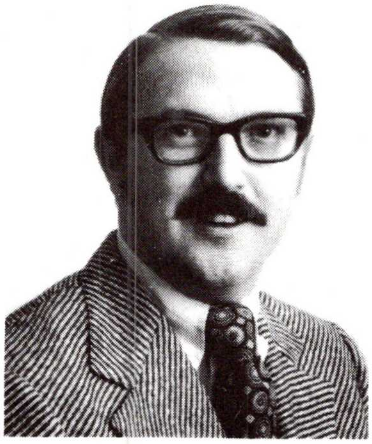
28 g of Prevention is Worth 0.454 kg of Cure



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In January, 1970, Ottawa published the White Paper on Metric Conversion in Canada. Most people are aware of the conversion, but not that Canada is in its sixth year of metric conversion. It is usually the fifth, sixth or even the seventh year before the general public becomes consciously aware of a country converting to the metric system.

The Metric Commission of Canada (S.M. Gossage, chairman) is the official arm of the government for metric conversion. Metric conversion has already begun in the following areas -

- the pharmaceutical industry is almost completely metric; for example, toothpaste is available in 25, 50, 75, 100, and 150 ml tubes,

- approximately 75 percent of all Canadian hospitals use metric measurements in their internal procedures,

- highways signs (especially in Ontario) state distances in kilometres and speed limits in kilometres per hour (expected to be complete by 1979),

- the metric system of measurement is being presented in a large number of schools across Canada and will eventually be taught in all Canadian schools,

- public weather forecasts and temperatures are given in degrees Celsius,

- in intervals, rainfall amounts are given in millimetres and snowfall in metres,

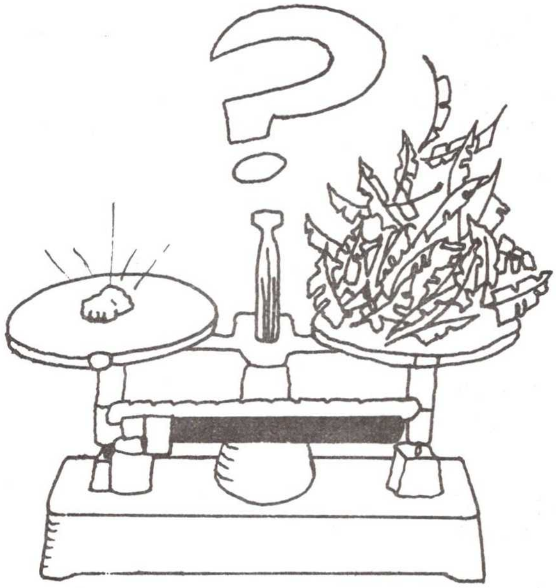
- The Canadian Grains Council has set a target date of August, 1976 for all shipments from seaboard to be in tonnes (metric ton/1 000 kg).

The metric conversion momentum should peak in 1976-78.

Canada is not inching its way down the road to metric conversion to be an isolationist. In fact, so much of the world is already committed to the metric system that it is possible to list all the countries in the world that are NOT: Barbados, Burma, Gambia, Ghana, Jamaica, Liberia, Muscat and Oman, Naura, Tonga, Sierra Leone, Southern Yemen, Trinidad, and the United States. Of these, the U.S., Jamaica, Trinidad, and the Barbados will not likely be far behind.

At this point you should use a piece of paper to cover up the rest of this page. Now uncover each line of print one at a time. I am about to ask you a question you probably have heard before, but may have thought that it was a trick question. It is a question that people from metric countries love to ask people who still use the English (or common, or British, or imperial) system of measurement.

Question Which weighs more, a pound of gold or a pound of feathers? (No peeking at the answer!)



Answer Feathers!

Feathers are weighed using the avoirdupois pound which contains 7000 grains. Gold is weighed using the troy pound which contains only 5760 of those same grains.

Question Which weighs more, an ounce of gold or an ounce of feathers?

Answer Gold!

There are 12 ounces in the troy pound, so each ounce weighs 480 grains. There are 16 ounces in the avoirdupois pound, so each ounce weighs only 437.5 grains.

Discussion could continue about the two different units called the "foot," used today in North America, or the seventeen different tons, but let's turn our attention to the variety of units in the English system of measurement. (Continue to uncover the lines of print one at a time. Also, you will need a pen or pencil.)

Final Exam

This test is called a final exam since I hope it is the last test you will ever give or take over the English units of measurement.

1. How many cubic inches are there in a gallon? ______________________
2. What is the difference between a liquid quart and a dry quart? __________ ("One is wet and one is dry" is not acceptable.)
3. How many square feet are in an acre? ______________
4. A common aspirin tablet is 5 grains. How many scruples does that represent? ______________
5. How many pennyweight are there in a troy ounce? ______________
6. How many firkins are there in a hogshead? ______________

Answers to the Odd Numbered Questions

1. About 277
3. About 43 560
5. About 20

After the results of the tests are compiled it will be time to turn our attention to a very close look at some of the units of the English system. If one wants to find out what a particular word means, he goes to the dictionary. I wanted to know what a "quart" was, so I looked in the dictionary.

Definition - Quart (pronounced kŵort) is a liquid and also a dry measure of capacity equal to one-fourth of a gallon or one-eighth of a peck, respectively (of varying content in different systems, places and times).

Now *there* is a definition that nails it right down. Everyone knows what a quart is now! The definition of a "quart" didn't slow me down though. I next looked up the definition of a "foot."

Definition - Foot (pronounced fo͝ot) is a unit of length derived from the length of the human foot. In English-speaking countries it is divided into 12 inches and equal to 30.48 cm.

Let's look at the above definition. First, I assume that the human foot the unit is derived from was the king's foot, since he was the "ruler." Secondly in North America units of length have been defined in terms of metric units for almost a century. But, for now, leave off the metric part of the definition and what we have is that the "foot" is derived from the length of the human foot and divided into 12 inches. In the same dictionary I found the following definition of an "inch."

Definition - Inch (pronounced ĭnch) is a unit of length, 1/12 of a foot, equivalent to 2.54 cm.

What really happens in class? You don't define a foot or an inch, you let your class measure objects, using the units and point out that one foot is the same length as 12 inches. The same is true in the metric system. You don't have to worry about *defining* metric units, just *using* them. Make sure your class gets ample opportunity to use the metre, don't worry about defining it.

The metric system which we will use in Canada is called the International System of Units (Système International d'Unités) (SI). The "metre" was originally defined as one ten millionth of the distance from the north pole to the equator passing along a specified meridian. As the north pole shifts position, the length of the metre changes. SI revised most of the definitions of metric units so that the unit would never change and the unit could be replicated in any scientific laboratory in the world. Following is the scientific definition of "metre."

Definition - Metre (pronounced mē′tər) is 1 650 763.73 wave lengths in vacuum of the orange-red line of the spectrum of krypton 86.

That is quite a definition!! Again, remember, you never have to use the above definition. All you have to do is feel warm all over knowing that SI has fixed up the old definitions in such a way that they are standard throughout the world.

O.K., now let's go metric.

There are basically three levels of going metric. The first level, denoted L_0, is when a country is strictly English in its measuring. All packages are labelled in English units. Canada has not been at this level for almost a century.

The second level, denoted $L_{½}$, is when a country is using the metric equivalents to the English units. Canada is in $L_{½}$. Many packages are now labelled in metric units but are exactly the same size as they always were. For example, cereal comes in 453.6 g boxes. You think the packagers count out the flakes until they get that extra 0.6 g? Or could it be by coincidence that 453.6 g is the metric equivalent of one pound? There are salad dressing bottles that say they have a capacity of 227.3 ml. A litre is smaller than a quart, a millilitre (ml) is 0.001 of a litre. The companies are simply converting mathematically from the English unit to the metric unit without changing the size of the package. The third level, denoted L_T, is when a country uses both metric sizes and labels. This is the level for which Canada is striving. Some items are already at L_T: toothpaste (mentioned earlier), wine bottles are seen in 500 ml, 1 ℓ(litre) and 1.5 ℓ sizes, medicine has come in packages labelled in cubic centimetres for a long time. Cereal will probably come in 200 g and 400 g packages.

A lot of confusion goes along with the trip from $L_{\frac{1}{2}}$ to L_T. The speed limit in front of schools will be 32 km/h. (A speed of 32 km/h just happens to be the equivalent of 20 mph when applying English unit thinking to the metric system--which is $L_{\frac{1}{2}}$.) Just as we don't have speed limits of 32 mph we won't have speed limits of 32 km/h; it will probably be 30 km/h in front of our schools.

But what *will* it be like in metric Canada? Following is a story about what a typical day in the life of a school teacher will be like in metric Canada:

> Get up at 06.30 (this is no different - how many of you get up at 6:30 a.m. and say, "Oooh, 6:30!"), have 200 ml of coffee, two 20 g slices of bacon, and one 40 g egg for breakfast.
>
> The radio announcer says it is already 20°C so you know you won't need a coat. You hop into your car and you're off to school. You make the 10 km drive in 20 minutes since you had to creep along at 30 km/h in the heavy traffic.
>
> Classes start at 09:00. You spend your day helping others inch their way down the road to metric conversion.
>
> At 15:00 you go home to start grading the 2 kg of papers you have to grade. First, you slip out of your petite size 38 dress and slip into your slim, size 61 pants and comfortable size 40 shoes. (For the men, you might wear size 85 slacks, size 45 shoe, size 23 socks, and size 70 hat. For comparison's sake, the "petite" size 38 dress is a size 10 by our current standards.)
>
> The temperature has risen to 28°C so you have a drink out on the patio before starting to work.

Now prepare yourself for a very short course on the metric system of measurement. We will hold our discussion to seven areas of measurement: length, area, volume, capacity, mass, temperature, and time.

LENGTH - In the SI, certain units are singled out for special attention and are called *SI preferred units*. The SI preferred units are: the base units; 1 000 times the base units; 0.001 times the base units. The base unit for length is the metre. One thousand times the metre is the kilometre and 0.001 times the metre is the millimetre. Following is a list of the different prefixes.

<u>Metric Prefixes</u> (*SI preferred units)

*kilo	unit times 1 000
hecto	unit times 100
deca	unit times 10
*----	unit times 1
deci	unit times 0.1
centi	unit times 0.01
*milli	unit times 0.001

kilogram	(kg)	means 1 000 grams
kilometre	(km)	means 1 000 metres
kilolitre	(kl)	means 1 000 litres

milligram (mg) means 0.001 g
millimetre (mm) means 0.001 m
millilitre (ml) means 0.001 ℓ

In everyday practice there is one exception to the SI preferred unit rule--the centimetre. Since the millimetre is such a short unit of length (a dime is about a millimetre thick), the centimetre is also used very frequently. The mile, yard, foot, inch, will be replaced by the metre, kilometre, centimetre and, more rarely in everyday usage, the millimetre.

Some examples are -

I am about 177 cm tall.
It is about 300 km from Edmonton to Calgary.
She ran the 100 m dash in 11.3 seconds.
The tubing was 2.5 mm in diameter.

AREA - As in the English system, area is a direct derivative of length. We measure length in feet, inches, yards, etc. and area in square feet, square inches, square yards etc. We will soon measure area in square centimetres (or centimetre squares), square metres (or metre squares), etc. The symbol is a bit different, cm^2 is the symbol for square centimetres and m^2, mm^2 respectively for square metres and square millimetres. When one gets to very large areas, such as acres, the unit used is the hectare (ha) which is equivalent to 10 000 m^2.

Some examples are -

The room had an area of 12 m^2.
The farm has an area of 8 ha.
The postcard's area was 96 cm^2.
The microdot's area was only 2 mm^2.

VOLUME - For volume we simply use one more dimension. Technically speaking, volume is the amount of space filled by an object. It is becoming quite common to use the units of volume to measure dry capacity and the units of capacity for liquid measurement. The commonly used units of volume are cubic centimetres (or centimetre cubes), metre cubes, or millimetre cubes. The symbols should be no surprise: cm^3, m^3, mm^3.

Some examples are -

The adult dosage is 30 cm^3.
The truck can only carry 2 m^3 of dirt.
There are one billion (1 000 000 000) mm^3 in 1 m^3.

CAPACITY - Capacity is the measurement of how much something will hold. Practically speaking, as mentioned above, the units of capacity are used to measure liquid quantities. In the metric system the distinction between volume and capacity and the units to use is less important since a container with an inside volume of 1 cm^3 will hold 1 ml of water. The present units of gallon, quart, pint, cup, tablespoon, and teaspoon will all be replaced with the litre and its division, the millilitre--just two units, the second being derived from the first. The other preferred unit is the kilolitre which, of course, is 1 000 ℓ and not used in everyday practice.

If a container with an inside volume of 1 cm^3 will hold 1 ml of water, then a container with an inside volume of 1 dm^3 (1 dm=10 cm so 1 dm^3=1 000 cm^3) will hold 1 000 ml of water, or 1 ℓ. So the litre is derived from volume units.

Some examples are -

The baby's formula calls for 100 ml of water.
The wine bottle holds 1.5 ℓ
The swimming pool has 1.7 kl of water in it.

MASS - A lot of confusion has been generated by this area of measurement for reasons that should not be of too much concern in everyday life.

Yes, mass and weight are different! The most common example is the moon story. If you weigh 120 pounds on earth, then you will weigh about 20 pounds on the moon and 0 pounds in a vacuum. If you have a mass of about 50 kg on the earth, then you have a mass of about 50 kg on the moon and in a vacuum.

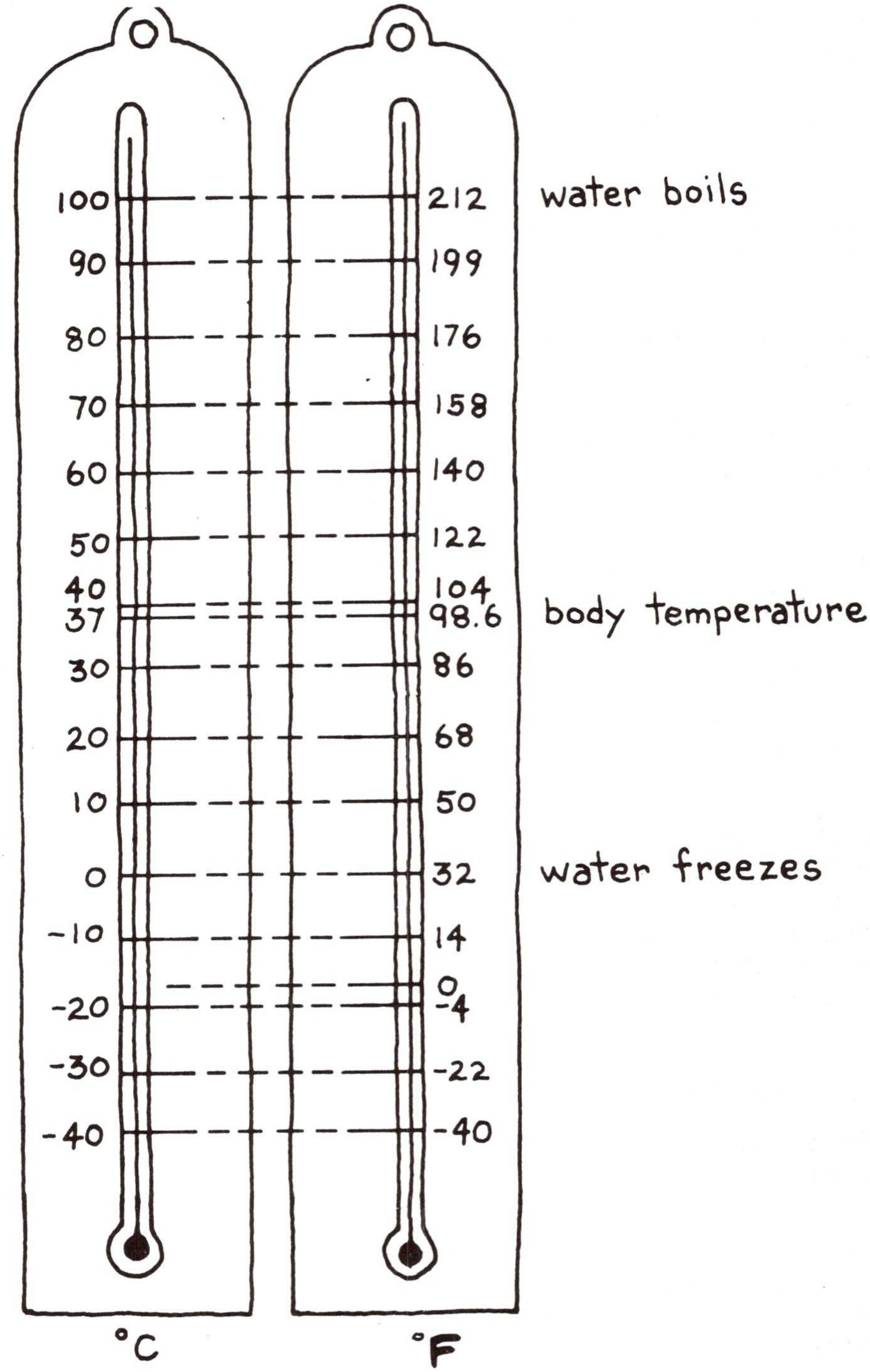
In the metric system the units of <u>mass</u> are being used when you use the gram, kilogram (the only two used in everyday life). If you want to say that you "weigh" 50 kg, then go ahead. The world will not crumble beneath your feet. To be correct you should say that you have a mass of 50 kg. The U.S. National Bureau of Standards has ruled that one may use the words "weight" and "mass" synonymously. While you are on the face of the earth, mass and weight are the same for all practical purposes.

Some examples are -

The standard paper clip has a mass of 1 gram.
My mass is about 77 kilograms.

TEMPERATURE - This is the most troublesome area of metric measurement during the period of conversion. There is no physical model for the degree Celsius (^0C) and it is in the area of weather forecasts that the public is generally shocked into the awareness that we are going metric.

The Celsius scale and the centigrade scale are the same. In parts of Europe the centigrade is the name of a unit used for an angular measurement, so another name was needed and the SI chose Celsius, after Anders Celsius who developed the centigrade scale. It is *much* simpler than the old Fahrenheit scale. Water boils at 100^0C and freezes at 0^0C, two very easy numbers to remember. Normal body temperature is 37^0C instead of 98.6^0F. Normal room temperature is about 20^0C.



TIME - The change that will occur in writing hours and minutes has nothing to do with the metric system of measurement. It was decided that, since so much change would be taking place, why not bring Canada in line with most of the rest of the world and introduce the universal clock. Following are some examples in both the sun clock notation and the universal clock notation.

Time

Sun Clock	Universal Clock
12:30 a.m.	00:30
1:15 a.m.	01:15
10:45 a.m.	10:45
1:05 p.m.	13:05
4:00 p.m.	16:00
8:30 p.m.	20:30
12:00 p.m.	00:00

The final section of this article must be addressed to the problem of notation --- actually writing numerals and results of measurements in the metric system. There has been (and will continue to be, for a short while) some confusion about the proper symbols and notational devices in the metric system. So many people have tried to jump the gun and use any symbols they want. So many people have again applied English system thinking to the metric system and used abbreviations when they shouldn't. My favorite example was on the front of a truck which stated that it could carry 4 000 KG and on the back of the truck it read that it could carry 4 000 Kg. Neither KG nor Kg is the proper symbol for kilogram.

There is one very simple rule to remember - symbols are just that -- symbols, *not* abbreviations! In the English system we use abbreviations, in the metric system we use symbols. The use of symbols means that there are *NO* periods, *NO* plurals, and *NO* capital letters, unless the symbol is a capital letter such as C for Celsius. Some of the many incorrect ways of symbolizing eight centimetres and the one correct way are -

Correct	Incorrect
8 cm	8 cms
	8 cms.
	8 Cm
	8 Cm.
	8 Cms.
	8 cm.

A hint for remembering the proper symbol is that it is always (would you believe *almost* always) the first letter in the prefix and the first letter in the root word.

Several examples are -

Metric Symbols

millimetre	mm
centimetre	cm
metre	m
kilometre	km
gram	g
kilogram	kg

millilitre ml
litre 1 or ℓ*
degree Celsius °C**

Some of you may have already noticed in some of the new textbooks that even the numerals are written differently. As with the change in writing the time of day, the change in writing numerals has nothing to do with the metric system except as it is part of the scheme to have everyone in the world write the numerals the same way. Eventually the numerals in all textbooks will be written in the following manner - *Example* Old way: 1,230,456. New way: 1 230 456.

If a numeral has 5 or more digits, there is a space (NOT a comma) to set off each group of three digits starting from the decimal point.

The following change I have not seen in textbooks yet, but I do know it will occur very soon. Any decimal fraction between 1 and -1 will have a zero (0) to the left of the decimal point. *Example* Old way: .604. New way: 0.604.

Some of the changes that have been mentioned probably seem very strange to you, especially notation, but remember -- the changes are being made so that we will be in line with the rest of the world. In a few years when all the benefits of the metric system start becoming very evident to the general public, people will wonder why we waited so long to go metric.

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*The script (or cursive) ℓ is used when the printed 1 might cause confusion. For example, does 141 1 mean 1411 or 141 litres? To avoid the confusion you should write it 141 ℓ.

**The symbol for degrees Celsius, °C, is the exception to the rule that the symbol is the first letter in the prefix and the first letter in the root word (in everyday units).