# Thread NSTA Metric Unit Conversion question

**From:** physicalscience-request@list.nsta.org [mailto:physicalscience-request@list.nsta.org] **On Behalf Of** Joviak, Kurt
**Sent:** Monday, September 17, 2012 11:57 AM
**To:** physicalscience@list.nsta.org; physics@list.nsta.org
**Subject:** Metric Units....

My students are still struggling with the conversions between the metric units. I know at one point I had a chart that was simple as going from one to another all you have to do is move the decimal point one way or another. Does anyone have one that they would like to share. I know that it is to convert to larger unit , move the decimal point to the left or multiply. Is there a graphic that shows this?

Thanks
Joviak, Kurt [kjoviak@lcjvs.net]

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This free video might help: http://www.mathplayground.com/howto_Metric.html

Also search "metric system" and choose images. They have useful images that show how to move the decimal point.

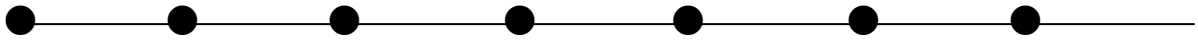
Jeff

This is the chart we use. Look for the unit you are starting with. Count the spaces between it and the unit you are converting to. Move the decimal that number of spaces and in the same direction that you moved from unit to unit. I hope that helps.

My leaning would be to use factor label (dimensional analysis) but we teach the same thing in all our classes and I am out voted on this. In my Honors classes, I teach factor label. Once they are comfortable with that they use it for everything even though they have learned to move the decimal in the past.
Vicki LaPlace [laplacev@sjabr.org]

# Chart for Metric Conversion

| Kilo- | Hecto- | Deca- | meter<br>Liter<br>gram | Deci- | Centi- | milli- |
|---|---|---|---|---|---|---|
| K | H | Da | m<br>L<br>g | D | C | m |



1. 35mL =_____dL
2. 950g = _____kg
3. 275m = _____cm
4. 1,000L= _____kL
5. 1,000mL = _____L
6. 4,500 mg = _____g
7. 25cm = _____mm
8. 0.005kg = _____dag
9. 0.0075m = _____cm
10. 15g = _____mg

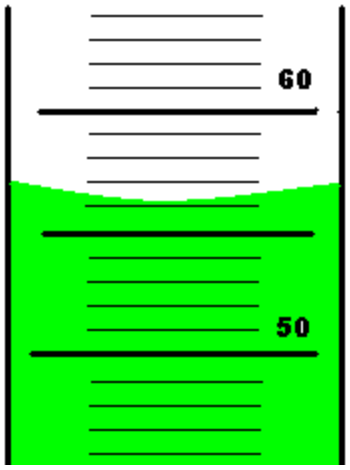
What unit would you use to measure each of the following:

| | | | | | |
|---|---|---|---|---|---|
| $cm^3$ | kg | mg | mL | cc | g |
| L | m | cm | mm | km | |

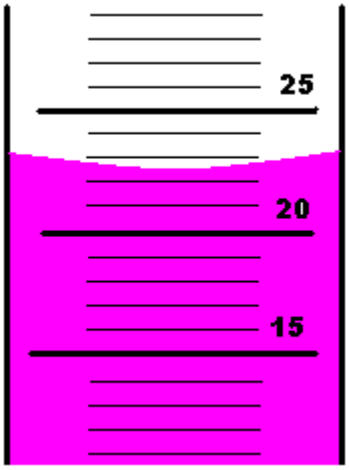
a. The volume of soda in a can:
b. The distance between SJA and your house:
c. The amount of salt in a corn chip:
d. The mass of a Catholic High football player:
e. The volume of your computer case:
f. The length of your eyelashes:
g. The amount of medicine in a booster shot:
h. The mass of a chocolate chip cookie:

# Measuring Liquids

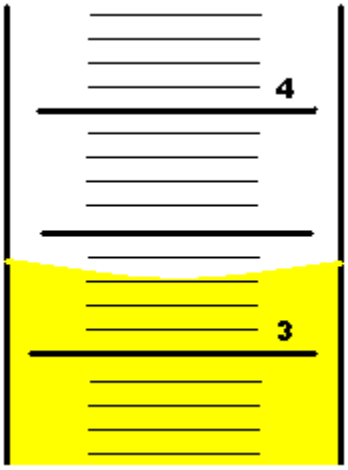
What volume is indicated on each of these graduated cylinders? The unit of volume is mL.



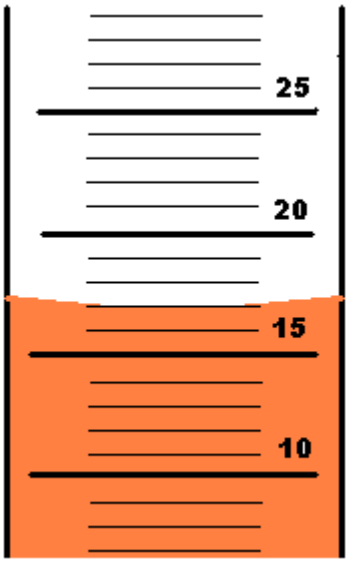

a) _____



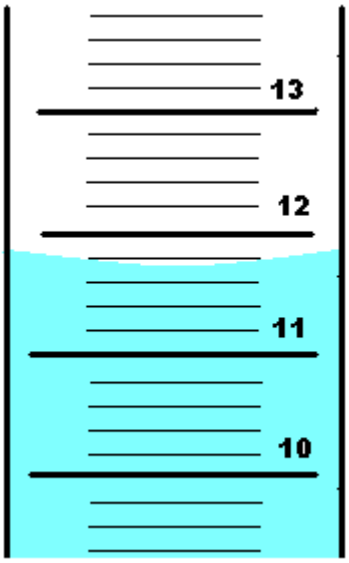

b) _____



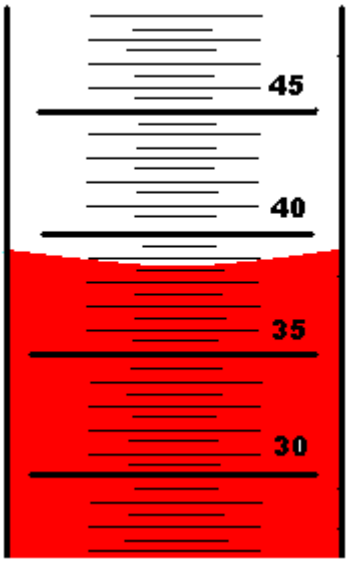

c) _____




d) _____




e) _____




f) _____

They don't care about conversion except when they have to. They don't care if station A sells gas for $3.45 a gallon while station B sells gas for $1.34/liter.

Immersion is a far better technique than memorization. Spend a lab period cooking in metric. It is SO much easier because there are no fractions. Students by and large hate fractions in my experience.

Make punch. Use liters for the recipe but fill each cup with 200mL of punch.
Make pudding from a mix. Use grams for the mix and liters for the milk. Serve in either (both?) grams and mLs.
Make trail mix. Use kilograms for the ingredients, but serve each student grams.

When they SEE and feel that a kilogram of sugar is a large amount and a gram of sugar is very small, they'll get the conceptual understanding. Don't worry about deciliters and centiliters - the only place I've ever seen deciliters is on a bottle of European beer. Sweet sweet European beer.

Perry

Perry,

Great suggestions. Just manipulating the math gives no feel for the quantities. Students need to have a feeling for relating the units to the real world. My memory is a bit fuzzy on this but Arnold Aarons use to ask students, "What do you see? What does it mean? How do you know?" Students need to internalize knowledge.

Maxine

Maxine Willis
Associate Fellow Department of Physics and Astronomy willism@dickinson.edu
(717)245-1843 (Voice)
(717)245-1642 (FAX)

How about this from the net?
http://atlantis.coe.uh.edu/archive/science/science_lessons/scienceles3/metric/metric.html#metricch

There is also the unit conversion method that illustrates why the "moving of decimals" works.

Brian Patterson
Northeast Middle School
Bethlehem, PA
Gr 8 Earth & Space Science

My methods are not very precise, but it helps kids to remember the basics. . . . then you can teach them the precise conversions. I have found that kids have no idea about the size of most measurements so I go to body parts.

A centimeter is about as wide as your pinky. An inch is about as long as from the tip of your thumb to the first joint. I do a little chant:

When I say pinky, you say centimeter. When I say thumb, you say inch. (It's very elementary, but it works.)

Also, I tell them that a quart and a liter are about the same. . . . . A liter is a quart and a spit. . . .meaning a mouthful of water. If you demonstrate they will always remember.

I got a rhyme from an AIMS book to remember Celsius temperatures:

30 is hot.
20 is nice.
10 is cool.
0 is ice.

I'm sure you can think up others.

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Suzanne L. Beckman
Science Lab
Berryhill School (preK-8)
10501 Windy Grove Road
Charlotte, NC 28278
(980)343-6100

-----Original Message-----
From: "Peter Tordo" <ptordo@gmail.com>
To: "Joviak, Kurt" <kjoviak@lcjvs.net>
Cc: physicalscience@list.nsta.org, physics@list.nsta.org
Date: 09/18/12 10:46 AM
Subject: Re: Metric Units....

I have been watching this and previous strands on the teaching of metric conversion, and not speaking up for too long. Is anyone else feeling like I do about middle school metrics lessons? And I am hoping for interesting sharing of views, not having anyone tell me what their "right way" is to handle this issue.

My issues are that:

1) students are being taught to use units that are never actually used in the real world, and not taught units that are common.

I challenge anyone to find a use of deci, deca or hecto as a prefix to any base unit, anywhere in any store, on any product, or on any commercial Internet website (except in metric lesson plans, unit conversion apps, or reference sources - or on European beer, thank Perry). Prefixes such as mega, giga, tera, micro, nano are very commonly used, but the metric lessons don't usually mention these.

2) students are being taught tricks like "move the decimal" and "King Henry. . .", which don't work well when applied to many real world problems. They don't understand the math behind why they work, so they can't filter out problems where they don't work well? Like in "How many liters of water would fill a fish tank that is 12inch x 18inch x 30inch, if 1inch = 2.54cm and 1mL = 1cm^3?"

Conversion tricks give some students (about 1/3 of my CP1 Physics 11th and 12th graders, over 3 years) the illusion that the original quantity changes during the unit conversion. And many students refuse to write out the formula for complex unit conversion problems, saying "King Henry is how I learned to do it in middle school, it has worked ever since then, so why can't I use it now?", despite repeatedly getting the wrong answers on tests and quizzes. I have been referred to as a bad teacher by students and parents, because I don't give problems that "work with King Henry". But no one in any of my classes has ever successfully converted 2.19 x10^8 nanometers into centimeters using "move the decimal", yet most insist their use of the trick was correct? (My own King Henry phrase is "King Henry's Debacle Undermines Direct Calculation Method".)

3) I have to teach metric conversion to high school juniors and seniors, when I should be teaching them Physics.

I think most middle school teachers don't have any idea that we high school physics teachers (I hope I am not the only one, after this long rant!?) have so much trouble with their former students and their cool metric lesson.

For the past few years I have attempted to un-teach the tricks that don't work and re-teach a method (Unit Conversion by multiplying conversion factor fraction equivalents of 1) that eventually works for most. But I have not done this with the whole class, only the 1/3 who have trouble using their tricks, and usually during small after school help sessions. I am frantically trying to develop a lesson plan for the whole class, that gives students a tool/process that always works, before we get too far into the the need to use unit conversion on complex problems. But there is a big stack of lab reports from last weeks measurement lab to grade, so I again can't give it the attention I need. Any help pointing to resources would be great!

Peter Tordo
Framingham HS

Peter, I am sorry but you are mistaken.

I lived in Europe for awhile.

All of those prefixes mentioned below are indeed used in everyday life in the rest of the world. In a restaurant, you order wine by specifying 3 "deci" or 5 "deci" liters (i.e. one glass or a small carafe). Land is measured in Hectare, not acres. Large packages of liquids in the supermarket are measured in Decaliters, not gallons.

If we want our students to be successful in a global competitive environment, they need to understand how the rest of the world measurers things.

Ron Brandt

On Sep 18, 2012, at 1:29 PM, ssweet@perry.k12.ok.us wrote:

I whole heartedly agree. I use conversion factors with my physical science students and chemistry students. They always resist at first. They only students I allow to use the method of moving the decimal the correct number of places are my IEP kids who cannot grasp the conversion factor concept.

Shanna Sweet

On 9/18/2012 8:41 AM, Peter Tordo wrote:

I have been watching this and previous strands on the teaching of metric conversion, and not speaking up for too long. Is anyone else feeling like I do about middle school metrics lessons? And I am hoping for interesting sharing of views, not having anyone tell me what their "right way" is to handle this issue.

I agree with many of Peter's concerns, but also worry about a conversation going in the direction of high school teachers telling middle school teachers what they *should* teach. I have not taught middle school, so I'm not clear on developmental stages of middle school teachers, but I hope this list allows us to have a conversation where we high school teachers can raise some concerns we have, and middle school teachers can give us some feedback on what they can and can't do (and what they do and our students say they never got!).

Peter's concerns:
Prefixes that are never used. I agree that the d* and h* are never used and there is no need to teach them. If students learn other prefixes, and are later confronted with a "deca," they will recognize that this is a prefix they haven't seen and can look it up. If any standardized tests use them, the publisher should be chastised. I tell my students that the main prefixes they need to know are the ones where we would "put the comma" (e.g. thousands, millions, billions and thousandths, ...). Then I tell them there is one other they need to know, but they already know it: A centi, just like a cent, is 1/100 of the base unit.

Numocis and other memorization techniques. These may be good for getting the basic memorization of order, but let's not include the d* and h* prefixes.

Use of memorizing "moving the decimal." It seems to me that this is an extra memorization step that is not needed, if students truly understand what a prefix represents, and can do simple multiplication. First off, I find that I rarely need to convert from one prefix to another, so in the rare occasion that I do the following: Say I need to convert 54,634 centimeters to kilometers (not sure why I'd ever need to do this, but here goes).
54,634 cm * 1 m/100 cm * 1 km/1,000 m (of course, this looks better with horizontal fractions)
At this point, I might say that I need to move the decimal over two times then three times, but not from some memorization system that won't ever help me except for changing prefixes. This method will help students in converting from SAE to metric, etc.

IMHO, the ability to mathematically convert (using the multiplicative identity of one--2.54 cm/inch = 1, etc.) is a skill that we should not help students with 'shortcuts' around. Learn the skill once, then apply in in different situations.

--
Lee Trampleasure
Physics and Physical Science Teacher
Carondelet High School
Concord, CA

@leetramp
http://trampleasure.net/lee

Peter, thanks for the rant--it's helpful for us to know that.

I'm not sure if anyone's mentioned this approach yet, but I teach **"Dimensional Analysis" to** my students in middle school, instead of all those conversion tricks, and I require them to use it...fairly often (not all the time!). It takes quite a while for students to catch on, but so worth it in the end. They can convert anything, including numbers in scientific notation.

There are some great videos on the web that present it, like this one:
http://www.youtube.com/watch?v=OEpGEErsajY

Here's my rant: IT"S RIDICULOUS THAT WE HAVE TO STILL TEACH OUR KIDS TO CONVERT BETWEEN INCHES AND CENTIMETERS, WHEN WE COULD JUST CHUCK THE WHOLE STANDARD SYSTEM AND JOIN THE REST OF THE WORLD IN USING A VERY CONVENIENT, BASE-10 SYSTEM.

Ok, I'm done...for now.

In Europe, produce is measured in decagrams at the market and small grocery stores (possibly large ones too but I've never been to one).

Kathryn Jensen
Science Teacher - Chemistry & General Science
Rochester, NY

Ron and others,
Thanks for the euro view on this. I definitely need to adjust my thinking on this over a few Deci of wine.
Sarah,
I think your Dimensional Analysis is the chemistry term for exactly what I try to teach in physics. Hopefully when I get my lesson on this packaged, it will look similar to the video you offer and to examples several others have offered, off-list.

On your rant . . . It IS ridiculous, but it is also reality. In a free country like the USA, we can not dictate or force people to adopt the metric system. For many, their freedom of speech means that they can use feet and pounds if they want. By teaching well the metric system, we move our culture in the right direction. As long as things all around us are in feet/inches and pounds and gallons, it is better to teach conversion to metric, than to leave metric out.

(I love to watch students squirm when asked to calculate the volume of a cubic box that is 1 foot, 7 22/32 inches on each side. They no longer fight me on the value of learning metric.)

Peter Tordo
Framingham HS

Sarah,

I agree about dimensional analysis and have used it exclusively in teaching chemistry since 1983. I wrote a paper for J Chem Educ "Working Backwards is a Forward Step in Solving Chemistry Problems." (Pretty corny, I know.)

The last couple of times I taught Honors Chemistry I had the kids solving "the hardest question in the book" (given the density of a gas calculate the molar mass, with temperature in degrees C and pressure in torr) within the first week of class. The gas was xenon, and just about everyone got it right! They had no idea what a K, mol, and torr was at the time, but they knew what they needed to do and they did it. And they did it well for the rest of the year. By the time we got to the chapter on gas laws all the blanks had been filled in.

When packing my car for summer camping I discovered a box with a bunch of copies of my dimensional analysis book Chemistry without Equations. If anyone is interested in a copy write me off list. It is about 100 pages long -- from edge to edge on each page to save space and was meant for college general chemistry but I have adapted much of it high school honors.

One of my students said her brain had been rewired for dimensional analysis and was disappointed that her AP chem teacher refused to use it. So she and the rest of my former students (most of the AP class) would huddle to solve the problems "the Drake way." And they usually got the answer before the teacher.

Bob Drake

I agree with Perry that conversion is a waste of time and doesn't help. I lived in Europe for quite a few years, and quickly got used to the system - although I did relate inches to 2.5 cm in my head for a long time, and that a liter is sort of like a quart - but I rarely did conversions.

Following one lead after another I came upon this wonderful Prezi http://htwins.net/scale2/index.html The Scale of the Universe, with all the scale names - going from the tiniest quarks to the whole universe zooming in or out. Puts it all in perspective.

Bonnie

In real life, I do conversions from F to C, m to ft, in to cm, in to ft, m to y, km to mi, kg to lb, fl oz to l and vice versa (for all).

When I was practicing medicine, we had to convert temps, in to cm (patient height), lb to kg (patient weight or mass) and fl oz to ml, particularly for fluids in and fluids out (volume of urine for patients who are hospitalized).

Jeff

I agree with Jeff, I have had lots of instances where I have had to do conversions. My students in AZ do not know the metric system or customary units, and these are high school students. Unfortunately many didn't even know how many days or weeks there are in a year. For me it is all about the process because in Chemistry they will have to know how to perform these conversions.

Kathy

I never said conversion wasn't useful. However many of the problem sets we give students are completely contrived - such as a gas station advertising in $/gallon while the other station down the street advertises teir price in $/liter. That simply isn't the real world. People convert not for sake of conversion but to accomplish a particular task. Hence the immersion aspect.

Giving someone a standard contractor-grade tape measure and asking them to build a box 1 meter cubed is real world.

Giving someone a thermometer in F and asking them to heat beakers of water to 0 / 25 / 50C is real world.

Perry

Once upon a time with my 9-10 grade students I had them draw a multi-segmented "monster"--ok a slightly creative caterpillar type creature--where each successive segment was larger than the previous. It started at the left with the smallest (milli-) and went up to kilo- or Mega-. Each segment was labelled with its relationship to the base unit (i.e.-- milli- also said 1/1000th ; there was a segment labeled base) as well as the "name" of the prefix. [NOTE: I stopped labelling deci-, deca- and hecto- after a couple of years as, except for a unit on metrics, no one ever uses these. The relationship and segments were still there.]

Students then could move between units moving their finger in the appropriate direction from any unit to any other unit and that told them both which direction and how many places the decimal point needed to move. The physical difference in the size of the segments helped reinforce the relative size differences between the units.

In changing schools and computer systems I haven't used this recently, but I'm thinking this would be a better thing to help the visual and body-kinesthetic learners. If you are interested, I can share a version of it when I rework it this year. Hope this was helpful.

Marci Denney [marci.denney@nlcsd.org]

I frame this question as part of our ongoing energy thread - do people pay more for gas in Europe? How much more? Does that encourage smaller cars? Do they pay more per mile to drive? Does that encourage taking trains? I start it off with a photo of a gas station showing prices in Amsterdam (usually relatively

high) and one of the station across the street from the high school - they have to figure out what other questions to ask, and/or answer them using the web.

Mark Holthouse
Math, Science & Engineering
Westwood (MA) High School
http://www.mholthouse.org

On Thu, Sep 20, 2012 at 8:32 AM, Ron Brandt <reb124@aol.com> wrote:
Excellent real life application. (BTW, the fuel prices in Europe are much higher due to taxes, designed to encourage small cars, trains,
etc.)

nother tricky conversion I used to try to do in my head while driving there. In the U.S. we calculate miles per gallon. In europe, they do the inverse and calculate liters per 100 KM.  so the lower the number, the more fuel efficient.

Although I give my students the conversion factors and practice a few in class, to me the important thing is to have an idea of about what each metric measure is, so on a quiz or test  the questions are more in the nature of "What would be the appropriate metric unit of measure to use when measuring the mass of a postage stamp?"
Elizabeth Warren [warren.beth@gmail.com]