Representing chemical reactions

This resource is part of the **Structure strips** series of resources, designed to support literacy in science teaching. More resources in this series can be found at: rsc.li/4aXYgzt.

Learning objectives

1. Recall the definition of reactants and products.
2. Compare and contrast the features of word and symbol equations.
3. Interpret chemical formulas to balance symbol equations.

Introduction

Chemical reactions can be represented using word equations or balanced symbol equations. Word equations show the names of the reactants and the products separated by an arrow. Balanced symbol equations give more detail, showing the reactants and products, how they are bonded together and how mass is conserved by balancing the equation. Symbol equations also give detail about whether a substance is a solid, liquid, gas or is in solution (aqueous) through the presence of state symbols: (s), (l), (g) or (aq).

How to use structure strips

Structure strips are a type of scaffolding that support learners to retrieve information independently. Use them to take an overview at the start of a topic, to activate prior knowledge, or to summarise learning at the end of a teaching topic. Visit rsc.li/3EszCfr for more ideas on how to use structure strips with your learners.

Structure strips have sections containing prompts, sized to suggest the amount that learners must write. Ask learners to glue the strips into the margin of an exercise book and write their answers next to the sections, in full sentences or in bullet points. When learners have finished using the structure strip, they will have an A4 page set of notes and examples.

Scaffolding

- Encourage learners to use the suggested key words in their answers. These key words link with our key terms support resources for introducing chemical change, available at: rsc.li/3Rej6T9.
- Learners can support each other with think, pair, share activities to discuss answers prior to answering the questions.

- To further support learners, include additional prompts in the structure strip. If learners are struggling to engage with the task, supply them with sentence starters created from the example answers.
- As learners grow in confidence, ask them to attempt the extension task first and then use the structure strip to improve or self-assess their attempt.

Metacognition

This resource supports learners to develop their metacognitive skills in three key areas.

- **Planning:** the strips provide scaffolding to plan the written response. Learners will decide where to gather information from (textbooks, own notes, revision websites). Ask learners: is the source of information you are using reliable?
- **Monitoring:** learners are prompted by the questions in the structure strip and can check their own answer against the prompts. Ask learners: have you covered all of the prompts in the space provided? Do you need to change anything to complete the task?
- **Evaluation:** learners can self-assess or ask a peer to check their work against the answers. Ask learners: did you achieve what you meant to achieve? What will you do differently another time?

Example answers for the structure strip are on page 3.

Structure strip Representing chemical reactions	Example answer
Define the terms 'reactants' and 'products' in a chemical equation.	Reactants are substances that you start with in a chemical reaction. Products are new substances that are made in a chemical reaction.
Explain why symbol equations must be balanced. Use the key words to support your answer.	Symbol equations must be balanced to show that mass is conserved in a chemical reaction. Conservation of mass states that no atoms are lost or made during a chemical reaction, so the total mass of reactants equals the total mass of products.
Both word equations and symbol equations can be used to represent chemical reactions. Compare the equations below. What information does each equation give you? copper carbonate → copper oxide + carbon dioxide $CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$	Word equations give the names of the reactants involved, so in this case copper carbonate, and the products produced which are copper oxide and carbon dioxide. Symbol equations, however, give more detail, showing the atoms and how they are bonded together through chemical formulas. For example, that copper carbonate has one copper atom, one carbon atom and three oxygen atoms. Symbol equations also give detail about whether substances are solid, liquid, gas or are in solution (aqueous) through the presence of state symbols: (s), (l), (g) or (aq). In this equation copper carbonate and copper oxide are both solids, whereas carbon dioxide is a gas.
Part of a balanced symbol equation is shown below. Describe what this tells you, using the arrows to guide you. $2H_2O$	The large '2' before the formula shows how many of the whole molecule are needed to balance the equation, therefore there are two molecules of water. The H shows that the compound contains hydrogen and the O shows that the compound contains oxygen. The subscript '2' shows how many of that atom are within the molecule. This means that H_2O contains two hydrogen atoms and only one oxygen atom.

Extension question answers

The number of hydrogen, chlorine and oxygen reactants and products are all correct in the table. However, the number of calcium atoms in the reactants column is wrong. In the formula for $Ca(OH)_2$ the subscript '2' only refers to the elements in the brackets.

The correct tally is:

Element	Reactants	Products
H	III	II
Cl	I	II
Ca	I	I
O	II	I

Balanced symbol equations show how mass is conserved by balancing the equation.

The incorrect equation included in the learner question is:

$$HCl + Ca(OH)_2 \rightarrow CaCl_2 + H_2O$$

The correct balanced equation is below:

$$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$$

To balance the equation, learners need to add a large '2' before H_2O. This means they now have four hydrogens and two oxygens in the products. Learners then need to add a '2' in front of hydrogen chloride to mean that they now have four hydrogens in the reactants and two chlorines in the products. The equation is now balanced and mass is conserved.