

Authentic Research Projects in Schools

Guidance for schools on how to engage students in research,
both in and outside of the classroom



Using original research, inside and outside of the classroom, is an inspiring way to increase your students' understanding and interest in science.

School science can often seem far removed from real science. Students can gain a huge amount from taking part in the opportunities suggested in this booklet - whether it's analysing real data and possibly publishing original research, taking part in a research project or challenge, or working towards an award.

While this approach is good for all students, it can be of particular benefit to improving the uptake of STEM subjects by girls. National projects such as CREST and IRIS tend to attract even numbers of boys and girls with students who are involved in these projects more likely to take STEM Highers.

This booklet contains information for schools interested in setting up a research group. It includes details of organisations that run structured challenges, research opportunities and competitions, guidance on accessing large data sets which your students can utilise, as well as information on applicable grants schemes.

The suggestions in this booklet are not exhaustive. For information about regional and other opportunities search for Student Research Groups on **TalkPhysics.org**

Research opportunities and open-ended challenges

Opportunities for research may be local, national, or international. Consider contacting the schools outreach department at your closest university to learn about local opportunities.

British Physics Olympiad Experimental Project

bit.ly/OlympiadPhysics

Age: S4–6 | Cost: Free | Time: Open ended, autumn term only

During the autumn term, individual pupils investigate a given open-ended problem, and write it up as an academic report. This is a useful introduction to project work, which is self-contained but structured.

Arkwright Engineering Scholarship

arkwright.org.uk

Age: S4–6 (Sitting Nat5) | Cost: £40 | Time: 2 years

Arkwright look to support students interested in becoming leaders in engineering. Successful applicants get paired with an industrial sponsor, receiving mentoring and access to work experience and enrichment activities, and get £600 towards components and materials for personal or curriculum technical projects. Their school also gets £400 to spend on equipment, materials or teacher training for the delivery of STEM subjects. Applications are taken between November and January.

Institute for Research in Schools (IRIS)

researchinschools.org

Age: S4–6 | Cost: Free | Time: Open ended

Students can take part in genuine scientific research, accessing and analysing data from sources such as the Large Hadron Collider, the International Space Station and the LUCID satellite. IRIS also promotes biomedical research in schools and supports schools to develop their own research projects. This requires commitment from the school and students.

Nuffield Research Placements

nuffieldfoundation.org/nuffield-research-placements

Age: S6 | Cost: Free, travel expenses refunded | Time: Two weeks

Students complete authentic tasks working with researchers in universities, companies and research institutions for two weeks during the summer holidays. The tasks may be original, but are not necessarily new or unique. Students with no family history of university are encouraged. Local coordinators provide induction and support. Takes place outside school time and not under teacher control.

Qualifications and awards

Students and schools may prefer students to receive external recognition for their science research.

Qualifications will usually require school registration, some formal teacher input, payment of fees and specific outcomes.

Big Bang Competition

bit.ly/bigbangcomp

Age: S1–6 | Cost: Free | Time: Variable

An opportunity to showcase students' STEM projects and recognise and reward their achievements. Students compete regionally to showcase their projects on a national stage.

CREST awards

crestawards.org

Age: S1–6 | Cost: £5-20 per student (grants available) | Time: 10–70 hrs

Students, teachers or organisations plan science-based projects, which are carried out by students. The best projects are hands-on, student-led and include original research. Local coordinators help schools register, and give advice on running projects. Work on CREST awards counts as a Duke of Edinburgh Award skill.

Engineer leaders awards

bit.ly/ScottishLeaderAward

Age: P5–S6 | Cost: free | Time: Variable

This award encourages pupils to work with local engineers to come up with engineering solutions to real world problems. When they have come up with their ideas pupils create a pitch to graduate engineers who may even make the design in real life.

Scottish Space School

bit.ly/ScottishSpaceSchool

Age: S5 | Cost: free | Time: One week

This exciting opportunity gives pupils a chance to spend a residential week at Strathclyde University studying STEM subjects and completing various group projects related to space and engineering challenges. Every year, 10 of the space school participants are invited to go on a once-in-a-lifetime trip to Houston to visit NASA's Johnson Space Centre.

Data analysis

There is a wealth of data that students can access and analyse. You may want to start by practising basic data analysis with the students, before they move on to analysing the data sets below.

Practising data analysis

Big Picture: Statistics

bigpictureeducation.com/number-crunching

A pack from the Wellcome Trust with data activities and lesson outlines.

Frozen Oceans

bit.ly/frozenoceans

This download includes data activities, with PPTs and Excel files, based around research carried out by the Catlin Arctic Surveys in 2009–11.

Sources of data

Scotland's Environment

bit.ly/environmentScotland

Projects and data on water, air quality, energy and climate.

Faulkes telescope

resources.faulkes-telescope.com

Opportunity to make observations using a network of telescopes around the world which can be remotely controlled by the user.

Hubble Space Telescope

bit.ly/HubbleScience

Access to images taken through different wavelength filters with links to related new releases.

Met Office

metoffice.gov.uk/datapoint

Access to Met Office data feeds (historical or forecast) using keyword, location or weather type.

NASA/IPAC Archive Research

bit.ly/NASAIPAC

Helps teachers and students get involved with authentic astronomical research. US based but UK opportunities available.

Schools Observatory

schoolsobservatory.org.uk/obs

Opportunity to request and analyse images of objects in space using the Liverpool Telescope. Also includes teaching resources.

Sky Server

bit.ly/SkyServer

Data from the Sloan Digital Sky Survey, mapping the Universe. Projects include research challenges.

Sun Trek

bit.ly/suntrek

Includes projects using solar data written by teachers and educators, useful for preparation or research.

Zooniverse

zooniverse.org/projects

Opportunity to access physics data about supernovae, the LHC and several space related data sets. Most activities involve routine classification of images.



Applying for grants to run a research project

Grants that include under-represented groups, engage widely, have a large impact and include ideas easily copied by other schools are more likely to be supported. Many grant awarders will not support the purchase of standard school resources, or routine school trips. Larger grants often require the involvement of external scientists or organisations.

British Science Week

britishscienceweek.org/grants

Application times:

Annual | Amount: £300–700

Grants are available to support schools in challenging circumstances to run an activity during British Science Week, either school-based or involving students and the local community.

IOP/ STFC/ IET School Grants Scheme

iop.org/schoolgrants

Application times:

Three rounds per year | Amount: Up to £600

Grants are available for projects or events linked to teaching or promoting physics or engineering.

Science and Technology Facilities Council Small Awards Scheme

bit.ly/STFCsmallawards

Application times:

Two rounds per year | Amount: £500–10,000

These grants are available for projects promoting STFC science and technology, especially in partnership with other schools or the community.

Royal Society Partnership Grants

bit.ly/RoyalSocietyGrant

Application times:

Annual | Amount: Up to £3,000

Grants for students (aged 5–18) to buy equipment for STEM projects in partnership with a practicing scientist or engineer. Applications are made jointly by the school and the partner.

Other useful organisations and activities

STEM Learning

stemnet.org.uk

Provides resources and support to run STEM clubs in school and runs a network of volunteers from a STEM background, known as STEM Ambassadors.

STFC Public Engagement

stfc.ac.uk/public-engagement

A range of online resources and teacher CPD are available, and they will also coordinate school visits to research facilities, loan moon rocks and meteorites to schools, and provide other support as needed.

SUPA (Scottish Universities Physics Alliance)

supa.ac.uk

It may be possible to set up a research project in partnership with the university physics department, alternatively they may be able to provide support such as workshops, talks or mentoring.

Young Engineers and Science Clubs

yecscotland.co.uk/index.html

Advice and support in setting up STEM clubs including competitions, challenges, CPD and STEM celebration events.

SSERC

sserc.org.uk

Support for teaching science and technology including CPD and health and safety advice.

Research Councils UK Schools Engagement

rcuk.ac.uk/pe/schools

Online resources and professional development for teachers are hosted on the site.

Young Engineers

youngeng.org.uk

Provides resources for STEM activities and challenges, competitions and kits on loan, for both students and teachers, as well as offering mentoring for 16- to 18-year old students.

Young Scientist

Journal.ysjournal.com

A peer review science journal for young people, which could be a great place for students to share the results of their research.

Wellcome Trust

bigpictureeducation.com/extended-projects

A practical guide to extended projects, with advice for students and teachers.

Ogden Trust

ogdentrust.com/university-outreach/science-officers

This network of Science Officers are university-based physics outreach professionals, and could be good contacts if you are trying to make links with a university physics department.

Tips on running research activities in schools

Decide **why** you are running the research activity, **what** students should achieve, **how** the research activity will run, **who** will be involved; **when** and **where** sessions will be.

- **Choose something achievable.** It's better to complete a smaller activity than abandon a larger one.
- **Inform and involve others early on**, such as Senior pupil mentors, technicians, TAs, SLT. Some may actively help, others may support.
- **Grant applications can be time-consuming, so involve at least one other person.** Before applying, check you will be able to run the activity if successful.
- **After-school and out-of-school sessions are possible, even in rural areas:**
 - Provide specific information on dates, times, venues (including pick-up) to students, staff, parents and carers.
 - Check school policy on transporting students to and from school.
 - Give ample notice of cancellations.
- **Recruit students:**
 - Check for clashes with other clubs or activities.
 - Advertise widely and raise awareness, eg via posters and emails. Invite target student groups – personal invitations also work well.
- **Keep students coming:**
 - It's a club, not a lesson: don't over-plan, and try to give students ownership and choice.
 - Use routine reminders for each session and reward points, if appropriate.
 - Raise the profile in school, eg via noticeboards and newsletters.
- **Look after visitors attending sessions:**
 - Check and share school guidance and department risk assessments.
 - Collect visitors from reception.
 - Consider using name badges for students and visitors.
- **Encourage students to share their research findings:**
 - Tell the school community, eg via the website, newsletter, or in lessons
 - Share conclusions more widely, eg via journals or competitions.
 - Collaborate with other schools or organisations.

Want to find out more or get support from the IOP?

- Email us at education@iop.org
- Discuss authentic research with our community of physics teachers at talkphysics.org