

Metrication in a day

The fastest, simplest, and cheapest metrication process that I ever had anything to do with, or even heard about, occurred when about 200 plumbers and their assistants completed their whole metrication process in a single day.

How was this achieved?

This successful metric transition was achieved with 10 carefully planned steps:

- 1 All the plumbers and their managers from one company were invited to a public hall for a '*Metric information and training day*'. Prior to this day, they were informed that their company had decided to '*Go metric*' along with all the other trades in the building industry.
- 2 Their invitation included a request to bring along all their company-owned rulers and tapes as they would be doing some practical measuring exercises during the day.
- 3 At the registration desk, the old rulers and tapes were exchanged for brand new high quality rulers and tapes marked in millimetres only. The plumbers were also given a booklet summarising the day's activities and a simple, robust calculator.
- 4 The plumbers then attended a relatively short presentation by a professional speaker who outlined the reasons why the company (and their industry, and the nation) had decided to '*Go metric*'. Part of this presentation was training in how to '***Learn the metric system in a minute***' (see below).
- 5 After the first presentation, the plumbers were directed to a courtyard for morning tea.
- 6 Before tea or coffee was served in labelled 250 mL robust mugs to take back to the job, their old feet-and-inches tapes and rulers were ceremoniously wheeled, in labelled 200 litre drums, into the centre of the courtyard. Flame accelerant was poured on to them and the old rulers and tapes were burned to total destruction. This dramatic demonstration made it absolutely clear that the object of the day's training was to change completely to metric system units and to do it now.
- 7 The next session, back in the hall, included a practical session about human body measurements, useful in on-the-job estimations that plumbers do every day. Using millimetres only, they measured fingernail widths, finger widths and lengths, hand widths, hand spans, cubits (elbow to finger tip), arm lengths, and they happily discussed some others that we need not mention here. Facilities were also provided to measure their height in metres and their body mass in kilograms and from these to calculate their body mass index. This session was not hurried, as time was needed to absorb information to change mindsets.
- 8 Back outside, after a barbecue lunch, the next session was planned to make larger length and mass estimations. For this they measured (again in millimetres only) their foot lengths and the length of their normal pace, before they used pre-marked lengths of 5 metres (5 000 mm), 10 metres, 20 metres, and 50 metres to establish a stretched pace of 1000 millimetres (= 1 metre).
- 9 The next formal presentation in the hall focussed on water with concepts such as:
 - 1 litre of water has a mass of 1 kilogram.
 - 1 cubic metre of water has a mass of 1 tonne.
 - 1 millimetre of rain on 1 square metre of roof will add 1 litre of water to a rainwater tank.
 - 1 millimetre of rain on 1 hectare of land will provide 10 000 litres of water to soils or dams.
- 10 For the final session, several stations had been set up in a room adjacent to the hall. Here the plumbers were asked for '*your best guess*'. Estimates, in millimetres, were made of normal structures such as tables, chairs, doors, and windows using their fingers, hands, arms and feet. Helpers, people who had received pre-training in both the procedures to be followed at this session and the principles behind the chosen processes, were available to answer the plumbers' questions. Again this was a leisurely session with plenty of time for discussion.

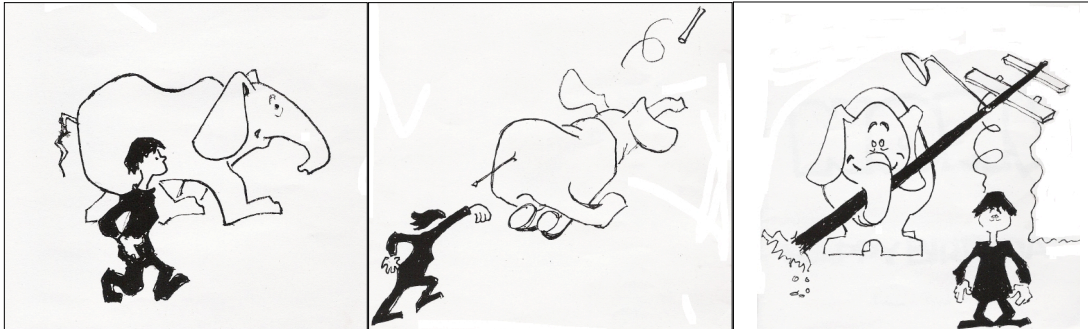
Why did "**Metrication in a day**" work so well?

This program used the well-established experience of metrication transitions elsewhere where:

The optimum change is a quick change.

The program was also based on the simplicity of the **KISS** principle:

Keep It Simply Structured.



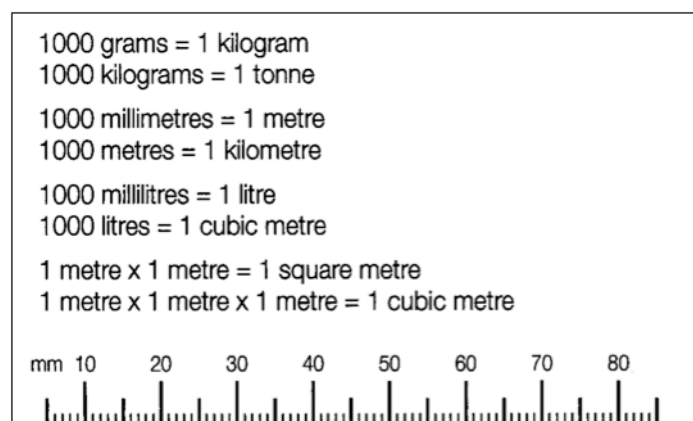
This metrication plan had a number of features that ensured its success:

- ◇ It was based on dramatically and immediately stopping the use of old pre-metric measures, and the immediate use of metric-only practices. It also immediately prevented the metric conversion available with dual scaled rulers and tapes. There was no going back. Burning the old pre-metric rulers and tapes made it clear to all the plumbers that company management was unequivocally committed to the metrication process and was prepared to spend money to achieve this goal.
- ◇ The plumbers were introduced to the metrication policy of all of the building trades in Australia. The Australian Building and Construction Advisory Committee effectively banished centimetres from the building trades in Australia, with the result that metric conversion in these trades was smooth, rapid, complete, and above all — **FAST**. They made it clear that the centimetre should not be used. The Australian Building and Construction Advisory Committee policy was:

The metric units for linear measurement in building and construction will be the metre (m) and the millimetre (mm), with the kilometre (km) being used where required. This will apply to all sectors of the industry, and the centimetre (cm) shall not be used. ... the centimetre should not be used in any calculation and it should never be written down. (Standards Association of Australia "Metric Handbook, Metric Conversion in Building and Construction" 1972)

- ◇ The simplicity of the metric system was demonstrated using industry standard millimetre rulers and tapes, kilogram scales and degree Celsius thermometers to make real measurements and to enter results on to worksheets. The process recognised that resistance to metric change is often fear of the unknown; it countered this by making the metric system known through practical hands-on activities. Here is a description of some of the stations that had been set up around the hall and the types of measurements:
 - a Some stations were for measuring short lengths in millimetres, with a range of plumbing tools, books, pencils etc.
 - b Various pieces of A-series papers from A4 to A1 showing the standard paper sizes used for building designs. These were all marked and measured in millimetres. Lengths, widths, and length to width ratios were calculated with the plumber's new calculators and then recorded (A- series papers are all = 1.414 mm/mm).
 - c Some stations were for measuring longer lengths using folding 1000 mm rulers. These had instructions for guessing the heights and widths of doors and windows.

- d Using tapes the lengths and widths of the floor of the hall with a view to calculating the roof area in square metres to quote for work such as alterations, repairs, and replacements; and for calculating the possible capture of rainfall in tanks given various rainfall events in millimetres. A square metre (internal) made from plumbing pipe was provided with the question: "How many plumbers can stand on one square metre?" This proved very popular (but there was a tendency to choose (relatively rare) thin plumbers!)
- e Some stations were for measuring small amounts of mass. There were kitchen scales for measuring grocery items such as sugar and flour, various fruits and vegetables, and more plumbing tools. These were measured in grams.
- f Some stations were for measuring larger amounts of mass. There were bathroom scales that went to 150 kilograms and workshop scales up to 500 kilograms. Safe lifting posters using kilograms were also displayed.
- g Some stations were for measuring volume. There were graduated metric measuring cylinders, calibrated jugs and cups, teaspoons and tablespoons, and a variety of unmarked flasks and containers filled with various amounts of free-pouring dry sand or water. These were measured in millilitres.
- h One station was for measuring temperatures from below freezing in a deep freeze, to drinking water from a refrigerator, to cold and hot water from sink tap outlets, to boiling water. These were measured with thermometers in degrees Celsius only.
- i Some stations had a range of building plans, on A-series papers, showing various plumbing designs; these included designs for a single toilet, house plans, and multi-level buildings with all dimensions in millimetres. The plumbers had to estimate some of the plumbing materials needed for each job.
- j They calculated the volume of a circular rainwater tank in cubic metres and litres using the π button on their new calculators. This station feature posters showing the formula "diameter squared by $\pi/4$ " and an approximation to use when you haven't got a calculator "diameter squared by 0.8 ($\pi/4 = 0.785$)".
- k The metric system was made personal by measuring their own body dimensions as a basis for making good on-the-job estimations.
- l The process did not in any way use any thought of a metric conversion as these have been shown not to work for a metrication upgrade. The message was loud and clear — old to new conversions (and worse from new to old) were simply not needed on any job in the building construction industry. It followed that metric conversions did not need to be considered or discussed any further and any such discussion was actively discouraged on the day.
- m All the company plumbers were involved. There was no chance that any individual could be isolated outside the metrication process, or for a metric elite to develop within the company. Special arrangements were made for training the three plumbers who could not attend on the day.
- n A clear and definite decision was made to use millimetres for all length measurements? There was no dithering. This not only can lead to long-term disputes and confusion, it also dramatically slows the whole metrication process. The units chosen were on the back of a business card like this:



- o Using only millimetres (and only very occasionally metres) means that common or vulgar fractions or decimal fractions with their sliding decimal points are not required. Also, many people have observed that if people are given two choices during a metrication program, dithering will occur — some will plump for one of the choices and others will settle on the other — and long-lasting disputes will develop. The psychologists, Chip and Dan Heath refer to this dithering as "*decision paralysis*".
- p No attempt was made to completely describe the metric system — the program only covered what was necessary for the everyday needs of working plumbers and their assistants.
- q The program was complete. There was no thought of learning about temperature this week, volume next week, and length the week after that. The interrelationships within the metric system, such as a litre of water has a mass of a kilogram and a millimetre of rain on a square metre of roof would put a litre of water into a rainwater tank, were clear to all of the plumbers. This helped to portray the decimal metric system as a whole considered and planned system rather than being disjointed like the old measuring methods. All irrelevant knowledge such as the history and politics of the metric system was simply left out of this program.

Note: In later interviews the plumbers reported that they '*changed their mind to metric*' on that day and then consolidated their metric knowledge on the job over the next two weeks. Surveys of participants a month later showed that they, personally, saw their metric transition as complete by then. The plumbers and their unqualified labourers were comfortably using millimetres for all of their work. They reported that critical factors in their success were using only millimetres so they didn't have to mix measurements or to use any fractions or decimals at all. They particularly liked avoiding the confusion that comes from using centimetres and from "*slithering decimal points all around the place*".

Metrication in a minute

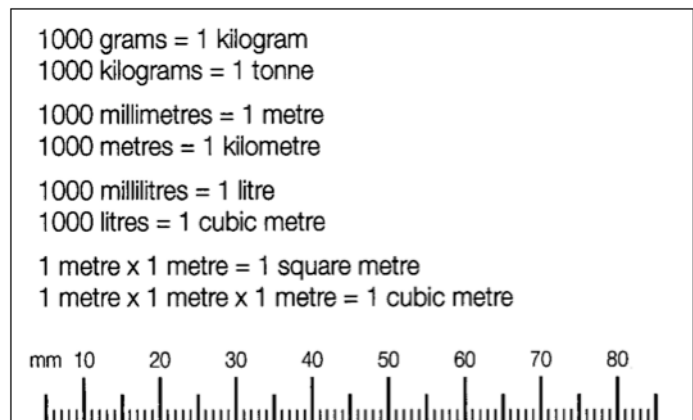
Hi, my name is Pat Naughtin and I am confident that you can learn enough about the metric system — in less than a minute — to design and build a house or a multi-storey office block, bake a cake, or set out a new garden. This may sound impossible, but I know from extensive experience that you can do this if you follow these steps:

- 1 Look at the front of my business card. Notice that I am a qualified and experienced metrication specialist who has helped thousands of people to learn enough of the metric system for almost all practical activities in *their* lives. I tell you this, not to brag, but to assure you that thousands of people have done this exercise before you.



Now look at the back of the business card.

- 2 Find how many millimetres are there in a metre?
- 3 Repeat aloud: 'There are 1000 millimetres in a metre'.
- 4 Find metres and kilometres, and repeat aloud: 'There are 1000 metres in a kilometre'.
- 5 Next find grams, kilograms, and tonnes, and remember that: 'There are 1000 grams in a kilogram' and 'There are 1000 kilograms in a tonne (t)'.



- 6 See that: 'There are 1000 millilitres (mL) in a litre (L)' and 'There are 1000 litres in a cubic metre (m³)'.
- 7 Finally, note that 'a square metre is 1 metre by 1 metre' and that 'a cubic metre is 1 metre by 1 metre by 1 metre'.

When you are satisfied with steps 2 to 7, fold or cover this page so that you can't see the business card, and complete this test:

Metric system assessment test

- 1 How many grams are there in a kilogram? — — — —
- 2 How many millilitres are there in a litre? — — — —
- 3 How many kilograms are there in a tonne? — — — —
- 4 How many millimetres are there in a metre? — — — —
- 5 How many metres are there in a kilometre? — — — —
- 6 How many litres are there in a cubic metre? — — — —

That's it — Congratulations! I know you got all 1000 answers right!

Questions and answers about 'Learn the metric system in a minute'

When I successfully demonstrate this method to '*Learn the metric system in a minute*' to live audiences, they realise how fast a metrication upgrade can be. Some then ask questions such as:

Why does "*Metrication in a minute*" work?

'*Learn the metric system in a minute*' works because it includes several benefits. They are:

- ◇ It does not use centilitres, centimetres, or centigrams. These — especially centimetres — have been shown to slow any metrication upgrade dramatically. It only includes the metric measuring units that people use every day (whether they know it or not; measurements are often not obvious).
- ◇ For more than 95 % of daily measuring, people only use the 11 units on the business card. I have included a summary of the complete metric system and the list of prefixes as appendices, but it is most unlikely that the plumbers, or you, will ever need to refer to these lists.

By the way, only 29 decimal metric units and 20 prefixes describe the whole of the metric system. These all have fixed and definite meanings based on an international law called the "Treaty of the metre". The metric system units can be combined with the 20 prefixes that can then be used to measure anything in the entire Universe from sub-atomic particles to super Galaxies. These 29 decimal metric system units, with the 20 prefixes, completely replace the many millions of old pre-metric measuring words available with all of their various meanings; see <http://en.wikipedia.org/wiki/Mile> where the old pre-metric measuring word, mile, can be seen to vary from about 1 kilometre to about 15 kilometres!

- ◇ The choice of metric prefixes on the business card means that all measurements and calculations can be done in whole numbers with simple calculators.
- ◇ With whole numbers there is no reason to use decimal fractions or to move decimal points. Let the prefix do the work!
- ◇ There are no common or vulgar fractions, as they are not needed.
- ◇ There are no conversions. No conversions from old words to metric units; no conversions from metric units to old words (anti-metric conversion); and no conversions within the metric system such as from decimetres to centimetres.

Why do you cut down the metric system to this really small size?

Because the direct practical experience of millions of people in the world every day is that they only choose to use a small number of metric units. The 11 units on the back of my business card probably cover more than 95 % of all the measuring done in the world each day. The decimal metric system is able to measure anything in the Universe from the smallest thing to the size of the Universe itself but for most people only 11 units is enough for most things. You don't need to use all 7 of the metric system base units and the 22 derived units every day. Only specialists will use 1000 joules = 1 kilojoule and 1000 kilojoules = 1 megajoule on a daily basis.

Can I do all the things that I want to do in my life with just these few units?

Almost! You will find that using units from outside these 11 decimal metric system units is quite rare. However, it is not too difficult to adjust if you have to. Consider these questions:

- 1 'How many joules of energy are there in a kilojoule?' — — — —
- 2 'How many milliwatts of power are there in a watt?' — — — —
- 3 'How many pascals of pressure are there in a kilopascal?' — — — —

See, no trouble! Again, you got all 1000 answers right!

Does anyone in the world actually use this reduced metric system?

Yes, in Australian occupations, about 85 % of workers predominately use only these 11 units. In the whole world, all auto workers and almost all building and construction workers use a reduced metric system like this. Autoworkers might add: 1000 micrometres = 1 millimetre; water engineers might use 1000 litres = 1 kilolitre (= 1 cubic metre m³) and 1000 kilolitres = 1 megalitre.

What are the advantages of using a reduced metric system?

Overall simplicity that leads directly to ease of learning, ease of use with many fewer mistakes leading to less waste of materials and reduced costs - estimated as about 10 % of overall turnover.

How does 'Metrication in a minute' fit with metrication policies?

Consider this building and construction policy from Australia:

The metric units for linear measurement in building and construction will be the metre (m) and the millimetre (mm), with the kilometre (km) being used where required. This will apply to all sectors of the industry, and the centimetre (cm) shall not be used. ... the centimetre should not be used in any calculation and it should never be written down. (Standards Association of Australia 'Metric Handbook, Metric Conversion in Building and Construction 1972')

Within two years (1974 to 1976) the entire industry had upgraded to the metric system. The estimated savings from builders and their sub-contractors is estimated at about 10 % a year of gross turnover and an increase in profits of about 15 % every year since 1976.

Become familiar with the metric system in an hour

When you have done all of these activities, you will have developed a set of measuring references and a metric mindset and it is likely that you will never go back to using old pre-metric measures ever again.

You will need:

- ◇ 1 ruler with millimetre markings (without inches and without centimetres). A 300 millimetre ruler will do but the longer the better, with the best being a metre long.
- ◇ 1 tape measure with millimetre markings (without inches and without centimetres). Length doesn't matter but 10 metres is good.
- ◇ 1 kitchen scale that can measure in grams (without ounces and without pounds).
- ◇ 1 bathroom scale that can measure in kilograms (without pounds and without stones).
- ◇ A thermometer that can measure in degrees Celsius (without Fahrenheit degrees).
- ◇ Some standard metric measuring jugs, cups and spoons (with millilitres only).
- ◇ A simple calculator.
- ◇ Your measurements (my measurements are in brackets):

Use the ruler to measure:

- ◇ Across your little finger nail (mine = 10 mm — my wife's little finger is 10 mm wide)
- ◇ Across your hand (mine = 100 mm — my wife's = 80 mm)
- ◇ Your handspan from thumb to little finger (250 mm with a stretch)
- ◇ Your cubit from elbow to longest finger (500 mm)
- ◇ Your height (1830 mm — I refer to this as 1.83 to facilitate BMI calculations)
- ◇ Your shoe length (340 mm) Your foot length with socks (305 mm)
- ◇ Your shoe width (120 mm) Your foot width with socks (115 mm)

Use the tape to measure:

- ◇ Your largest room (5 m x 10 m)
- ◇ The length of your house (20 m)
- ◇ Calculate the area of the roof of your house (200 square metres)
- ◇ A bedroom (4200 mm x 3600 mm = 4.2 m x 3.6 m)
- ◇ Any other rooms

Mark out 10 metres then step out to calculate:

- ◇ Your average pace (750 mm) and your longest – stretched – pace (1000 mm = 1 metre)
- ◇ Step out an unknown length that you estimate to be 10 metres. Then check with your tape.

Use the bathroom scales to measure:

- ◇ Your body mass (114 kg)
- ◇ Your height (1.83 m)
- ◇ Calculate your Body Mass Index (34 kg/m² – I am obese)
- ◇ Your maximum body mass for good health can be estimated by taking the 1 and the decimal point from your height (for me 1.83 take away the 1. = 83 kg) so I should not be more than 83 kilograms! (114 kilograms is not good!)

Use kitchen jugs (millilitres), scales (grams), and cups:

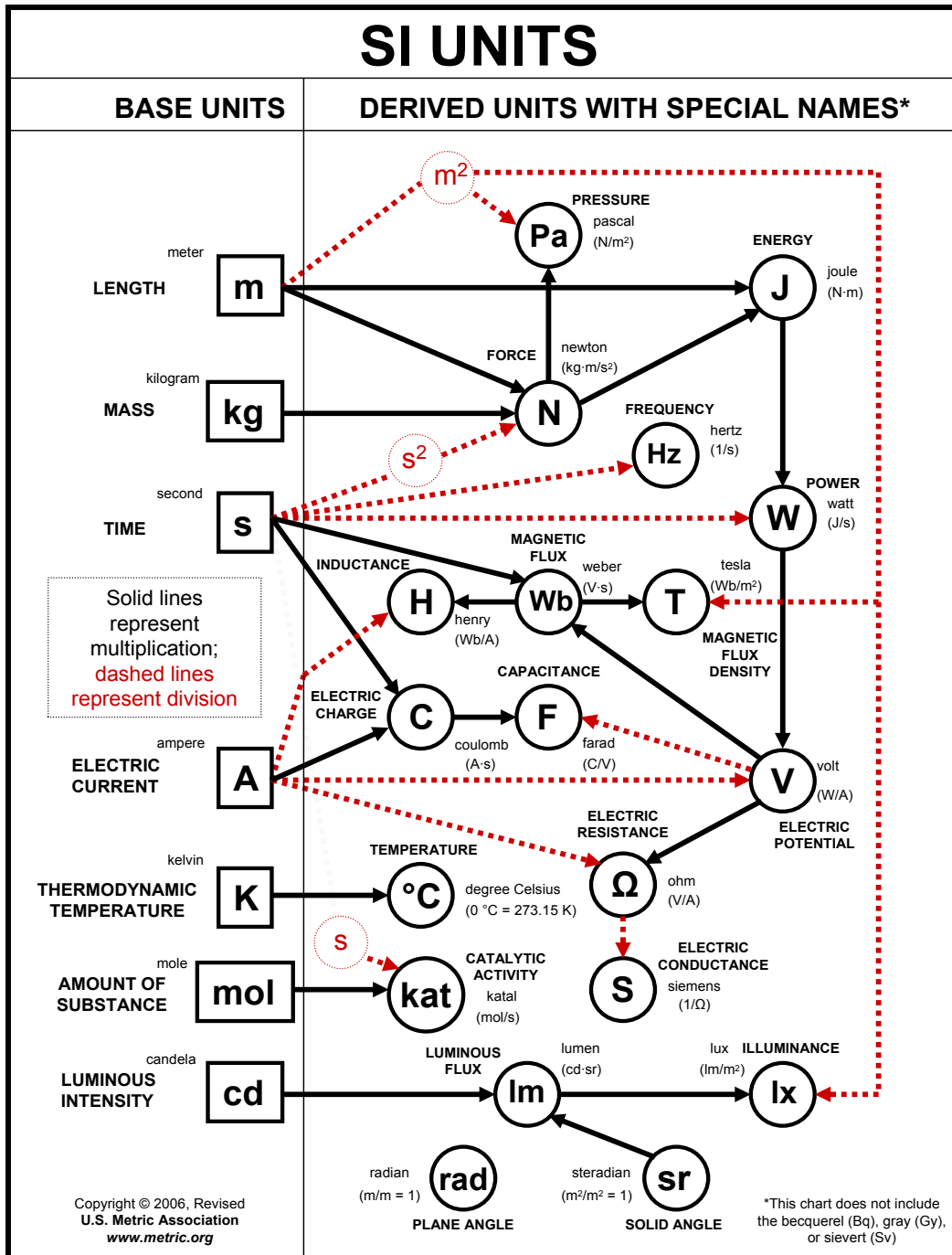
- ◇ Establish that a teaspoon has a capacity of 5 mL
- ◇ Establish that a tablespoon has a capacity of 20 mL (15 mL in the UK and the USA)
- ◇ Find the mass of an empty cup (say 350 g)
- ◇ Find the volume of a cup (250 mL)
- ◇ Establish that 250 mL of water is 250 g
- ◇ Establish that 1 L of water has a mass of 1 kg
- ◇ Measure the temperature of the water from the hot tap (60 °C)
- ◇ Measure the temperature of the water from the cold tap (15 °C)
- ◇ Measure the air temperature outside (14 °C)
- ◇ Measure the air temperature inside (20 °)

Learn this rhyme:

**Forty is hot, Twenty is nice,
Ten is cool, Minus is ice.**

© 2011 Pat Naughtin

Metric system consultant, writer, and speaker, Pat Naughtin, has helped thousands of people and hundreds of companies upgrade to the modern metric system smoothly, quickly, and so economically that they now save thousands each year when buying, processing, or selling for their businesses. Pat provides services and resources for many different trades, crafts, and professions for commercial, industrial and government metrication leaders in Asia, Europe, and in the USA. Pat's clients include the Australian Government, Google, NASA, NIST, and the metric associations of Canada, the UK, and the USA. See <http://www.metricationmatters.com> for more metrication information. For articles about metrication go to <http://metricationmatters.com/articles.html> or to receive the free 'Metrication matters' newsletter: <http://www.metricationmatters.com/newsletter>



Complete chart of the decimal metric system

Thanks to the United States Metric Association (USMA)

SI prefix list

Prefix	Symbol			Example using metres
yotta	Y	10^{24}	1 000 000 000 000 000 000 000 000	1 Ym ~ radius of the 'Local supercluster of stars ~ the diameter of the known visible Universe is about 500 Ym
zetta	Z	10^{21}	1 000 000 000 000 000 000 000	1 Zm ~ diameter of the Milky Way galaxy
exa	E	10^{18}	1 000 000 000 000 000 000	1 Em ~ the nearest star similar to the Sun is 1.9 Em away
peta	P	10^{15}	1 000 000 000 000 000 000	1 Pm ~ light travels about 9.5 Pm in a year
tera	T	10^{12}	1 000 000 000 000 000	1 Tm ~ distance halfway from the Sun to Jupiter (0.8 Tm) or Saturn (1.4 Tm)
giga	G	10^9	1 000 000 000	1 Gm ~ diameter of a small star (Sun = 2.4 Mm)
mega	M	10^6	1 000 000	1 Mm ~ Distance: Geelong to Sydney; Sydney to Brisbane; New York city to Detroit; Nashville to Dallas
kilo	k	10^3	1 000	1 km ~ 10 minute brisk walk ~ longest MW radio wave
hecto	h			not preferred
deca	da			not preferred
deci	d			not preferred
centi	c			not preferred
milli	m	10^{-3}	0.001	1 mm ~ diameter of a pin
micro	μ	10^{-6}	0.000 001	1 μ m ~ small bacterial cell
nano	n	10^{-9}	0.000 000 001	1 nm ~ DNA helix diameter
pico	p	10^{-12}	0.000 000 000 001	1 pm ~ atomic nucleus
femto	f	10^{-15}	0.000 000 000 000 001	1 fm ~ proton or neutron
atto	a	10^{-18}	0.000 000 000 000 000 001	1 am ~ electron or quark
zepto	z	10^{-21}	0.000 000 000 000 000 000 001	1 zm ~ diameter of a preon (sub-component of a quark)
yocto	y	10^{-24}	0.000 000 000 000 000 000 000 001	1 ym ~ cross section of a neutrino