

The Factor-Label Method

Adapted from http://www.thinkquest.org/pls/html/think.site?p_site_id=2923 by Brush Prairie, WA students.

In math you use numbers, in science we use quantities. A quantity is described by a number and a unit. 100 is a number, but 100 kg is a quantity (notice that in science we must give meaning to numbers). In science we solve a lot of the "math" by watching the units of the quantities.

There are two main rules to solving science problems with the factor-label method:

1. Always carry along your units with any measurement you use.
2. You need to use the appropriate labeled ratios, fractions, or equalities.

Example Problem: How many centimeters in 2 meters?

You will see from a metric conversion chart that 1 meter = 100 cm.

We turn this into a ratio by writing it like this:

$$\frac{100 \text{ cm}}{1 \text{ meter}} \quad \text{or} \quad \frac{1 \text{ meter}}{100 \text{ cm}}$$

Once you have the ratios you must pick the one that will cancel out the units leaving the desired units. As a rule of thumb your problem set up should look like this:

$$\text{Starting Units} \times \frac{\text{Desired Units}}{\text{Starting Units}} = \text{Desired Units}$$

Multiply your starting quantity (2 meters) by the equality that will give you your desired units.

$$2 \text{ meters} \times \frac{100 \text{ cm}}{1 \text{ meter}} = 200 \text{ cm}$$

Notice that the top and bottom meters (the starting unit) cancel each other out, leaving us with only the desired units.

Sometimes you will need to multiply by more than one ratio to get to your desired units, you can do this by using linking units. Your setup will look like this:

$$\text{Starting Units} \times \frac{\text{Linking Units}}{\text{Starting Units}} \times \frac{\text{Desired Units}}{\text{Linking Units}} = \text{Desired Units}$$

Notice that once again that if all the matching units cancel each other out, we're left with only the desired units.

Practice Problems:

1. How many wheels on 350 Ford pickups (use the equality 1 pickup = 4 wheels)

Note: The starting units are pickups; the desired units need to be wheels.

2. How many millimeters in 34 hectometers (use the equality 10,000 mm = 1 hm)?

3. How many inches are in 1 meter given the equality 1 in. = 2.54 cm and 1 m = 100 cm?

Note: the linking unit in this problem is cm.

4. If a warehouse holds 300 boxes, and a truck holds 25 boxes. How many truckloads will it take to fill up one warehouse?

5. How many grams in 150 pounds given the equalities 1 lb. = 0.454 kg and 1 kg = 1000 g?