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Hello and welcome to the third episode of Chemistry.

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The study of change.

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Previously in chemistry the study of change...

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We differentiated between physical and chemical changes.

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Between physical and chemical properties.

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Between extensive and intensive properties.

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And between mass and weight (wink wink).

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In today's episode...

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We will familiarize ourselves with the SI and its units.

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We will learn how to use metric prefixes.

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And write conversion factors.

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And we will learn how to use linear distance relations to obtain area and volume conversion factors.

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These are the units used by the international system of units, or SI.

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You will notice that the units are almost the same as the old metric system.

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Except for the mass.

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The SI uses our derived unit because the gram is just too small to be practical for commerce.

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Even though chemists use it [the gram] a lot.

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I guess we didn't have a majority.

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The metric prefixes.

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Of course, are used by the ISI.

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Which is a great advantage over all other systems.

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Here is the condensed version of the table on your textbook.

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Let's look at a couple of examples.

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Suppose you need a conversion factor between centimeters and meters.

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The first step is to find the prefix “centi-” on the prefix table.

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And of course.

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Write it down along with its meaning.

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Centi- is equal to 10 to the negative 2.

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We are going to introduce the desired unit.

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Meters and this becomes 1 centimeter is equal to 10 to the negative 2 meters.

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And there's your conversion factor.

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It is just that simple.

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Or let's say instead that you need a conversion factor between nanoseconds and seconds.

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We first find the prefix in “nano-” and its meaning on the table.

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We write it down.

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And we bring in the desired unit, seconds.

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And now we have one nanosecond is equal to 10 to the negative 9 seconds.

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Let's look at another example.

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Let's say we want to know how many microliters there are in one liter.

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What then?

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As before, we find the prefix micro.

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On the table.

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We write it down opposite it's meeting.

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And we introduce the desired unit.

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So one microlitre is equal to 10 to the negative 6 liters.

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This is a valid conversion factor.

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But it does not answer the question.

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How many microliters are there

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In one liter?

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To answer that question, we just need a little bit of maths.

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Our question can be written as an equation.

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And now we must manipulate our conversion factor so it looks exactly like our question.

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Well, maybe not exactly, but darn similar.

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There's my manipulation.

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And we will divide both sides by 10 to the negative 6.

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Because any number divided by itself is equal to 1.

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That's all we need to do.

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10 to the six microliters are equal to 1 liter.

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Now let's consider a situation in which more than one prefix is used.

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To answer how many centimeters there are in 1 decimeter?

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We first find the two mentioned prefixes.

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On the table.

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“Centi-” and “deci-”.

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We write them down...

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And insert the unit meter in each one of those prefixes.

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To get one decimeter is equal to 10, to the negative 1 meters.

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And one centimeter is equal to 10, to the negative, 2 meters.

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And now we will use dimensional analysis for the first time.

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To find our answer.

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Dimensional analysis allows you to know with certainty whether you should multiply or divide by each value.

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Dimensional analysis requires that you start with a given quantity and use each conversion factor as a fraction to make sure that all units cancel except for the desired ones.

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This method is easier to understand with an example, so let's get to it.

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One decimeter is the given quantity.

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And therefore our starting point.

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Here is the setup.

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This set of frames has room for the given quantity.

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And two conversion factors.

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The given quantity always goes on the upper part of the 1st frame.

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The lower part of the 1st frame is empty except for the very special case when the given quantity has compound units.

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By compound units, I mean things like meters per second.

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Or grams per milliliter, or something per something else.

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Each conversion factor will take up an entire frame.

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Both the upper and lower parts.

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We choose which part of the conversion factor goes in the upper or lower side of the frame based on which position will cancel the previous unit.

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In this case, we want to cancel decimeters so that one decimeter will go in the lower frame.

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And the 10 to the negative 1 meters will go in the upper frame.

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That way.

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The unit decimeters cancels and we are left with the unit meters.

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Our second conversion factor will be used to cancel the unit meters.

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The centimeter will go in the upper frame.

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So that 10 to the negative 2 meters can go in the lower frame.

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And cancel the unit meters.

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And finally.

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We multiply our given quantity by the values in the upper frames.

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And divide by the values in the lower frames.

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This results in our final answer.

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10 centimeters.

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We will review dimensional analysis in a later episode.

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For now we used it just to establish that one decimeter is equal to 10 centimeters.

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You might be thinking well, who cares about that?

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You do.

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Volume is measured using a unit derived from the unit for length.

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In the previous example, we determined that 10 centimeters is equal to 1 decimeter.

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So that can be used as a conversion factor.

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To make a volume calculation, we use the length unit in three dimensions width, length and height.

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To the left.

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We have a representation of a cubic decimeter.

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A cube that is 10 centimeters by 10 centimeters by 10 centimeters.

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By cubing the conversion factor.

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We realize that 10 to the third cubic centimeters is equal to 1 cubic decimeter.

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Or if you prefer, 1000 cubic centimeters is equal to 1 cubic decimeter.

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All you have to do to derive a volume conversion factor is cube.

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The linear conversion factor.

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If you want an area conversion factor, all you have to do is square the linear conversion factor.

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An interesting side point is that a liter is defined as exactly 1 cubic decimeter.

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This is not by accident.

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The French know what they're doing.

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And this means also.

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That one milliliter will be equal to exactly 1 cubic centimeter.

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Later on, the term exactly will have a very important meaning, so don't forget this is exactly.

00:12:18

Later on, the term exactly will have a very important meaning, so don't forget this is “exactly”.

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Now let's consider the following.

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How many square inches are there...

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In a square yard?

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Follow the example of the decimeter, the cubic decimeter, and the cubic centimeter.

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And look for the answer in our next episode.

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Because that's all there is...

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There isn't any more.