14–16 years

Elements, compounds and mixtures: Frayer models

ROYAL SOCIETY OF CHEMISTRY

Education
Inspiring your teaching and learning

Frayer models

Frayer models are a simple but effective way to develop learners' understanding of a new piece of vocabulary. You will see what your learners already know and identify any misconceptions they have.

There are four stages learners can work through, but you can adapt this model to best suit your learners. You can guide learners through all quadrants, but particularly quadrant 2 works best as a teacher-led discussion. Quadrant 3 might also need/benefit from some discussion.

1. Explore Link to science capital and draw on learners' experience.	**2. Break down** Look at the composite parts of the word to help unpack its meaning.
4. Consolidate Learners apply their knowledge.	**3. Explain** Introduce the definition.

Key term

Find more guidance including tips, adaptations and further reading, in the teacher notes: rsc.li/4j5xfyj

1. What does the word ‘dilute’ mean to you?

Where have you come across this term (or parts of this term) before?

2. Break down the word ‘dilute’.

di-

-lute

dilute

4. A learner makes up two solutions.

In solution A, she dissolves 10 g of solute in 100 cm^3 of solvent.

In solution B, she dissolves 2 g of solute in 100 cm^3 of solvent.

Which solution is the more dilute? Explain your answer.

3. Write down what you think ‘dilute’ means.

Compare what you wrote with the definition (slide 7).

concentrated

1. What does the word ‘concentrated’ mean to you?

Where have you come across this word (or parts of this word) before?

2. Break down the word ‘concentrated’.

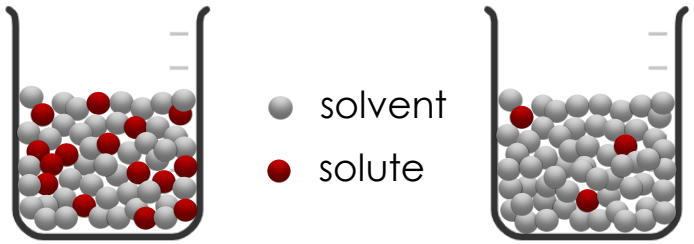
con-

centr-

3. Write down what you think ‘concentrated’ means.

Compare what you wrote with the definition (slide 8).

4. Explain which image represents a more concentrated solution?



Solution X

Solution Y

1. What does the word 'precipitate' mean to you?

Where have you come across this word (or parts of this word) before?

2. What do we know about precipitates?

Each of the equations below are simple ionic equations for precipitation reactions. What do they have in common?

$$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$$

$$Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$$

$$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$$

State symbols; (s) solid; (l) liquid; (g) gas; (aq) aqueous

precipitate

4. A learner investigated the effect of concentration on rate of reaction using the reaction shown below:

$$2HCl(aq) + Na_2S_2O_3(aq) \rightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$$

They measured the reaction rate by timing how long it took for a set amount of precipitate to form. Which product is the precipitate?

3. Write down what you think a 'precipitate' is.

Compare what you wrote with the definition (slide 9).

1. What does the word ‘formulation’ mean to you?

Where have you come across this term (or parts of this term) before?

2. Break down the word ‘formulation’.

formula-

-ation or -tion

formulation

4. A sample of stainless steel contains:

72.3% Fe; 16% Cr; 7.5% Mn; 4% Ni; 0.15% C and 0.05% P

Explain why this is an example of a formulation.

3. Write down what you think a ‘formulation’ is.

Compare what you wrote with the definition (slide 10).

1. What does the word 'dilute' mean to you?

Where have you come across this term (or parts of this term) before?

2. Break down the word 'dilute'.

di-

Prefix meaning 'apart' or 'not'.

-lute

From Latin luĕre, meaning 'to wash'.

dilute

Washed apart

dilute

4. A learner makes up two solutions.

In solution A, she dissolves 10 g of solute in 100 cm^3 of solvent.

In solution B, she dissolves 2 g of solute in 100 cm^3 of solvent.

Which solution is the more dilute? Explain your answer.

Solution B is more dilute because it contains less solute dissolved in 100 cm^3 of the solvent.

3. Write down what you think 'dilute' means (below is the definition from the key terms list).

When there is not very much solute dissolved in a particular volume of solvent.

Encourage learners to compare their attempted definition with this one.

concentrated

1. What does the word 'concentrated' mean to you?

Where have you come across this word (or parts of this word) before?

2. Break down the word 'concentrated'.

con-

Prefix meaning 'with' or 'together'

centr-

From **classical Latin** '*centrum*' meaning centre

concentrated

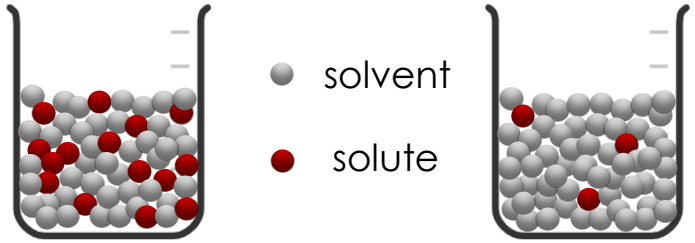
Brought together to a common centre

3. Write down what you think 'concentrated' means (below is the definition from the key terms list).

When there is a lot of solute dissolved in a particular volume of solvent.

Encourage learners to compare their attempted definition with this one.

4. Explain which image represents a more concentrated solution



Solution X **Solution Y**

Solution X is more concentrated because there are more particles of solute dissolved in the same volume of solvent.

1. What does the word 'precipitate' mean to you?

Where have you come across this word (or parts of this word) before?

2. What do we know about precipitates?

Each of the equations below are simple ionic equations for precipitation reactions. What do they have in common?

$$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$$

$$Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$$

$$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$$

State symbols; (s) solid; (l) liquid; (g) gas; (aq) aqueous

They all form a solid from two aqueous solutions.

precipitate

4. A student investigated the effect of concentration on rate of reaction using the reaction shown below:

$$2HCl(aq) + Na_2S_2O_3(aq) \rightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$$

They measured the reaction rate by timing how long it took for a set amount of precipitate to form. Which product is the precipitate?

S(s) or sulfur

3. Write down what you think 'dilute' means (below is the definition from the key terms list).

An insoluble solid that is formed within a solution during a chemical reaction between two soluble substances.

Encourage learners to compare their attempted definition with this one.

1. What does the word 'formulation' mean to you?

Where have you come across this term (or parts of this term) before?

2. Break down the word 'formulation'.

formula-

A formula gives the proportions of the different components in a substance or mixture.

-ation or -tion

Suffix meaning 'action' or 'resulting state'.

formulation

The state obtained from mixing components in a specific proportion.

formulation

4. A sample of stainless steel contains:

72.3% Fe; 16% Cr; 7.5% Mn; 4% Ni; 0.15% C and 0.05% P

Explain why this is an example of a formulation.

This is a formulation because the stainless steel is a mixture containing elements in carefully measured proportions.

3. Write down what you think a formulation is (below is the definition from the key terms list).

A mixture that has been designed as a useful product, made by mixing substances in carefully measured quantities, such as paint or medicines.

Encourage learners to compare their attempted definition with this one.

Example layout

1. Explore

Link to science capital and draw on learners' experience.

2. Break down/'what do we know about X'?

Look at composite parts of the word to help unpack its meaning.

Or invite learners to suggest what, as a class, they already know about the key term (with the help of a few bullet points).

Select your key term

3. Explain

Introduce the definition.

4. Consolidate

Learners apply their knowledge.