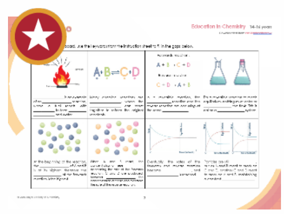
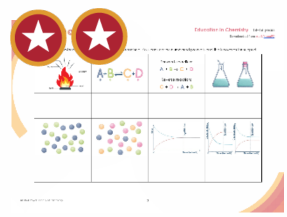
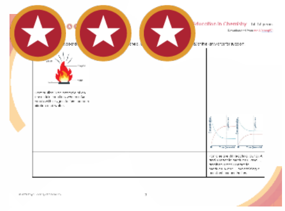
Reaching dynamic equilibrium: storyboard

This resource accompanies the article **Teaching equilibrium and reversible reactions** in *Education in Chemistry* which can be viewed at: rsc.li/4bcqPZI

Learning objectives

1. State what a reversible reaction is.
2. Describe how a reversible chemical reaction reaches dynamic equilibrium.

Resource components

			
Slides, including starter, prompts and answers to the student worksheet	**Student storyboard worksheet** – three levels of support: Fully scaffolded (one star in header), partially scaffolded (two stars) and unscaffolded (three stars).		

How to use the resource

'True or false' activity

The 'true or false' activity is common to all levels of worksheet and learners can use it to check their understanding before or after completing the storyboard. Learners can self-assess their answers. If using before the storyboard activity, you can use learners' answers to gauge the level of support they need to complete the storyboard.

Storyboard activity

Ask learners to create a storyboard using images and text to describe how chemical reactions reach dynamic equilibrium. Provide different combinations of the worksheet and support sheet to offer a range of scaffolding options. The finished storyboard will be the same for all levels of support.

Scaffolding

The storyboard activity is available at three levels:

- **Fully scaffolded** ✪
  This is a cloze activity. Learners choose from the keywords provided to complete the written description beneath each illustration. Provide learners with a version with all the illustrations, ask learners to draw their own illustrations, or give them a sheet of illustrations to choose from to complete the storyboard.
- **Partially scaffolded** ✪✪
  Ask learners to write their own descriptions beneath the illustrations. Prompts and keywords are provided on the instruction sheet.
- **Unscaffolded** ✪✪✪
  Ask learners to write their own descriptions and draw their own illustrations. Prompts are provided on the instruction sheet. Keywords and illustrations are available separately on an optional support sheet. Get learners to attempt the worksheet without the additional support first and ask for it if needed.

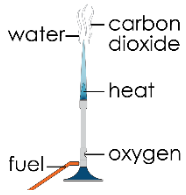
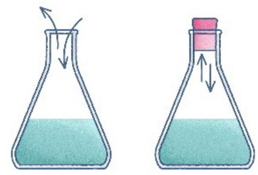
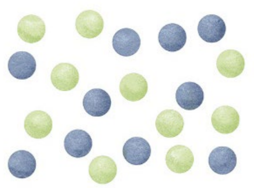
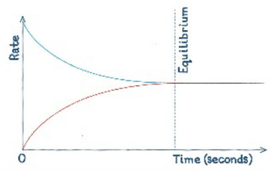
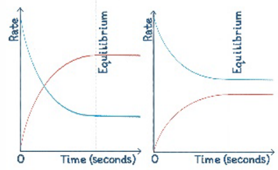
Answers

True or false?

1. Combustion is an example of an irreversible reaction. **True**
2. The symbol for a reversible reaction is →. **False**
3. Products must be allowed to leave the flask in a reversible reaction. **False**
4. A reversible reaction can only reach equilibrium in a closed system. **True**
5. A reaction at equilibrium has stopped. **False**
6. At equilibrium, the rate of the forwards reaction is equal to the rate of the reverse reaction. **True**
7. If a reaction is at equilibrium, it means that all reactants have been fully converted into products. **False**
8. A system at equilibrium will show measurable changes in the concentrations of reactants and products over time. **False**
9. If the forwards reaction is exothermic, then the reverse reaction will be endothermic. **True**

Storyboard

Words picked out in bold red are the answers to the cloze version in the fully-scaffolded student sheet.

		Forwards reaction: A + B → C + D Reverse reaction: C + D → A + B	
Combustion is an example of an **irreversible** reaction, where a fuel reacts with **oxygen** to form **carbon dioxide** and water.	Many chemical reactions are **reversible**, where the **products** can react together to reform the original reactants.	In a reversible reaction, the **forwards** reaction and the reverse reaction are occurring at the same **time**.	For a reversible reaction to reach equilibrium, nothing must be able to enter or **leave/escape** the flask. This is called a **closed** system.
			
At the beginning of the reaction, the **concentrations** of A and B are at their highest, therefore the **rate** of the forwards reaction is the highest.	When A and B react, their concentrations **decrease**, decreasing the rate of the forwards reaction. The reaction produces C and D so their concentrations **increase**, increasing the rate of the reverse reaction.	Eventually, the rates of the forwards and reverse reaction become **equal**, and equilibrium is **reached**.	Particles are still **reacting**, but as A and B react to produce C and D, another C and D react to produce A and B, maintaining a constant **concentration**.