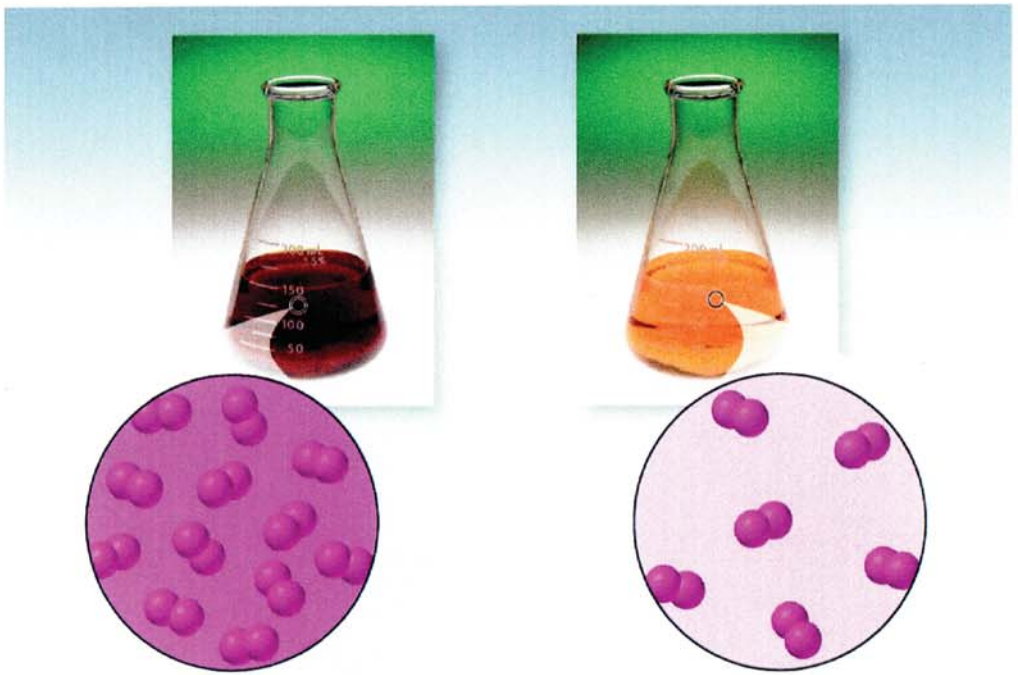
Dilution

- Many laboratory chemicals such as acids are purchased as **concentrated** solutions (stock solutions).

- **More dilute** solutions are prepared by taking a certain quantity of the stock solution and adding it to a diluent (typically water)

- Dilution factor is the total # of unit volumes in which your stock solution will be dissolved.



Concentrated solution:
More solute particles per unit volume

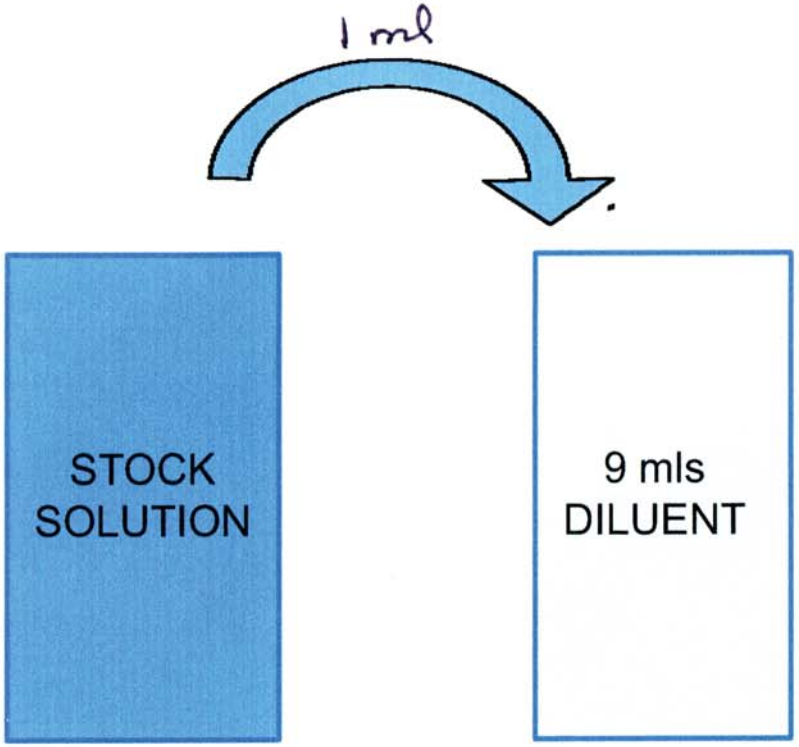
Dilute solution:
Fewer solute particles per unit volume

$$\text{Factor} = \frac{\text{Volume of stock soln taken}}{\text{Final volume of diluted soln}}$$

(total)

amt. of stock
amt. of diluent

Dilution Factor Calculations

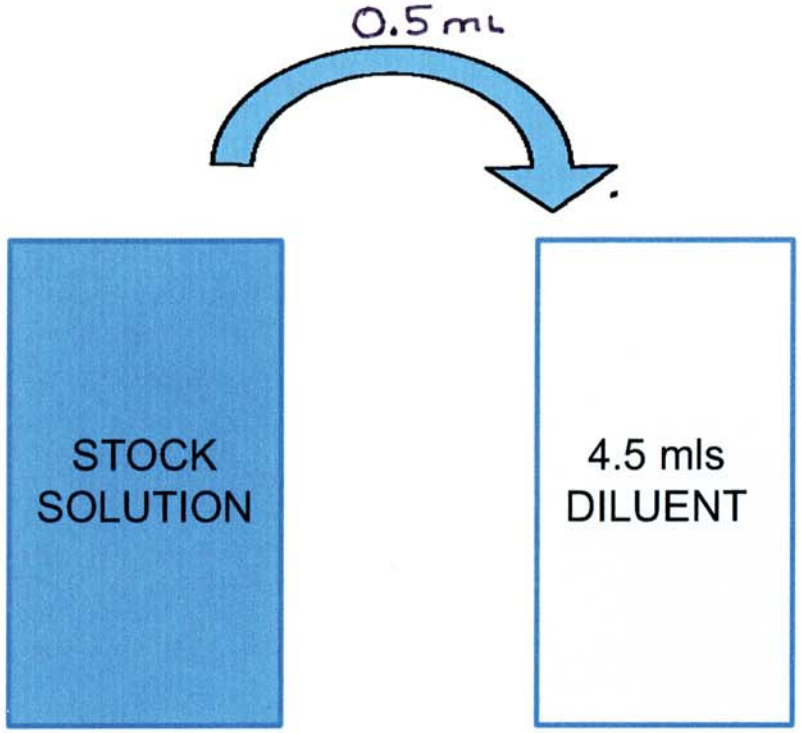


$$\text{Factor} = \frac{\text{Volume of stock soln}}{\text{Final vol. (stock + diluent)}}$$

$$\text{Factor} = \frac{1\ \text{mL}}{1 + 9\ \text{mL}}$$

$$= \frac{1}{10} = 0.1 = 1 \times 10^{-1} \quad (10^{-1}) \quad = \text{10-fold dilution}$$

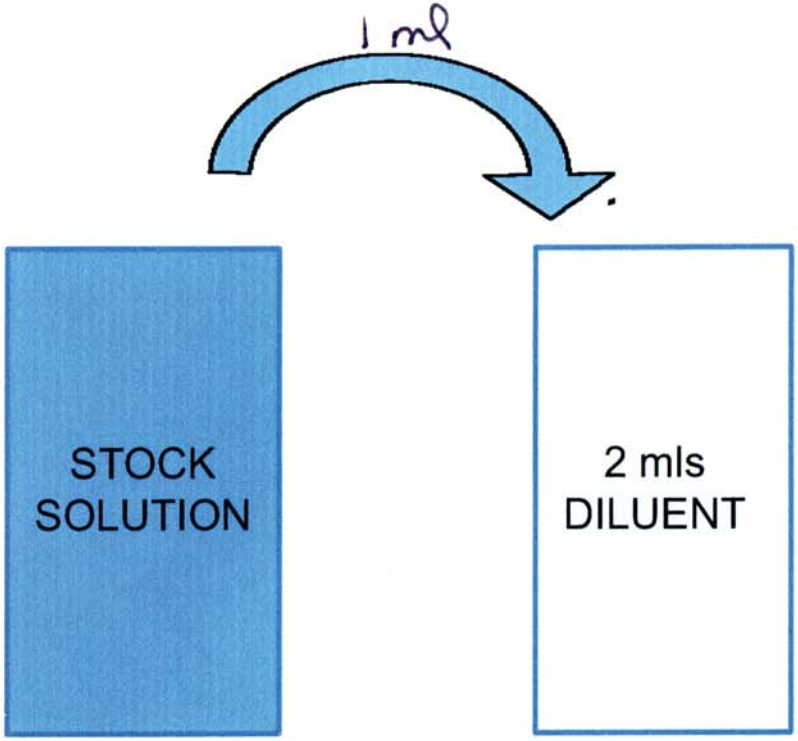
Dilution Factor Calculations



$$D.F. = \frac{\text{Volume of stock taken}}{\text{Final vol. (stock + diluent)}}$$

$$= \frac{0.5\,mL}{0.5+4.5\,mL} = \frac{1}{10} = 0.1 = 10^{-1} = \text{10-fold dilution}$$

Dilution Factor Calculations



D. F. = $\frac{\text{Vol. stock taken}}{\text{Final vol. (stock + diluent)}}$

= $\frac{1\text{ ml}}{3\text{ ml}} = \frac{1}{3}$ = 3-fold dilution.

Dilution Factor Examples

Final vol ↓ D. F.

I want to make 30 µl of a 10-fold dilution of a stock solution in diluent. How would I do it?

$\frac{1}{10} = 0.1 = 10^{-1}$

$D.F. = \frac{\text{Vol. stock}}{\text{Final vol.}} = \frac{1}{10} \cancel{\leftarrow} \frac{X\ \mu l}{30\ \mu l}$

(stock + diluent)

$X = 3\ \mu l$

① Take 3 µl of stock solution.

② Add it to 27 µl of diluent

$\text{Final vol} = \begin{array}{r} 30\ \mu l \\ -3\ \mu l \\ \hline 27\ \mu l \end{array}$

I have 50 mls of a concentrated solution of acid that I want to dilute down 3-fold in water. I only want 40 mls of diluted acid. How would I do it?

↑ final vol.

D. F. = $\frac{1}{3}$

$D.F. = \frac{\text{Vol. stock}}{\text{Final vol.}} \quad \frac{1}{3} \cancel{\leftarrow} \frac{X\ ml}{40\ ml}$

$X = 13.3\ \text{mls}$

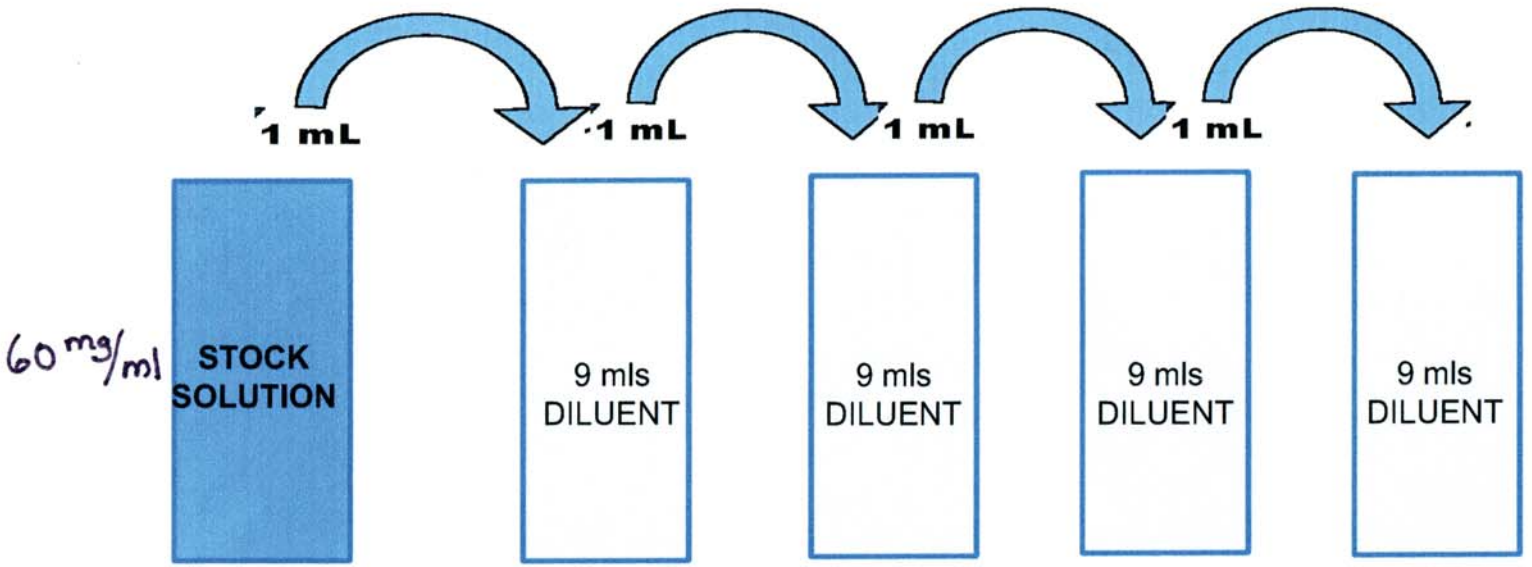
① Take 13.3 mls of conc. ACID

② Add it to 26.7 mls of water

$\text{Final vol} = \begin{array}{r} 40\ \text{mLS} \\ -13.3\ \text{mLS} \\ \hline 26.7\ \text{mLS} \end{array}$

Serial dilutions

Serial dilutions are successive dilutions of a sample. The final dilution factor is the multiplicative product of all dilutions.

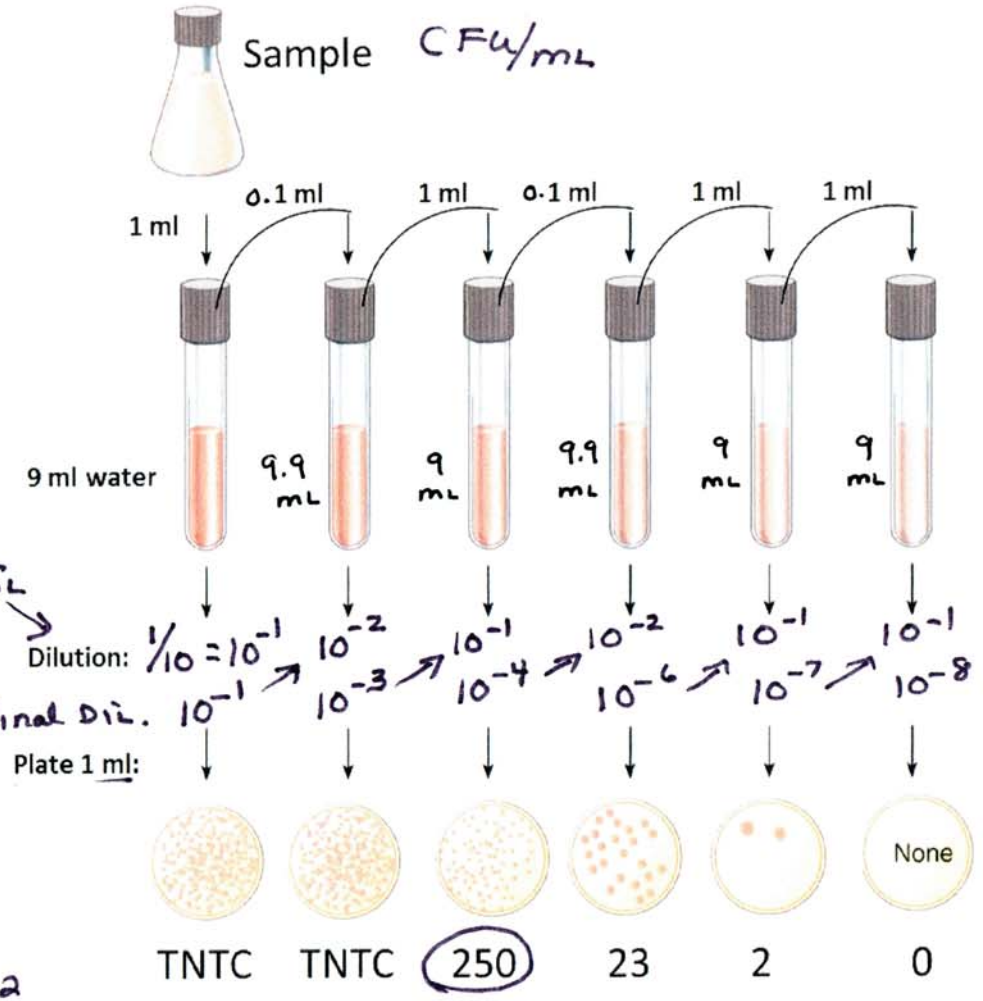


Dilution made: Vol. stock / Total vol.	$\frac{1\text{ ml}}{1+9\text{ mL}} = \frac{1}{10} = 0.1 = 10^{-1}$	0.1 or 10^{-1}	10^{-1}	10^{-1}
Final dilution:	10^{-1}	0.01 or 10^{-2}	10^{-3}	10^{-4}
Concentration: (mg/mL)	$60 \times 10^{-1} =$ 6	$60 \times 10^{-2} =$ 0.6	$60 \times 10^{-3} =$ 0.06	$60 \times 10^{-4} =$ 0.006

[Stock] x Final Dilution

Viable Count Assay

- Bacteria (CFU/mL)
- Bacteriophages (PFU/mL)



Plates with 300+ colonies/plaques:
Too numerous to count (TNTC)

Plates with < 30 colonies/plaques:
Too few to count (TFTC)

$30 \leq X \leq 300$

$$DF = \frac{0.1\,mL}{.1 + 9.9\,mL} = \frac{1}{100} = .01 = 10^{-2}$$

$$250 \div 1 \times 10^{+4} = \boxed{2.5 \times 10^{6}\ CFU/mL}$$

 # colonies/plaques ÷ Amt plated (mls) x Dilution = CFU/ml

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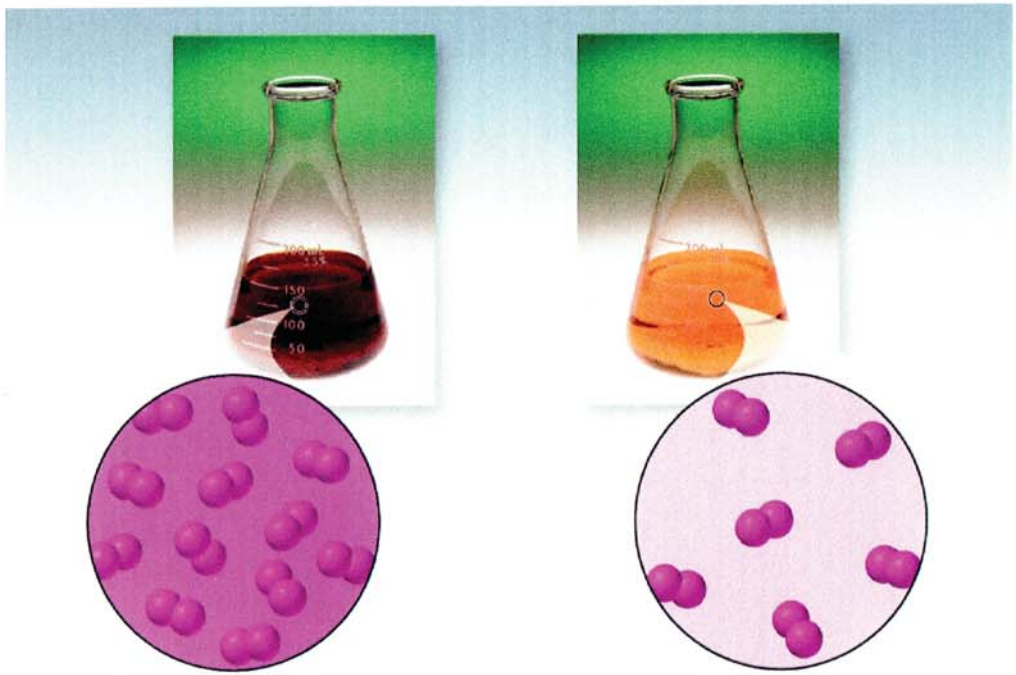

Concentrated solution:
More solute particles per unit volume

Dilute solution:
Fewer solute particles per unit volume

$$\text{Concentration} = \frac{\text{moles solute}}{\text{Volume}}$$

moles of solute before dilution = moles of solute after dilution

(Inital Conc) · (Inital Vol) = (Final Conc) · (Final Vol)

$$C_1 V_1 = C_2 V_2$$

$$(\text{Conc})(\text{Vol}) = \text{moles solute}$$

Another Practice Dilution Example

Molarity

In an experiment, a student needs 250.0 mL of a 0.100 *M* $CuCl_2$ solution. A stock solution of 2.00 *M* $CuCl_2$ is available.

V_2 C_2 C_1

How do I prepare this? Need to find = V_1

① Take 12.5 mls of stock

② Add to 237.5 mls of diluent

$$C_1 V_1 = C_2 V_2$$

$$(2.00\,M)(V_1) = (0.100\,M)(250\,mL)$$

$$\frac{(2.00\,M)(V_1)}{2.00\,M} = \frac{25\,M \cdot mL}{2.00\,M}$$

$$V_1 = 12.5\,mL \text{ stock}$$

Final volume (stock + diluent) = 250 mls − 12.5 ml = 237.5 ml

Dil. Factor = $\frac{\text{Vol. stock}}{\text{Final vol (stock + diluent)}}$

$$= \frac{12.5\,mL}{250\,mL} = 0.05$$

Final concentration = (Stock soln) · (Dilution factor)

$= (2.00\,M) \times (0.05) =$

0.1 M

Another Practice Dilution Example

I have a 50X stock solution. I want to make 300 mls of a 1X solution. 50-fold dilution

C_1 V_2 C_2

How do I prepare this?

$$C_1 V_1 = C_2 V_2$$

$$(50x)(V_1) = (1x)(300\,mls)$$

$$\frac{50x \cdot V_1}{50x} = \frac{300x \cdot ml}{50x}$$

$$V_1 = 6\ mL$$

① Take 6 mL of 50X stock

② Add it to 294 mL of diluent

Final Volume (stock + diluent) = 300 mL − 6 mL = 294 mL

Another Practice Dilution Example

I have a stock solution of glucose at a concentration of 10 mg/ml. (10-fold or $\frac{1}{10}$ or 0.1 or 10^{-1})
I want to make 500 mls of a 1 mg/ml glucose solution in water. How do I prepare this?

$C_1 V_1 = C_2 V_2$

$(10\ mg/mL)(V_1) = (1\ mg/mL)(500\ mls)$

$V_1 = 50\ mLs$

① Take 50 mL of 10 mg/mL glucose soln.
② Add to 450 mL of water

I have a stock solution of lactose at a concentration of 20 mg/ml.
I want to make 500 mls of a 5 mg/ml ~~glucose~~ Lactose solution in water. How do I prepare this?

$C_1 V_1 = C_2 V_2$

$(20\ mg/mL)(V_1) = (5\ mg/mL)(500\ mL)$

$V_1 = 125\ mL$

① Take 125 mL of 20 mg/mL lactose soln.
② Add 375 mL of water.

Final vol = 500 mLs − 125 mL

Using my two stock solutions of sugars (glucose at 10 mg/ml and lactose at 20 mg/ml). I want to make 500 mls with a concentration of 1 mg/ml glucose and 5 mg/ml lactose. How do I prepare this?

500 mLs (Final) = stock + diluent

① Add 50 mls of 10 mg/mL glucose
② Add 125 mL of 20 mg/mL lactose
③ Add 325 mL of water

$500 - (50 + 125)$: