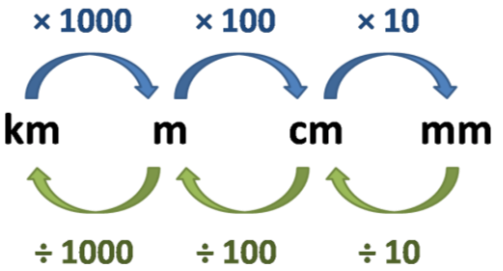
An Ideal System of Units:

1. **The fundamental units can be accurately reproduced without reference to a prototype. (Portability)**

2. **There are simple ratios(conversion factors)among units of the same type.(Convertibility)**



3. **Different types of units are defined in terms of each other using simple relationships.(Interrelatedness)**



Length:

Unit	Abbreviation	Relation to a meter
millimeter	**mm**	$\frac{1}{1{,}000}m$ or $.001m$
centimeter	**cm**	$\frac{1}{100}m$ or $.01m$
decimeter	**dm**	$\frac{1}{10}m$ or $.1m$
meter	**m**	$1m$
dekameter	**dam**	$10m$
hectometer	**hm**	$100m$
kilometer	**km**	$1{,}000m$

Conversions:

1) Convert 480mm into meters.

2) Convert 6.6cm into millimeters.

3) Convert 2km into dekameters.

4) Convert 423.56dm into kilometers.

"I know we're inchworms, but let's get into the spirit of this! Change is good!"

Area:

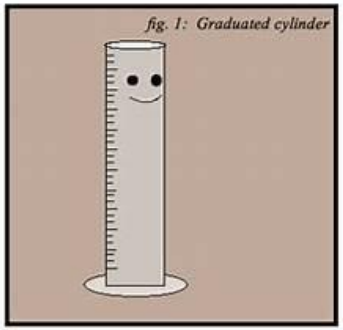
Unit	Abbreviation	Relation to a square meter
Square millimeter	mm^2	$\frac{1}{1{,}000{,}000} m^2$ or $.000001 m^2$
Square centimeter	cm^2	$\frac{1}{10{,}000} m^2$ or $.0001 m^2$
Square meter	m^2	$1 m^2$
Square kilometer	km^2	$1{,}000{,}000 m^2$

Conversions:

1) Convert 480,256 square milimeters into square meters.

2) Convert 6.23754 square kilometers into square meters.

3) Convert 48.6 square meters into square centimeters.



Volume:

Unit	Abbreviation	Relation to a liter
Milliliter(cubic centimeter)	$mL\left(cm^3\right)$	$\frac{1}{1{,}000}$ L or $.001L$
Liter(cubic decimeter)	$L\left(dm^3\right)$	$1L$
Kiloliter(cubic meter)	$kL\left(m^3\right)$	$1{,}000\,L$

Conversions:

1) Convert 42,280 liters into kiloliters.

2) Convert 6.23754 liters into milliliters.

"You still haven't quite got metric figured out, have you?"

Mass:

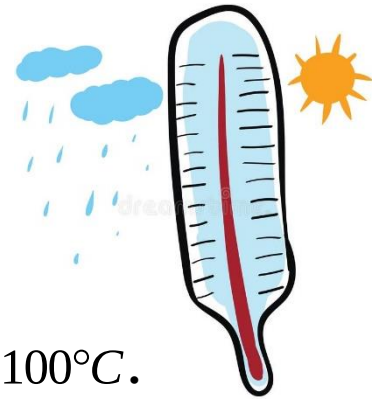
Unit	Abbreviation	Relation to a gram
milligram	**mg**	$\frac{1}{1{,}000}g$ or $.001g$
gram	**g**	$1g$
kilogram	**kg**	$1{,}000\,g$

Conversions:

1) Convert 176 mg into grams.

2) Convert 176 mg into kilograms.

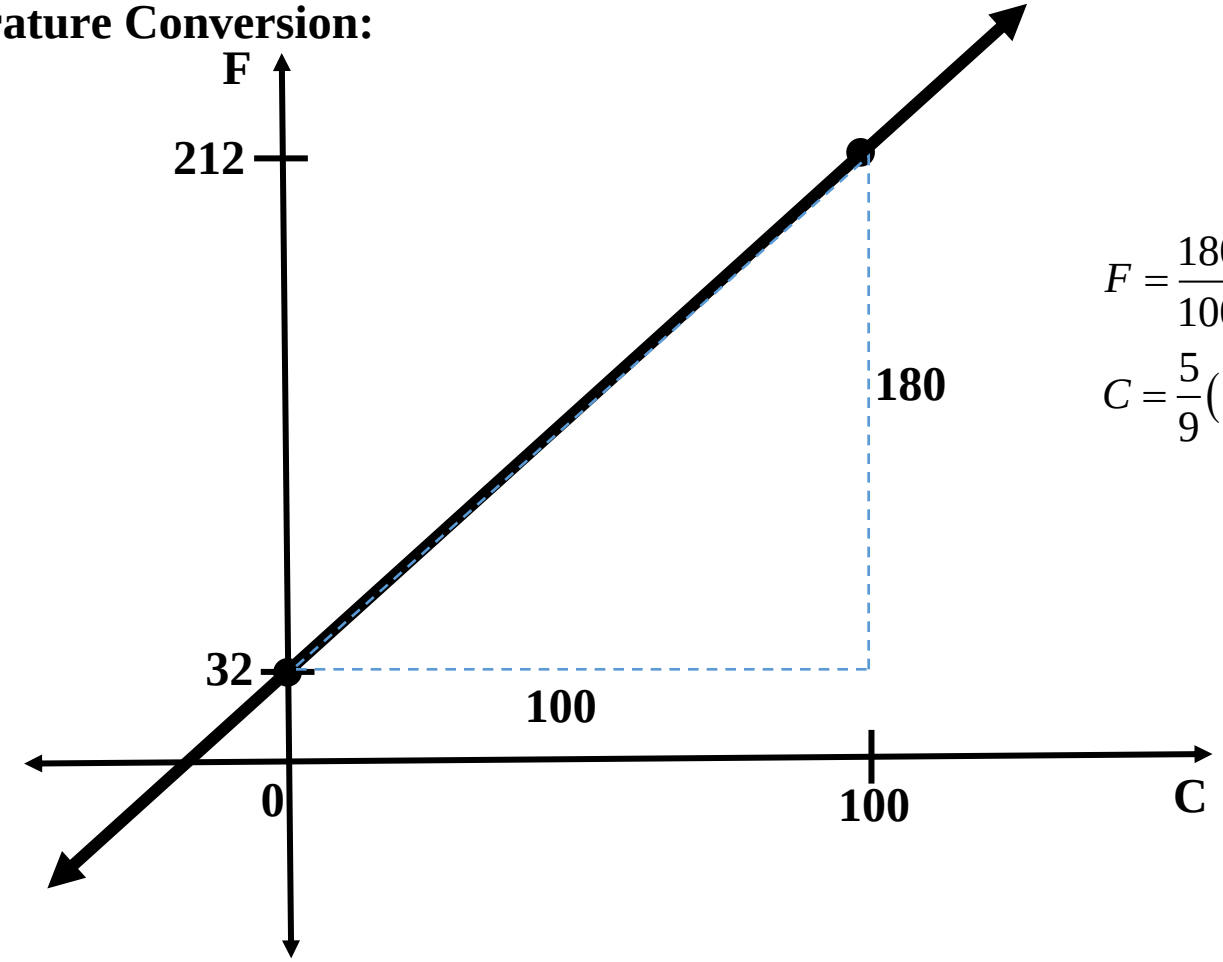
"What about Instagram?"



Temperature:

Celsius scale with water freezing at $0°C$ and boiling at $100°C$--- a range of $100°C$.

Temperature Conversion:



$$F = \frac{180}{100}C + 32 = \frac{9}{5}C + 32$$

$$C = \frac{5}{9}(F - 32)$$

Convert $55°C$ into Fahrenheit.

Convert $78°F$ into Celsius.

Rate Conversions:

Convert 55 miles per hour into feet per minute.

$$\frac{55 miles}{1 hour} \cdot \left(\frac{1 hour}{60 minutes} \right) \cdot \left(\frac{5{,}280\ feet}{1 mile} \right) =$$

Convert 40 kilograms per meter into grams per centimeter.

$$\frac{40 kg}{1 m} \cdot \left(\frac{1{,}000 g}{1 kg} \right) \cdot \left(\frac{1 m}{100 cm} \right) =$$

Convert $72 lb / ft^3$ **into tons per cubic yard.**

$$\frac{72 lb}{1 ft^3} \cdot \left(\frac{1 ton}{2{,}000 lb} \right) \cdot \left(\frac{27\ ft^3}{1 yd^3} \right) =$$