

Teaching ideas – complete

Education in Chemistry

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rsc.li/EiC617-catalysts-get-helping-hands

These teaching ideas accompany the above article 'Catalysts get helping hands'.

In your class

Catalysis is a core topic in secondary school chemistry. Many of the catalysts pupils study will appear to belong to old-fashioned chemistry (eg, the Haber and Contact processes) and students may consider enzymes as firmly within a box marked 'biology'. This article provides a useful introduction to the most up to date research in catalysis that shows catalytic processes are constantly improved and evolved. There is a bewildering array of different demonstrations and whole class investigations for this topic. So, in the attached resources we have signposted some favourites, including tried and tested ones from Learn Chemistry.

Download the text of this article, and all the related teaching resources, worksheets and experiments from the Education in Chemistry website: rsc.li/EiC617-catalysts-get-helping-hands

Busting gender myths

(Draw a scientist homework, primary and ages 11–14)

The first paragraph of this article is powerful for busting gender myths in STEM. Elizabeth Fulhame's work was almost forgotten until recently. A great first homework for ages 11–14, or even primary pupils, is to get them to draw a scientist. When collected in, discuss what stereotypes have arisen. Despite the progress made in the visibility of women in STEM in recent years it is still likely that pictures will be caricatures of white, old men with crazy hair and white coats.

Follow up with some display work showcasing the diversity of science and scientists beyond the famous men represented in textbooks. Students can turn scientist profiles into LEGO® minifigures.

This year [scientists took to Twitter](https://bit.ly/2fCHQD2) (bit.ly/2fCHQD2) to show the range of their work. The hashtag #reallivingscientist when combined with #dresslikeawoman brings up a wide range of female scientists. In addition, '[Not all chemists wear white coats](#)', and '[Faces of Chemistry](#)' within Learn Chemistry are useful research resources: rsc.li/whitecoats; rsc.li/faceschemistry.

Download a LEGO® minifigure handout for students to design their scientist profiles from the Education in Chemistry website: rsc.li/EiC617-catalysts-get-helping-hands

Catalysis in exams

(Exam style practice questions, ages 14–16)

Catalysis is a commonly assessed concept in GCSE and National 5 examinations. This resource includes a number of different question types for the topic and is suitable for a classwork or revision exercise. Also included is a 'level of response' question, similar to those included in the new GCSE assessments.

Download the worksheet of six exam style questions for students and the answers sheet from the Education in Chemistry website: rsc.li/EiC617-catalysts-get-helping-hands

Decomposition of hydrogen peroxide demonstration

(Comparing catalysts with elephant's toothpaste, ages 11–14 and 14–16)

The decomposition of hydrogen peroxide is a classic demonstration which can be used to compare catalyst effectiveness when time and logistics mean a whole class investigation is impractical. The reaction forms the basis of the demonstration known as 'elephant's toothpaste'. Mix hydrogen peroxide in a measuring cylinder with washing up liquid and add a catalyst. The hydrogen peroxide decomposes to oxygen and water, producing bubbles which make the mixture shoot up the measuring cylinder.

Using the above article, 'Catalysts get helping hands' as a stimulus, compare traditional chemical catalysts (like potassium iodide, manganese dioxide and iron(III)oxide) and enzyme based catalysts found in yeast, lettuce, potato, liver, and blood.

Emphasise to pupils that the hydrogen peroxide is decomposing without any catalyst, but very slowly. The catalysts added just speed it up. A common misconception is that added catalysts make the reaction happen, rather than making an existing reaction happen quicker (in this case, much quicker). This demonstration also provides a useful opportunity to revisit the test for oxygen: a glowing splint placed near the top of the foam should relight.

This demonstration is simple and effective, but it is worth practising beforehand as hydrogen peroxide can be temperamental. Quantities found in guidance documents may need adjusting depending on the age of your hydrogen peroxide and where it has been stored.

Suggested lesson order

1. Demonstrate the reaction and prompt pupils to suggest ways the best catalyst could be judged.
2. Carry out the series of reactions with pupils recording their observations on the pupil sheet provided as you go along.
3. Give pupils copies of the article 'Catalysts get helping hands' to help them complete the follow up questions

Further guidance

The *Decomposing hydrogen peroxide* article (rsc.li/hydrogenperoxidedemo) and Learn Chemistry (rsc.li/H2O2decompose) give further guidance for this demonstration. Additionally, Learn Chemistry has a [class practical resource for detecting the presence of enzymes](#) in liver, potato and celery: rsc.li/detecting-enzymes-practical.

Download the student handouts from the Education in Chemistry website: rsc.li/EiC617-catalysis.

More demonstrations

Sodium thiosulfate and hydrogen peroxide (ages 14–16 for catalysis concepts, ages 11–14 and 14–16 for acids and alkalis concepts)

rsc.li/learn-chemistry-H2O2sodiumthiosulfate

If you don't have time to carry out a full class investigation of catalysis, this demonstration of the reaction between sodium thiosulfate and hydrogen peroxide is simple and quick. Demonstrate the uncatalysed reaction and get pupils to time it. Then repeat the demonstration with the addition of the catalyst, ammonium molybdate. The reaction is carried out in alkaline conditions and sulfuric acid is produced as the reaction proceeds. So, the reaction progress is easily followed with the addition of universal indicator. This also gives an opportunity to revisit ideas about pH and indicators with older groups or demonstrate neutralisation to younger pupils.

Catalysts for the thermal decomposition of potassium chlorate (ages 14–16)

[rsc.li/learn-chemistry-potassiumchlorate](https://www.rsc.li/learn-chemistry-potassiumchlorate)

This demonstration is trickier to carry out but has the added advantage of showing that the catalyst is not used up, which can be difficult to demonstrate with the aqueous reactions usually used in class. Demonstrate the uncatalysed reaction and one catalysed reaction only if there is no time to demonstrate all three, which takes around 30 minutes.

Tartrate and hydrogen peroxide catalysed by cobalt ions (ages 14–16 and 16–19)

[rsc.li/learn-chemistry-H2O2Cobalt](https://www.rsc.li/learn-chemistry-H2O2Cobalt)

This is another striking demonstration which is particularly suitable for 16-19 as it provides an opportunity to discuss transition metal catalysis and the colours associated with cobalt complexes. Students can be presented with a reaction scheme for the demonstration and predict the colour changes from their prior knowledge.

Whole class investigations

(Ages 14–16)

A wide range of experiments investigating catalysis are available on the Learn Chemistry website. Here are two which are particularly effective and easily done in a single lesson. The article 'Catalysts get helping hands' makes useful reading before experimental work.

Comparing the effectiveness of different transition metal ions as catalysts

[rsc.li/learn-chemistry-transition-catalysts](https://www.rsc.li/learn-chemistry-transition-catalysts)

This experiment is particularly effective for a whole class practical, giving reliable results in 25–30 minutes.

Copper catalysis of the reaction of zinc and sulfuric acid

[rsc.li/learn-chemistry-zinc-sulfuric-acid](https://www.rsc.li/learn-chemistry-zinc-sulfuric-acid)

This experiment is useful for a whole class practical when time is limited as it uses small quantities of reagents. All three reactions can be carried out at once. A disadvantage is no quantitative results. However, this limitation could be discussed in follow-up questions evaluating the experiment.

Science club activity

(Enzymes and jellies, ages 11–14 and primary)

[rsc.li/learn-chemistry-enzymes-jellies](https://www.rsc.li/learn-chemistry-enzymes-jellies)

This kitchen chemistry activity provides an excellent opportunity to explore enzymes in everyday life. Pupils can do this in a science club or even at home.

Relevant to your syllabus

England

- AQA chemistry ([4.6.1.2 Factors which affect the rates of chemical reactions](#); [4.6.1.4 Catalysts](#))
- AQA synergy ([4.7.4.6 Catalysts](#))
- AQA trilogy ([5.6.1.2 Factors which affect the rates of chemical reactions](#); [5.6.1.4 Catalysts](#))
- Edexcel chemistry ([Topic 7, rates of reaction, 7.6, catalysts](#))
- Edexcel combined science ([Topic 7, rates of reaction, 7.6, catalysts](#))
- OCR Gateway A Chemistry ([5.2f Controlling reactions](#))
- OCR 21st Century B Chemistry ([6.2 How do chemists control the rate of reactions](#); [6.3 What factors affect the yield of chemical reactions?](#))

International

- IB (6.1 Collision theory and rates of reaction; 16.1 Rate expression and reaction mechanism; A.3 Catalysts)
- Cambridge iGCSE (0620 [7.2 Rate \(speed\) of reaction](#))

NI

- CCEA chemistry ([Unit 2.3.5, rates of reaction, page 28](#); [unit 7.1, cross-curricular skills \(communication\) page 50](#))
- CCEA Double ([Unit 2.3, rates of reaction](#), page 57)
- CCEA Single ([Unit 2.9, rates of reaction](#), page 28)

Rol

- Leaving certificate ([6.2 Factors affecting rates of reaction](#))

Scotland

- SQA Nat 4 and 5 Chemistry ([1 Chemical change and structure](#))

Wales

- WJEC Chemistry ([1.5 Rate of chemical change](#))
- WJEC Double ([3.4.1 Controlling chemical reactions](#))
- WJEC Single ([2.2.1 Controlling chemical reactions](#))

Will you use this article and resources with your students? What would make it more useful to you in the classroom? Let us know: eic@rsc.org
