# Experiment 1
# THE METRIC SYSTEM

The **metric system** of units is used in most scientific work, and a list of commonly used units follows. You should familiarize yourself thoroughly with these units, and with the relationship of these units to common units of the English system.

The fundamental unit of **linear** measurement is the **meter**, (m).
The fundamental unit of **mass** measurement is the **gram**, (g).
The fundamental unit of **volume** measurement is the **liter**, (L).

Commonly used prefixes of the foregoing fundamental units are

| | | |
|---|---|---|
| deci- | (d) | 1/10 or 0.1 |
| centi- | (c) | 1/100 or 0.01 |
| milli- | (m) | 1/1000 or 0.001 |
| deka- | (dk) | 10 |
| hecto- | (h) | 100 |
| kilo- | (k) | 1000 |

Thus, 1,000 meters (m) is 1 kilometer (km), 0.1 gram (g) is 1 decigram (dg), 0.001 liter (L) is 1 milliliter (mL), and so on.

Some of the common English units and their approximate metric equivalents are

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 inch | = | 2.54 centimeters | | 1 meter | = | 39.37 inches |
| 1 foot | = | 30.5 centimeters | | 1 liter | = | 1.06 quarts |
| 1 pound | = | 53.6 grams | | 1 kilogram | = | 2.2 pounds |
| 1 ounce | = | 28.3 grams | | 1 quart | = | 0.94 liters |
| 1 fluid ounce = | | 29.6 mL | | | | |

1.0 mL of water weighs 1.0 g.   1.0 liter (L) of water weighs 1.0 kg.

## FACTOR LABEL SYSTEM FOR MAKING CONVERSIONS

A convenient method for converting from one set of units to another without getting mixed up is to use a **numerical factor** followed by a **units label**; the **factor-label method**. A pattern that can be followed is:

| What you have | Leave a space | An equals | What you want |
|---|---|---|---|
| plus its units | for factors | sign | plus its units |

The **factor** should be written so a unit on the top (numerator) will cancel a unit on the bottom (denominator).

**EXAMPLES:**

1. A shoe imprint found at a scene was found to be 13. 0 inches long. How many centimeters long is this shoe?

$$\frac{13.0\ inches}{1} \times \frac{2.54\ cm}{1.0\ inch} = 5.12\ cm$$

Notice that the factor is arranged so that the numerator (top) of one set of units will cancel the denominator (bottom) of another set of units. You use as many factors as you need until the units on the left side of the equation equals the units on the right side of the equation.

2. I am 74 inches tall. How many meters tall am I?

$$\frac{74\ inches}{1} \times \frac{2.54\ cm}{1.0\ inch} \times \frac{1\ meter}{100\ cm} = 1.88\ meters$$

3. A bullet slug weighs 0.62 ounces. How many milligrams does it weigh?

$$\frac{0.62\ ounces}{1} \times \frac{28.35\ grams}{1.0\ ounce} \times \frac{1,000\ mg}{1.0\ grams} = 17,577\ mg$$

4. A room is 12 ft wide and 15 ft long. How many square meters ($m^2$) is the floor in this room? Follow the same pattern, just use the factors more than once if you need to.

$$\frac{12\ ft}{1} \times \frac{15\ ft}{1} \times \frac{30.5\ cm}{1.0\ ft} \times \frac{30.5\ cm}{1.0\ ft} \times \frac{1.0\ m}{100\ cm} \times \frac{1.0\ m}{100\ cm} = 16.7\ m^2$$

For practice in evaluating units of the metric system, do the following exercises.

**EXERCISES**     Convert ALL answers to English

1. Add: 3.45 g, 0.06 kg, 0.67 g, 690 mg, 2 dg.

2. Add: 3.28 g, 8,604 mg, 6.20 dg, 0.780 kg, 5.62 g, 0.08 dg.

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3.  Add: 5.2 L, 5,300 mL, 0.44 L, 50 mL.

4.  Add: 0.30 m, 450 cm, 4.2 m, 600 mm, 2.8 cm, 4 dm, 60 mm.

5.  Add: 78 cm, 567 mm, 14 dm, 1.2 m, 0.023 km, 75 mm.

6.  How many liters are contained in a 1.00 cubic meter container, and what would it weigh if it were filled with water? Ignore the weight of the container (hint: 1 L of water weighs 1 kg).

7.  Fill in the blanks.

    a. 1 centimeter (cm) = _____ inch (in)

    b. 1 pound (lb) = _____kilogram (kg)

    c. 1 quart (qt) = _____ liter (L)

    d. 1 ounce (oz) = _____grams (g)

    e. 2 ounces (oz) = _____milliliters (mL)

    f. 100 meters (m) = _____ yards (yd)

    g. 1 mile (mi) = _____kilometers (km)

    h. 1 gallon (gal) = _____milliliters (mL)

    I. 1 square inch ($in^2$) = _____ square centimeters ($cm^2$)

    j. 1 cubic decimeter ($dm^3$) = _____ cubic centimeters (cc) or ($cm^3$)

Metric Conversion

 A. The gunpowder burn on the wall is 5 inches wide. Convert to centimeters.
 B. It is 13' 6" in distance from the gunpowder burn to the point of impact. Convert to meters.
 C. The spent shotgun shell weighs 2.4 ounces. Convert to grams.
 D. The footprint on the door is 12 inches in length. Convert to centimeters.
 E. The indentation on the doorframe is 15 millimeters in width. Convert to inches.
 F. The skull fragment found weighs 14.3 grams. Convert to ounces.
 G. You were able to suck up 4.5 ounces of blood off the floor using an eyedropper. Convert to milliliters.
 H. The distance from the exit wound to the curtains in the living room is 10' 1" in length. Convert to centimeters.
 I. The bloodstain is 46 centimeters in length. Convert to inches.
 J. The skull fragment weighs .25 ounces. Convert to centigrams.