

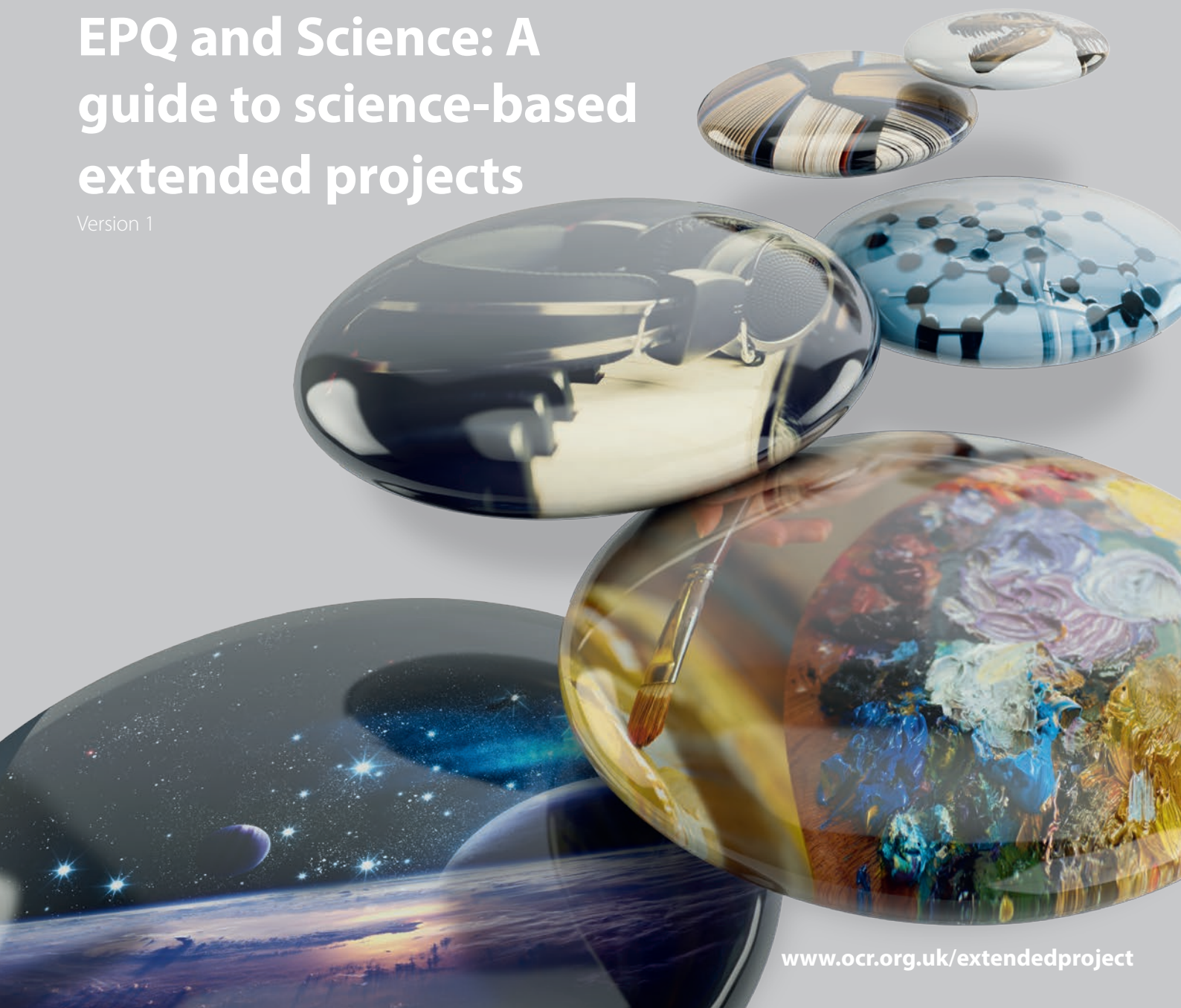
PROJECT
Teacher's Guide

EXTENDED PROJECT

H856

**EPQ and Science: A
guide to science-based
extended projects**

Version 1

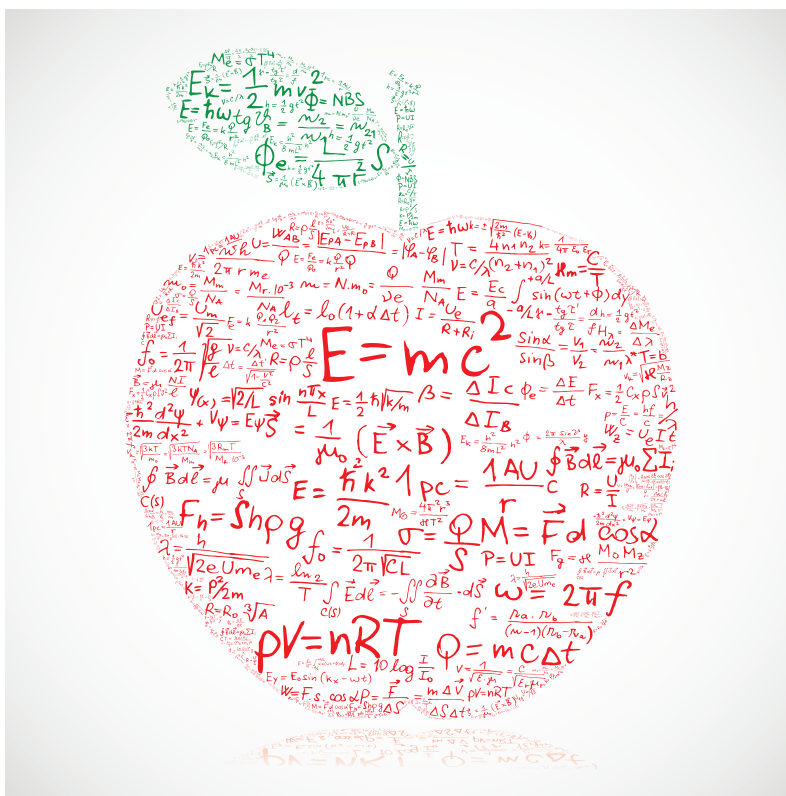


Introduction

Most projects for the Extended Project Qualification (EPQ) currently focus on the production of a written report or dissertation. But other types of outcome may be more appropriate for students whose main interests and aptitudes lie in science and its applications.

In addition to literature research, a science-based EPQ can help students develop and demonstrate skills relating to experimental design, hands-on techniques and data handling. A huge variety of science-based project work is possible, for example:

- collecting water quality data in a local stream to investigate effects of run-off from farmland;
- using an infrared spectrometer in a local university to analyse the results of organic preparations;
- designing and making a solar-powered cooker.



This guide is intended to help teachers support students who want to undertake a science-based EPQ. It contains suggestions about possible subject areas, a range of possible outcomes and pointers for further research and referencing. It also gives guidance on ethics and health & safety.

The suggestions in the guide are intended to inspire students rather than direct them. They must still be able to demonstrate independence of research and developed ideas.

Science projects for the EPQ

There are several possible types of science-based project.

1. An investigation using data from laboratory or fieldwork

An investigation project has a research question (maybe phrased as a hypothesis to be tested) which requires the collection and analysis of data. For example 'How do temperature and light levels affect the concentration of vitamin C in tomatoes after they are picked?', 'How does radioactive background radiation vary with time and location within the school building and grounds?', or 'Are introverted people better at repetitive tasks than people with extrovert personalities?'

The question or hypothesis drives the experimental design and the collection and analysis of data. The project includes literature research and explores the wider context, for example looking at social, economic or ethical aspects of the research question. The report evaluates the method(s) used, states clearly any conclusions that can be drawn in order to answer the research question and shows how these conclusions are supported by data.

2. An item designed and made for a science-related purpose

A project of this type has a brief stating the intended purpose of the item and the design criteria that should be met. The item could be a physical object, such as a telescope, a burglar alarm, a 3D model of the human digestive system, or a children's picture book about the structure of the Earth. Or it could be a website or a computer program, for example a video game based on the periodic table, a program to control a radio-operated car, or a website to help GCSE students revise a science topic.

The project includes literature research relating to the wider context of the item's design and use. The report shows how the student developed and tested the design, and how the final product relates to the original brief and design criteria. Testing the item might generate data whose analysis forms part of the project.

3. An event organised for a science-related purpose

This type of project has a brief setting out the purpose of the event and identifying the intended participants or audience. Many types of event are possible, for example a drama performance exploring a controversial application of science such as fracking, a guided tour of local sites of scientific interest, or an exhibition of images and objects designed to communicate an aspect of science.

The project includes literature research relating to the event and its wider context. The report shows how the student planned and organised the event, and evaluates the responses of the audience/participants.

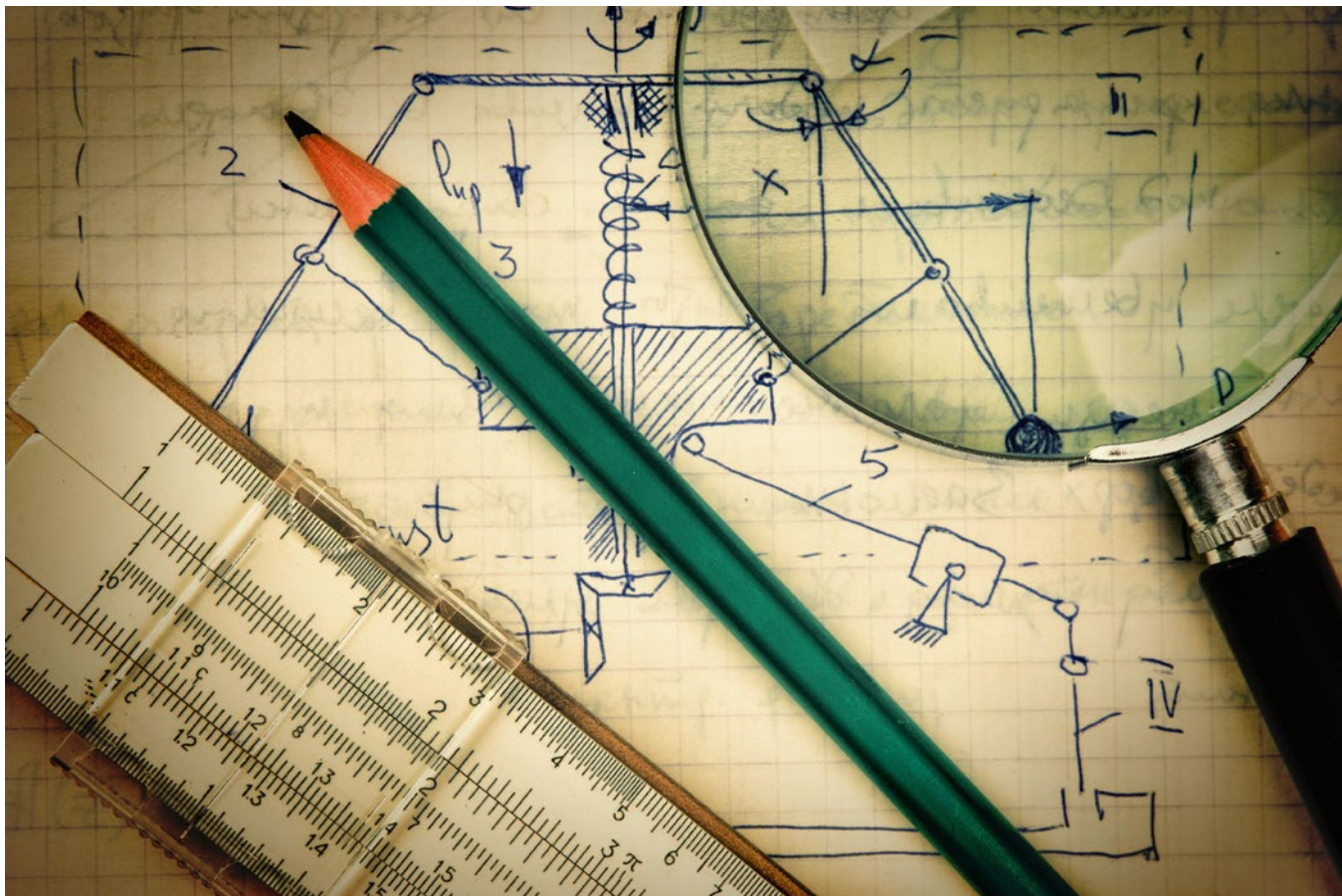
4. A written dissertation exploring a science-based question

A dissertation project has a focused research question that is explored through literature research and discussion. The project is concerned with addressing the question, presenting evidence and arguments through which the student develops and argues for their own point of view; there is a well-supported conclusion.

Questions with an ethical, philosophical or historical dimension such as 'Should GM fish be bred for human consumption?', 'Can the various interpretations of quantum mechanics be reconciled?', or 'Who should get the credit for discovering oxygen?' can be explored through a dissertation project. Controversial questions can lead to particularly interesting projects.

Making it happen

In addition to literature research, a science-based EPQ can help students develop and demonstrate skills relating to experimental design, hands-on techniques and data handling. These notes are intended to encourage and help teachers and students to undertake such EPQs. The references are far from being an exhaustive list – rather, they have been chosen to exemplify some of the many resources and support available for science-based EPQs.



The project-shaped space

Many centres have successful experience of individual lab-based project work or fieldwork within former A level specifications, for example OCR Chemistry B (Salters Advanced Chemistry), OCR Physics B (Advancing Physics). Such project work could now form the basis of an EPQ.

The lab/field work for an EPQ can be similar in extent to that in former A Level projects (10-20 hours), but should be part of a more substantial body of work. For example, an A Level Chemistry project might have involved synthesising aspirin using different methods and comparing the yields. For an EPQ, a student would also carry out literature research into some aspects of analgesics; they could investigate economic factors that determine the method(s) used by pharmaceutical companies, and/or research the historical development of analgesics, and/or explore ethical questions about testing medication on living subjects.

It can be simple

It is possible to do interesting and sophisticated work using equipment readily available in schools and colleges. For example, a student might do some ecology fieldwork that used only basic items (e.g. quadrats) as part of a well-designed and innovative study. A simple item of physics apparatus, such as a water rocket, a magnet falling through a metal tube, or a string telephone, could be investigated through careful experimentation and mathematical modelling.

Do it with data

Data analysis is a key part of scientific research, and there are many professionally collected datasets available via websites. For example, there are datasets relating to astronomy, ecology and meteorology etc. that students can access to address their own EPQ research question. If using published data, students should make their own decisions about which data to use and how to analyse it, not merely reproduce published research.

Students could use published datasets in addition to their own primary data. For example, a student might collect their own data to explore correlations between local air temperature, pressure and rainfall, and use Met Office data to investigate different regions or to look for trends over a long timescale. Or a project might be entirely based on the analysis of published data; for example a student might use an ecology dataset to investigate the impact of invasive species on biodiversity.

Met Office datasets

<http://www.metoffice.gov.uk/datapoint>

Operation Wallacea: conservation research and management

<http://opwall.com/sixth-form-high-school/independent-research-projects/>

Hubble Space Telescope datasets

https://www.spacetelescope.org/projects/fits_liberator/datasets_archives/

Students with an interest in astronomy could use a robotic telescope to gather their own data remotely.

Robotic telescopes

<http://www.faulkes-telescope.com>

<http://www.schoolsobservatory.org.uk>

Ask the experts

A number of bodies concerned with science and education offer advice and support for EPQ students and their teachers. For example, the National STEM Centre has an EPQ support group, the Science and Plants for Schools (SAPS) website suggests many possible EPQ research areas in biology and biochemistry, and the Wellcome Trust publishes resource materials and has a web page linking to numerous relevant sites.

National STEM Centre

<http://www.nationalstemcentre.org.uk/epq>

SAPS

<http://intobiology.org.uk/extended-project-ideas-biology-and-biochemistry/>

<http://intobiology.org.uk/category/student-projects/>

Wellcome Trust

<http://www.wellcome.ac.uk/Education-resources/Education-and-learning/Resources/Independent-research-projects/index.htm>

An increasing number of universities run programmes targeted at EPQ students. While most aim at developing generic project management and study skills, some science departments provide hands-on workshops, some offer apparatus on loan, and some even have facilities dedicated to EPQ work. For example, the Nowgen centre at the University of Manchester offers EPQ students an opportunity to use DNA bar coding, the physics department at the University of Birmingham loans cosmic ray detectors to schools, and the University of Bristol school of chemistry runs practical workshops.

Nowgen

<http://www.genomicsforschools.org/carousel/epq/>

University of Manchester

<http://www.manchester.ac.uk/connect/teachers/students/post-16/extended-project/>

University of Birmingham physics outreach

<http://www.birmingham.ac.uk/schools/physics/outreach/resources.aspx>

University of Bristol chemistry outreach

<http://www.bristol.ac.uk/chemistry/outreach/>

Many university science departments offer EPQ students access to academic libraries, and many will respond positively to requests for expert advice. Some may be able to offer mentoring to students. To find out what support is available, visit the websites of your local university's science departments. Most have an outreach/schools liaison officer who is a good first point of contact, or enquiries can be addressed to the departmental manager or administrator.

Local businesses and industry can also be a source of help and advice. Companies that offer work experience placements may be more likely to respond positively to requests for help with EPQs; a student's work experience can sometimes provide a starting point for an EPQ.

Read about it

Accounts of projects undertaken by other students can be a source of ideas and inspiration - though of course an EPQ must not merely reproduce someone else's work. You can, for example, find case studies of science-based projects in the EPQ resources published by the Wellcome Trust, on the website of the Institute of Physics, and in materials relating to EPQs in genomics and environmental issues available from the University of York's Project Qualifications web page.

Wellcome Trust

<http://www.wellcome.ac.uk/Education-resources/Education-and-learning/Resources/Independent-research-projects/index.htm>

Institute of Physics

http://www.iop.org/education/teacher/resources/extended_project/page_62232.html

University of York project qualifications

<http://www.york.ac.uk/education/research/uyseg/projects/project-qualifications/>

The Young Scientists Journal, written and edited by students, publishes students' accounts of their project work and includes reports of work undertaken for the EPQ.

Young Scientists Journal

<http://ysjournal.com/>

Frontier research

Some professional research projects offer opportunities for students to get involved. If a student can demonstrate that they have taken responsibility and made their own decisions, work on such a project may form the basis for an EPQ along with the student's own literature research. For example, some students taking part in the Authentic Biology initiative are using facilities at the University of Southampton to do research for their EPQs, while CERN@school students are contributing to particle physics research. These projects and several more are coordinated through the Langton Star Centre.

Langton Star Centre

<http://www.thelangtonstarcentre.org/lucid/>

A student's experience of directed research, for example through the Nuffield Research Placement Scheme, could provide a starting point for EPQ work.

Nuffield Research Placements

<http://www.nuffieldfoundation.org/nuffield-research-placements>

Working well

Finally and by no means least ...

Health and safety is an important aspect of any project that involves work in the laboratory or workshop or any type of field work - including data collection by interview or questionnaire. A student undertaking any project of this type should complete their own school/college's risk assessment form in consultation with their EPQ supervisor or mentor. Guidance about laboratory health and safety can be obtained from the CLEAPSS website.

CLEAPSS

<http://www.cleapss.org.uk/secondary/secondary-science/secondary-science-guides>

It is also important that all project work is carried out ethically. Students should follow ethical guidelines relating to the collection, storage and reporting of data, and to wider aspects of project work. Guidance on research ethics with particular reference to the EPQ is available from the website of the Wellcome Trust.

Ensuring your research is ethical

<http://www.wellcome.ac.uk/EPQethics>





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