THE ROYAL SOCIETY

What can we do locally to reduce flooding from surface run-off?

1. Project overview

Duration of project
2 terms minimum to cover common rain seasons. Easily repeatable year-on-year
Can be considered as part of the Tomorrow's Climate scientists programme

Through this project students will be able to investigate the effects of built up spaces on rainfall within their school grounds. They will discover and again a greater understanding of material properties, learning about how different materials (both built and natural) effect the flow and absorption of water during rain fall. Working with their STEM partner, the students will be able to explore different ways to prevent or reduce surface run-off to reduce flooding, implementing and evaluating the most popular ideas and communicating their findings with the wider school community. Linking strongly to the curriculum, this project will enable teachers to inspire the next generation of climate conscious architects and urban planners. Details of the investigative work required to support this project can be found in section 4.

2. Student involvement

This project is aimed at secondary school students aged between 11 – 14, however, it could be adapted to suit other age groups and abilities. This project can be adapted to suit large groups, from clubs to whole year groups or larger, and we encourage projects to be as inclusive as possible. The project can be used to engage a wide variety of students in the school. For example:

1) older students mentoring younger years to engage with the observation and monitoring sections of the investigation
2) students with an interest in art and design helping to communicate the findings of the project to the wider school community via media such as video, posters etc.
3) students with an interest in design and technology helping to build any simulated systems or interventions.

3. STEM Partner involvement

Funding will only be offered to schools that can demonstrate a strong partnership. The partnership can either be with one individual STEM partner or a team of STEM partners. If there is a team of STEM partners, one must be identified as the lead STEM partner for the application process and must have sustained and meaningful engagement (in-person or online) with the students and teacher throughout the duration of the project. Other STEM partners in the team can support the project, if needed, to provide specialist knowledge or to help spread the time commitment and ensure the students have regular STEM partner engagement. For a two-term project such as described here, we would expect a ***minimum of 7 in-person visits over the course of the project***, undertaken by any of the STEM partners involved. The STEM partner(s) will provide the students with relevant guidance and knowledge to help them with their investigations, as well as an insight into potential careers.

The main role of the STEM partner(s) is to support the planning, design and implementation of the investigation that the students will carry out. Examples of how the STEM partner(s) could support the implementation of the investigations include (but are not limited to):

- supporting students to form their own hypotheses
- supporting students to set up their investigations following the scientific method

- helping provide secondary research sources and support the understanding of technical information
- helping with data collection and identification
- helping the development and implementation of student plans to reduce the effects of surface run-off
- helping with any building or design elements.

Other activities that the STEM partner(s) could get involved with are:

- arranging a visit to their place of work
- providing an introductory talk to the project group, or whole school, regarding their career and the relevance of this to the project being undertaken; and
- supporting the students end of project presentations.

Examples of STEM partners that could support this project are university or industry-based researchers, with a degree or equivalent background in a subject such as geography, meteorology, sustainable design and infrastructure. Professionals who are working in landscaping, urban design and maintenance or council environment managers.

For more information about the STEM partner eligibility requirements and guidance on how to find a STEM partner, please read the What is the partnership page on our website.

4. Investigation options

The following investigations described in the plan below will underpin this project and help the students answer the project title question. Please note some of the investigations may need to take place in parallel rather than sequentially throughout the year. The individual investigations suggested may need to be adapted or altered, dependant on the school grounds and spaces available locally. Teachers can also add in additional investigations and other project elements as required.

Project plan	Equipment suggestions
Initial survey: Identify the different material features of buildings and surfaces (such as roads, playgrounds and open areas) within the school and research how their properties may affect the absorption or movement of water during periods of rainfall. Simple modelling can be utilised to understand these processes under different conditions (light rain – heavy rain).	Materials to run simple modelling (e.g. sample tile, grass, brick, gravel etc)
Baseline data collection: Using the findings from the initial survey, identify the most suitable areas to place a weather monitor and collect surface run-off data within the schools grounds. Monitor rainfall events and build a picture of the areas most prone to flooding due to surface run-off. Before the data is collected, make predictions on what is expected to be observed. As results are collected, the collection process might need to be adapted and improved to get the best results. Review data collated to see if the data confirms or disproves the original predictions.	Wifi enabled weather monitor Rain gauge Bucket to collect surface run-off.

Secondary research: Carry out secondary research to learn about the most common anti-flooding interventions used to combat surface run-off.	
Main Investigation: 1. Based on the secondary research and baseline observations, test the effectiveness of a range of interventions. These could include: • rain gardens • water butts • permeable drainage • green roofs Research how each intervention works, analyse the benefits and drawbacks for each, research/test for the most effective variables for each of the interventions (plant species for rain gardens, size of pipe and butt for water butts etc) and then test the effectiveness of the intervention in a simple water flow model to determine what effect it may have on overall water flow. 2. Design a simple school/house model that can be used to simulate the conditions the interventions would be more realistically used in. Set up the interventions (on their own and in combination) and test to see what effect they have on a simulated rainfall event. 3. Look at the results of the previous investigations and decide what could be used in the school grounds and the best place to locate them. Build one or more test examples in-situ to test the intervention in a real world situation and see if it reduces the surface run-off measured in the baseline data collection.	Sample pipes, water containers, plants etc to simulate interventions. Materials to build simple water flow model for testing. Materials to build school/house model (or cost towards model being created externally) Materials to test one or more interventions in reality (i.e. water butt, rain garden planter, green roof frame and plants).
Wider communication: Communicate the results to the wider school community; methods could include information leaflets/posters, school assemblies, getting other years practically involved in the project, or a short film.	Please note: additional film grants towards a camera / software / microphones etc. are available to Partnership Grant holders.

A suggestion of essential equipment and supplies needed to undertake each of the parts of the project has been listed to assist you when putting together your budget. Please also consider any relevant additional costs permitted within the scheme, such as teacher cover, essential teacher CPD and/or travel costs for project related visits. For more guidance please read the eligibility and judging criteria page on our website.

5. Benefits and skills

Involvement in a long-term investigative project should enable students to have an in-depth experience of working scientifically as well as developing their general team working and communication skills.

Through this project the students will specifically learn about the interaction between the weather and the built environment in a real world context, gaining detailed knowledge about material properties as well as a broader understanding of the issues of flooding in urban areas. They will learn skills in research, observation and monitoring, identification, data capture and problem solving. Dependant on the exact investigations and activities you propose to undertake, there may be additional benefits and skills you can identify in your application.

6. Legacy activities

It is important that Partnership Grant projects are sustainable, providing long-term benefits to your students and wider school community in terms of the teaching and learning of STEM subjects.
Your legacy activities could include (but are not limited to):

- repeating the project with successive year groups
- re-using the equipment to gather evidence on the long-term impact of the student's surface run-off interventions
- testing new interventions and monitoring their success
- expanding the project to include other schools in the area, loaning out the weather station or testing models to collate more evidence to compare with your own.

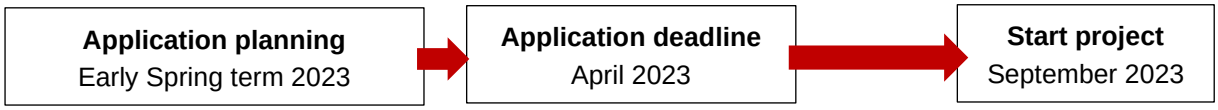
7. Next steps

1 - Securing your STEM partner

Using the information about STEM partners above, search for universities and businesses within reasonable travelling distance to you that might have suitable contacts to approach. A good route to finding these contacts is often your own school's Governors and student's parents, another is the national STEM Ambassador scheme. Once you have a few contacts in mind, write an email/letter inviting them to be involved in the project, providing clear and concise information about areas you need support with, the time commitment you are expecting, and the duration of the project. If you need further advice as to how to find a STEM partner, please contact the Schools Engagement team directly via education@royalsociety.org .

2 - How to start an application

This project is ideally started in the autumn term to allow the project to run for two terms during the most common rainfall times. To get the funding secured and paid in time, you will need to submit the full grant application for the April deadline in the academic year before. An example timeline is given below, and more information about The application process and timelines can be found on our website.



You can access the application form via the Royal Society's grant management system called Flexi Grant: https://grants.royalsociety.org/. When you first create your log-in and access Flexi Grant several grants will be visible on the screen. Please make sure you choose the ***Partnership Grants stage 1*** form to start.

3 - Where to get more information

You can find full information about the Partnership Grants scheme, including eligibility and judging criteria, application guidance and exemplar forms via our website: www.royalsociety.org/partnership

If you have specific questions about your project idea, STEM partner or application, please either attend one of our online training sessions or please contact the Schools Engagement team directly via education@royalsociety.org .