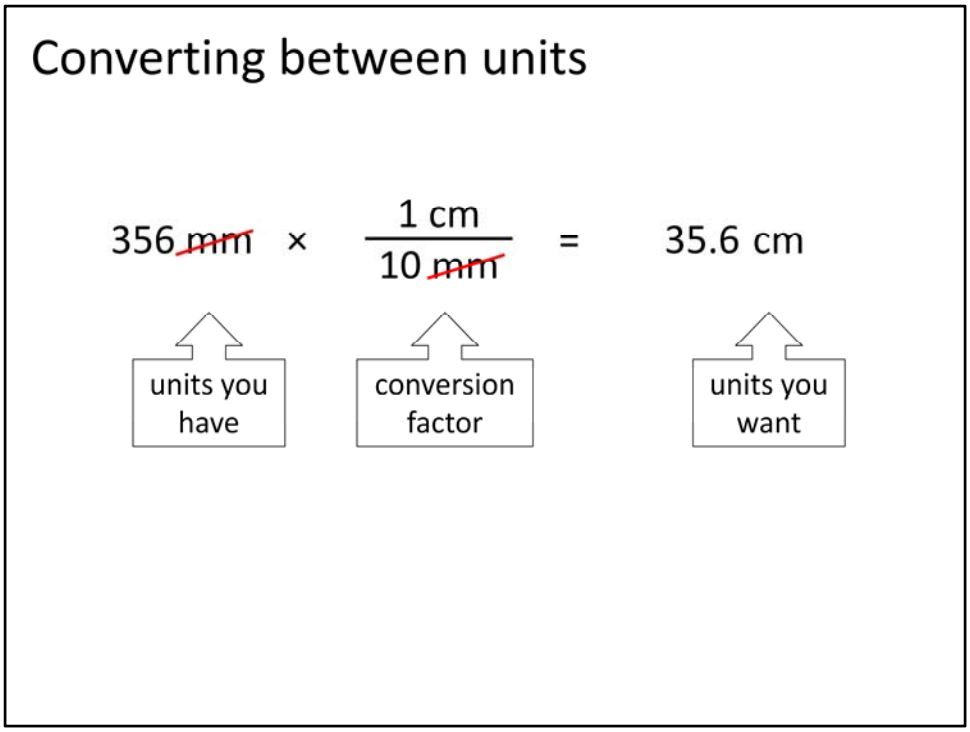
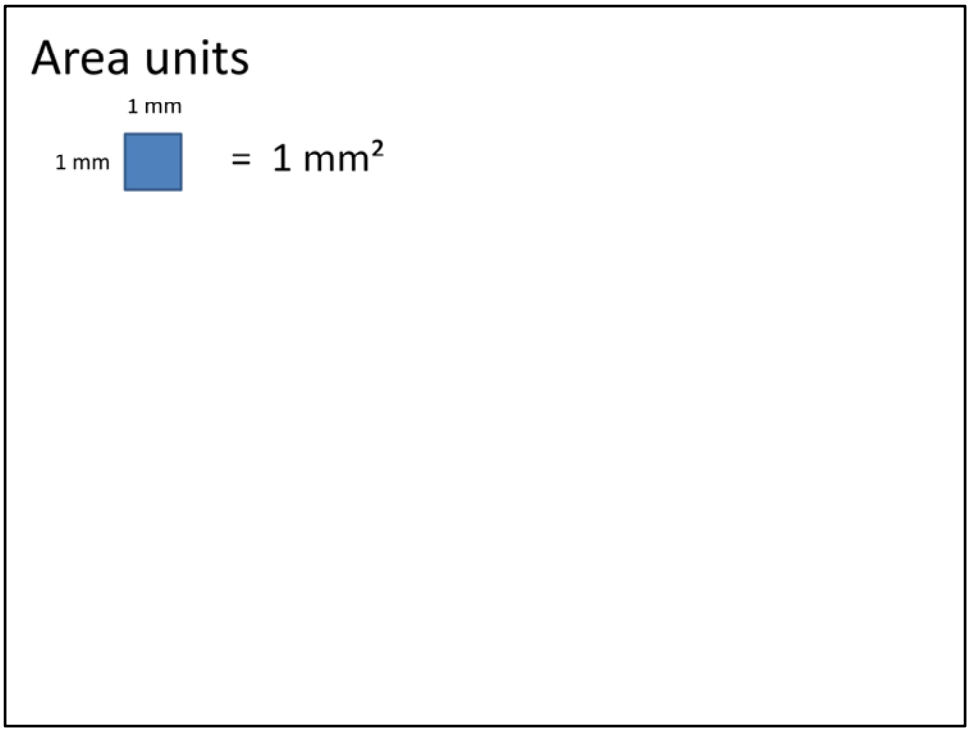
Unit Conversions

Area and Volume

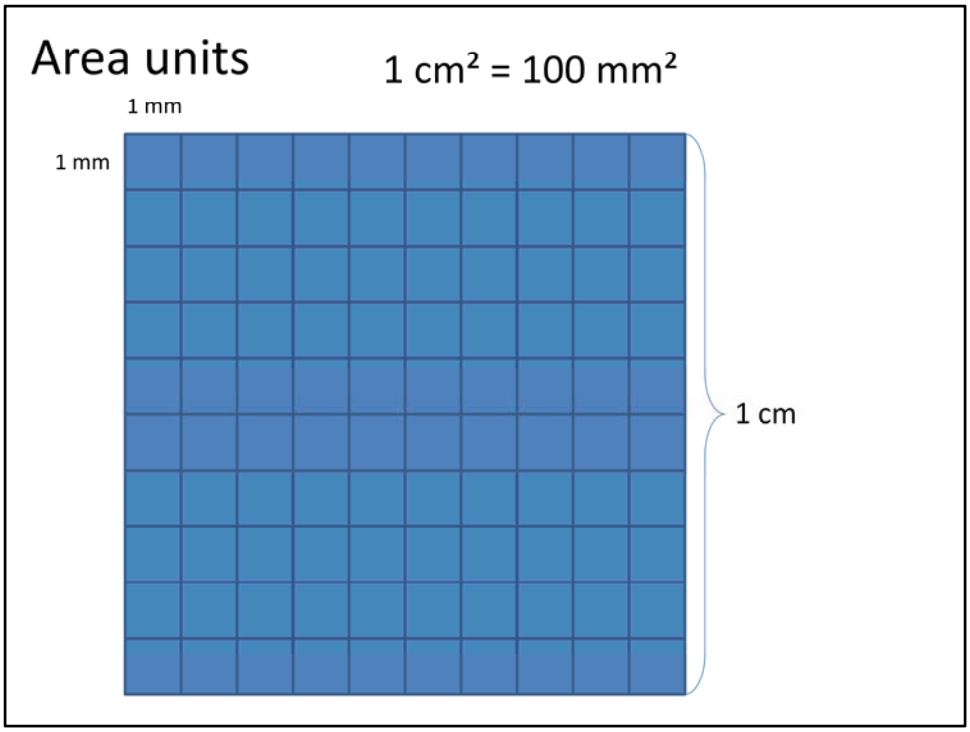


When converting between units, you multiply by a conversion factor that properly represents the relationship between the units you have and the units you want. Units in the conversion factor cancel out with the units you have, leaving the units you want.

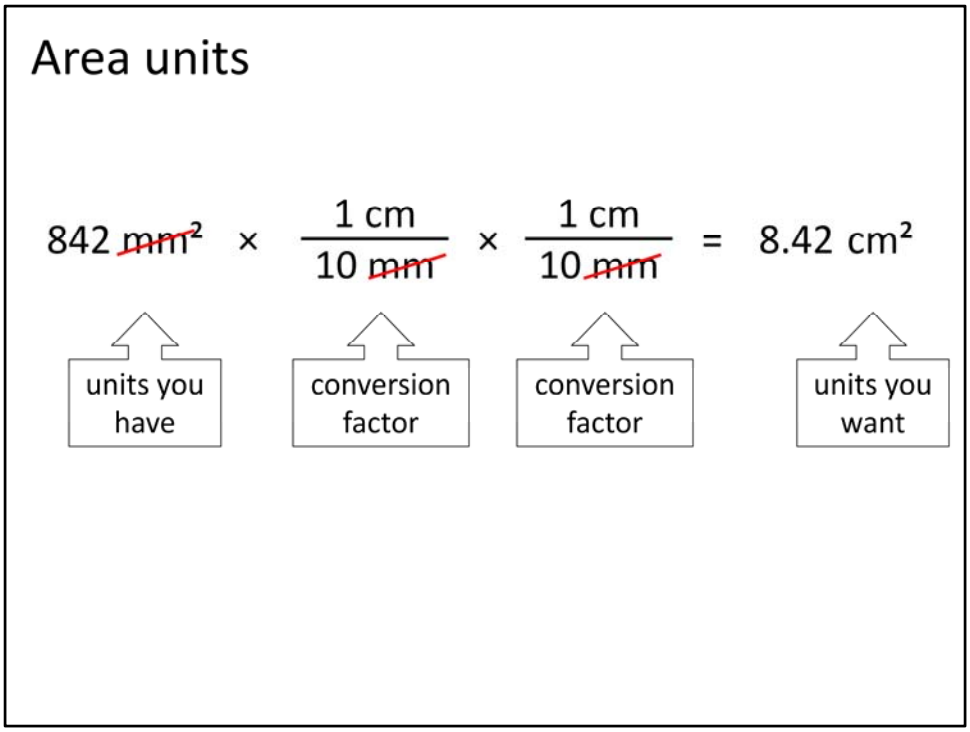


However, when dealing with units of area or volume, the conversion factors are not quite so simple.

Area is measured in square units. A square that is one millimeter on each side would have an area of one square millimeter.



You know there are ten millimeters in one centimeter. However one square centimeter is ten millimeters on each side, so one square centimeter is actually one hundred square millimeters.

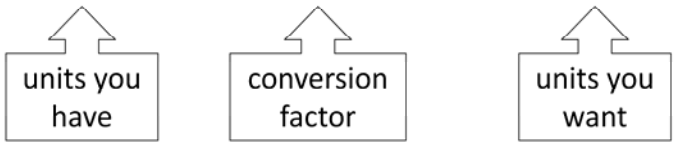


You have two ways to think about the conversion factor when converting area units.

First, you could use the common conversion, but convert twice so that the units fully cancel out. In this case, millimeters shows up twice in the denominator, so will cancel out millimeters squared in the units you have. Centimeters appears twice in the numerator, so when multiplied together, they will result in centimeters squared, the units you want.

Area units

$$842\ \cancel{mm^2} \times \frac{1\ cm^2}{100\ \cancel{mm^2}} = 8.42\ cm^2$$



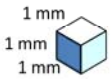
Alternately, you could remember that there are 100 square millimeters in one square centimeter and use that as your conversion factor.

Area units

$$\frac{1\text{ cm}}{10\text{ mm}} \times \frac{1\text{ cm}}{10\text{ mm}} = \left(\frac{1\text{ cm}}{10\text{ mm}}\right)^2 = \frac{1\text{ cm}^2}{100\text{ mm}^2}$$

You can see that these two methods are equivalent because when you multiply by the simple conversion twice, it is the same as squaring the simple conversion, which results in the actual conversion factor.

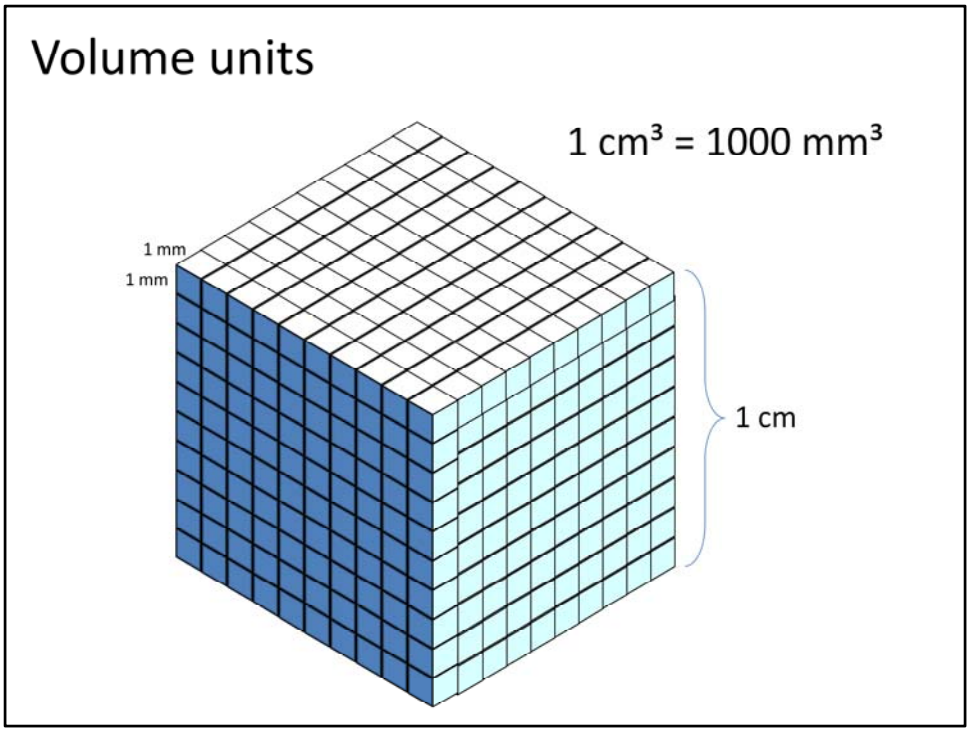
Volume units



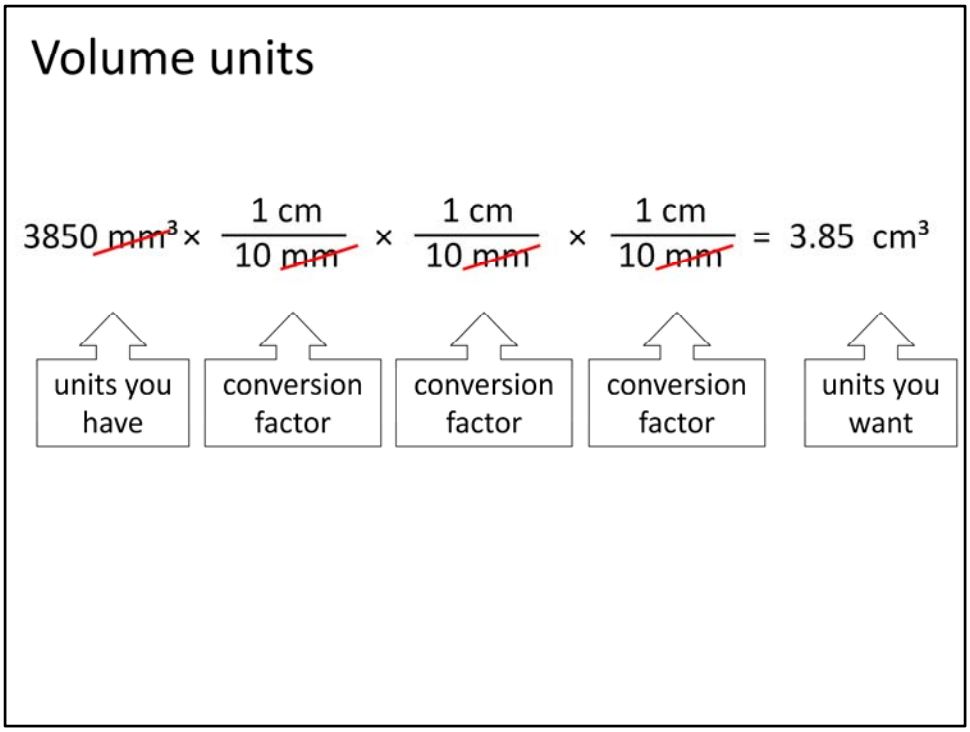
$= 1\ mm^3$

When dealing with units of volume, the conversion factors are still more challenging.

Volume is measured in cubed units. A cube that is one millimeter on each side would have a volume of one cubic millimeter.



You know there are ten millimeters in one centimeter. However one cubic centimeter is ten millimeters on each side, so one cubic centimeter is actually one thousand cubic millimeters.



Again, you have two ways to think about the conversion factor when converting volume units.

First, you could use the common conversion, but convert three times so that the units fully cancel out. In this case, millimeters shows up three times in the denominator, so will cancel out millimeters cubed in the units you have. Centimeters appears three times in the numerator, so when multiplied together, they will result in centimeters cubed, the units you want.

Area units

$$3850\ \cancel{mm^3} \times \frac{1\ cm^3}{1000\ \cancel{mm^3}} = 3.85\ cm^3$$

units you have | conversion factor | units you want

Alternately, you could remember that there are 1000 square millimeters in one square centimeter and use that as your conversion factor.

Area units

$$\frac{1\text{ cm}}{10\text{ mm}} \times \frac{1\text{ cm}}{10\text{ mm}} \times \frac{1\text{ cm}}{10\text{ mm}} = \left(\frac{1\text{ cm}}{10\text{ mm}}\right)^3 = \frac{1\text{ cm}^3}{1000\text{ mm}^3}$$

Again, you can see that these two methods are equivalent because when you multiply by the simple conversion three times, it is the same as cubing the simple conversion, which results in the actual conversion factor.