GCSE Science Practical Support Guide

It is important to do practicals with your students where possible in these challenging circumstances. This guide lists the OCR suggested practical activities and provides additional activities and resources suitable for each practical activity group (PAG). The past paper practical questions on [ExamBuilder](https://exambuilder.ocr.org.uk/marketing/Security/login) can be used to reinforce your students’ learning and prepare them for the exams.

This guide has been provided to help with delivery of the course where some practical activities are not possible. This guide is also a useful revision or homework resource for students.

Students are tested on practical skills in the examinations. In addition to using the appropriate apparatus and techniques in practical activities, it is important to practice skills such as identifying variables, safety features, how to write a conclusion etc. For more detail about the skills required, please see the Working Scientifically section of the Gateway specifications and the Ideas about Science section in the 21st Century Science specifications.

CLEAPSS has produced [guidelines](http://science.cleapss.org.uk/Resource-Info/GL343-Guide-to-doing-practical-work-during-the-COVID-19-Pandemic-Science.aspx) for carrying out practical work safely at this time, as well as guides to carrying out a practical in a classroom. The guidelines are updated frequently.

# Biology

| **Practical Activity Group (PAG) activity\*** | **Apparatus and techniques that the practical must use or cover** | **Examples of other suitable biology practical activities and alternative support resources** |
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| **B1**  Microscopy  [Suggestion 1](https://www.ocr.org.uk/Images/309171-pag-activity-biology-microscopy-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/419677-pag-activity-biology-microscopy-suggestion-2.docx) | Use of appropriate apparatus, techniques and magnification, including microscopes, to make observations of biological specimens and produce labelled scientific drawings7 | This virtual microscope [simulation](http://www1.udel.edu/biology/ketcham/microscope/scope.html) goes through the steps of using a microscope, allowing students to carry out the steps.  This Cambridge International [experiment](https://learning.cambridgeinternational.org/classroom/course/view.php?id=3902) includes a video, virtual experiment and quiz. It covers both cheek cell and onion cell slides.  This [video](https://www.youtube.com/watch?v=SX6mow1AExI) details how a microscope works, how to create a slide and how to measure cell size. |
| Use of appropriate apparatus to make and record a range of measurements accurately,  including length, area, mass, time, temperature, volume of liquids and gases, and pH 1 |
| **B2**  ***(separate science only)***  Testing for biological molecules  [Suggestion 1](https://www.ocr.org.uk/Images/310656-pag-activity-biology-testing-for-biological-molecules-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/379274-pag-activity-biology-testing-for-biological-molecules-suggestion-2.docx)  [Suggestion 3](https://www.ocr.org.uk/Images/419678-pag-activity-biology-testing-for-biological-molecules-suggestion-3.docx) | Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 | Cambridge International have produced a series of [resources](https://learning.cambridgeinternational.org/classroom/course/view.php?id=3648) to support teaching testing for biological molecules. The resources include an interactive virtual experiment, a teacher walkthrough, and a follow up quiz.  This [video](https://www.youtube.com/watch?v=13H1urX3gxI) goes through the steps of food tests, covering: Benedicts Test; Iodine Test; Biuret Test; Sudan III Test; and the Emulsion test.  This is a longer [video](https://www.youtube.com/watch?v=akMLGbNA0gE) from Malmesbury Education, covering: Benedicts Test; Iodine Test, Ethanol Test; Biuret test. It also goes through a results analysis, and explains why results have been seen. |
| Use of appropriate techniques and qualitative reagents to identify biological molecules and processes in more complex and problem-solving contexts including continuous sampling in an investigation. |
| **B3**/**B2**  Sampling techniques  [Suggestion 1](https://www.ocr.org.uk/Images/324538-pag-activity-biology-sampling-techniques-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/324539-pag-activity-biology-sampling-techniques-suggestion-2.docx)  [Suggestion 3](https://www.ocr.org.uk/Images/449188-pag-activity-biology-sampling-techniques-suggestion-3.docx) | Application of appropriate sampling techniques to investigate the distribution and abundance of organisms in an ecosystem via direct use in the field (to include: biotic and abiotic factors) | An online random sampling [[practical](https://www.stem.org.uk/resources/elibrary/resource/83457/online-ecology-one-measuring-abundance-and-random-sampling)](https://www.saps.org.uk/secondary/teaching-resources/258-ecology-practical-1-measuring-abundance-and-random-sampling) created by SAPS, giving students opportunity to practice the technique. Students use random sampling techniques to measure the abundance of different species in a grassland area.  This second online sampling [practical](https://www.saps.org.uk/secondary/teaching-resources/127-ecology-practical-distribution-of-species-and-fieldwork-sampling) from SAPS gets students to investigate the distribution of species across a footpath. This allows them to see how systematic sampling can be used. It also includes suggestions for how to carry out the activity. |
| Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH 1 |
| **B4**/**B3**  Rates of enzyme-controlled reactions  [Suggestion 1](https://www.ocr.org.uk/Images/312977-pag-activity-biology-rates-of-enzyme-controlled-reactions-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/428737-pag-activity-biology-rates-of-enzyme-controlled-reactions-suggestion-2.docx) | Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 | This BBC Bitesize [video](https://www.bbc.co.uk/teach/class-clips-video/science-biology-gcse-explain-this-effect-of-ph-on-enzyme-activity/zk73gwx) looks at the effect of pH on enzyme activity. It includes teacher notes and suggested activities to use alongside and after watching the video.  This [virtual experiment](http://glencoe.mheducation.com/sites/0078695104/student_view0/unit2/chapter6/virtual_labs.html) allows data to be collected when the pH and substrate concentration is varied in an enzyme controlled reaction.  This [resource](https://learning.cambridgeinternational.org/classroom/course/view.php?id=3636) from Cambridge International outlines investigating the effect of temperature on the rate of an enzyme-catalysed reaction. It includes a virtual experiment, teaching pack and safety information.  This BBC bitesize [revision page](https://www.bbc.co.uk/bitesize/guides/zwnstv4/revision/5) looks at the effect of temperature on enzyme activity. It goes through the method, results and control variables. This could be useful for students to be able to practice practical skills, such as identifying variables, as well as familiarising themselves with a method and expected results. |
| Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes3 |
| Measurement of rates of reaction by a variety of methods including production of gas, uptake of water and colour change of indicator5 |
| Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH 1 |
| **B5**/**B4**  Photosynthesis  [Suggestion 1](https://www.ocr.org.uk/Images/340064-pag-activity-biology-photosynthesis-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/360175-pag-activity-biology-photosynthesis-suggestion-2.docx)  [Suggestion 3](https://www.ocr.org.uk/Images/458996-pag-activity-biology-photosynthesis-suggestion-3.docx) | Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes3 | This virtual [photosynthesis experiment](https://www.reading.ac.uk/virtualexperiments/ves/preloader-photosynthesis-full.html) from the University of Reading allows students to measure the rate of photosynthesis in pondweed under different light intensities.  Cambridge International have produced an [online experiment](https://learning.cambridgeinternational.org/classroom/course/view.php?id=2994), including videos, a teach walkthrough, a virtual experiment and quiz to follow up with. It again looks at how different light intensities affect the rate of photosynthesis in pondweed.  This [phototropism activity](https://www.saps.org.uk/secondary/teaching-resources/1238) from SAPS could be used with students, getting them to especially consider the safe and ethical use of living organisms to measure responses to the environment.  This [activity](https://serc.carleton.edu/sp/mnstep/activities/26481.html) can be used with students to practice designing an experiment. Teachers or technicians could carry out the practical (either as a demonstration or between lessons) following students’ instructions, and then give them the data to practice analysis with. The principles in this activity could be applied to many practicals. |
| Safe and ethical use of living organisms (plants or animals) to measure physiological functions and responses to the environment4 |
| Measurement of rates of reaction by a variety of methods including production of gas, uptake of water and colour change of indicator5 |
| Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 |
| Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH 1 |
| **B6**  ***(separate science only)***  Physiology, responses, respiration  [Suggestion 1](https://www.ocr.org.uk/Images/338624-pag-activity-biology-physiology-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/449189-pag-activity-biology-physiology-suggestion-2.docx) | Safe and ethical use of living organisms (plants or animals) to measure physiological functions and responses to the environment4 | This website contains [instructions](https://www.scientificamerican.com/article/bring-science-home-heart-rate-excercise/) to carry out an investigation into how exercise affects heart rate. This investigation can be done at home. There are prompt questions that you can use with students whether the investigation is carried out or not.  [Maths is fun](https://www.mathsisfun.com/games/reaction-time.html) has an online reaction time test. Students carry out the test 5 times, and an average is calculated. Students could share results with the class and use these to plot graphs and practice analysis skills.  This [video](https://www.youtube.com/watch?v=b4MWrb9B0IU) from the Royal Society shows the effect of exercise on the heart rate of an elite athlete, and how it is measured.  This [video](https://www.youtube.com/watch?v=-Q406ha2Lh8) shows how a heart rate can change from resting through different types of exercise. It also shows that the heart rate takes time to return to normal. |
| Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 |
| **B7**/**B5**  Microbiological techniques  [Suggestion 1](https://www.ocr.org.uk/Images/310655-b5-microbiological-techniques-suggestion-one.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/459132-pag-activity-biology-microbiological-techniques-suggestion-2.docx) | Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes3 | This [video](https://www.youtube.com/watch?v=sI2Dp5fNdDY) from Malmesbury Education shows the method for investigating the effect of antibiotic discs on bacterial growth. It also goes through an analysis of results.  This [BBC Bitesize](https://www.bbc.co.uk/bitesize/guides/z8fkmsg/revision/7) page gives the method for setting up a bacterial plate and the method for investigating factors that affect bacterial growth. All steps contain a reason why that particular step is needed.  This [video](https://www.youtube.com/watch?v=cuCSELaQ_Go) goes through safety and aseptic techniques in detail.  This Cambridge International [experiment](https://learning.cambridgeinternational.org/classroom/course/view.php?id=2998) demonstrates how disease can spread. It makes use of microbiological techniques, and includes a video, teacher walkthrough, teaching pack and quiz.  This [virtual experiment](http://www.classzone.com/cz/books/bio_07/resources/htmls/virtual_labs/virtualLabs.html) allows students to investigate how different antibacterial agents can affect bacterial growth. |
| Use of appropriate apparatus, techniques and magnification, including microscopes, to make observations of biological specimens and produce labelled scientific drawings7 |
| Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 |
| Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH 1 |
| **B8**  ***(separate science only)***  Transport in and out of cells  [Suggestion 1](https://www.ocr.org.uk/Images/338623-pag-activity-biology-transport-in-and-out-of-cells-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/458997-pag-activity-biology-transport-in-and-out-of-cells-suggestion-2.docx) | Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes3 | This Cambridge International [osmosis experiment](https://learning.cambridgeinternational.org/classroom/course/view.php?id=2992) includes a video, teacher walkthrough, quiz and teaching pack.  This [blog](https://www.ocr.org.uk/blog/practical-biology-at-home-osmosis/) details possible variations that can be made to the investigation into the water potential of a potato.  This [video](https://www.youtube.com/watch?v=oieXYuQm_xE) from Malmesbury Education demonstrates the osmosis experiment, and analysis of the results. |
| Use of appropriate apparatus to make and record a range of measurements accurately, including  length, area, mass, time, temperature, volume of liquids and gases, and pH 1 |
| **Other useful practical resources**  Here is a small selection of other resources for supporting practical activities related to the GCSE specifications:  This [natural selection](https://phet.colorado.edu/en/simulation/natural-selection) simulation from PhET allows students to manipulate a species, including whether there are mutations (dominant and recessive) and environmental factors.  This [resource](https://learning.cambridgeinternational.org/classroom/course/view.php?id=2999) from Cambridge International details how gas exchange in the lungs works. It includes a virtual experiment, teaching pack and quiz. All available experiment resources (including lab safety resources) from Cambridge International can be found [here](https://learning.cambridgeinternational.org/classroom/course/view.php?id=2977).  This BBC Bitesize [page](https://www.bbc.co.uk/bitesize/guides/zh94y9q/revision/1) explains how to plan an investigation, including the different types of variables. It also includes a video.  This [video](https://www.youtube.com/watch?v=xIR5yv0nz9g) demonstrates two ways to investigate whether respiration is occurring, and ends with a true or false quiz.  This [virtual experiment](https://www.reading.ac.uk/virtualexperiments/ves/preloader-transpiration.html) from University of Reading can be used to investigate factors affecting transpiration. | | |
| \* Centres are free to substitute alternative practical activities that also cover the apparatus and techniques from DfE: Biology, chemistry and physics GCSE subject content, July 2015 Appendix 4. 1–8 These apparatus and techniques may be covered in any of the groups indicated. Number corresponds to that used in from DfE: Biology, chemistry and physics GCSE subject content, July 2015 Appendix 4. | | |

# Chemistry

| **Practical Activity Group (PAG) activity\*** | **Apparatus and techniques that the practical must use or cover** | **Examples of other suitable chemistry practical activities and alternative support resources** |
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| **C1**  ***(separate science only)***  Reactivity Trend  [Suggestion 1](https://www.ocr.org.uk/Images/360166-pag-activity-chemistry-reactivity-trends-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/323617-pag-activity-chemistry-reactivity-trends-suggestion-2.docx) | Safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes and/or products | A [video](https://edu.rsc.org/resources/displacement-reactions-practical-videos-14-16-students/4012012.article) showing a demonstration of displacement reactions from RSC. Other videos are pointed to at the end of the video. |
| **C2/C1**  Electrolysis  [Suggestion 1](https://www.ocr.org.uk/Images/358283-pag-activity-chemistry-electrolysis-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/311750-pag-activity-chemistry-electrolysis-suggestion-2.docx)  [Suggestion 3](https://www.ocr.org.uk/Images/358332-pag-activity-chemistry-electrolysis-suggestion-3.docx) | Use of appropriate apparatus and techniques to draw, set up and use electrochemical cells for separation and production of elements and compounds | This electrolysis [video 1](https://edu.rsc.org/resources/electrolysis-practical-videos-14-16-students/4011983.article) shows the electrolysis of copper chlorine and Sodium sulphate. It is a good demonstration of electrolysis. This video shows what happens at each electrode. It also talks about competing reactions at the electrodes. There are more videos on this RSC page which you may find useful to use to help learning.  This is a [simulation](https://media.pearsoncmg.com/bc/bc_0media_chem/chem_sim/html5/Electro/Electro.php) of electrolysis using non-inert electrodes.  This electrolysis [video 2](https://www.youtube.com/watch?v=AmlwCyKhwG0) shows the micro-scale electrolysis of brine. |
| Use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests, flame tests, precipitation reactions, and the determination of concentrations of strong acids and strong alkalis8 |
| **C3/C3**  Separation Techniques  [Suggestion 1](https://www.ocr.org.uk/Images/358305-pag-activity-chemistry-separation-techniques-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/323640-pag-activity-chemistry-separation-techniques-suggestion-2.docx)  [Suggestion 3](https://www.ocr.org.uk/Images/358282-pag-activity-chemistry-separation-techniques-suggestion-3.docx) | Safe use of a range of equipment to purify and/or separate chemical mixtures including evaporation, filtration, crystallisation, chromatography and distillation4 | [Chromatography videos](https://edu.rsc.org/resources/paper-chromatography-practical-videos-14-16-students/4011446.article): Here is a page from the RSC with three videos showing the technique of chromatography and how to work out Rf values. The third video is the chromatography of food dyes by Malmesbury Education. This video has a Good explanation of how to set up a chromatogram and how to measure Rf values. |
| **C4/C2**  Distillation  [Suggestion 1](https://www.ocr.org.uk/Images/323641-pag-activity-chemistry-distillation-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/360827-pag-activity-chemistry-distillation-suggestion-2-.docx) | Safe use of a range of equipment to purify and/or separate chemical mixtures including evaporation, filtration, crystallisation, chromatography and distillation4 | These [two videos](https://edu.rsc.org/resources/simple-distillation-practical-videos-14-16-students/4012011.article) show the equipment and technique of distillation.  This [video](https://edu.rsc.org/resources/water-purification-practical-videos-14-16-students/4012010.article) shows the purification of sea water using distillation. It shows also the tests for sodium and chloride ions in the sea water. This is suitable for higher tiered students – it uses simple distillation apparatus. (Malmesbury education) |
| Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 |
| Use of appropriate apparatus to make and record a range of measurements accurately, including mass, time, temperature, and volume of liquids and gases1 |
| **C5**  ***(separate science only)***  Identification of species  [Suggestion 1](https://www.ocr.org.uk/Images/351862-pag-activity-chemistry-identification-of-species-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/323621-pag-activity-chemistry-measuring-rates-of-reaction-suggestion-2.docx) | Use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests, flame tests, precipitation reactions, and the determination of concentrations of strong acids and strong alkalis8 | This [video](https://edu.rsc.org/resources/identifying-ions-practical-videos-14-16-students/4011491.article) is about identifying ions starting with flame tests to identify cations then moving onto anion tests.  Here is a series of videos showing how to identify cations and anions in an unknown sample from Cambridge International iGCSE Chemistry. Good to use after watching the video from the RSC.  <https://learning.cambridgeinternational.org/classroom/course/view.php?id=2941>  <https://learning.cambridgeinternational.org/classroom/course/view.php?id=2945>  <https://learning.cambridgeinternational.org/classroom/course/view.php?id=2946> |
| Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 |
| **C6**  ***(separate science only)***  Titration  [Suggestion 1](https://www.ocr.org.uk/Images/351861-pag-activity-chemistry-titration-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/323620-pag-activity-chemistry-titration-suggestion-2.docx) | Use of appropriate apparatus and techniques for conducting and monitoring chemical reactions, including appropriate reagents and/or techniques for the measurement of pH in different situations | [Titration of sodium hydroxide with hydrochloric acid](https://edu.rsc.org/resources/simple-titration-practical-videos-14-16-students/4011981.article). The second video on this RSC paper is a good demonstration of the titration of NaOH and Sulfuric Acid from Malmesbury Education |
| Use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests, flame tests, precipitation reactions, and the determination of concentrations of strong acids and strong alkalis8 |
| Use of appropriate apparatus to make and record a range of measurements accurately, including mass, time, temperature, and volume of liquids and gases1 |
| **C7/C4**  Production of Salts  [Suggestion 1](https://www.ocr.org.uk/Images/323623-pag-activity-chemistry-production-of-salts-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/340544-pag-activity-chemistry-production-of-salts-suggestion-2.docx) | Safe use of a range of equipment to purify and/or separate chemical mixtures including evaporation, filtration, crystallisation, chromatography and distillation4 | This [RSC page](https://edu.rsc.org/resources/preparing-a-salt-practical-videos-14-16-students/4011982.article) takes you to a Malmesbury education video showing how to make a salt, copper sulphate. It covers safety issues. The page contains many other useful links  A [Fuse School](https://www.youtube.com/watch?v=lpM_VCMPFug&vl=en-GB) video showing how to make a soluble salt using two methods including the titration method. This is in a simulation style. |
| Use of appropriate apparatus to make and record a range of measurements accurately, including mass, time, temperature, and volume of liquids and gases1 |
| Use of appropriate apparatus and techniques for conducting and monitoring chemical reactions, including appropriate reagents and/or techniques for the measurement of pH in different situations |
| Safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes and/or products |
| Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater2 |
| **C8/C5**  **Measuring rates of reaction**  [Suggestion 1](https://www.ocr.org.uk/Images/351867-pag-activity-chemistry-measuring-rates-of-reaction-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/323621-pag-activity-chemistry-measuring-rates-of-reaction-suggestion-2.docx)  [Suggestion 3](https://www.ocr.org.uk/Images/360172-pag-activity-chemistry-measuring-rates-of-reaction-suggestion-3.docx)  [Suggestion 4](https://www.ocr.org.uk/Images/340535-pag-activity-chemistry-measuring-rates-of-reaction-suggestion-4.docx) | Use of appropriate apparatus to make and record a range of measurements accurately, including mass, time, temperature, and volume of liquids and gases1 | This [video](https://www.youtube.com/watch?v=TUcBpWXwkMM) shows how to measure the rate of reaction by measuring the decrease in mass of the reaction vessel. It shows the data plotted on a graph and the results discussed.  This [video](https://www.youtube.com/watch?v=ssa3wh3RNt0) shows how to measure the rates of reaction by the collection of gas both using a measuring cylinder and a gas syringe from Malmesbury Education. It includes the processing of the data and sources of error.  A [video](https://edu.rsc.org/resources/rates-of-reaction-practical-videos-14-16-students/4011986.article) looking at the effect of concentration on rates of reaction. It is a demonstration of the disappearing cross experiment.  This [video](https://edu.rsc.org/resources/temperature-change-of-neutralisation-practical-video-14-16-students/4012042.article) from the RSC website is again from Malmesbury education, showing an experiment to measure the temperature change with a chemical reaction. This comes with a set of results that students could process.  Instructions put together by the RSC to help teachers use online simulations. This [simulation exercise](https://edu.rsc.org/how-i-teach/use-on-screen-simulations-to-successfully-boost-data-skills/4011935.article) takes you through using a simulation to look at how rate is affected by concentration and temperature. Processing of results is also included. The downloadable sheet contains links to a video showing the effect of surface area on rate of reaction. |
| Making and recording of appropriate observations during chemical reactions including changes in temperature and the measurement of rates of reaction by a variety of methods such as production of gas and colour change |
| **Other useful practical resources**  Here is a small selection of other resources for supporting practical activities related to the GCSE specifications:  RSC [video](https://www.youtube.com/watch?v=Ta4DomSDzF8) of the decomposition of Hydrogen peroxide using different catalysts.  A [video](https://www.youtube.com/watch?v=c8HIFW1dfFs) showing the reaction of zinc with sulfuric acid using a copper catalyst.  A [video](https://www.youtube.com/watch?v=gvNuMpxqG7Q) explaining the principles of how metals are extracted from their ores using carbon.  A [video](https://www.youtube.com/watch?v=iPYyRNjXkgY) from the RSC showing how to make standard solutions.  A [video](https://www.azolifesciences.com/article/What-is-a-pH-Meter-and-How-Does-it-Work.aspx) showing how to calibrate and use a pH meter.  RSC [video](https://www.youtube.com/watch?v=0KonBvfnzdo&feature=emb_rel_end) showing the properties of Group 1 metals and the reactions when heated in air and with water. Another RSC [video](https://edu.rsc.org/exhibition-chemistry/alkali-metal-roulette/2000039.article) that shows their reaction with acid.  A [video](https://edu.rsc.org/exhibition-chemistry/the-reaction-of-magnesium-with-steam/4012602.article) showing how the reaction of magnesium with steam to explain the reaction of metals with water and acid.  RSC page on [simulations](https://edu.rsc.org/resources/ph-scale-basics-simulation/1459.article) on pH scale from Phet simulation  Acid/base [PhET simulation](https://phet.colorado.edu/en/simulation/acid-base-solutions%3B) | | |
| \* Centres are free to substitute alternative practical activities that also cover the apparatus and techniques from DfE: Biology, chemistry and physics GCSE subject content, July 2015 Appendix 4. 1–8 These apparatus and techniques may be covered in any of the groups indicated. Number corresponds to that used in from DfE: Biology, chemistry and physics GCSE subject content, July 2015 Appendix 4. | | |

# Physics

| **Practical Activity Group (PAG) activity\*** | **Apparatus and techniques that the practical must use or cover** | **Examples of other suitable physics practical activities and alternative support resources** |
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| **P1**  Materials  [Suggestion 1](https://www.ocr.org.uk/Images/293854-pag-activity-physics-materials-suggestion-1.docx) | Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature.1 | This Malmesbury education [video](https://www.youtube.com/watch?v=lvqu6JAbaKc) demonstrates a practical method to determine the density of irregular and regular shapes – includes Eureka can.  Here a [video](https://www.youtube.com/watch?v=ovdE_-FCWpc) shows a simple practical method for determining the density of an irregular shape.  A Practical [simulation](http://www.thephysicsaviary.com/Physics/Programs/Games/VolumeUsingGCDisplacement/) and quiz for measuring the volume of an irregular object using the displacement of a fluid.  PhET [simulation](https://phet.colorado.edu/sims/density-and-buoyancy/density_en.html) for investigating density of different materials using water displacement. |
| Use of such measurements to determine densities of solid and liquid objects.1 |
| **P2**  Forces  [Suggestion 1](https://www.ocr.org.uk/Images/311701-pag-activity-physics-forces-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/472160-pag-activity-physics-forces-suggestion-2.docx) | Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature.1 | Malmesbury education [video](https://www.youtube.com/watch?v=QQCJeAqBumE) on Hooke’s law featuring extension of a spring.  [Simulation](http://www.thephysicsaviary.com/Physics/Programs/Labs/ForceElastic/index.html) for a practical investigation of Hooke’s law from the Physics Aviary.  PhET [simulation](https://phet.colorado.edu/en/simulation/hookes-law) on Hooke’s law.  Simple IOPSpark practical [activity](https://spark.iop.org/stretching-rubber) on stretching elastic bands including a sample set of results. |
| Use of appropriate apparatus to measure and observe the effects of forces including the extension of springs.2 |
| **P3**  Motion  [Suggestion 1](https://www.ocr.org.uk/Images/309690-pag-activity-physics-motion-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/472159-pag-activity-physics-motion-suggestion-2.docx) | Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature.1 | Malmesbury education [video](https://www.youtube.com/watch?v=J9-J0cFQCrE) investigating Newton’s 2nd law using light gates, air track, trolley and falling mass.  This Cambridge International [video](https://ocr.org.uk/rpgphys4) shows a practical activity for investigating the motion of a car on a ramp.  This [video](https://www.youtube.com/watch?v=AcsrBCEJz-Y) shows a practical method to investigate the terminal velocity of a ball in oil. The GCE [PAG 1.2](https://www.ocr.org.uk/Images/585204-pag-01-investigating-motion-.zip) features a similar method, as well as a simple classroom experiment with bun cases.  IOPSpark has a [collection](https://spark.iop.org/collections/acceleration-due-gravity#gref) of practical activities to investigate the acceleration of freefall.  Practical physics [simulation](http://www.thephysicsaviary.com/Physics/Programs/Labs/MeasuringPhotogateAccelerationPrelab/index.html) for a toy car accelerating through light gates.  For the momentum topic, this practical [simulation](https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts/Collision-Carts-Interactive) studies trolleys colliding. This IOPSpark [resource](https://spark.iop.org/collections/momentum-and-newtons-second-law#gref) has a number of practical activities for investigating collisions.  This Cambridge International [video](https://learning.cambridgeinternational.org/classroom/course/view.php?id=3971) features a practical activity to investigate the conservation of momentum. |
| Use of appropriate apparatus and techniques for measuring motion, including determination of speed and rate of change of speed (acceleration/deceleration).3 |
| **P4**  Measuring waves  [Suggestion 1](https://www.ocr.org.uk/Images/311749-pag-activity-physics-measuring-waves-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/423274-pag-activity-physics-measuring-waves-suggestion-2.docx) | Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature.1 | Suitable for a classroom, this OCR [blog](https://www.ocr.org.uk/blog/practical-science-at-home/) discusses a similar activity to PAG activity 2 to investigate the speed of water waves.  This Malmesbury Education [video](https://www.youtube.com/watch?v=OY0lXHPo_nM) demonstrates practical activities for measuring the speed of waves with a ripple tank and with strings.  This Cambridge International [video](https://ocr.org.uk/rpgphys10) demonstrates transverse and longitudinal waves using a slinky.  This PhET [simulator](https://phet.colorado.edu/sims/html/waves-intro/latest/waves-intro_en.html) allows wavelength measurements to be taken for different waves.  This challenge [game](http://thephysicsaviary.com/Physics/Programs/Games/ReadTheOscilloscope/) from Physics Aviary will help students familiarize themselves with an oscilloscope display. |
| Making observations of waves in fluids and solids to identify the suitability of apparatus to measure speed/frequency/wavelength.4 |
| **P5**  Energy  [Suggestion 1](https://www.ocr.org.uk/Images/309692-pag-activity-physics-energy-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/423276-pag-activity-physics-energy-suggestion-2.docx) | Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature.1 | Malmesbury education have both a [video](https://www.youtube.com/watch?v=loeRLKNeUsc) for a practical activity to determine the specific heat capacity of a metal and a [video](https://www.youtube.com/watch?v=MUy1o4ogCvw) for a practical activity to investigate insulation.  This [video](https://www.youtube.com/watch?v=HAPmwu7byGM) discusses a practical investigation to determine the specific heat capacity for an oil.  A practical [activity](http://www.schoolphysics.co.uk/age14-16/Heat%2520energy/Heat%2520energy/experiments/Latent_heat_of_fusion.doc) to investigate the latent heat of fusion of ice.  Short [video](https://www.youtube.com/watch?v=3zwj3_Eidg8) of a practical activity to determine the latent heat of vaporization of water.  This guided lab [simulation](https://www.thephysicsaviary.com/Physics/Programs/Labs/SpecificHeatSolidGuidedLab/) from Physics Aviary uses the method of mixtures to determine specific heat capacity. |
| Safe use of appropriate apparatus in a range of contexts to measure energy changes/transfers and associated values such as work done.5 |
| **P6**  Circuit components  [Suggestion 1](https://www.ocr.org.uk/Images/311746-pag-activity-physics-circuits-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/473501-pag-activity-physics-circuits-suggestion-2.docx) | Use of appropriate apparatus to measure current, potential difference (voltage) and resistance, and to explore the characteristics of a variety of circuit elements.6 | Malmesbury Education [video](https://www.youtube.com/watch?v=ksPfzUjMbBk) looking at I-V characteristics of circuit components.  Some simulations of simple circuits to investigate Ohm’s law from [PhET](https://phet.colorado.edu/sims/html/ohms-law/latest/ohms-law_en.html) and [Walter Fendt](https://www.walter-fendt.de/html5/phen/ohmslaw_en.htm).  This short Cambridge International [video](https://learning.cambridgeinternational.org/classroom/course/view.php?id=2987) shows a practical activity to determine the resistance of a wire. |
| **P7**  ***(separate science only)***  Series and parallel  circuits  [Suggestion 1](https://www.ocr.org.uk/Images/324542-pag-activity-physics-series-and-parallel-circuits-suggestion-1.docx) | Use of circuit diagrams to construct and check series and parallel circuits including a variety of common circuit elements.7 | The PhET [circuits virtual lab](https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html) can be used to investigate the brightness of bulbs in series and parallel circuits.  This simple [IOP](https://spark.iop.org/sites/default/files/media/documents/episode-110-2-calibration-of-a-thermistor.doc) GCE practical activity investigates the effect of temperature on the resistance of a thermistor and comes with a sample set of results. |
| **P8**  ***(separate science only)***  Interactions of waves  [Suggestion 1](https://www.ocr.org.uk/Images/317638-pag-activity-physics-interaction-of-waves-suggestion-1.docx)  [Suggestion 2](https://www.ocr.org.uk/Images/423270-pag-activity-physics-interaction-of-waves-suggestion-2.docx) | Making observations of waves in fluids and solids to identify the suitability of apparatus to measure the effects of the interaction of waves with matter.8 | This Malmesbury Education [video](https://www.youtube.com/watch?v=tiqiN3y1ze4&list=PLAd0MSIZBSsGNWKdHJdQYIndKl3HZUrSB&index=3) features a practical activity to investigate refraction.  This [PhET simulation](https://phet.colorado.edu/en/simulation/bending-light) allows students to simulate the passage of a ray of light from one medium into another. Tools are available for measurements.  A [simulation](http://ophysics.com/l9.html) to show image formation in a plane mirror.  This optics bench [simulation](https://www.physicsclassroom.com/Physics-Interactives/Refraction-and-Lenses/Optics-Bench/Optics-Bench-Refraction-Interactive) shows ray diagrams for convex and concave lenses. |
| Making observations of the effects of the interaction of electromagnetic waves with matter. 4 |
| **Other useful practical resources**  Here is a small selection of other resources for supporting practical activities related to the GCSE specifications.  A [game](http://thephysicsaviary.com/Physics/Programs/Games/RulerUse/) is available on Physics Aviary for students to practice reading a rule graduated in mm.  This Cambridge International [video](https://learning.cambridgeinternational.org/classroom/course/view.php?id=3936) shows a practical activity to demonstrate the energy transfers of a falling object.  This IOPSpark practical [activity](https://spark.iop.org/using-electric-motor-raise-load#gref) shows a method to determine the work done by a motor lifting a load and the motor’s efficiency.  This Physics Aviary [simulation](http://www.thephysicsaviary.com/Physics/Programs/Labs/ScaleLab/) runs through a simulation for a practical activity to determine an unknown mass using moments.  A [video](https://ocr.org.uk/rpgphys6) walkthrough on simple practical activities to demonstrate electrostatic effects including charging by induction.  Physics classroom [simulation](http://www.physicsclassroom.com/Physics-Interactives/Light-and-Color/Color-Filters) using colour filters. | | |
| \* Centres are free to substitute alternative practical activities that also cover the apparatus and techniques from DfE: Biology, chemistry and physics GCSE subject content, July 2015 Appendix 4. 1–8 These apparatus and techniques may be covered in any of the groups indicated. Number corresponds to that used in from DfE: Biology, chemistry and physics GCSE subject content, July 2015 Appendix 4. | | |



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