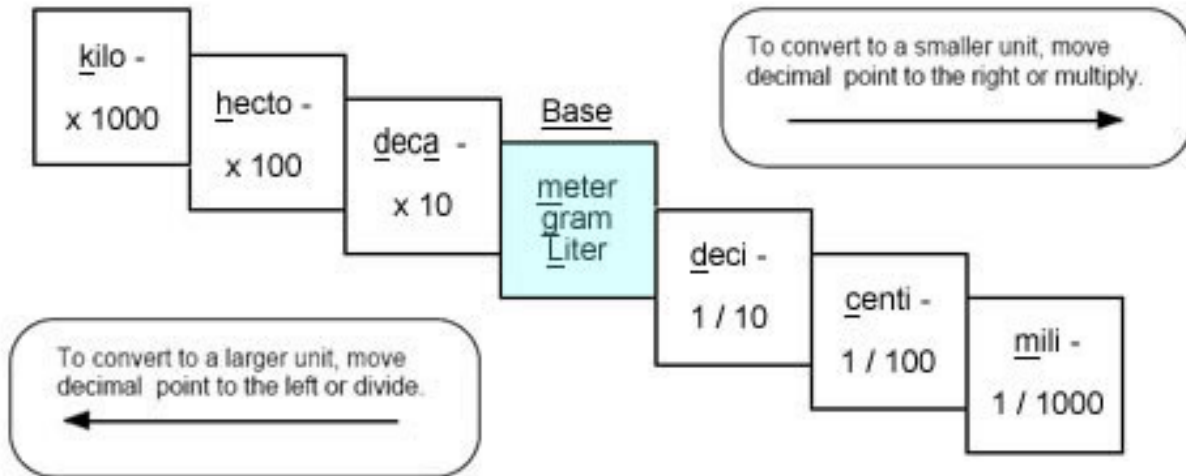


# Metric System and Using the Metric Ladder

Below is the standard "metric ladder". Each box shows a metric prefix and its size in relation to the base unit (meter, gram or Liter). Underlined letters are used to indicate how the prefixes and base units are abbreviated. The metric ladder is helpful when making conversions for any of the following



base units (meter, gram and Liter).

## Using the Metric Ladder

Try these steps each and every time you want to use the metric ladder.

1. Find the spot (unit) on the ladder that has the same prefix as the measurement you are starting with
2. Locate the spot on the ladder that you want to convert your number to
3. Count the number of steps you must move on the ladder to make your conversion
4. Move the decimal in your original number this same number of steps and in the same direction (don't forget the Base step)

## An Example Using the Metric Ladder

How many dg (decigrams) are there in 5276.4 mg (milligrams)?

1. Put your pencil on the "milli" box
2. Put your finger on the "deci" box
3. Move the pencil until it meets your finger (two steps to the left)

4. Move the decimal two steps to the left to get your answer = 52.764 dg (decigrams)

**Think you get it? Quiz yourself below:**

Look at the table below. Eight of the equations are correct. Use the metric ladder above to determine which equation is incorrect? Write that equation in your notebook and raise your hand to have your teacher check it.

Metric Equations		
1 m = 100 cm	1 m = 1000 mm	10 m = 0.01 km
1 g = 10 dg	10 g = 1 dag	1000 mg = 1 g
1 L = 100 cL	100 cL = 10 L	1 L = 0.001 kL

## The Metric System and U.S. History

---

The Metric System originated in France in the 1790's. It offered a huge benefit to anyone involved in selling, buying or trading goods (which was almost everyone). Unfortunately, the Metric System has never been designated the official system of measurement in the United States, although Congress did make it *legal* to use the Metric System in 1866. [Read more about the Metric System and U.S History.](#)

## **The Metric System in the United States**

Article I, Section 8 of the U. S. Constitution gives Congress the power to "fix the standard of weights and measures" for the nation. The First Congress, meeting in 1789, took up the question of weights and measures, and had the metric system been available at that time it might have been adopted. What actually happened is that Thomas Jefferson, who was then serving as the first Secretary of State, submitted a report proposing a decimal-based system with a mixture of familiar and unfamiliar names for the units.

Jefferson's system actually resembles the metric system in many ways. Its biggest shortcoming is that Jefferson didn't hit on the idea of using prefixes to create names for multiples of units. Consequently, his system was burdened with a long list of names. For example, he divided his basic distance unit, the foot (it was slightly shorter than the traditional foot) into 10 inches. Each inch was divided into 10 lines, and each line into 10 points. For larger distances, 10 feet equalled a decade, 100 feet was a rood, 1000 feet a furlong, and there were 10 000 feet in a mile (making the Jeffersonian mile about twice as long as the traditional mile). His basic volume unit was the cubic foot, which he proposed to call a bushel (it was about  $\frac{3}{4}$  the size of a traditional bushel). The basic weight unit was the ounce, defined so that a bushel of water weighed 1000 ounces. (This is very similar to the metric system, in which a liter of water weighs 1000 grams). Congress gave this plan serious consideration, but because it lacked independent support from other scientists it was easy to criticize. Ultimately, Congress took no action. This left Americans with a version of the traditional English weights and measures, including:

- distance measurements identical to those of the 1592 Act of Parliament,
- the traditional avoirdupois system of weight measurements,
- a system of measurement for dry volumes based on the "Winchester" bushel used in England for wheat and corn since the late Middle Ages, and
- a system of measurement for liquid volumes based on the English wine gallon of 1707.

It is remarkable that Congress never established this traditional system, or any other system, as the mandatory system of weights and measures for the United States. In 1832, Congress directed the Treasury Department to standardize the measures used by customs officials at U.S. ports. The Department adopted a report describing the traditional system, and Congress allowed this report to stand without taking any formal action. This is the closest the U.S. has ever come to adopting a single system of measurement. Ironically, the U.S. missed two opportunities in 1832. Americans could have adopted the metric system, which was then at an uncertain point in its history; or they could have decided to align their measurements with the British Imperial measures established by Parliament in 1824 and thus created a possible alternative to the metric system in international commerce.

The [metric system](#) originated in France in the 1790's, a few years after Jefferson's proposals. During the mid-nineteenth century, as expanding trade demanded a consistent set of measurements, use of the metric system spread through continental Europe. As they imported goods from Europe or exported goods to Europe, Americans became increasingly aware of the metric system. In 1866, Congress legalized its use in an act reading:

It shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.

As a result, the U. S. has been "metric" since 1866, but only in the sense that Americans have been free since that time to use the metric system as much as they like. Although there has always been popular resistance to changing the traditional measures, the metric system has actually enjoyed strong support from American business leaders and scientists since the late nineteenth century. In 1875, the U.S. was one of the original signers of the Treaty of the Meter, which established the International Bureau of Weights and Measures (BIPM). This agency administers the [International System of Units](#), the official version of the metric system. American scientists and engineers have always been among the leaders in improving, extending, and revising the metric system. The general public, however, has lagged far behind.

In 1893, Thomas C. Mendenhall, then Superintendent of Weights and Measures in the Treasury Department, concluded that the metric standards, the official meter and kilogram bars supplied by BIPM, should become the standards for all measurement in the U.S. With the approval of the Secretary of the Treasury, this decision was made and published; it has since been called the [Mendenhall Order](#). The order didn't mean that metric units had to be used, but since that time the customary units have been defined officially in terms of metric standards. Currently, the foot is legally defined to be exactly 0.3048 meter and the pound is legally defined to equal exactly 453.59237 grams.

In 1901, Congress established the National Bureau of Standards (NBS), now known as the [National Institute of Standards and Technology](#) (NIST), to support technical standards for American industry and commerce, including the maintenance of standards of weight and measurement. In 1964, NBS announced:

Henceforth it shall be the policy of the National Bureau of Standards to use the units of the [International System \(SI\)](#), as adopted by the 11th General Conference of Weights and Measures, except when the use of these units would obviously impair communication or reduce the usefulness of a report.

In the 1970's there was a major effort to increase the use of the metric system, and Congress passed the Metric Conversion Act of 1975 to speed this process along. However, American consumers generally rejected the use of metric units for highway distances, weather reports, and other common measurements, so little was accomplished except for the encouragement of faster metric conversion in various scientific and technical fields.

In 1988, Congress passed the Omnibus Trade and Competitiveness Act, which designates "the metric system of measurement as the preferred system of weights and measures for United States trade and commerce." Among many other things, the act requires federal agencies to use metric measurements in nearly all of their activities, although there are still exceptions allowing traditional units to be used in documents intended for consumers. The real purpose of the act was to improve the competitiveness of American industry in international markets by encouraging industries to design, produce, and sell products in metric units.

The debate over metric conversion continues. Although metric units have become more familiar and more widely used, the United States remains a "soft metric" country. (The phrase "soft metric" refers to designations like "1 pint (473 mL)" in which metric equivalents are simply tagged onto traditional measurements.)

Proponents of the metric system in the U.S. often claim that "the United States, Liberia, and Burma (or Myanmar) are the only countries that have not adopted the metric system." This statement is not correct with respect to the U.S., and probably it isn't correct with respect to Liberia and Burma, either. The U.S. adopted the metric system in 1866. What the U.S. has failed to do is to restrict or prohibit the use of traditional units in areas touching the ordinary citizen: construction, real estate transactions, retail trade, and education. The U.S. has not made the crucial transition from "soft metric" to "hard

metric", so that "1 pint (473 mL)" becomes "500 mL (1.057 pint)", with the traditional equivalent fading into smaller type sizes and finally disappearing.

All material in this folder is copyright © 2000 by Russ Rowlett and the University of North Carolina at Chapel Hill. Permission is granted for personal use and for use by individual teachers in conducting their own classes. All other rights reserved. You are welcome to make links to this page, but please do not copy the contents of any page in this folder to another site. The material at this site will be updated from time to time.  
August 8, 2000