14–16 years

Organic compounds and reactions: 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.

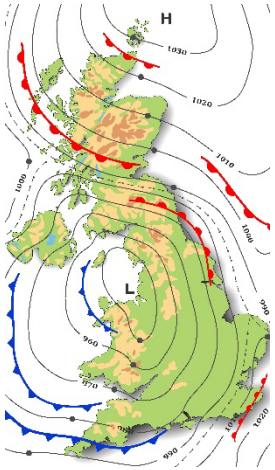
1. Explore Link to science capital and draw on learners' experience.	**2. Break down** Look at the composite parts of the word to help unpack its meaning.
4. Consolidate Learners apply their knowledge.	**3. Explain** Introduce the definition.

Key term

Find more guidance including tips, adaptations and further reading, in the teacher notes: rsc.li/4js7w2l

1. What does the word isomer mean to you?

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



Here are some ideas.

- An **iso**sceles triangle is a triangle which has two sides the same length.
- An **iso**bar on a weather map connects places of equal atmospheric pressure.

A poly**mer** is a very large molecule made by joining lots of small molecules together.

2. Break down the word 'isomer'.

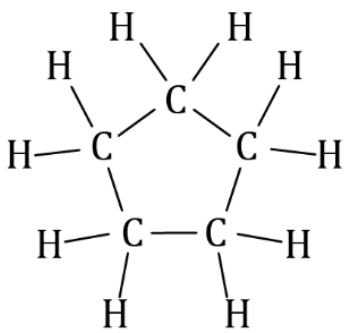
iso-

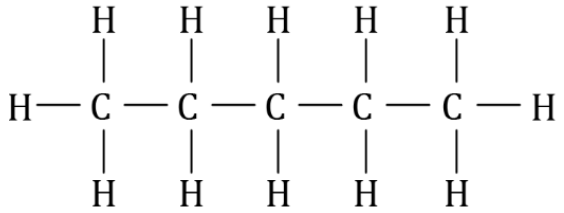
From the Greek isos meaning 'equal'.

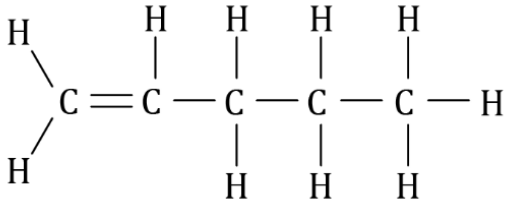
-mer

From the Greek word meros, meaning 'part' or 'segment'.

4. Which two of the molecules shown are isomers?







Hint: work out their molecular formula.

3. Write down what you think an 'isomer' is.

Put together your understanding of the parts iso- and -mer to form the definition.

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

anaerobic

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

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

Here are some ideas.

- What is the reason for the prefix ‘aero’ in aeroplane?
- You might describe something as **a**typical if it is **not** typical. Can you think of something that could be described as atypical?

2. Break down the word ‘anaerobic’.

an-

The prefix **a-** or before a vowel **an-** means ‘not’ or ‘without’.

-aer-

From classical Latin āēr, meaning ‘air’

bic

From ‘bio’ Indicating or involving life or living organisms

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

Put together your understanding of the parts an-, -aer- and -bic to form the definition.

4. Which equation represents an anaerobic reaction?

Equation 1: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Equation 2: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

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

empirical formula

1. What does the term 'empirical formula' mean to you?

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

Here are some ideas.

- Where have you met the word **formula** before in chemistry? How would you describe to someone what it meant?
- **Empirical** evidence is evidence obtained through systematic observation, measurement or experimentation. It contrasts with 'anecdotal evidence', which relies on things people saw or heard rather than facts.

2. What do we know about the term 'empirical formula'?

empirical

Means 'derived from experiment, experience and observation rather than from theory or logic.'

formula

In chemistry, this is an expression of the constituents of a compound using symbols and figures.

3. Write down what you think an 'empirical formula' is.

4. Give the empirical formula for each of the compounds below.

- Butene C_4H_8
- Glucose $C_6H_{12}O_6$
- Ethanoic acid CH_3COOH

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

1. What does the term 'amino acid' mean to you?

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

Here are some ideas.

- What organic **acid**s do you know? Can you draw their displayed formula?
- **Am**monia has the formula NH_3. Which element do you think is in all molecules starting with **am-**?

2. Break down the term 'amino acid'.

am-

From 'ammonia'

-in

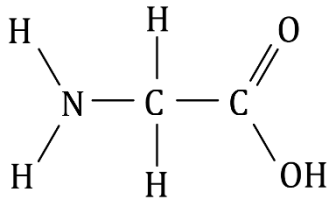
Shortened from –ine; suffix meaning 'of' or 'pertaining to,' 'of the nature of,' 'like'

acid

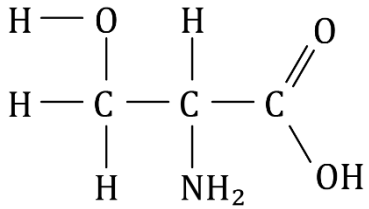
A molecule capable of producing hydrogen ions, H^+ when dissolved in water.

amino acid

4. Identify the amine group and the acid group in each amino acid.



glycine



serine

3. Write down what you think an 'amino acid' is.

Put together your understanding of the parts of the word to form the definition.

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

isomer

1. What does the word isomer mean to you?

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

2. Break down the word 'isomer'.

iso-

From the Greek isos meaning 'equal'.

-mer

From the Greek word meros, meaning 'part' or 'segment'

isomers

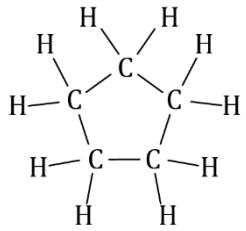
Molecules with equal parts

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

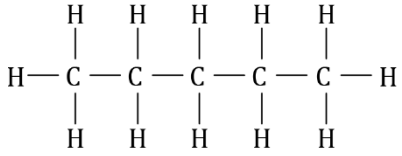
Compounds which have the same molecular formula but their atoms bonded in a different arrangement.

Encourage learners to compare their attempted definition with this one.

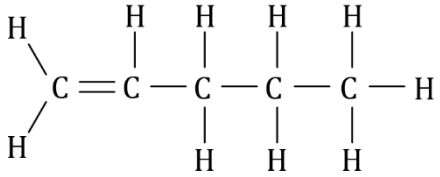
4. Which two of the molecules shown are isomers?



C_5H_{10}



C_6H_{12}



C_5H_{10}

Hint: work out their molecular formula.

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

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

2. Break down the word 'anaerobic'.

an-

The prefix **a-** or before a vowel **an-** means 'not' or 'without'.

-aer-

From classical Latin āēr, meaning 'air'

-bic

From 'bio' Indicating or involving life or living organisms

anaerobic

A process in living organisms that occurs without air.

anaerobic

4. Which equation represents an anaerobic reaction?

Equation 1: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Equation 2: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Equation 2 because oxygen is not a reactant.

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

Takes place when oxygen is not present.

Encourage learners to compare their attempted definition with this one.

empirical formula

1. What does the term 'empirical formula' mean to you?

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

2. What do we know about the term 'empirical formula'?

empirical

Means 'derived from experiment, experience and observation rather than from theory or logic.'

formula

In chemistry, this is an expression of the constituents of a compound by symbols and figures.

empirical formula

The constituents of a compound determined using experimental data.

3. Write down what you think an 'empirical formula' is (below is the definition from the key terms list).

Gives the simplest whole number ratio of atoms of each element in a substance, such as CH_2 for ethene which has molecular formula C_2H_4.

Encourage learners to compare their attempted definition with this one.

4. Give the empirical formula for each of the compounds below.

- Butene C_4H_8 CH_2
- Glucose $C_6H_{12}O_6$ CH_2O
- Ethanoic acid CH_3COOH CH_2O

1. What does the term 'amino acid' mean to you?

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

2. Break down the term 'amino acid'.

am-

From 'ammonia'

-in

Shortened from –ine; suffix meaning 'of' or 'pertaining to,' 'of the nature of,' 'like'

acid

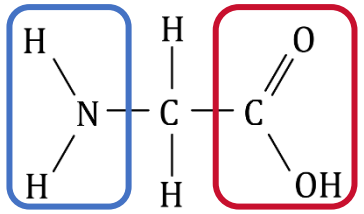
A molecule capable of producing hydrogen ions, H^+ when dissolved in water.

amino acid

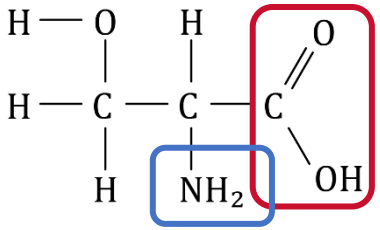
A molecule that has one part that reacts like ammonia and another part that is an acid.

amino acid

4. Identify the amine group and the acid group in each amino acid.



glycine



serine

amine group

carboxylic acid group

3. Write down what you think an 'amino acid' is (below is the definition from the key terms list).

A molecule with both amine and carboxylic acid functional groups that is the monomer for polypeptides; there are 20 different naturally occurring amino acids.

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

4. Consolidate

Learners apply their knowledge.

3. Explain

Introduce the definition.