A stock solution is a concentrated solution used to make other solutions of lower concentration. For example, suppose I have an 8 M CuSO₄ stock solution and I want 600 mL of 4 M CuSO₄. If I take 300 mL of the 8 M solution and add water until the volume is 600 mL, I'll have diluted the concentration to 4 M.

By adding water until the volume has doubled, I reduce the concentration by half.
We can use a formula to help us calculate the amount of stock solution we need to prepare a more dilute solution.

\[ M_1V_1 = M_2V_2 \]

\( M_1 \) = molarity of the stock solution
\( V_1 \) = volume of the stock solution

\( M_2 \) = molarity of the dilute solution
\( V_2 \) = volume of the dilute solution

The units of volume can be anything: mL, L, gallons, quarts, etc. As long as \( V_1 \) and \( V_2 \) both use the same type of volume unit, you can use any volume unit you want.

How much 2.00 M MgSO\(_4\) is needed to prepare 1.00 \( \times \) 10\(^2\) mL of 0.400 M MgSO\(_4\)?

\( M_1 = 2.00 \text{ M} \) \hspace{1cm} \( M_2 = 0.400 \text{ M} \)
\( V_1 = ? \) \hspace{1cm} \( V_2 = 100 \text{ mL} \)

\[ M_1V_1 = M_2V_2 \]
\[ (2.00 \text{ M}) \cdot V_1 = (0.400 \text{ M})(100 \text{ mL}) \]
\[ 2.00 \cdot V_1 = (0.400)(100) \]
\[ V_1 = \frac{(0.400)(100)}{2.00} = 20.0 \text{ mL} \]

To prepare 100 mL of 0.400 M solution, take 20.0 mL of 2.00 M stock solution and add water until the volume is 100 mL.
If 15.0 mL of 10.0 M HCl solution is diluted to $3.00 \times 10^2$ mL, what is the molarity of the diluted solution?

$M_1 = 10.0 \text{ M}$  \hspace{1cm} $M_2 = \ ?$

$V_1 = 15.0 \text{ mL}$  \hspace{1cm} $V_2 = 300 \text{ mL}$

$$M_1 V_1 = M_2 V_2$$

$(10.0 \text{ M})(15.0 \text{ mL}) = M_2 (300 \text{ mL})$

$(10.0)(15.0) = M_2 (300)$

$$M_2 = \frac{(10.0)(15.0)}{300}$$

$M_2 = 0.500 \text{ M HCl}$