

## 1.1: Metric and Standard Measurements

Compare and convert units of measure using the metric system and the standard system.

## **Units of Measurement**

Scientists have measured things for many centuries. Measurement allows for a quantitative description, a set of numbers to represent size. In order to communicate with others, scientists developed measurement standards. Standards were necessary to be able to reproduce and communicate results.

Let's imagine we want to measure the length of an object and describe that length to a friend. Suppose you were to measure how tall you were by counting the number of paper clips stacked end to end. You could describe to your friend how tall you are by telling him the number of paper clips you counted. This would work great if your friend had the same paper clips, but what if his paper clips were not the same size as the ones you used?

You can see how important it would be to use the same measurement standard so that if you communicate a measurement with someone else, they will be able to understand exactly what that means. We need to have a standard method of measuring. For this purpose scientists created standard units of measure. Standard units are exact quantities to which all measurements can be compared. For example, if an American scientist states that an object has a length of one meter, a British scientist will know its length exactly. The use of the meter as a standard for length allows people to communicate exact measurements.

## **Common Measurement Systems**

There are two commonly used measurement systems—the standard system and the metric system, which is often abbreviated as the SI system. SI stands for Système International, which is French for

international system. The standard system is primarily used in the United States, while the metric system is used throughout most of the rest of the world. Examples of units in the standard system include feet, pounds, miles, and gallons. Examples of units in the metric system include meters, grams, and liters. Each of these units has an abbreviation. Abbreviations make it easier for scientists to communicate measured values with each other. The basic units in the metric system are the meter (m), gram (g), and liter (L).

Measurement	U.S. Standard System Units	Metric System (SI) Units
length	inch, foot, yard, mile	meter, centimeter, kilometer
mass	slug	milligram, gram, kilogram
volume	cup, quart, gallon	liter
temperature	degrees Fahrenheit (°F)	degrees Celsius (°C), Kelvins (K)
force (including weight)	pounds, ounces	newton*

Table 1.1: Units of Measure in the U.S. Standard Systemand the Metric System

\*The metric unit of weight is technically the newton, but most people use kilograms for weight. We'll discuss the difference between mass and weight in lesson 2.

## **Conversion in the Metric System**

The metric system uses measurement standards with prefixes (prefixes are word parts that come before the root word) to denote larger or smaller measurements than the standards. Metric prefixes are based on powers of ten. These prefixes are placed in front of the base units to denote a multiple or a fraction of that unit. An example of this would be the centimeter. Notice the centi in front of the meter. Centi means 1/100th, so a centimeter is 1/100th of a meter. It is abbreviated cm. Similarly, a kilometer means 1000 meters, because the prefix kilo means 1000. It is abbreviated km. Note the table with some common metric prefixes and their abbreviations:

Table 1.2: Metric prefixes

Prefix	Meaning	Example
micro (µ)	1/1,000,000th (10 <sup>-6</sup> )	3.2 µm (micrometers)
milli (m)	1/1000th (10 <sup>-3</sup> )	47 mg (milligrams)
centi (c)	1/100th (10 <sup>-2</sup> )	33 cm (centimeters)
deci (d)	1/10th (10 <sup>-1</sup> )	22 dg (decigrams)
deka (dk)	10 (10 <sup>1</sup> )	0.22 dkg (dekagrams)
hecto (h)	100 (10 <sup>²</sup> )	4.99 hL (hectoliters)
kilo (k)	1000 (10³)	45 km (kilometers)
mega (M)	1,000,000 (10 <sup>6</sup> )	32.4 Mm (megameters)

Now go through the following activity and check your skill with metric conversions.

Fig. 1.1: Conversion guide for metric prefixes