

## Word equations











This resource is from the **Johnstone's triangle** series which can be viewed at: [rsc.li/43jMfSn](https://rsc.li/43jMfSn). In this series you will also find our Johnstone's triangle worksheet which introduces the triangle in the context of the reaction between sodium and chlorine: [rsc.li/4a40jml](https://rsc.li/4a40jml).

### Learning objectives

LO	Objective	Where assessed
1	Recognise what is and is not included in the word equation of a chemical reaction.	Q1
2	Write a word equation from a written description of a chemical reaction.	Q1, 2, 3
3	Link observations of a chemical reaction to the substances included in the word equation.	Q3, 4, 5

### How to use this resource

This resource aims to develop learners' understanding of word equations. The questions encourage learners to connect written descriptions and visual observations of chemical reactions to their representation with a word equation. As a result, learners should develop more secure mental models to support their thinking when representing chemical equations with word equations or when interpreting word equations presented to them.

<b>When to use?</b>	 Introduce	 Develop	 Revise	 Assess
	Use after initial teaching or discussion of this topic to develop ideas further. You can also use as a revision activity.			
<b>Group size?</b>	 Independent	 Small group	 Whole class	 Homework
	Suitable for independent work either in class or at home. Or use the questions for group or class discussions.			
<b>How long?</b>	 → 		15–30 mins	

## Johnstone's triangle

Johnstone's triangle is a model of the three different conceptual levels in chemistry: macroscopic, sub-microscopic and symbolic. You can use Johnstone's triangle to build a secure understanding of chemical ideas for your learners.

Find further reading about Johnstone's triangle and how to use it in your teaching at [rsc.li/494IFAY](https://rsc.li/494IFAY).

### Johnstone's triangle and this resource

The icons in the margin indicate which level of understanding each question is developing to help prompt learners in their thinking.



**Macroscopic:** what we can see. Think about the properties that we can observe, measure and record.



**Sub-microscopic:** smaller than we can see. Think about the particle or atomic level.



**Symbolic:** representations. Think about how we represent chemical ideas including symbols and diagrams.

The levels are interrelated, for example, learners need visual representation of the sub-microscopic to develop mental models of the particle or atomic level. Our approach has been to apply icons to questions based on what the learners should be thinking about.

Questions may be marked with two or all three icons, indicating that learners will be thinking at more than one level. However, individual parts of the question may require learners to think about only one or two specific levels at a time.

## Support

This worksheet is ramped so that the earlier questions are more accessible. The activity becomes more challenging in the later questions. You can give extra explanations for the more challenging questions. If completing as an in-class activity it is best to pause and check understanding at intervals, as often one question builds on the previous one.

It is useful for learners to observe macroscopic properties first hand. You could circulate examples of substances in the classroom, run a class practical of a chemical reaction or show a teacher demonstration of properties. For full instructions and safety information, see the suggested practicals in the guidance notes for each question.

Additional support may be needed for any learners still lacking in confidence in the required symbolic representation, for example by sharing and explaining a diagram or a simulation that can show movement of the particles.

## Answers



1. *Guidance note:* This question develops learners' understanding of how to express a written description of a chemical reaction (macroscopic understanding) as a word equation (symbolic understanding). In particular the questions support learners to understand what is, and is not, included in a word equation as well as why an arrow and not an equals sign is used.

To demonstrate this reaction for learners try our **Iron and sulfur reaction** class practical, which includes instructions and safety information: [rsc.li/3LVXGeC](https://rsc.li/3LVXGeC)

- (a) Some powdered iron is heated with some yellow sulfur powder. Black iron sulfide is formed.
- (b) iron + sulfur → iron sulfide
- (c) The sulfur is yellow and powdered.
- (d) Heat is not a substance and so it is not included as a reactant.
- (e) The arrow indicates a change. The products are not equal to the reactants.



2. *Guidance note:* This question continues to develop learners' understanding of how to express a written description of a chemical reaction (macroscopic understanding) as a word equation (symbolic understanding). In particular, this question supports learners' understanding of reactions in air and how the reactant that should be included in the word equation is oxygen.

Safety information and equipment for demonstrating this reaction to learners can be found in our class practical **The change in mass when magnesium burns:** [rsc.li/3LXAdtr](https://rsc.li/3LXAdtr)

- (a) magnesium
- (b) oxygen
- (c) magnesium oxide
- (d) magnesium + oxygen → magnesium oxide



3. *Guidance note:* This question supports learners' understanding of how to express diagrammatic observations of a chemical reaction (macroscopic understanding) as a word equation (symbolic understanding). This question also supports learners to recognise that oxygen may be a reactant, even if it cannot be observed.

To demonstrate this reaction for learners try our **Heating copper in air** class practical, which includes instructions and safety information: [rsc.li/3Yro7eN](https://rsc.li/3Yro7eN)

- (a) copper
- (b) copper oxide
- (c) oxygen
- (d) copper + oxygen → copper oxide



4. *Guidance note:* This question support learners' understanding of how to connect a word equation (symbolic understanding) to observations of a chemical reaction in order to give descriptions of the reactants and product (macroscopic understanding). This question supports learners' understanding of the idea that not all products of a reaction may be visible (in this case carbon dioxide gas).

- (a) Green
- (b) Black
- (c) Carbon dioxide is a colourless gas that is released into the air.
- (d) The carbon dioxide is observed as bubbles.



5. *Guidance note:* This question supports learners' understanding of how to connect a word equation (symbolic understanding) to a written description of a chemical reaction (macroscopic understanding) in order to name the different substances described. The question also supports learners to understand that an observation of smoke connects to the formation of a solid substance (but that it is produced as tiny fragments).

Watch a demonstration of this reaction, including instructions and safety information, in our *Exhibition chemistry* video, **That's a salt:** [rsc.li/3UW6BQz](https://rsc.li/3UW6BQz)

- (a) chlorine
- (b) sodium chloride
- (c) sodium