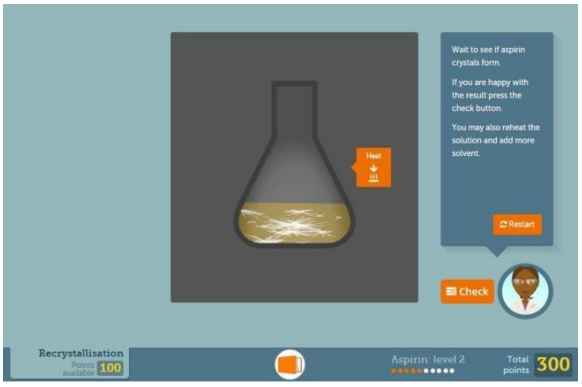
Aspirin screen experiment teacher notes

The Royal Society of Chemistry's aspirin screen experiment is a freely available digital resource. It is designed to enhance students understanding of organic chemistry and improve practical skills. The interactive screen experiments enable students to undertake an aspirin synthesis, perform recrystallisation, thin layer chromatography and modify experimental conditions to determine the effect on yield.



Important technical information

This resource has been developed using the latest HTML5 technology. The advantage is that this will work without any plug-ins or installations. However you will need to ensure you are using a modern browser like Internet Explorer 10+, Chrome or Firefox. The product will also work on touch screen devices like Android tablets using a Chrome browser and iPads using the Safari browser.

This product will not work on old browsers such as Internet Explorer 8 and 9 and the screen size is not responsive meaning it is not optimised for use on smartphones.

Making aspirin doesn't have to be a headache

Target pupil level: Key stage 5 / Scottish Credit and Qualifications Framework level 7 (A-Level / BTEC / Advanced Highers) and also suitable for Key Stage 4 – 5 transition.

Levels 1 and 2 covers the skills required for the preparation of a pure organic solid. Levels 1 to 3 are suitable for SCQF 6 Higher pupils who would also find the activity highly relevant although some teacher support may be required.

The resource is divided into 4 levels, each of which are estimated to take a student approximately 30 minutes to complete either as homework or as an in class activity.

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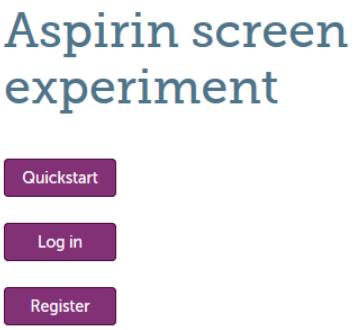
Levels 1 and 2 are ideal pre-lab activities which have the advantage of introducing the experiment to the student. This unique learning opportunity is designed to make it easier for the student to take part in the real class practical which currently without this prior knowledge can feel rushed with objective unclear.

Levels 3 and 4 are designed as ideal post-lab activities which allow students to investigate the effects of varying the conditions and reagents in order to optimise the reaction. It is based on real experimental data and so is an excellent enquiry tool for students to make guided discoveries.

Register for free to save your progress

One of the real advantages of this resource is the option to register and log in. Once logged in the user will see their scores, personal badges and can download their unique lab book anytime. Please note only one lab book is saved per level so if a user decides to repeat to improve their skills the existing lab book is overwritten. If you want to keep all your lab books it is recommended that you download or print them.



You can also register after using quickstart as the register button remains at the top right of the header bar during the activities.

Registration numbers are 10 digit numerical codes. We recommend students keep these safe and private although no personal information is linked to the accounts.

Teachers can quickly register classes by using the register class button. From there teachers can print multiple copies of the class registration numbers and cut these into strips for each student. If teachers keep a record of the registration numbers they can check completed homework themselves online. Alternatively students can print/save electronic lab books as a revision aid.

At the end of each level there is a review section for students to reflect on their progress and draw conclusions. It is expected that these reviews will be shown to a teacher so that more specific learning and understanding can be discussed. The lab books can be downloaded as pdf files or printed so there are many ways in which these can be shared with teachers.

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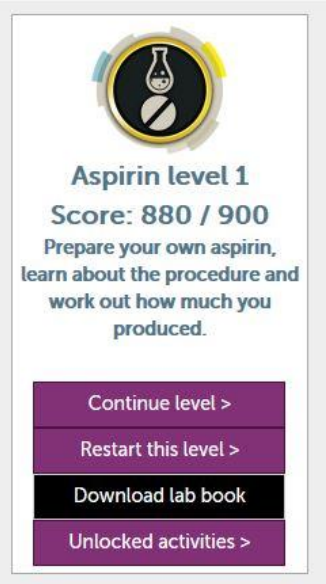
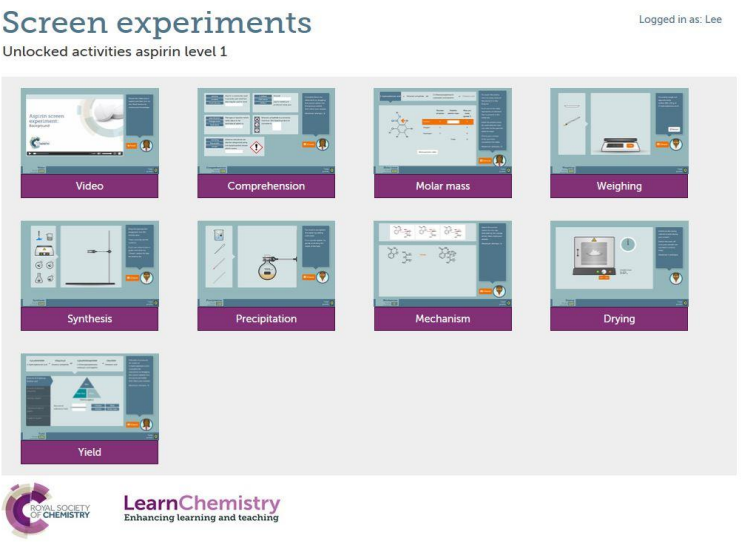
Unlock activities for classroom use

One of the newest features, as requested by you our teacher users, has been the 'unlock activities feature'. This provides easy access to the activities within the levels for a brief classroom demonstration.

To make use of this feature a teacher would need to:

- Create an account and make a note of it for the future
- Whilst logged in complete (or get a student to complete) any level of the screen experiment
- Done – that account will now have the extra 'unlocked activities button' which gives you access to all the activities from that level





All the accounts created by the screen experiment system are the same. We cannot provide the 'unlocked activities' upfront as this would prevent the use of the scoring and badging system as part of the design of the screen experiments, which is a student based pre-lab homework introduction to class practicals.

A-Level, BTEC and Advanced Highers curriculum coverage

This resource provides opportunities for reinforcement of the following curriculum areas:

- Organic synthesis techniques (heating under reflux, vacuum filtration and recrystallisation).
- Organic reaction mechanisms.

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- Amount of substance calculations (n = m/Mr).
- Percentage yield.
- Thin layer chromatography and R_f values.
- Effect of temperature and catalysts on rate of reaction.

Level 1 – Aspirin synthesis

This level provides some background context and guides the user through the steps required to synthesise aspirin. It may be used as a pre-lab exercise to familiarise students with the reaction they are going to be undertaking and how to set up the equipment or as post-lab exercise to reinforce the learning.

Practical skills developed:

i) Using a balance to weigh out solids and liquids.

ii) Heating under reflux.

iii) Precipitation and drying of product.

Key learning outcomes:

i) Reinforce ideas of relative atomic mass, molar mass and percentage yield with step by step calculations for the compounds involved in the reaction.

ii) Organic reaction mechanisms. Pupils develop their understanding of organic chemistry mechanisms (*e.g*. the meaning of a curly arrow) by completing the mechanism for aspirin synthesis. Whilst it is recognised that this is not a mechanism required by A-level syllabuses, it provides an excellent opportunity to develop understanding of reaction mechanisms and apply this knowledge within a less familiar context.

Level 2 – Aspirin purification

This level explores ideas of polarity in molecules and guides the user through the steps required to purify the sample of aspirin.

Practical skills developed:

i) Recrystallisation and Buchner filtration.
ii) Thin layer chromatography.

Key learning outcomes:

i) Reinforce ideas relating to polarity in molecules and non-polar and polar solvents. Students explore the polar nature of the aspirin molecule and relate this to the purification process.

ii) Amount of substance, yield and R_f calculations. Students calculate the percentage yield for the purified aspirin and compare this to the value for the crude product.

iii) Thin layer chromatography. Students produce a TLC plate and calculate an R_f value for the product.

Level 3 – Varying reaction conditions

This level explores the effect of varying reaction time, temperature and catalyst to determine optimum reaction conditions.

Key learning outcomes:

i) The effect of temperature on the rate of reaction (the Boltzmann distribution) and yield.

ii) The effect of reaction time on yield.

iii) The role of catalysts in the reaction.

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Level 4 – Alternative reagents

This level explores alternative reagents for aspirin synthesis and their viability on an industrial scale. It is intended as an extension exercise to enable students to broaden their chemical knowledge.

Key learning outcomes:

i) An understanding of the chemical similarities and differences between potential reagents and characteristics of a good leaving group. For resources providing further explanation about the concept of "a good leaving group" please see the links below.

ii) An understanding of significant factors for consideration when selecting a reagent for industrial production.

Further information

Complete aspirin synthesis resource	http://www.rsc.org/learn-chemistry/content/filerepository/CMP/00/000/045/Aspirin.pdf
The reactions of different reagents	http://www.chemguide.co.uk/organicprops/anhydrides/oxygen.html
Good leaving groups	http://www.masterorganicchemistry.com/2011/04/12/what-makes-a-good-leaving-group/ http://www.chemgapedia.de/vsengine/vlu/vsc/en/ch/12/oc/vlu_organik/substitution/sn_2/sn_2.vlu/Page/vsc/en/ch/12/oc/substitution/sn_2/abgangsgruppen/abgangsgruppe.vscml.html

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