

Partnership Grants: off-the-shelf project ideas

This document provides example project titles to spark ideas, as well as some selected projects in more depth that show the sorts of activity and equipment that have been funded in the recent past. These can be used as inspiration for teachers or STEM partners who are preparing a Partnership Grant application.

For advice on how to prepare your Partnership Grant application please visit www.royalsociety.org/partnership or call 020 7451 2531. There is additional advice available on the website for those wishing to undertake a project that supports students with special educational needs and disabilities.

Part 1: example project titles

Below is a list of example project titles showing the breadth of investigations undertaken through the Partnership Grants scheme. Partnership Grant projects must have a title that is a question, and the investigations suggested as part of the project aim to help the students answer this question. This list is not exhaustive but may give you some ideas of what could be investigated with your students.

All the project titles below could be adapted for use with students at a range of primary and secondary levels, dependant on the depth and complexity of the investigations undertaken as part of the project.

Observing the world around us:

- 1) What lives in our green space and why is it important?
- 2) What are the important features of gardens and particular flowers for wild pollinators?
- 3) Which species do we share our neighbourhood with?
- 4) How do badgers respond to scent from distant populations?
- 5) Why did the stickleback lose its spines?
- 6) Can daffodil phenotypes be identified from the plastosome sequence?
- 7) Can a school-based digital weather station provide accurate and useful data?
- 8) Can we power classroom items with renewable energy?
- 9) Does our biology influence our mood?
- 10) Can collecting physiological data help school sports team performance?
- 11) Can *Drosophila melanogaster* learn visual and olfactory cues?
- 12) How can we predict and measure growth rates of tardigrades?
- 13) Will improving our knowledge of the components of food, improve our eating habits?
- 14) How are different materials effected by tension and compression and how does this inform the design of a bridge?

Exploring beyond Earth:

- 1) What's in our atmosphere?

- 2) Can we use a radio antenna to detect the ionisation trails from meteors entering the Earth's atmosphere?
- 3) What are Moon rocks made of?
- 4) How would we grow food in space?
- 5) What needs to be prepared for a mission to Mars?
- 6) Can your team build a rover fit to explore Mars?
- 7) What are the best conditions to grow plants without soil?

Human impact on the environment:

- 1) What are the effects of flow regulation on river temperature?
- 2) What are the effects of water pollution on the ecosystem?
- 3) How can science help us investigate the impact of humans on our shoreline?
- 4) Is single-use plastic litter a problem on your local beach?
- 5) What is the prevalence of plastics in our local environment?
- 6) Does plastic have a future?
- 7) What impact do disposable contact lenses have on the environment?
- 8) How can agricultural bird feeding on farmland in the South Downs National Park best help mitigate declines in passerine birds?
- 9) How can we make our houses smart and energy efficient?

Solving problems with technology:

- 1) Investigating tissue engineering: how can we build new body parts?
- 2) Can you feed your phone for free?
- 3) How would ester flavourings be synthesised in industry?
- 4) Can robotic arms be improved using the latest technology?
- 5) Can a school contribute effectively to open source pharma via the synthesis of novel drug analogues?
- 6) How can we use data to improve the air that we breathe?
- 7) How do computers learn?
- 8) How do future self-drive cars work?
- 9) How is biometric security changing the world we live in?
- 10) How can robots work collaboratively to achieve an end goal?
- 11) Can low cost technology assist with social care?
- 12) Can 3D printing be applied in medical applications to improve the lives of others?
- 13) How can the use of drones impact positively on reducing pollution in the environment?

Part 2: projects in more depth

Below are a number of project examples showing the different investigations undertaken by primary and secondary level schools across the UK over the last few years. As well as the project title and investigations that were submitted in the application, information about the equipment asked for, the total grant awarded and where the STEM partner came from is also provided.

Whilst the examples given were undertaken by a particular level school, there is no reason that the investigation could not be adapted for a different target age group if desired.

Environment and climate change based projects

The following project was awarded a £1,361 grant and undertaken by a primary school.

Project title: What are the current and future environmental sustainability issues in a Victorian School?

Proposed investigations as identified on the application form:

- 1) Design experiments to assess the thermal efficiency of the school e.g. using thermal cameras and damp meters.
- 2) Investigate and identify measures to reduce the thermal energy requirements for the school i.e. the need to heat in winter and cool in the summer.
- 3) Investigate current and historic weather conditions by setting up a weather and climate station and linking in with climate data from existing weather stations locally. Identify changes in weather overtime and predict changes in the future and what this might mean for the school and its occupants.
- 4) Create a plan of physical improvements to the school buildings and playgrounds to improve the environmental resilience of the school, including carbon savings and a financial payback period of proposed measures.

What the grant was used for: 2 x thermal cameras, 2 x damp meters, laser measures, building materials to test, travel costs for STEM Partner and a research trip for students.

STEM partner: University partner (academia)

The following project was awarded a £2,926 grant and undertaken by a primary school.

Project title: Does plastic have a future?

Proposed investigations as identified on the application form:

- 1) Investigate types of plastic and how they are made. Students bring in their recycling from home and sort it according to its properties and type. STEM partner to use expertise to explain how plastic is made. Students to see a demonstration of how to make Nylon.
- 2) Weigh how much plastic has been collected over a week, extrapolate this across different settings, for example school, community, town, UK etc to see how much plastic waste is produced. Extrapolate for a figure over different time ranges.

3) Investigate the uses of different plastics. Plastic food wrap: what happens to food with and without it?, What alternatives are there? Compare how long food lasts in plastic wrap to alternatives. Test and compare the strength of different supermarket plastic bags. Compare plastic bags to paper alternatives, considering strength, cost of production, carbon footprint etc.

4) Research plastic waste. Where does it go and how does it get there? How could we clear it from water ways? Students to come up with ideas and design a prototype of the best solution.

5) Compare plastic to alternative materials including bio-plastics. Are the alternatives sustainable? Compare carbon footprints and cost of traditional plastics and bioplastics. Make our own bio-plastics from potato starch and from milk.

What the grant was used for: alternative food wrap – wax wrap, reusable silicone toxin free food wrap, cling film, plastic bags, paper bags, resources to build a prototype of the winning design to clear the seas and oceans of plastic, clamp stands and weights, pestle and mortar – potato starch plastic, bunsen burner, heat proof mat, tripod and gauze, potato starch, protective clothing for health and safety.

STEM partner: Industrial partner

The following project was awarded a £1,925 grant and undertaken by a secondary school.

Project title: What impact do disposable contact lenses have on the environment?

Proposed investigations as identified on the application form:

- 1) Assess the biodegradability of disposable contact lenses in different types of soil and aquatic environments.
- 2) Monitor the change in chemical composition of contact lenses using IR spectroscopy.
- 3) Monitor the effect of contact lens disposal in aquatic environments using LC-MS.
- 4) Design and carry out a survey about disposal methods with contact lens users.

What the grant was used for: LC-MS columns, solvents, shaker and tube holder, tubes for shaker, misc. consumables.

STEM partner: University partner (academia)

The following project was awarded a £2,875 grant and undertaken by a secondary school.

Project title: How can we make our houses smart and energy efficient?

Proposed investigations as identified on the application form:

- 1) How can a home become energy efficient? Include use of analytical thinking.
- 2) How can sensors be used to aid efficiency and what is their role in Smart Homes? Create the code for microcontrollers to collect signals from electronic sensors.
- 3) How are automation systems programmed? Students will investigate modern engineering technologies.

- 4) A key component for the investigation will address sustainability and ecology as functions such as energy harvesting, water recycling and air flow management. These will be implemented in models.

What the grant was used for: Arduino controllers, set of electronic sensors, potentiometers, set of mechanical sensors, DC actuators, large servo-motors, small servo-motors, cables and wires set, multimeters, battery set and charges, bench power supply, set of tools, plastic and wood materials, screws, nuts, assembly materials.

STEM partner: University partner (academia)

Observation and wildlife based projects

The following project was awarded a £2,454 grant and undertaken by a primary school.

Project title: Why did the stickleback lose its spines?

Proposed investigations as identified on the application form:

The goal will be to understand the reasons for the evolution of armour loss in North Uist sticklebacks by:

- 1) Formulate a hypotheses about why sticklebacks need plates and spines and why they might lose them through evolution.
- 2) Collect samples of sticklebacks from local lochs using traps and nets and collecting water samples from lochs.
- 3) Collect data by measuring sticklebacks and counting their plates and spines and measuring the pH of water samples. Examine maps of North Uist and, with local knowledge of farming methods (especially management of the machair grassland), relate land use and management to stickleback armour evolution.
- 4) Make direct observations of the behaviour of sticklebacks in an aquarium to understand if fish with different types of armour interact?
- 5) Draw conclusions by matching data and observations with hypotheses.

What the grant was used for: a set of buckets, sorting trays and dip nets for collecting sticklebacks; hand lenses for counting spines and plates; and an aquarium for observing stickleback behaviour.

STEM partner: University partner (academia)

The following project was awarded a £2,874 grant and undertaken by a primary school.

Project title: What lives in our green space and why is it important?

Proposed investigations as identified on the application form:

- 1) What plants grow in our green space? Tree survey; identifying trees in the local woods and looking at seasonal plants in the nearby grassland using a quadrat and recording how they change with the seasons.

- 2) What comes out at night? Walks to look for bats and find their potential homes in the trees. Using bat detectors which show what bat species are in the nearby park/woods. Additionally, setting up camera traps to catch images of nocturnal animals (foxes, badgers, small mammals).
- 3) Creepy crawlies and where they live? Pitfall traps in the soil (buckets) to see what insects can be found and why they are there. Using school's iPads with digital microscopes attached. We would discuss the importance of the creature we find in terms of ecosystem services.
- 4) Who's that singing? Bird surveys: looking and listening for the local birds. Using ID books and binoculars and a parabolic microphone to monitor the bird species in the local area.
- 5) Why do we need to look after our green space? Discussions with ecologists and follow up research on why the above animals/plants are important, and why we should protect them. Enhancements to local woodland/parkland installed for monitoring by the school.

What the grant was used for: quadrats, plant and tree identification guides, binoculars, bird identification guides, heterodyne bat detectors, camera traps, buckets and digging tools, invertebrate identification guides, hand lenses/iPad microscopes, parabolic microphone, time lapse camera, bat boxes, bird boxes, bug hotels.

STEM partner: Other (Environmental Consultancy)

The following project was awarded a £2,965 grant and undertaken by a secondary school with students with special educational needs and disabilities.

Project title: Which species do we share our neighbourhood with?

Proposed investigations as identified on the application form:

Using camera traps and data-handling techniques the following questions will be answered:

- 1) Which species are present in and around our school grounds?
- 2) Does the species community differ between contrasting habitats?
- 3) Does the time that species are active differ between contrasting habitats?
- 4) Can we make our own camera traps with Raspberry Pi technology?
- 5) Are our 'homemade' Raspberry Pi camera traps as effective in capturing the wildlife in our environment as more traditional 'ready-made' camera traps?

What the grant was used for: camera traps, accessories for camera traps (e.g. batteries, locks, memory cards, etc.), components to build Raspberry Pi camera traps, travel costs for fieldwork.

STEM partner: University partner (academia)

The following project was awarded a £1,386 grant and undertaken by a secondary school.

Project title: Can we use a radio antenna to detect the ionisation trails from meteors entering the Earth's atmosphere?

Proposed investigations as identified on the application form:

- 1) Monitor the diurnal variation in meteors entering the Earth's atmosphere.
- 2) Categorise meteor sizes based on their ionisation trails.
- 3) Determine the velocity of meteors based on their doppler shift.
- 4) Observe the time evolution of the ionisation track produced by a meteor.
- 5) Simulate a light-curve of a young star from different viewing angles and compare the light-curves to actual datasets.

What the grant was used for: telescope, chrome book laptop and any additional software licences, equipment to build a 3 element Yagi radio antenna to detect the reflected radio signals. A FunCube Dongle Pro+ to produce an input from the antenna into the required software. Funding to purchase a computer and housing. A 360 field of view camera. A small proportion of the funding for transportation and entry to a local observatory (entry for group £30).

STEM partner: Other (Observatory)

Design and build projects

The following project was awarded a £2,998 grant and undertaken by a primary school.

Project title: How do we get energy from wind?

Proposed investigations as identified on the application form:

Students will investigate and answer the following questions:

- 1) How does a wind turbine work to make energy?
- 2) What is the most efficient design for a wind turbine?
- 3) Can we use a wind turbine to power something?
- 4) Is wind a good source of energy? Why?
- 5) How does it compare to battery power?

What the grant was used for: equipment to build simple battery circuits with motors/buzzers/bulbs - class set, model wind turbine with exchangeable blades/paddles, multimeters to measure voltage and current and compatible bulb circuits.

STEM partner: Industrial partner

The following project was awarded a £827 grant and undertaken by a primary school.

Project title: Can Sir win the race in a kayak made of bottles?

Proposed investigations as identified on the application form:

- 1) Every year group (480 pupils) will investigate how much plastic each class produces in waste in a week from food, drinks, bathroom products (bubble bath bottles). This will form a mini environmental impact assessment project with a link to the local recycling centre (currently in

discussion about visiting).

- 2) Using the waste bottles collected, build and test boat prototypes. Tests will include floating and sinking experiments (variety of practicals adapted and differentiated to age as the whole school from Nursery to Year 8 will be involved as an off timetable curriculum day).
- 3) STEM club students to develop prototypes to make a giant kayak that will take the mass of a man. The full size kayak will be made from the waste bottles that the school has collected, no new plastics will be used (new adhesives will have to be used in order to hold the kayak together and make it safe).
- 4) Take the idea of reusing the bottles / plastic further - what else could we use them for? Look at options for a greenhouse to grow food.

What the grant was used for: Duct tape for binding bottles, Liquid nails polyurethane glue - for holding bottles together, Dowling - forms an upright structure to build the kayak, Tent pegs - for holding down the greenhouse structure to prevent it being blown away in the wind, String / rope - to hold together structures (kayak / greenhouses), Greenhouse equipment - staging / seed trays / seeds making the greenhouse have a future purpose, USB sticks - these will become the 'take away' digital packs for schools to have the resources we have developed for the plastics events to take back to their schools so they can continue to work on their plastics story.

STEM partner: Industrial partner

The following project was awarded a £2,663 grant and undertaken by a secondary school.

Project title: Can you feed your phone for free?

Proposed investigations as identified on the application form:

Electricity is only available at night at the Za'atari refugee camp in Jordan, and mobile phones are essential for refugees to keep in touch with their families back home. Students will design and prepare kits and instructions for wind turbines that could power phones that will be sent to schools in developing countries to test. Investigations to include:

- 1) Manufacture prototypes from scrap. PC parts vs car parts in terms of ease of build.
- 2) Calculate the efficiency of rotational vs vertical axis wind turbines.
- 3) Compare the cost of making from scrap vs commercially available products.
- 4) Review and assess the safety of rotational vs vertical axis wind turbines.

What the grant was used for: Commercially available devices for charging mobile phones, "scrap" computer and car parts bought for testing, materials for the construction and testing of wind turbines, required electrical components and cabled to connect parts to a mobile phone, postage and packaging materials to ship devices abroad.

STEM partner: University partner (academia)