

# THE UNITED STATES AND THE METRIC SYSTEM

## A Capsule History

The United States is now the only industrialized country in the world that does not use the metric system as its predominant system of measurement.

Most Americans think that our involvement with metric measurement is relatively new. In fact, the United States has been increasing its use of metric units for many years, and the pace has accelerated in the past three decades. In the early 1800's, the U.S. Coast and Geodetic Survey (the government's surveying and map-making agency) used meter and kilogram standards brought from France. In 1866, Congress authorized the use of the metric system in this country and supplied each state with a set of standard metric weights and measures.

In 1875, the United States solidified its commitment to the development of the internationally recognized metric system by becoming one of the original seventeen signatory nations to the **Treaty of the Meter**. The signing of this international agreement concluded five years of meetings in which the metric system was reformulated, refining the accuracy of its standards. The Treaty of the Meter, also known as the "Metric Convention," established the *International Bureau of Weights and Measures (BIPM)* in Sèvres, France, to provide standards of measurement for worldwide use.

In 1893, metric standards, developed through international cooperation under the auspices of BIPM, were adopted as the fundamental standards for length and mass in the United States. Our customary measurements -- the foot, pound, quart, etc. -- have been defined in relation to the meter and the kilogram ever since.

The *General Conference of Weights and Measures*, the governing body that has overall responsibility for the metric system, and which is made up of the signatory nations to the Treaty of the Meter, approved an updated version of the metric system in 1960. This modern system is called *Le Système International d'Unités* or the International System of Units, abbreviated SI.

The United Kingdom, began a transition to the metric system in 1965 to more fully mesh its business and trade practices with those of the European Common Market. The conversion of the United Kingdom and the Commonwealth nations to SI created a new sense of urgency regarding the use of metric units in the United States.

In 1968, Congress authorized a three-year study of systems of measurement in the U.S., with particular emphasis on the feasibility of adopting SI. The detailed U.S. Metric Study was conducted by the Department of Commerce. A 45-member advisory panel consulted with and took testimony from hundreds of consumers, business organizations, labor groups, manufacturers, and state and local officials.

The final report of the study, "**A Metric America: A Decision Whose Time Has Come**," concluded that the U.S. would eventually join the rest of the world in the use of the metric system of measurement. The study found that measurement in the United States was already based on metric units in many areas and that it was becoming more so every day. The majority of study participants believed that conversion to the metric system was in the best interests of the Nation, particularly in view of the importance of foreign trade and the increasing influence of technology in American life.

The study recommended that the United States implement a carefully planned transition to predominant use of the metric system over a ten-year period. Congress passed the **Metric Conversion Act of 1975** “to coordinate and plan the increasing use of the metric system in the United States.” The Act, however, did not require a ten-year conversion period. A process of voluntary conversion was initiated, and the U.S. Metric Board was established. The Board was charged with “devising and carrying out a broad program of planning, coordination, and public education, consistent with other national policy and interests, with the aim of implementing the policy set forth in this Act.” The efforts of the Metric Board were largely ignored by the American public, and, in 1981, the Board reported to Congress that it lacked the clear Congressional mandate necessary to bring about national conversion. Due to this apparent ineffectiveness, and in an effort to reduce Federal spending, the Metric Board was disestablished in the fall of 1982.

The Board’s demise increased doubts about the United States’ commitment to metrification. Public and private sector metric transition slowed at the same time that the very reasons for the United States to adopt the metric system -- the increasing competitiveness of other nations and the demands of global marketplaces -- made completing the conversion even more important.

Congress, recognizing the necessity of the United States’ conformance with international standards for trade, included new encouragement for U.S. industrial metrification in the **Omnibus Trade and Competitiveness Act of 1988**. This legislation amended the Metric Conversion Act of 1975 and designates the metric system as the *preferred* system of weights and measures for United States trade and commerce.” The legislation states that the Federal Government has a responsibility to assist industry, especially small business, as it voluntarily converts to the metric system of measurement.

Federal agencies were required by this legislation, with certain exceptions, to use the metric system in their procurement, grants and other business-related activities by the end of 1992. While not mandating metric use in the private sector, the Federal Government has sought to serve as a catalyst in the metric conversion of the country’s trade, industry, and commerce.

The current effort toward national metrification is based on the conclusion that industrial and commercial productivity, mathematics and science education, and the competitiveness of American products and services in world markets, will be enhanced by completing the change to the metric system of units. Failure to complete the change will increasingly handicap the Nation’s industry and economy.

## Questions and Answer

Q. What is the metric system?

A. The metric system is a decimal-based system of measurement units. Units for a given quantity, such as length or mass, are related by factors of 10. Calculations involve the simple process of moving the decimal point to the right or to the left. This modern system is called *Le Système International d'Unités* or the International System of Units, abbreviated SI.

Q. Is the metric system hard to learn and use?

A. No. In everyday usage, the most common metric units are the *meter* (m) to measure length, the *second* (s) to measure time, the *kilogram* (kg) for mass (or weight\*), the *liter* (L) for volume, and the *degree Celsius* (EC) for temperature. The metric system avoids confusing dual-use of terms, such as the inch-pound system’s use of ounces to measure both weight and volume. The metric system also avoids the use of multiple units for the same quantity; for instance, the inch-pound system’s multiple units for volume include teaspoons, tablespoons, fluid ounces, cups, pints, quarts, and gallons.

\*In commercial and everyday use, the term “weight” may be used as a synonym of mass. Weight is actually the force with which a body is attracted toward the earth because of gravity.

- Q. Will “thinking metric” be difficult?
- A. Not really. For example, “thinking metric” for temperature means relating zero degrees Celsius ( $0^{\circ}\text{C}$ ) with the freezing point of water, 20 degrees Celsius ( $20^{\circ}\text{C}$ ) with room temperature, 37 degrees Celsius ( $37^{\circ}\text{C}$ ) with body temperature, and 100 degrees Celsius ( $100^{\circ}\text{C}$ ) with the boiling points of water. One millimeter (1 mm) is about the thickness of a dime, and a centimeter (1 cm) is about the width of a fingernail. Almost everyone easily recognizes one liter (1 L) and two liter (2 L) soda bottles. The contents of that unopened one liter soda bottle “weighs” approximately one kilogram (1 kg).
- Q. Who decided the United States should convert to the metric system?
- A. No one “decided the United States should go metric.” As stated in the amended **Metric Conversion Act**, continued use of “traditional systems of weights and measures” is still permitted “in nonbusiness activities.” However, metric system use has become widespread throughout our economy. Consumers may be surprised at the number of items in everyday use that have been manufactured in metric units for some time. These items are accepted with little difficulty and include photographic equipment, automobiles, computers, pharmaceutical products, wine and distilled spirits, and soft drinks. Also, our scientific and medical communities use metric units almost exclusively.
- Q. Is there a deadline for conversion?
- A. No deadline has been established. Conversion in the private sector, while encouraged, is voluntary. The **Omnibus Trade & Competitiveness Act of 1988** amended the 1975 law to make the metric system the “preferred system of weights and measures for United States trade and commerce” and charged federal agencies with converting their activities to the metric system.
- Q. What is voluntary conversion?
- A. Individuals, groups, and industries decide whether or not to convert and determine conversion timetables according to their own needs.
- Q. Why should the United States convert to the metric system?
- A. Since trade and communication with other nations is critical to the health of our economy, adopting the measurement system used by 95 percent of the world’s population is not a matter of choice, but a matter of necessity for the United States.
- Q. Why didn’t we convert before?
- A. Support for a decimal-based measuring system has existed in the United States since the 1700s. However, there was no compelling reason to switch because of our geographical isolation and because our principal trading partner, England, did not use metric units. In time the United States became a dominant force in world trade and was able to impose its products, manufactured in their unconventional units, on other nations. Times have changed. We no longer overwhelmingly dominate world trade and must recognize the need to “fit” our goods and services into other strong markets, including the European Union, the new markets of Eastern Europe, and the expanding market of the Pacific Rim. These markets continually stress their preference for products and services based on the metric system of measurement.
- Q. What are the advantages of conversion for U.S. industry?
- A. During conversion to the metric system, U.S. companies are able simultaneously to streamline their operations, eliminate inefficiencies, and reduce their inventories. Because products destined for both foreign and domestic markets can be designed and manufactured to the same (metric) specifications, overlapping product lines can be eliminated. The standardization of fasteners, components,

and sub-assemblies increases the efficiency and productivity of all manufacturing processes. When firms convert fully to the metric system, they are often surprised to discover how much the conversion has increased their profits. "Converted" firms frequently report finding new customers for their new metric products and services.

- Q. What are the educational benefits of completing the U.S. transition to the metric system?
- A. A population that is highly skilled in math and science is essential for national economic and social progress. By completing the U.S. transition to the metric system, education and training in these key subjects will become much more efficient. Currently, huge blocks of time are spent learning the cumbersome inch-pound measurements, including learning to manipulate inch-pound fractions and learning to make tedious conversions between metric and inch-pound units. Much of this time can be redirected toward more worthwhile endeavors. Opportunities for numerous additional curriculum improvements will surface when textbooks are revised to reflect the simpler metric system of units. Training at all levels, from elementary school through graduate-level engineering programs, will benefit from this important step forward. A workforce that is truly able to "speak" the metric measurement language will be better able to excel in the global marketplace.

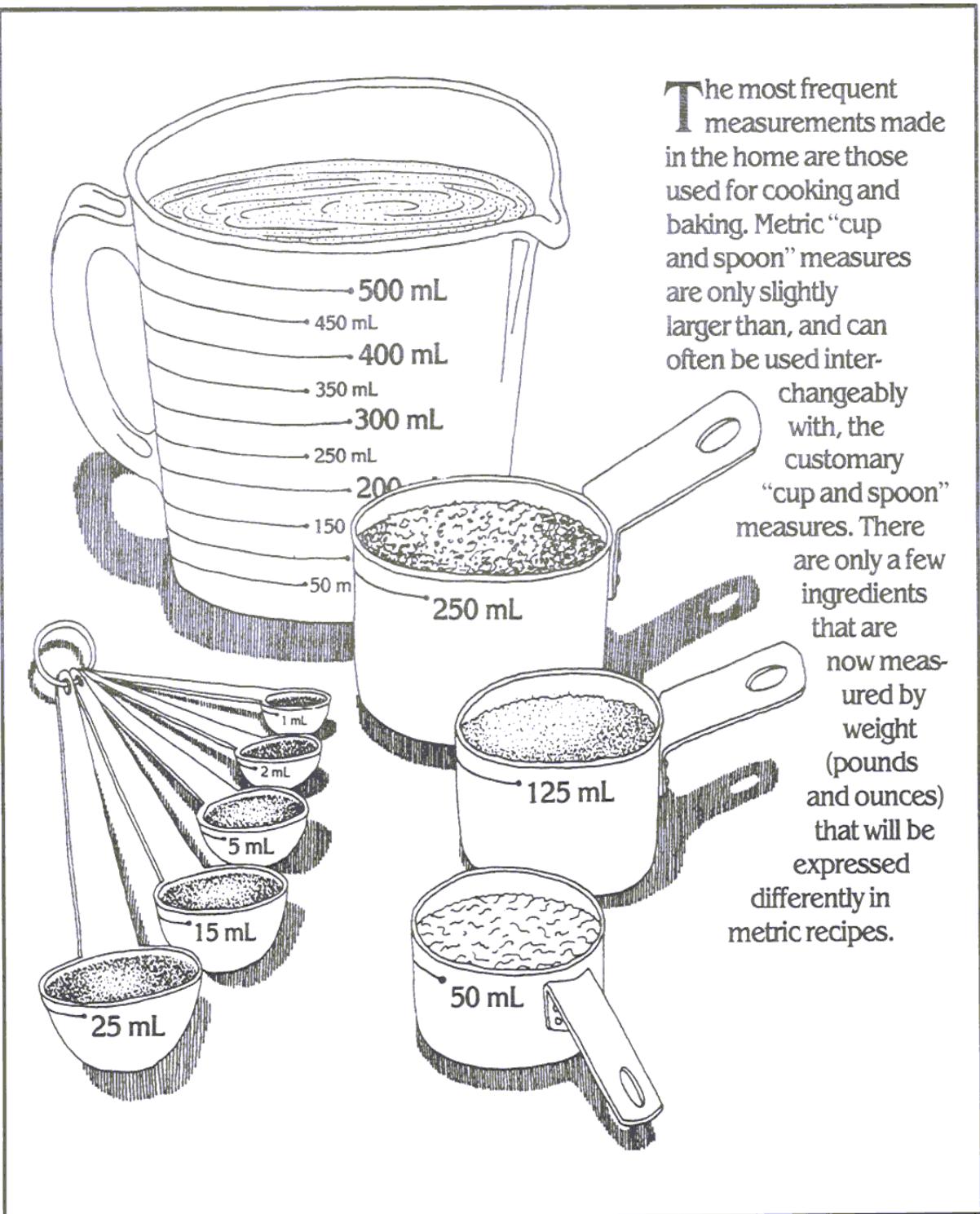
- Q. Will conversion be costly?
- A. Costs will vary in different sectors of the economy. However, in most areas, long term benefits will be realized and should more than offset any one-time conversion costs. Many industries are converting as they develop new products and as older equipment wears out. In this way, conversion costs can be held to a minimum.
- Q. What is government doing about metric conversion?
- A. All of the major Federal agencies have

established plans and internal task forces for managing their change to the metric system as called for by the amended Metric Conversion Act and a 1991 Presidential Executive Order. The General Services Administration has established metric specifications for products that it buys for Federal agencies. The Defense Department uses metric specifications in procurement and in activities involving our allies around the world. Many new NASA projects are being designed and built to metric specifications. Most design and construction of Federal Government buildings and facilities is now being done in metric units. The Commerce Department's Metric Program works with the member agencies of the Interagency Council on Metric Policy to identify and help remove barriers that may stand in the way of metric conversion in federal and state/local rules, standards, codes, and regulations.

The Department of Commerce has started to implement several new outreach initiatives that seek to create greater understanding and a more favorable environment for national metrification by gaining broad-based support from industry and the general public. These initiatives include a series of information and public awareness campaign.

- Q. When should the U.S. transition be completed?
- A. Sooner is better. America remains dependent upon two systems of measurement -- a situation that is uneconomical, inefficient, and confusing. Time is of the essence because our transition to the metric system is not becoming cheaper or easier. Costs and inconvenience will increase dramatically for everyone as society continues to grow larger and more complex. A short-term, nationwide investment in metric conversion will eliminate the costs of using two measurement systems and will provide the long-term return of an efficient single-system metric economy.

# Metric in the Kitchen

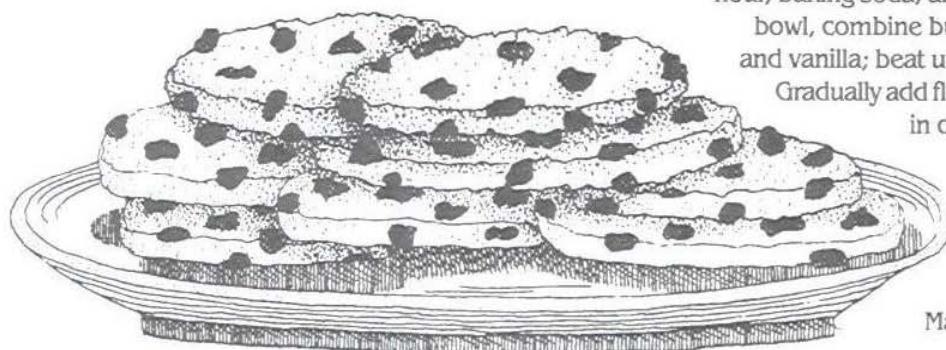


The most frequent measurements made in the home are those used for cooking and baking. Metric "cup and spoon" measures are only slightly larger than, and can often be used interchangeably with, the customary "cup and spoon" measures. There are only a few ingredients that are now measured by weight (pounds and ounces) that will be expressed differently in metric recipes.

# "Metric Chocolate Chip Cookies"

Recipe reprinted from "Living With Metrics" courtesy of Reader's Digest Association, Inc., Pleasantville, New York.

550 mL	unsifted flour
5 mL	baking soda
5 mL	salt
250 mL	butter or margarine, softened
175 mL	granulated sugar
175 mL	firmly packed brown sugar
5 mL	vanilla extract
2	eggs
2	168 gram packages semisweet chocolate chips
250 mL	chopped nuts



Preheat the oven to 190 °C. In small bowl, combine flour, baking soda, and salt; set aside. In large bowl, combine butter, sugar, brown sugar, and vanilla; beat until creamy. Beat in eggs.

Gradually add flour mixture; mix well. Stir in chocolate chips and nuts.

Using 5 mL measure, drop by rounded measures onto ungreased cookie sheet. Bake 8 to 10 minutes. Makes 100 5 cm cookies.

## Liquid and Dry Measure Equivalencies \*

Customary	Metric
1/4 teaspoon	1.25 milliliters
1/2 teaspoon	2.5 milliliters
1 teaspoon	5 milliliters
1 tablespoon	15 milliliters
1 fluid ounce	30 milliliters
1/4 cup	60 milliliters
1/3 cup	80 milliliters
1/2 cup	120 milliliters
1 cup	240 milliliters
1 pint (2 cups)	480 milliliters
1 quart (4 cups, 32 ounces)	960 milliliters (0.96 liters)
1 gallon (4 quarts)	3.84 liters
1 ounce (by weight)	28 grams
1/4 pound (4 ounces)	114 grams
1 pound (16 ounces)	454 grams
2.2 pounds	1 kilogram (1000 grams)

\* approximately

## Oven Temperature Equivalencies

Description	°F	°C
Cool	200	90
Very slow	250	120
Slow	300-325	150-160
Moderately slow	325-350	160-180
Moderate	350-375	180-190
Moderately hot	375-400	190-200
Hot	400-450	200-230
Very hot	450-500	230-260

**METRIC**  
**MEASURES UP**

U.S. DEPARTMENT OF COMMERCE  
TECHNOLOGY ADMINISTRATION



United States Department of Commerce  
Technology Administration  
National Institute of Standards and Technology  
Metric Program, Gaithersburg, MD 20899

## METRIC CONVERSION CARD

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	6.5	square centimeters	cm <sup>2</sup>
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.8	square meters	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.6	square kilometers	km <sup>2</sup>
	acres	0.4	hectares	ha
<b>MASS (weight)</b>				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric ton	t
<b>VOLUME</b>				
tsp	teaspoons	5	milliliters	mL
Tbsp	tablespoons	15	milliliters	mL
in <sup>3</sup>	cubic inches	16	milliliters	mL
fl oz	fluid ounces	30	milliliters	mL
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°F	degrees Fahrenheit	subtract 32, multiply by 5/9	degrees Celsius	°C



# METRIC

## MEASURES UP

Approximate Conversions from Metric Measures

<i>Symbol</i>	<i>When You Know</i>	<i>Multiply by</i>	<i>To Find</i>	<i>Symbol</i>
<b>LENGTH</b>				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
<b>AREA</b>				
cm <sup>2</sup>	square centimeters	0.16	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	1.2	square yards	yd <sup>2</sup>
km <sup>2</sup>	square kilometers	0.4	square miles	mi <sup>2</sup>
ha	hectares (10,000 m <sup>2</sup> )	2.5	acres	
<b>MASS (weight)</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton (1,000 kg)	1.1	short tons	
<b>VOLUME</b>				
mL	milliliters	0.03	fluid ounces	fl oz
mL	milliliters	0.06	cubic inches	in <sup>3</sup>
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m <sup>3</sup>	cubic meters	35	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.3	cubic yards	yd <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°C	degrees Celsius	multiply by 9/5, add 32	degrees Fahrenheit	°F
				
•C	-40      -20      0      20      37      60      80      100			
•F	-40      0      32      80      98.6      160      200      212			
	water freezes	body temperature	water boils	

# All You Will Need to Know About Metric (For Your Everyday Life)

# 10

## Metric is based on the Decimal system

The metric system is simple to learn. For use in your everyday life you will need to know only ten units. You will also need to get used to a few new temperatures. Of course, there are other units which most persons will not need to learn. There are even some metric units with which you are already familiar; those for time and electricity are the same as you use now.

### BASIC UNITS

**METER:** a little longer than a yard (about 1.1 yards)

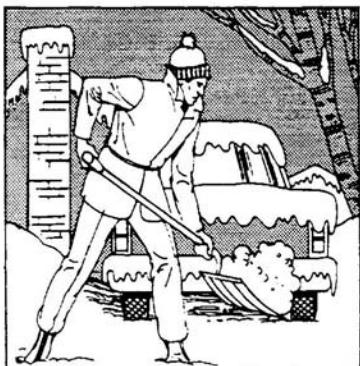
**LITER:** a little larger than a quart (about 1.06 quarts)

**GRAM:** a little more than the weight of a paper clip

(comparative sizes are shown)

1 METER

1 YARD



25 DEGREES FAHRENHEIT

### COMMON PREFIXES

(to be used with basic units)

**milli:** one-thousandth (0.001)

**centi:** one-hundredth (0.01)

**kilo:** one-thousand times (1000)

#### For example

1000 millimeters = 1 meter

100 centimeters = 1 meter

1000 meters = 1 kilometer

1 LITER



1 QUART

### OTHER COMMONLY USED UNITS

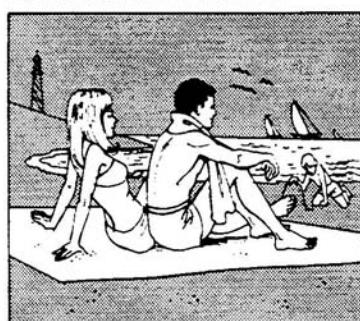
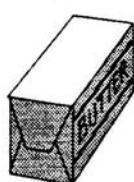
**millimeter:** 0.001 meter diameter of a paper clip wire

**centimeter:** 0.01 meter a little more than the width of a paper clip (about 0.4 inch)

**kilometer:** 1000 meters somewhat further than 1/2 mile (about 0.6 mile)

**kilogram:** 1000 grams a little more than 2 pounds (about 2.2 pounds)

**milliliter:** 0.001 liter five of them make a teaspoon



25 DEGREES CELSIUS

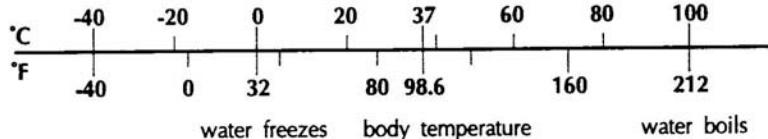
### WEATHER UNITS:

FOR TEMPERATURE  
degrees celsius

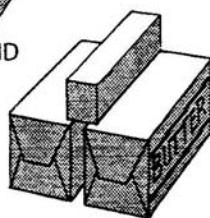
### FOR PRESSURE

kilopascals are used

100 kilopascals = 29.5 inches of Hg (14.5 psi)



1 POUND



1 KILOGRAM

**For More Information Contact:**

Office of Weights and  
Measures/Metric Program  
National Institute of Standards and  
Technology  
100 Bureau Drive, Stop 2000  
Gaithersburg, MD 20899-2000

Phone:(301) 975-3690  
FAX: (301-948-1416  
Email: [metric\\_prg@nist.gov](mailto:metric_prg@nist.gov)  
URL: <http://www.nist.gov/metric>

NIST LC1136  
October 1997  
[Contact info.](#)  
Revised 5/2002