A chronology of the SI metric system

Important dates in the history of the modern metric system:

1585 In his book "The Tenth" Simon Stevin suggests that a decimal system should be used for weights and measures, coinage, and divisions of the degree of arc.

1670 Authorities give credit for originating the metric system to Gabriel Mouton, a French vicar, on about this date.

1790 Thomas Jefferson proposed a decimal-based measurement system for the United States. France's Louis XVI authorized scientific investigations aimed at a reform of French weights and measures. These investigations led to the development of the first "metric" system.

1792 The U.S. Mint was formed to produce the world's first decimal currency (the U.S. dollar consisting of 100 cents).

1795 France officially adopted the metric system.

1812 Napoleon temporarily suspended the compulsory provisions of the 1795 metric system adoption.

1840 The metric system reinstated as the compulsory system in France.

1866 The use of the metric system made legal (but not mandatory) in the United States by the (Kasson) Metric Act of 1866 (Public Law 39-183) [See: Page 1 and Page 2]. This law also made it unlawful to refuse to trade or deal in metric quantities.

1875 The Convention of the Metre signed in Paris by 18 nations, including the United States. The Meter Convention, often called the Treaty of the Meter in the United States, provided for improved metric weights and measures and the establishment of the General Conference on Weights and Measures (CGPM) devoted to international agreement on matters of weights and measures.

1889 As a result of the Metre Convention, the U.S. received a prototype meter and kilogram to be used as measurement standards.

1893 These metric prototypes were declared "fundamental standards of length and mass" in the Mendenhall Order. Since that date, the yard, pound, etc. have been officially defined in terms of the metric system.

1916 The Metric Association formed as a non-profit organization advocating adoption of the metric system in U.S. commerce and education. The organizational name started as the American Metric Association and was changed to the U.S. Metric Association (USMA) in 1974.

1920 The Metric Association published its first metric style guide. [Its current edition is now available as Guide to the Use of the Metric System (SI)]

1954 The International System of Units began its development at the 10th CGPM. Six of the new metric base units were adopted.

1958 A conference of English-speaking nations agreed to unify their standards of length and mass, and define them in terms of metric measures. The American yard was shortened and the imperial yard was lengthened as a result. The new conversion factors were announced in 1959 in the Federal Register.

1960 The meter was redefined in terms of wavelengths of light by the 11th CGPM, and the new metric system was given the official symbol SI for the Système International d'Unités, the "modernized metric system".

1964 The National Bureau of Standards (NBS) made the metric system its standard "except when the use of these units would obviously impair communication or reduce the usefulness of a report."

1968 Public Law 90-472 authorized a 3-year U.S. Metric Study, to determine the impact of increasing metric use on the U.S. This study was carried out by the National Bureau of Standards (NBS).

1971 The U.S. Metric Study resulted in a Report to the Congress: A Metric America, A Decision Whose Time Has Come. The 13-volume report concluded that the U.S. should, indeed, "go metric" deliberately and carefully through a coordinated national program, and establish a target date 10 years ahead, by which time the U.S. would be predominately metric.

1973 The UCLA/USMA/LACES/STC/and other professional groups National Metric Conference, the largest ever held, totaling 1700 registrants, took place at the University of California, Los Angeles in September. It took place as a result of USMA's recommendation. USMA coordinated and directed the event. One of the speakers was the U.S. Secretary of Commerce. Also, the American National Metric Council (ANMC) formed as a not-for-profit, non-advocative trade organization to plan and coordinate SI implementation by U.S. industry.

1974 The Education Amendments of 1974 (Public Law 92-380) encouraged educational agencies and institutions to prepare students to use the metric system of measurement as part of the regular educational program.

1975 The Metric Conversion Act of 1975 (Public Law 94-168) passed by Congress. The Act established the U.S. Metric Board to coordinate and plan the increasing use and voluntary conversion to the metric system. However, the Act was devoid of any target dates for metric conversion.

1979 The Treasury Department's Bureau of Alcohol, Tobacco, and Firearms (BATF) requires wine producers and importers to switch to metric bottles in seven standard [liter and milliliter] sizes.

1980 The Treasury Department's Bureau of Alcohol, Tobacco, and Firearms (BATF) requires distilled spirits (hard liquor) bottles to conform to the volume of one of six standard metric [liter and milliliter] sizes.

1982 President Ronald Reagan disbanded the U.S. Metric Board and canceled its funding. Responsibility for metric coordination was transferred to the Office of Metric Programs in the Department of Commerce.
1983 The meter is redefined in terms of the speed of light by the 17th CGPM, resulting in better precision but keeping its length the same.
1988 The Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418) amended and strengthened the Metric Conversion Act of 1975, designating the SI metric system as the preferred measurement system, and requiring each federal agency to be metric by the end of fiscal year 1992.
1991 President George Bush signed Executive Order 12770, Metric Usage in Federal Government Programs directing all executive departments and federal agencies implement the use of the metric system. The Executive Order is also available as an appendix to: Interpretation of the SI for the United States and Federal Government Metric Conversion Policy
1994 The Fair Packaging and Labeling Act (FPLA) was amended by the Food and Drug and Administration (FDA) to require the use of dual units (inch-pound AND metric) on all consumer products.
1996 All four Canadian Stock Exchanges began decimal trading on April 15, the first exchanges in North American to abandon the old "pieces-of-eight" trading system and welcome the new decimal system. The old tradition of trading stocks in increments of one-eighth of a dollar, or 12.5 cents, dates back to when the Spanish mille dollar was divided into "pieces of eight".
1996 As of July 1996 all surface temperature observations in National Weather Service METAR/TAF reports are now transmitted in degrees Celsius.
2000 September 30 This deadline that all agreements, contracts, and plans processed by individual states for federally-funded highway construction be in metric units was canceled by Congressional action, leaving metric conversion as voluntary but still recommended to comply with the Omnibus Trade and Competitiveness Act of 1988. Several State Departments of Transportation continue to use the metric system despite the deadline being rescinded. See Did You Know That for more details on this topic.
2001 April 09 U.S. Stock Exchanges finalized the change to decimal trading. The Securities and Exchange Commission has ordered that all stocks must be quoted in dollars and cents rather than fractions by this date. The switch to decimal trading brought the U.S. in line with the rest of the world's major exchanges. This follows the change of the Canadian Stock Exchanges to decimal trading in 1996.
Future metric deadlines:

***200?* The U.S. should allow metric-only packaging by amending the Fair Packaging and Labeling Act (FPLA). This would be a good step towards meeting EU requirements for SI only labels in 2009.**

***2009* December 31 All products sold in Europe (with limited exceptions) will be required to have only SI metric units on their labels. Dual labeling will not be permitted. Implementation of the labeling directive, previously 1999 December 31, was extended by the EU Commission for 10 years, giving more time for companies to comply and for U.S. regulations to allow metric-only labeling on consumer products. See Did You Know**

http://lamar.colostate.edu/~hillger/dates.htm

Metric System Units
Brief Historical Intro

The first standardized system of measurement, based on the decimal was proposed in France about 1670. However, it was not until 1791 that such a system was developed.
It was called the "metric" system, based on the French word for measure. The driving force was the growing importance of weights in the sciences, especially chemistry. At that time, every country had their own system of weights and measures. England had three different systems just within its own borders!!
On May 20, 1875, delegates of 17 countries signed the Meter Convention. It was amended in 1921 and today 48 countries are signatories.
The modern metric system has been renamed *Systeme International d'Unites* (International System of Units) and is denoted by the letters SI. SI was established in 1960, at the 11th General Conference on Weights and Measures. It was then that units, definitions, and symbols were revised and simplified.
There are three major parts to the metric system: the seven base units, the prefixes and units built up from the base units. Here is a list of the base units which make up the metric system:

Physical Quantity	Name of SI unit	Symbol for SI unit
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
temperature	Kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

Prefixes were also agreed on in 1791 The set from kilo- down to milli- was developed then. For the multipliers (prefixes greater than 10), Greek was used and for the fractions (prefixes less than 1), Latin was used.
In 1958, the International Committee on Weights and Measures added Mega-, Giga-, and Tera- to the multipliers and micro-, nano-, and pico- to the fractions. In 1960, at the 11th General Conference on Weights and Measures, everything was offically adopted.
Since that time, additional prefixes have been added as the need arose. Typically, as scientific instruments get better and better, smaller and smaller quantities can be detected. So, new fractional prefixes need to be added. When they are, new multipliers are added also, to keep the system symmetrical.

Non-SI Units Commonly Used

1) Liter: symbol = L. The SI unit for volume is m^3 (cubic meter). One dm^3 (cubic decimeter) equals one L. A cubic decimeter is a cube 0.1 m on a side..
2) cubic centimeter: symbol = cm^3. Often used for measuring the volume of solids, one cm^3 equals one milliliter (mL).
3) Ångström: symbol = Å. One Å equals 10^{-8} cm

Definitions of Selected Units

The Meter

The meter has a most interesting history. The original definition was one ten-millionth of the distance from the North Pole to the Equator. From that, French scientists made a bar of 90% platinum and 10% iridium and put two marks on it to signify the meter distance.
This particular alloy was used because it resisted expansions due to temperature very well and it could take a high polish, resulting in the ability to take a very fine line. This reduced the error due to the width of the lines.
As science moved into the 1900s, it was becoming apparent that wavelength measurements were among the most accurate ones in all of science. In 1907, the red line of cadmium at 6438 Å was adopted as a new meter standard, however many continued to advocate the green line at 5460 Å in mercury's spectrum. By the way, using a particular wavelength of light as a standard for measurement was made as early as 1829. It took almost 80 years for the technology of measurement to become exact enough for use as an international standard.
In 1960, the orange line at 6058 Å of krypton-86 was adopted. The wavelength was specified as $_{vac}$ = 6057.802106 Å so that one meter equaled:
1,650,763.73 Hz^{-1} If you want to be really technical, this is the $2p_{10}$ to $5d_5$ transition (following the notation of Paschen). It can also be written: $^2P_{10}$ to $^5d_5$. So there! The definition was changed once again, in 1983, to the following: The meter is the length of path traveled by light in vacuum during a time interval of 1 / 299,792,458 of a second.
By the way, this definition depends on the fact that the speed of light is defined (not measured) as exactly 299,792,458 meters per second.
I think the meter's definition journey is over.

The Kilogram

An interesting fact about the kilogram is that it is the only SI base unit to incorporate a prefix. (By the way, teachers have been known to test that fact.) Why wasn't the gram used? I don't know for sure, but the gram is such a small amount of stuff that it would be easy to make a mistake in creating a standard. So I suspect they decided to deal with a larger amount of material.
Here is the definition of the kilogram, adopted in 1901: it is equal to the mass of the international prototype of the kilogram. What that means is that there is a cylinder of 90% platnium/10% iridium in a vault in Paris, France and that lump of stuff weighs exactly one kilogram, by definition. I have heard, although I have no proof, that it has been removed for use only 4 times during the 1900s. The kilogram is the only unit still based on a single lump of stuff.
All the other definitions can be reproduced with a high degree of accuracy in any laboratory with the proper equipment.

Amount of Substance (The Mole)

In 1860, at the first ever international meeting of chemists, it was decided that hydrogen would serve as the standard for all atomic weights. It was defined as weighing exactly one atomic mass unit (amu). (The concept of mole had not yet been introduced into chemistry.) In 1906, oxygen was made the standard. There wasn't anything wrong with hydrogen, it was just that oxygen formed compounds with almost every element known and hydrogen did not. So oxygen was defined to weigh exactly 16 amu.

However, in the 1940s (I think), the discovery of the O-17 and O-18 isotopes (both stable) changed matters, even though the two isotopes comprised only 0.24% of all oxygen atoms. Also, it was discovered that oxygen from different sources world-wide had slightly different mixes of the three isotopes. This was a BIG problem. In response, the physics community defined the amu as 1/16 the weight of the lightest oxygen isotope (which was O-16), while chemists do not come up with a new definition so fast. This meant that the atomic weights used by people in physics were different than those used in chemistry. This situation could not be tolerated.

During the years 1958-1961 this issue was first debated by the world-wide chemistry and physics community and then voted upon. What emerged from the debate were two possible new standards: fluorine and carbon. The final vote showed carbon as the winner. Although fluorine had the advantage of only one natural isotope, carbon is much the safer element to handle. Also, while carbon has two natural, stable isotopes, the isotopic mix between carbon-12 and carbon-13 is well known and stable world-wide.

These years were at the height of the Cold War between the USA and the Soviet Union. Despite this, the Soviet physics and chemistry communities was well-represented in the debate and the voting. As a personal note, the ChemTeam was in elementary school during those years. I can still hear the air raid siren being tested every Friday at 10AM and I remember the drop-and-cover drills in case of nuclear attack (!).

From 1971, the official wording (unchanged to the present day) is as follows: The mole is the amount of substance of a system that contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles. By the way, some books will rearrange the definition. For example: The amount of a substance of specified chemical formula, containing the same number of formula units (molecules, atoms, ions, electrons, etc.) as there are in 0.012 kilograms (exactly) of the pure nuclide carbon-12. This definition came from a reference book published in 1972 and is, of course, saying the same thing as the first definition

Metric Prefixes

In order to properly convert from one metric unit to another, you must have the prefixes memorized. You will also need to determine which of two prefixes represents a bigger amount AND you will also need to determine the exponential "distance" between two prefixes. A metric prefix is a modifier on the root word and it tells us the unit of measure. For example, centigram means we are count in steps of one one-hundredth of a gram,   g means millionths of a gram.

A List of the Metric Prefixes

		Multiplier	
Prefix	Symbol	Numerical	Exponential
yotta	Y	1,000,000,000,000,000,000,000,000	10^{24}
zetta	Z	1,000,000,000,000,000,000,000	10^{21}
exa	E	1,000,000,000,000,000,000	10^{18}
peta	P	1,000,000,000,000,000	10^{15}
tera	T	1,000,000,000,000	10^{12}
giga	G	1,000,000,000	10^{9}
mega	M	1,000,000	10^{6}
kilo	k	1,000	10^{3}
hecto	h	100	10^{2}
deca	da	10	10^{1}
no prefix means:		1 [unit]	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro		0.000001	10^{-6}
nano	n	0.000000001	10^{-9}
pico	p	0.000000000001	10^{-12}
femto	f	0.000000000000001	10^{-15}
atto	a	0.000000000000000001	10^{-18}
zepto	z	0.000000000000000000001	10^{-21}
yocto	y	0.000000000000000000000001	10^{-24}