

14–16 years



# Quantitative chemistry: Frayer models

... copper atoms are shown  
... occurring proportion.



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... 65

**Relative  
atomic  
mass**

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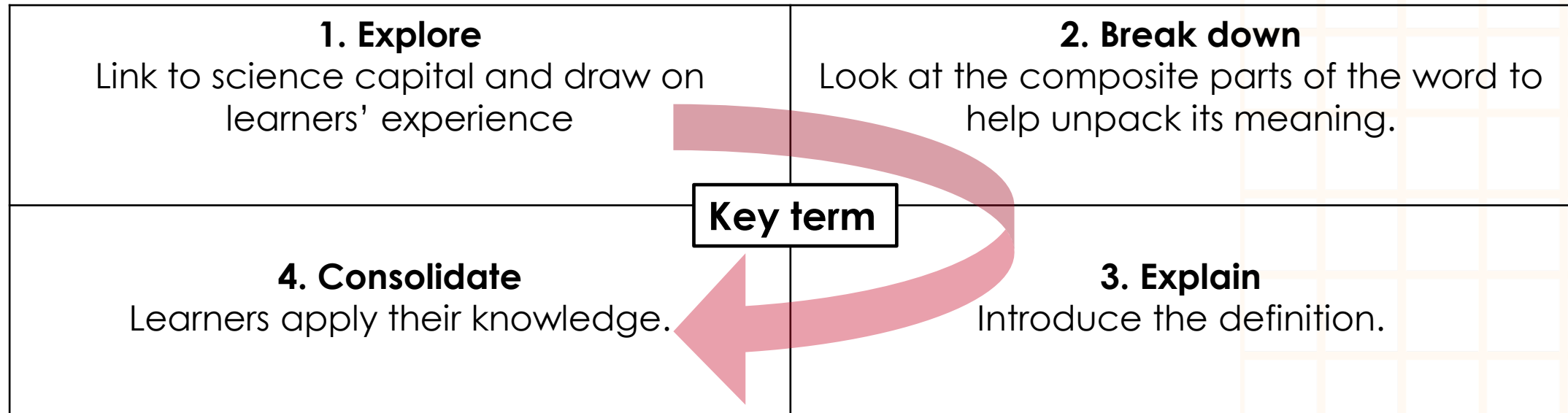
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# Frayer models

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.



Find more guidance including tips, adaptations and further reading, in the teacher notes: [rsc.li/3Gi9HHN](https://rsc.li/3Gi9HHN)



1. What does the term 'balanced symbol equation' mean to you?  
Where have you come across this term (or parts of this term) before?

2. Break down the term 'balanced symbol equation'.

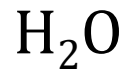
'Balanced' suggests that something is the same on both sides – what is the same?

How is the word 'equation' used differently in maths and chemistry?

## Balanced symbol equation

4. Here is a word equation for the complete combustion of methane. Arrange the chemical formulas given below to construct a balanced symbol equation for the reaction.

methane + oxygen → carbon dioxide + water



(There is no need to include state symbols.)

3. Write down what you think the term 'balanced symbol equation' means.

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



1. What does the the term 'relative atomic mass' mean to you?  
Where have you come across this word (or parts of this word)  
before?

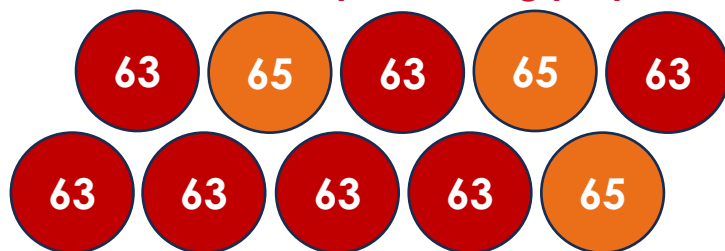
2. Break down the term 'relative atomic mass'

What does the adjective 'relative' mean?

Naturally occurring elements usually contain several isotopes, each with a slightly different mass. How can we calculate just one mass to represent all the isotopes?

## Relative atomic mass

4. The relative masses of ten copper atoms are shown below in their naturally occurring proportion.



The relative atomic mass of copper is:

- A** less than 65.
- B** in between 63 and 65, but nearer to 63.
- C** in between 63 and 65, but nearer to 65.
- D** more than 65.

3. Write down what you think 'relative atomic mass' means.

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



1. What does the term 'amount of substance' mean to you? Where have you come across this term (or parts of this term) before?

2. Break down 'amount of substance'

amount

substance

## Amount of substance

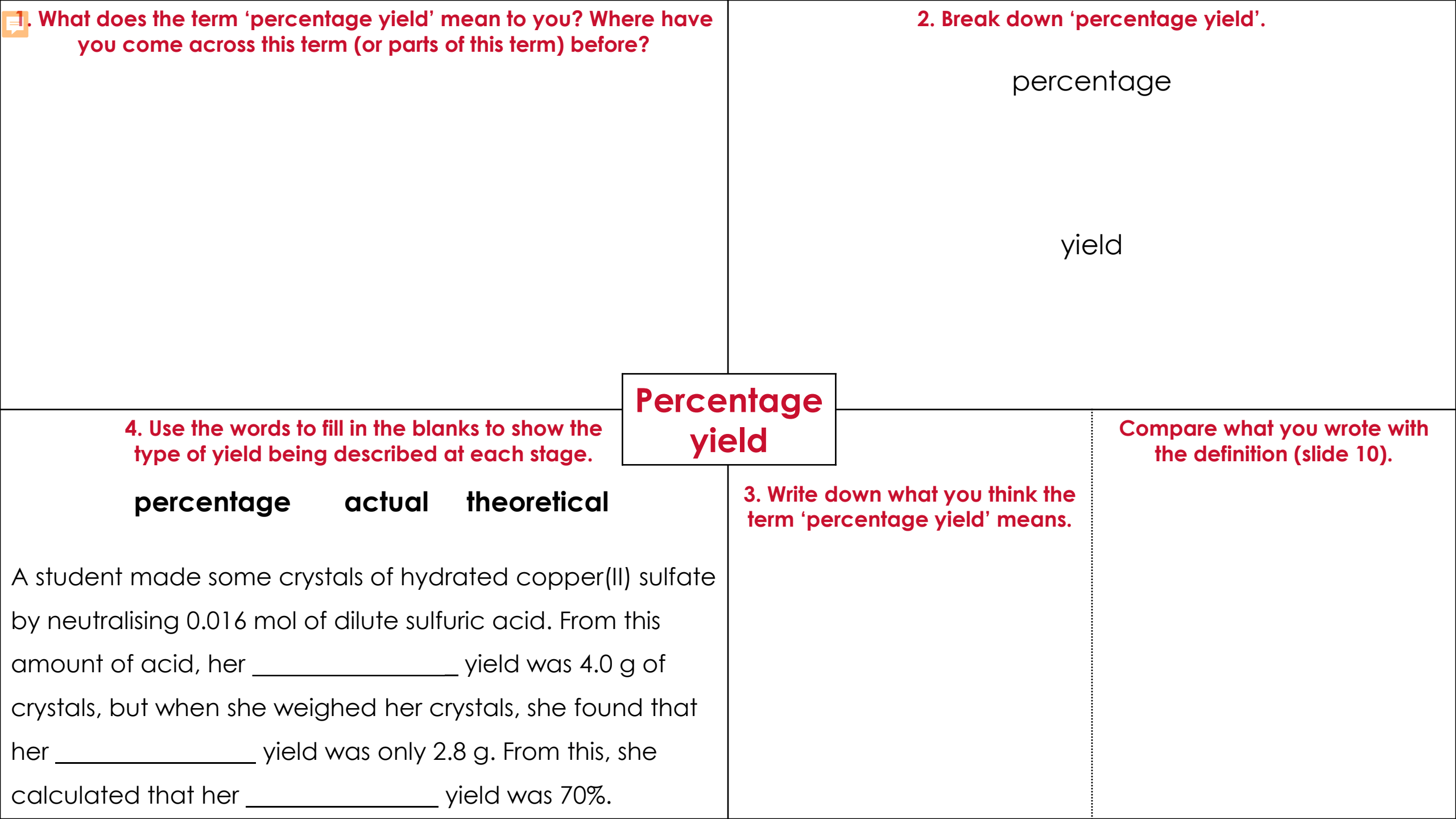
4. Circle the description that could describe the amount of helium in the balloon.



- A** It contains 0.4 g of helium.
- B** It has a volume of 2.4 dm<sup>3</sup>.
- C** It contains 0.1 mol of helium.
- D** All three descriptions above.

3. Write down what you think the term 'amount of substance' means.

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



1. What does the term 'percentage yield' mean to you? Where have you come across this term (or parts of this term) before?

2. Break down 'percentage yield'.

percentage

yield

Percentage yield

4. Use the words to fill in the blanks to show the type of yield being described at each stage.

**percentage      actual      theoretical**

A student made some crystals of hydrated copper(II) sulfate by neutralising 0.016 mol of dilute sulfuric acid. From this amount of acid, her \_\_\_\_\_ yield was 4.0 g of crystals, but when she weighed her crystals, she found that her \_\_\_\_\_ yield was only 2.8 g. From this, she calculated that her \_\_\_\_\_ yield was 70%.

3. Write down what you think the term 'percentage yield' means.

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

1. What does the term 'balanced symbol equation' mean to you?  
Where have you come across this term (or parts of this term) before?

2. Break down the term 'balanced symbol equation'.

'Balanced' suggests that something is the same on both sides – what is the same?

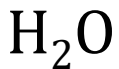
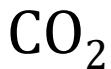
*The total number of atoms of each element and also the total mass.*

How is the word 'equation' used differently in maths and chemistry? *In maths, it is an expression or formula with an '=' sign showing how different quantities are related. In chemistry it shows the chemical formulas for the reactants and products separated by an arrow.*

## Balanced symbol equation

4. Here is a word equation for the complete combustion of methane. Arrange the chemical formulas given below to construct a balanced symbol equation for the reaction.

methane + oxygen → carbon dioxide + water



(There is no need to include state symbols.)

3. Write down what you think the term 'balanced symbol equation' means (below is the definition from the key terms list).

*For a chemical reaction this shows the chemical formulas of the reactants and products separated by an arrow. Whole numbers may be written before the formulas to balance the equation.*

Encourage learners to compare their attempted definition with this one.

1. What does the term 'relative atomic mass' mean to you?  
Where have you come across this word (or parts of this word) before?

2. Break down the term 'relative atomic mass'.

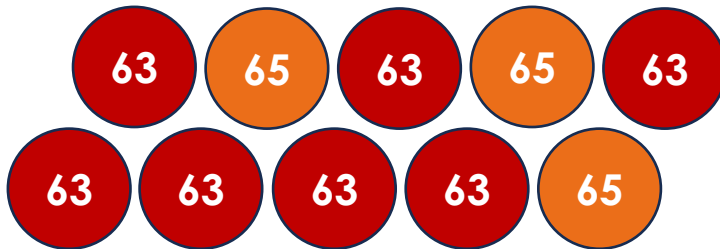
What does the adjective 'relative' mean?  
*One thing compared to something else. In this case atomic masses are compared to the approximate mass of a proton or neutron.*

Naturally occurring elements usually contain several isotopes, each with a slightly different mass. How can we calculate just one mass to represent all the isotopes?

*We can work out the average mass of an atom.*

## Relative atomic mass

4. The relative masses of ten copper atoms are shown below in their naturally occurring proportion.



The relative atomic mass of copper is:

- A less than 65.
- B** in between 63 and 65, but nearer to 63.
- C in between 63 and 65, but nearer to 65.
- D more than 65.

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

*The average mass of an atom of an element taking into account the naturally occurring percentages of its isotopes.*

Encourage learners to compare their attempted definition with this one.



 1. What does the term 'amount of substance' mean to you? Where have you come across this term (or parts of this term) before?

2. Break down 'amount of substance'.

amount

From the Middle English verb 'amounten' meaning to increase or add up to.  
Today it generally refers to the quantity of something.

substance

From Middle English it was first used to describe the essence of something.  
In chemistry it is used to refer to a particular solid, liquid or gas.

## Amount of substance

4. Circle the description that could describe the amount of helium in the balloon.



- A It contains 0.4 g of helium.
- B It has a volume of 2.4 dm<sup>3</sup>.
- C** It contains 0.1 mol of helium.
- D All three descriptions above.

3. Write down what you think the term 'amount of substance' means (below is the definition from the key terms list).

How many atoms, molecules or formula units are present in a sample of the substance, measured in moles (mol).

Encourage learners to compare their attempted definition with this one.

 1. What does the term 'percentage yield' mean to you? Where have you come across this term (or parts of this term) before?

2. Break down 'percentage yield'.

percentage

From the Latin 'percentum' meaning 'by the hundred'. It is a way of expressing the proportion of a whole in terms of hundredths.

yield

From the Anglo-Saxon 'geldan' meaning the idea of a reward or pay that is given. Today, the noun 'yield' refers to what you produce.

## Percentage yield

4. Use the words to fill in the blanks to show the type of yield being described at each stage.

**percentage**

**actual**

**theoretical**

A student made some crystals of hydrated copper(II) sulfate by neutralising 0.016 mol of dilute sulfuric acid. From this amount of acid, her theoretical yield was 4.0 g of crystals, but when she weighed her crystals, she found that her actual yield was only 2.8 g. From this, she calculated that her percentage yield was 70%.

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

The actual mass or amount of product, given as a percentage of the theoretical mass or amount of product you could make in a chemical reaction if no other reactions take place and nothing is lost.

Encourage learners to compare their attempted definition with this one.

## 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.