



**Royal Society
student conference
2024**

Programme and project abstracts

THE
ROYAL
SOCIETY

Wifi

Name **RS-Public**

Password **Newton+apple**

Share your experience of the conference

✂ @royalsociety #PartnershipGrants

Accessibility

The Royal Society is committed to accessibility for our events. If you require assistance please ask a member of staff.

Fire alarm

If you hear the fire alarm at any time, it is not a test. Please calmly leave the building through your nearest fire exit.

The abstracts in this booklet are provided by the students themselves and the Royal Society takes no responsibility for the content.

Cover image

Microscope © iStockphoto / Kkolosov

Introduction

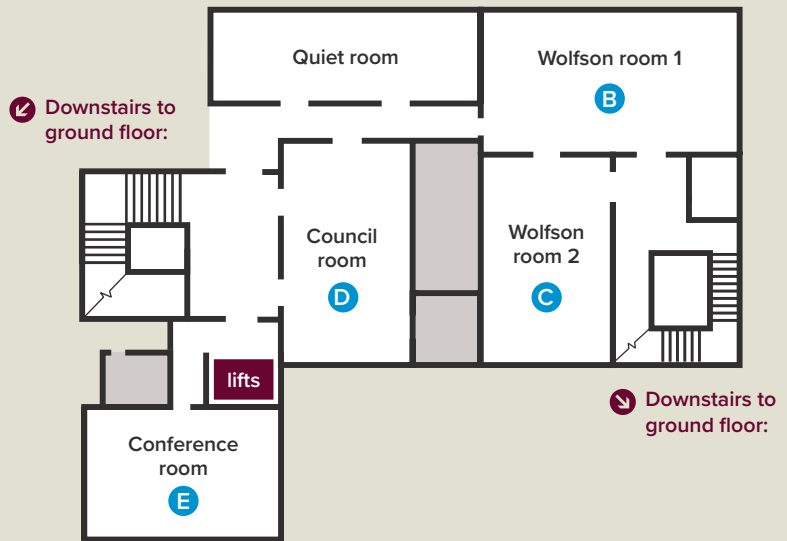
Welcome to the Royal Society student conference. This conference celebrates the work of students, from all backgrounds across the UK, who have undertaken investigative STEM project work via the Royal Society's Partnership Grants scheme including Tomorrow's climate scientists. The scheme funds schools up to £3,000 to run an investigative STEM project alongside a STEM professional from academia or industry. It aims to help students develop key STEM skills for broader future careers as well as seeing a range of possible career opportunities. Over the years this scheme has also helped to foster long term working relationships between schools and STEM professionals.

To find out more about the Partnership Grants scheme, visit royalsociety.org/partnership or scan the QR code.



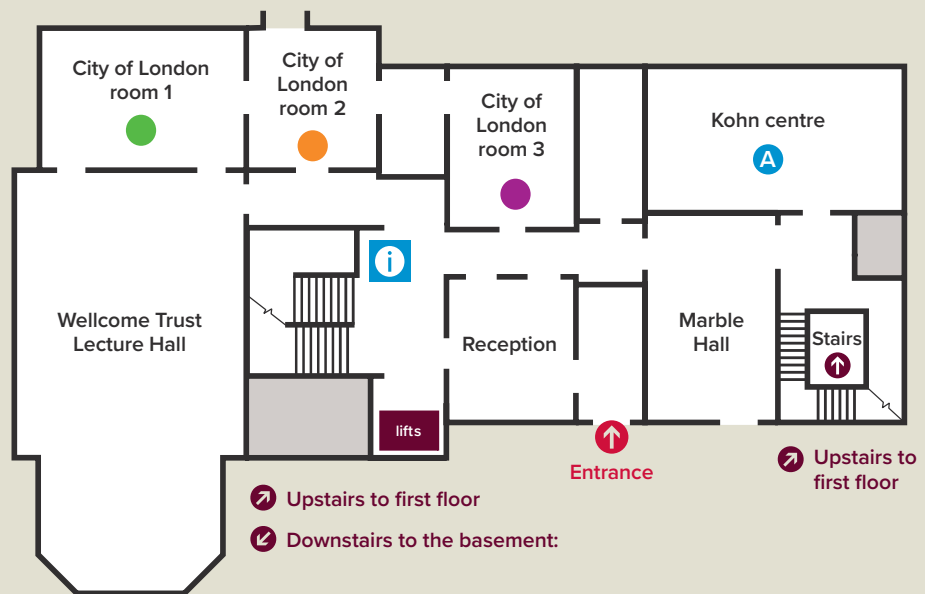
Map

First floor



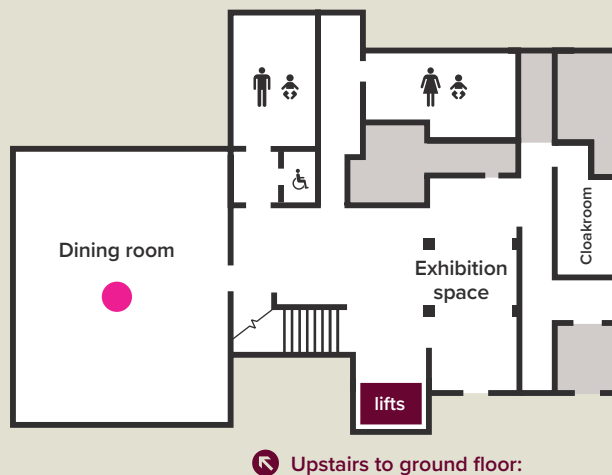
Ground floor

- City of London room 1
Projects: 1 – 4
- City of London room 2
Projects: 5 – 6
- City of London room 3
Projects: 7 – 10




Basement

- Dining room
Projects: 11 – 18



Programme

9am	School arrival and registration Lift lobby 
9.30am	Stand set up and refreshments City of London rooms 1 – 3, Dining room
10am	Welcome address by Professor Bryan Turner FMedSci FRS, Chair of the Partnership Grants Allocating Panel Wellcome Trust Lecture Hall Keynote speech by Professor Saiful Islam Wellcome Trust Lecture Hall
11am	Student and teacher workshops Teacher workshop Mercer Student workshop A Student workshop B Kohn centre Wolfson room 1 Student workshop C Student workshop D Wolfson room 2 Council room Student workshop E Conference room
12.30pm	Presentation by the Royal Society Archive team Wellcome Trust Lecture Hall
1pm	Lunch Conference room, Council room, Kohn centre, and Wolfson rooms 1 and 2
1.45pm	Student showcase City of London rooms 1 – 3, Dining room
3.45pm	Closing speech by Professor Bryan Turner FMedSci FRS, Chair of the Partnership Grants Allocating Panel Wellcome Trust Lecture Hall
4.15pm	Pack up and depart

Projects

See map on page 4 for location of projects.

City of London room 1

- 1** *How different could stellar hydrogen burning rates be before life becomes unviable on Earth?*
Lady Eleanor Holles School
- 2** *What level of ecological complexity can a (small) urban nature reserve support?*
Northfleet Technology College
Tomorrow's climate scientists
- 3** *Can image and sensor data be collected from remote airborne devices, for ground-based processing?*
Sutton High School
- 4** *Can we improve air quality in our area by influencing drivers to change their behaviour?*
Simon Langton Girls' Grammar School
Tomorrow's climate scientists

City of London room 2

- 5** *Can the school use new technology and renewable energy resources to reduce both its energy bills and its carbon footprint?*
Magnus Church of England Academy
Tomorrow's climate scientists
- 6** *What factors influence the growth of organic fruit and vegetables that will support a more sustainable future?*
Aston Fields Middle School
Tomorrow's climate scientists

City of London room 3

- 7** *What is the effect of various activities on wave patterns of the brain?*
William Perkin Church of England High School
- 8** *Will plants found in the mountains cope with climate change?*
Beaulieu Convent School
Tomorrow's climate scientists
- 9** *What species of tree will make the best raft?*
Alleyne's Academy
- 10** *What parameters need to be considered in composite design for real world cases?*
The Island Free School

Dining room

- 11** *What is the impact of prelim examinations on sleeping patterns in school children?*
Tynecastle High School
- 12** *Can you investigate the effects of changing climatological conditions on pond microflora using flow cytometry?*
Moulton School and Science College
- 13** *Can a single celled yeast be a model organism for neurodegenerative disease?*
Tapton School
- 14** *What is the impact of deprivation on air quality and noise pollution?*
Bilborough College
Tomorrow's climate scientists
- 15** *How will the coast around my hometown be affected by climate change in my lifetime?*
King Edward VI Grammar School
Tomorrow's climate scientists
- 16** *Can capturing rain water increase biodiversity and reduce flood risk?*
Wilberforce Sixth Form College
Tomorrow's climate scientists
- 17** *What can DNA barcoding reveal about the phylogenetic relationship of snowdrop species?*
Bedford School
- 18** *Does the volume, and chemical composition of frass affect the yield and growth rate of certain crops?*
George Stephenson High School

Abstracts

1 *How different could stellar hydrogen burning rates be before life becomes unviable on Earth?*

Lady Eleanor Holles School

Using Window To The Stars, we have been investigating how different stellar hydrogen burning rates could be, before life becomes unviable on earth. We aimed to do this by investigating how various factors, such as luminosity and density changed as hydrogen burning rates declined with age. Together with our STEM partner we investigated the distance a planet would need to be from a main sequence star at different points in its life using logarithms of the intensity of the star found from Hertzsprung-Russel diagrams. This showed us that a star like our Sun could sustain life on a planet at the current distance of the Earth, but in the far future our Sun could even sustain life as far out as the asteroid belt. Overall, our data shows that as stellar hydrogen burning increases, so does a star's density and intensity which shows us that it can sustain life at further distances.

2 *What level of ecological complexity can a (small) urban nature reserve support?*

Northfleet Technology College

Tomorrow's climate scientists

At Northfleet Technology College we have established a nature reserve exploring sustainability and climate change issues. Initially we asked the question "what lives on our reserve?". In answering this question, we found that we had a good balance of flora and fauna but realised that we should do whatever we could to increase biodiversity. Central to this was establishing a pollinators paradise. Using trees as the core to our sustainability led us to plant over 2,000 trees in 2 years.

With our trees in place, we created a community apiary. This will grow to house 10-12 beehives, nurtured by local primary schools. This will raise funds for climate change and net zero activities through the honey and wax harvest. As the trees grow, our harvest of fruit will increase, allowing the community to build food security through distribution of organic apples and pears to foodbanks, community groups and our pupils.

3 *Can image and sensor data be collected from remote airborne devices, for ground-based processing?*

Sutton High School

Our project integrates engineering and data science to explore if image and sensor data can be collected from remote airborne devices and transmitted for ground-based machine learning processing on the cloud, in real time. The goal was to collect local aerial image data for feature recognition, and air quality sensor data for correlation with historical Earth data, using Raspberry Pi computer components. To test this, we first transmitted image and sensor data from the Pi using LoRa radio within the classroom. With the support of our STEM partner we found whilst text-based sensor data could be transmitted efficiently for cloud processing, images were too large. When conducting the physical HAB and research rocket experiments to test stability of the computer payload during flight, image recognition and sensor data-logging algorithms set up on the cloud platform were unable to receive data live, so data was retrieved from the payloads once landed, for manual input to the cloud app.

4 *Can we improve air quality in our area by influencing drivers to change their behaviour?*

Simon Langton Girls' Grammar School

Tomorrow's climate scientists

We all know that traffic pollution can have a negative impact on people's health. The aim of this project is to investigate whether psychologically derived messaging can reduce engine idling at long-wait stops and therefore reduce air pollutants. Students collected control data at one long-wait stop in Canterbury, Kent. They wore air quality monitoring devices to examine levels of pollutants and counted the number of engines idling. They then used psychological principles to decide on the wording of two road signs to use in the experimental conditions. Students repeated the procedure with these signs and are currently analysing the data. Initial impressions suggest that the presence of the signs may reduce the number of engines idling, but air quality appears to be unaffected. With the help from our STEM partner we look forward to developing the project further by considering different wordings and investigating whether air quality might be affected at longer-wait stops such as railway crossings.

5 *Can the school use new technology and renewable energy resources to reduce both its energy bills and its carbon footprint?*

Magnus Church of England Academy
Tomorrow's climate scientists

The project is considering the school's energy use and how steps could be taken to reduce both its energy bills and carbon footprint.

Our project objectives include: how much energy could be generated by the school installing solar panels and wind turbines; how does the school use energy and can it be reduced; are new technologies available to help the school better manage its energy use?

Monitors are being installed at different locations to measure energy usage for different devices. A weather station is being installed to record the amount of sunlight and wind throughout the year; a classroom is being equipped with a battery that will be charged from both solar panels and a small wind turbine on the school roof.

We have already estimated the potential electricity savings from installing solar panels. With the help from our STEM partners we will compare these estimates to real data from our equipment over the next year.

6 *What factors influence the growth of organic fruit and vegetables that will support a more sustainable future?*

Aston Fields Middle School
Tomorrow's climate scientists

Together with our STEM partners we are investigating the optimal conditions required for organic fruit and vegetables to grow. Through this, the students will gain a better understanding of what is possible to grow in the school environment. They will also see that their actions are having a direct impact on the global issue of reducing the carbon footprint of the food we consume. For example, they will share the crops that we harvest with the school kitchen and the food technology department.

The students will be practicing their scientific enquiry skills such as data collection and following scientific methods. They will be using different ways to monitor the conditions, such as programming Micro:bits to measure temperature and soil moisture and using data loggers to monitor pH and light intensity. Overall, the project will allow them to see that small local changes can have an impact and ultimately, how we can encourage others to grow their own food too.

7 ***What is the effect of various activities on wave patterns of the brain?***

William Perkin Church of England High School

Our project is to investigate the effect of various activities on wave patterns of the brain, using the MyndPlay MyndBand with MyndPlayer Pro Software. The aim is for students to use cutting edge EEG Brain sets and MyndPlay Pro Software to collect and analyse individual brainwave patterns during various activities. Students wearing portable headsets connected by Bluetooth to laptops, record brainwave patterns at rest, and during eight different activities for about 5 minutes. Data will be uploaded into CSV files and analysed by the students with the help from our STEM partners. Data has just started to be collected; therefore, conclusions cannot be made yet. It has been predicted that physical activities (running on the spot), may elicit mainly alpha waves (focus), and mental activities (reading text) may elicit mainly beta brainwaves due to the relaxing nature of the tasks. Gamma waves may be elicited with both tasks, where heightened perception is involved e.g. playing computer games.

8 ***Will plants found in the mountains cope with climate change?***

Beaulieu Convent School

Tomorrow's climate scientists

The global climate is changing as our planet warms due to anthropogenic causes. Some scientists are hypothesising that we are in the midst of the sixth mass extinction, with so many species being lost to human activities and habitat loss. The UK is the home of some unique and rare species found in isolated pockets, such as snow pearlwort (*Sagina nivalis*). This plant exists at altitude which may mean that its available habitats become squeezed as the climate warms. Our project will investigate how these arctic-alpine plants respond to a warmer climate and more generalistic competitors. With the help from STEM partners we are using our location to model a "worse case scenario".

9 *What species of tree will make the best raft?*

Alleyne's Academy

To make a good wood-based raft it is important to choose a tree species which produces straight logs that are easy to cut and the timber must not absorb water too quickly. We designed a range of experiments to measure the workability and absorbency of six different tree species. All samples tested came from trees that had recently been cut down. Forty-four students from two schools, supported by two industry professionals, worked on the project. Using the scientific method, we repeated our experiments in fresh water and salt water conditions, and a field trip with our STEM partner helped us to learn about the size and shape of trees in different environments. Our investigations concluded that, within our local area, young sycamore trees, grown in a woodland would make the best raft.

10 *What parameters need to be considered in composite design for real world cases?*

The Island Free School

With the growing popularity of 3D printing techniques for a range of engineering applications, we considered material and structural factors when building a bridge to solve a local problem.

Using free-to-use CAD programs, the small team set about designing an aesthetic but structurally viable bridge design. We used a number of filament types, including TPU, ABS and PLA. With our STEM partner Gurit we tested for filament type, wall thickness and in-fill structure. Test coupons are limited in size so further structural testing is carried out onsite.

Our results showed that wall thickness plays an important role in flexural and tensile strength, whilst internal fill structure and fill percentage plays an important role in flexural strength.

3D printing materials are lighter and cheaper than traditional materials and could provide viable means for community engineering projects. Our next steps include streamlining the design process and, with our STEM partner Gurit, will look at the effects of UV light to reduce plastic pollution.

11 *What is the impact of prelim examinations on sleeping patterns in school children?*

Tynecastle High School

Sleep is important to health and well-being and we have all experienced good and bad sleep. Examinations are a feature of school life, and students regard examination periods as stressful. Our study collected both quantitative and qualitative sleep data using questionnaires and bespoke 'sleep wearables' built with Micro:bits, pulse sensors and remote data loggers. With the help from our STEM partner we developed the questionnaires, coded the hardware and conducted a full trial with student volunteers (12) over 3 nights of the November prelims. We adjusted the coding and conducted a second trial with controls using student volunteers (5) during the April/May SQA examinations. Results show that sleep pulse measures follow published trends and indicate low and highly variable sleep quality, independently of examinations. The qualitative data shows that the impact of examinations on student sleep is negative with students sleeping less and going to bed later. Generally, sleep hygiene is poor overall and worsens during an examination period.

12 *Can you investigate the effects of changing climatological conditions on pond microflora using flow cytometry?*

Moulton School and Science College

Our aim is to discover what life exists in our pond, why great crested newts live there and how we can encourage the population to thrive. This will take place over a long period of time (each academic year) and enable us to monitor the ecosystem as the climate changes.

So far, we have had ecologists visit our site to help us confirm the newts and identify plant and animal life, microscopy has been used to identify smaller organisms and we are also employing the use of flow cytometry to investigate at a cellular level which living organisms are present. So far we have had success in mapping the food web of the pond, and this year are focusing on using techniques such as PCR testing to further investigate any DNA in our pond and improve our understanding of the microscopic life in the pond.

13 *Can a single celled yeast be a model organism for neurodegenerative disease?*

Tapton School

Motor Neuron Disease (MND) is a neurodegenerative disease, affecting the function of motor neurons in the motor cortex, brain stem and spinal cord. MND affects 1:400 people in the UK. It results in an initial loss of muscle strength in the limbs, eventually the disease takes over all motor functions resulting in progressive paralysis. In some cases the patients can end up depending on life support to ventilate their lungs.

Development of model organisms for disease is a powerful tool in research, we have therefore attempted to develop a single celled yeast as a new model for this disease. We have shown that by introducing the MND related mutation into yeast we can slow the growth of these cells when this mutation is expressed as protein. Our initial data indicates that this is due to the same mechanisms responsible for neurodegeneration in humans. Future studies will use this system to identify potential therapeutic targets for MND.

14 *What is the impact of deprivation on air quality and noise pollution?*

Bilborough College

Tomorrow's climate scientists

Our project is investigating the link between air pollution, noise pollution, and deprivation as these are key issues that Nottingham faces. We are working in partnership with the University of Nottingham Geography Department to investigate air pollution around Nottingham and Derby using diffusion tubes. By using fixed and mobile data loggers we will monitor air pollution levels so that we can compare air quality and noise pollution in areas of high and low deprivation using the equipment provided by Kings College London. We have begun to use mobile air quality monitors to research air pollution in our local areas and we will use this data and the Index for Multiple Deprivation to examine links between deprivation and air pollution. We hypothesise that we will find a strong link between higher levels of deprivation and more severe air and noise pollution.

15 *How will the coast around my hometown be affected by climate change in my lifetime?*

King Edward VI Grammar School

Tomorrow's climate scientists

It is proposed that rising sea levels will inevitably affect our coastline. Some areas will be more at risk than others, and the spit at Gibraltar Point on the North Sea Coast of Lincolnshire offers a good opportunity to survey an area that has not been studied as much as similar coastal features. We hope to develop a record of the beach features, and how they change, at a much higher resolution than is currently available through satellite imagery.

Students at KEVIGS are undertaking a rolling programme of photographic surveys of the tidal area of the beach, using drones to take series of overlapping high resolution photographs which can be converted into 3D models of the beach (drone photogrammetry). These models can then be compared with future models to identify changes down to sub-centimetre scale to improve simulations and inform decisions based on their outcomes.

16 *Can capturing rain water increase biodiversity and reduce flood risk?*

Wilberforce Sixth Form College

Tomorrow's climate scientists

Climate change is exacerbating the risk of flooding of Hull which is worsening as the global temperatures increase. Our STEM partner organisation, Yorkshire Water, encourages and provides water butts to homes to capture rainwater as a sustainable solution. Our project is investigating whether capturing rainwater can also increase biodiversity. Six water butts (210L) and multiple 'living walls' were installed around our college. The living walls were watered allowing plant growth without taking up too much soil space. The plant boxes were sown with seeds of edible plants and decorative species. Large planters were planted with plants to attract butterfly species acting as green islands in the city.

Over summer, the food plants grew leading to an increase in large white caterpillars. Sunflowers attracted species of bees and housed a food chain of aphids, ants and ladybirds. The planters and boxes also played host to six species of wildflower which were all wild seedlings. The spinach and sunflowers provided seeds for sowing in 2024.

17 *What can DNA barcoding reveal about the phylogenetic relationship of snowdrop species?*

Bedford School

Multiple species of Snowdrop (*Galanthus*) chloroplast DNA have never been sequenced before. This project aims to achieve this through collaboration with the Head Gardener at Anglesey Abbey, and scientists at EMBL-EBI and Rothamsted. Firstly, chloroplasts will be isolated from our Snowdrop samples, following which the DNA will be extracted, isolated, and sorted by size using gel electrophoresis. The DNA will be sequenced using a MinION at Rothamsted Research and the reads assembled under the guidance of EMBL-EBI. The fundamental objective of this project is to analyse the results to create a phylogenetic tree containing all 12 sample species to see how they are related and how they have evolved. These findings will be made freely accessible online to benefit further research.

18 *Does the volume, and chemical composition of frass affect the yield and growth rate of certain crops?*

George Stephenson High School

It is estimated that between 20 – 25% of the world's CO₂ emissions come from arable farming. Ploughing land releases CO₂ back into the atmosphere. The requirement for arable farming continues to increase as the population increases; not only to provide food for humans but for the livestock that will subsequently be used for meat. Commercial fertiliser requires land to be ploughed prior to application as it is expensive and requires a lot of energy to produce. Furthermore, it can have devastating effects on local ecology.

The objective of the project is to test an alternative to commercial fertiliser. Frass, the byproduct of black soldier fly driven decomposition proves a promising alternative. This project will use a potting trial to determine if frass and/or chitin (a chemical found in the exoskeletons of insects) enriched soil will have comparable effects on the rate of growth and yield of sweetcorn.



The Royal Society is a self-governing Fellowship of many of the world's most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society's fundamental purpose, as it has been since its foundation in 1660, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

The Society's strategic priorities emphasise its commitment to the highest quality science, to curiosity-driven research, and to the development and use of science for the benefit of society.

These priorities are:

- The Fellowship, Foreign Membership and beyond
- Influencing
- Research system and culture
- Science and society
- Corporate and governance

For further information

The Royal Society
6 – 9 Carlton House Terrace
London SW1Y 5AG

T +44 20 7451 2500

W royalsociety.org