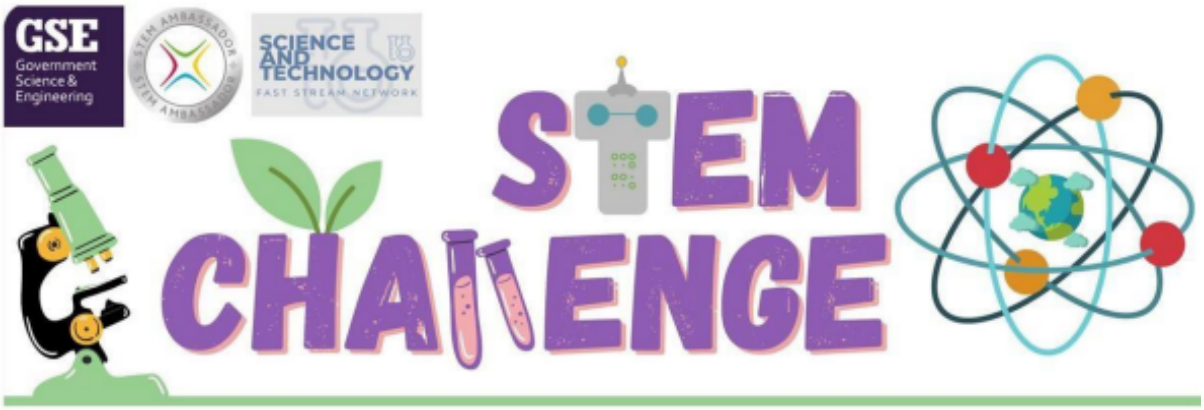

Teacher Pack

2023 Challenge

Civil Service Fast Stream · GSE Government Science & Engineering · SCIENCE AND TECHNOLOGY FAST STREAM NETWORK · NPL National Physical Laboratory · Royal Astronomical Society · BIOCHEMICAL SOCIETY · Royal Society of Biology

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Who are we?

We are a group of Civil Service Fast Streamers from a diverse range of fields and backgrounds, such as statistics, science and engineering, and technology, who wish to promote Science, Technology, Engineering and Mathematics (STEM) interest in schools. We are passionate about promoting STEM, and encouraging diversity, social mobility and inclusion within the field. Fast Streamers work across the Civil Service, typically gaining experience of working in different government departments, to target development in becoming future leaders.

What is the STEM challenge?

We believe that an engaging and effective way to communicate the real-world relevance of STEM can be delivered through a competition-based STEM challenge. The challenge involves a hypothetical but realistic scenario that students will address in a creative and scientific manner. This competition will be answered by groups of 4-6 students and is aimed at those in Years 9 and 10, as they will be able to respond with a degree of autonomy, and the challenge will be reflective of the school curriculum. The challenge is not limited to students in Years 9 and 10, and is open to any students who wish to take part! This will be open-ended to permit a range of approaches, and entries will be judged by a panel of civil servants from across government, including government policy experts, with prizes being awarded to the top three entries.

2023's challenge will be 'a vision of a carbon neutral day in 2050': imagine yourself as a scientist and policy maker in 2050 responsible for ensuring that resources are managed in a sustainable and carbon neutral way. This challenge will provide an opportunity for students to engage in discussion about the pressing issues of the environment and sustainability, while allowing scope for creative problem solving. Choose one of the three exciting and innovative topics provided to explore and build your carbon neutral world: sustainable food production, sustainable transport, or humans in space. Produce a poster or report explaining your team's vision for 2050 and focusing on your chosen topic.

Key dates

- The challenge launches on 6th March 2023.
- Submissions must be sent back by 7th July 2023, but can be sent earlier.
- For teams submitting before 9th June, feedback will be sent by 7th July 2023.
- All other submissions will receive feedback in September 2023.

If you have any questions, please email us with the subject line "STEM Challenge Enquiry" at stemchallenge@faststream.civilservice.gov.uk

Benefits to Students

The Challenge has been designed to reflect the school curriculum, tailored to target key skills in the Skills Building Partnership Framework and Gatsby Good Career Guidance benchmarks. We want students to gain experience of what scientific-based policy making looks like, providing a practical insight into how STEM skills are critical in a range of areas – not just the lab!

Skills Builder Framework

Designed to involve many skill strands within the Skills Builder Frame, the Challenge will specifically develop skills in the following strands:

- **Problem Solving**: Requiring consideration and evaluation of multiple routes to solve the Challenge, before arriving at the most appropriate solution. Demonstrates skill steps 4, 5, and 9.
- **Creativity**: Students consider a relevant and pressing area (carbon neutrality) with many possible solutions. Requiring a multidisciplinary and creative approach, students will share and articulate their thoughts. Demonstrates skill steps 0 through 8.
- **Teamwork**: Working in teams of 4-6 students, everyone will have to work cooperatively towards a common goal. Individuals will take responsibility to complete tasks and cooperate towards group decision making. Demonstrates skill steps 3, 6, 7 and 8.

Gatsby Good Career Guidance is designed to enable young people to make informed decisions about their future, with the Challenge linked to the following benchmarks.

- **Benchmark 4 'Linking curriculum learning to careers'**
  Students are presented with a 'real world' problem as carbon neutrality is a priority area for the government. We will also provide insight into our own 'journeys to the Fast Stream' to demonstrate how STEM degrees have brought us to the Civil Service.

- **Benchmark 5 'Encounters with employers and employees'**
  There will be opportunities for students to engage with Civil Servants working in a range of departments and professions.

- **Benchmark 6 'Experiences of workplaces'**
  The Challenge provides a virtual experience of working on policy development in Government through interactions with Fast Stream employees and potential further employer engagements.

Prizes

- All participants will receive a signed certificate by the Government's Chief Scientific Advisor and National Statistician, educational resources, and a talk from government scientists and statisticians for their class/year group.
- All participants will also receive small prizes such as pens from the Government Science and Engineering profession.

- The winning team will receive a year's free subscription to The Royal Society of Biology's BioNet membership and educational posters from the National Physical Laboratory.
- The top three teams will receive Amazon vouchers and engagement from one of the following Learned Societies: the National Physical Laboratory, Royal Astronomical Society and Biochemical Society.

Challenge areas

Resources for teachers and students

The following section details each area that each student group can focus on for the Challenge. Groups can choose any of the three problem statements.

*Please ensure students choose no more than **one** problem statement to address in their poster or report.*

Option 1: Sustainable Food Production

The world's population is estimated to reach 9.9 billion people by 2050. To feed the growing population, food production will need to be more efficient and sustainable. Sustainable food production involves producing food whilst protecting the land for future generations.

Imagine that you are in charge of creating policy for food production in the UK. **How will you make UK food production more sustainable?**

Research topic ideas to get you started:

- **Genetically modified (GM) crops**: What are the benefits and drawbacks of using GM crops? Who would be for and who would be against the use of GM crops? Have they been used anywhere before?
- **Alternatives to farming chemicals:** What effects can farming chemicals have on the environment? Are there ways to farm without using chemicals? Can we produce enough food without using farming chemicals?
- **Changing diets (insect consumption):** How could changing our diets improve sustainability of food production? What are the benefits and problems associated with including insects in our diets? Is lab-grown meat a realistic alternative to meat from animals?
- **Sustainable aquaculture and smart fishing:** Are there sustainable ways to catch fish? What issues are associated with fish farms? What are the latest technologies in aquaculture?
- **Land use:** How could land sharing or land sparing be used to improve sustainability of food production? What are the pros and cons of each system?
- **Reduce food waste during production or storage:** How could we minimise food waste in places like supermarkets and restaurants? Could technology help to reduce food waste? How could this impact farmers?



Websites to help with your research:

- BBC bitesize: http://www.bbc.co.uk/bitesize/topics/zjsc87h/articles/z88nhcw
- Food and Agriculture Organisation (FAO): https://www.fao.org/home/en
- Sustainable Food Trust: https://sustainablefoodtrust.org/

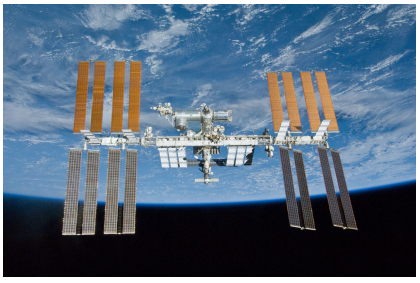
Option 2: Humans in Space

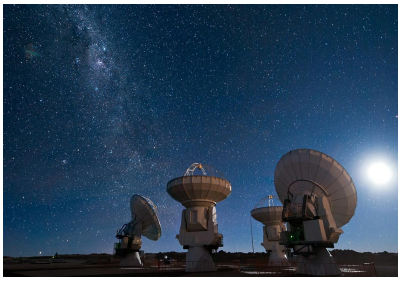
Space activities can benefit people back on Earth through space technologies, such as satellites for communication and weather monitoring. By advancing these space technologies, we can also progress scientific knowledge that may improve sustainability on Earth. We must also ensure that the space industry itself is sustainable, especially as it grows larger. This requires the consideration of the needs of people on Earth whilst also protecting space for future generations.

Imagine that you are overseeing the UK's space strategy: **How will you improve the sustainability of space exploration? How can you use emerging space technologies to improve sustainability on Earth?**

Research topic ideas to get you started:

- **Space food production:** How will you go about this task? What benefits might this have on earth? How might this help further space exploration?
- **Rocket fuels:** What sustainability issues result from current fuel options? What alternative could be used (biofuels)? What are the advantages and drawbacks from this change?
- **Reusable rockets:** What are the repercussions of one-time use rockets? What about safety? Are reusable rockets possible for full orbital flights?
- **Space tourism:** Are there benefits to humanity? What are the benefits to space exploration efforts (marketing, public opinions, etc.)?
- **International Space Station (ISS):** What science experiments are done on the ISS? How might this be beneficial to sustainability efforts on earth? What are the long-term impacts on astronauts?
- **Space technologies:** How might they improve sustainable development (natural disasters, reducing poverty, telecommunications)? How do they aid in reducing carbon emissions on earth? What are the drawbacks?





Websites to help with your research:

- UK Space Agency: About us - UK Space Agency - GOV.UK
- European Space Agency: https://www.esa.int/
- SpaceX: https://www.spacex.com/

Option 3: Sustainable Transport

Transport connects people to work, education, and healthcare, and enables the trade of goods. In 2019, the transport sector produced 27% of the UK's greenhouse gas emissions, the most of any sector in the UK. Since then emissions have fallen, likely as a result of less transport use during the COVID-19 pandemic, but transport remains one of the industry sectors producing the most CO_2 emissions.

Imagine that you are in charge of creating policy for the UK's transport system. **How will you make the UK's transport system more sustainable?**

Research topic ideas to get you started:

- **Electric vehicles**: How big an impact would it have if everyone used electric cars? What are the advantages and disadvantages of using them? Can any other vehicles be electric?
- **New fuel types**: Could new fuel types like biofuels or hydrogen be more sustainable than petrol and diesel? What are the advantages and disadvantages to using these different fuel types?
- **Personal choices**: What role do people's everyday choices have in creating a more sustainable transport system? What is the environmental impact of choosing to walk or cycle? What are the advantages and disadvantages?
- **Future modes of transport**: Are there any new or future modes of transport being developed that are more sustainable? What are the advantages and disadvantages? Will they be created soon enough to make a difference?
- **Air and water pollution**: What is the effect of unsustainable transport on air and water pollution? Are there ways to decrease it?
- **Green (sustainable) cities**: What are they? What are some examples? What role does transport have in making these cities sustainable?

Websites to help with your research:

- https://www.nationalgrid.com/stories/journey-to-net-zero-stories/future-transport-driving-change-next-10-years - This article has a good overview of lots of different topics, including new fuels and future types of vehicles.
- https://bettertransport.org.uk/ - This is the website for the charity Campaign for Better Transport, and contains lots of their ideas on how transport can be made greener in the UK.

FAQs

Is there a cost to entering?

No, the STEM challenge is free to enter.

Can multiple groups enter from the same school?

Yes, multiple groups can enter and compete from the same school.

Can I run the Challenge as part of a school club?

Yes.

How long does the challenge take?

We recommend students spend a minimum of four hours on the challenge. However, we anticipate that the challenge can be completed in as little as two hours. Please spend no more than 8 hours on the challenge. The challenge can be completed anytime between 6th March and 7th July 2023.

Will we receive feedback?

Yes! Every submission will receive feedback from judges. Judges will come from a range of cross-government areas and will include STEM civil servants and policy experts.

Submissions before 9th June 2023 will receive feedback by 7th July. All other submissions will receive feedback in September 2023.

What are the prizes?

Every submission will receive a certificate, educational resources, and a pre-recorded talk from a government scientist for their class/year group.

The top three teams will receive additional prizes such as Amazon vouchers, posters, and virtual/in-person engagement from the National Physical Laboratory, Royal Astronomical Society and BioChemical Society. The winning team will also receive a certificate signed by the Government's Chief Scientific Advisor and National Statistician.

What do students need to submit?

Students will submit either a written report or a poster to answer one of the three problem statements. More details on the submission can be found in the marking scheme.
Students are limited to four A4 pages.

Submissions for each team will need to be sent by teachers to stemchallenge@faststream.civilservice.gov.uk as PDFs by Friday 7th July 2023. Entries should not include any student names. Entries should be named as: STEM Challenge_[School Name]_Team[number to denote the team].pdf. Please ensure any scanned entries are written in a colour and size that is legible, and that electronic documents use an appropriate font size (we recommend size 12 for main text).

See our submission guidance below for more information

Marking criteria

This is the marking criteria that the students have been provided with:

	Definition
Problem Solving	1. Outline which of the three problem statements you have chosen to answer and provide information on how it affects us, why it is important and what the science community is currently doing to address the problem
	2. Present three relevant solutions to your chosen problem statement and explain how each of these will help solve the problem
Evaluation	3. Evaluate the proposed solutions by suggesting how effective they would be at tackling the problem and identify any potential drawbacks
	4. Compare the practicality of putting each of the solutions into practice, including assessing the overall cost
	5. Consider whether there are any uncertainties or problems with your solutions and what other research may need to be carried out to address these'
Scientific Evidence	6. Use evidence to back up the information used in your report or poster and clearly reference these in a list on the last page. References are the sources that you got evidence from, for example a scientific paper or a website
Presentation & Communication	7. Prepare a well structured report or poster, written clearly, concisely and persuasively
Creativity	8. Present original ideas using evidence from your research including original graphs, tables and diagrams where appropriate (these can be produced by computer or hand)

Submission Guidance for Teachers

Please see the following guidance about submission criteria.

Completing Entries

- Reports or posters can be completed by hand or in the software of your choice e.g. Microsoft Word/ Google Docs, etc, using the submission guidance provided.
- Please ensure the submissions are easy to read e.g. using biro for handwritten entries.
- Reports or posters completed by hand should be **scanned into a computer or photographed** to send for submission.
- Reports or posters completed in software must be **saved as a PDF** for submission.
- Reports or posters must be completed anonymously (no student names or details should be included).

Submitting Entries

- If multiple teams are entering from the same school, the teacher should give each team a number (Team 1/2/3 etc.) and **make a note of the team members in each team**. This list of team members should **not** be submitted to the STEM Challenge.
- Reports or posters completed in software, scanned in, or saved as a photograph should be named **STEM Challenge_[School Name]_Team[number to denote the team].pdf**
    - E.g. if the submission is from Primrose School the document would be called STEM_Challenge_Primrose School_Team 1.pdf
    - If there is only one team in the school, please specify the team number as Team 1
- Teachers or school advisors should submit the report or poster on behalf of the students by emailing it to stemchallenge@faststream.civilservice.gov.uk with the email subject line **STEM Challenge Submission**. Please submit all team entries for the school in one email. However, if file size does not allow this, then multiple emails will be accepted.
- **Student names must not be included in any documentation or in any emails.**
- Please aim to submit entries by **9th June 2023**, with a hard deadline of 7th July 2023.

Scaffolded Problem Statements

Some students may need more guidance than others to take part in the challenge. For those students, we have produced scaffolded problem statements. Please provide these only to students who would be unable to complete the challenge without the additional guidance.

Students are not required to answer these exact questions, but they can act as helpful guidance if necessary.

Problem statement one: How will you make UK food production more sustainable?

If you are considering '*genetic modification of crops'* as a possible solution, have a think about the below questions as you work through the challenge:

Abstract

Set your project aims and summarise what you will do*:*

- *What is the problem you are being asked to solve?*
- *How will your idea solve the problem?*
- *What will your report set out to do? (Inform? Persuade?)*
- *What are you going to cover? (List of possible solutions).*
- *What are you recommending?*

Introduction

Explain why solving this problem is important*:*

- *Why is the sustainability of food production important?*
- *What impact is climate change having on food production?*
- *How is agriculture contributing to climate change?*

Consider how this problem may affect you and others in the future:

- *Could climate change impact the amount of food we have to eat?*
- *Could climate change increase the cost of producing food?*
- *What is the impact on the environment if we continue our current farming methods?*

Reference what the scientific community is currently doing to tackle this problem:

- *Can you find examples of scientists, universities or charities who are currently tackling this problem? What are they doing to tackle the problem?*

Narrowing the topic

Consider why this specific area is important:

- *How can the genetic modification of crops have a positive impact on UK food production?*
- *How many people could be impacted by this? Are there health benefits to consuming GM crops? Can you fortify them with nutrients?*
- *What are the possible effects of eating genetically modified crops?*
- *What are the implications of using land for just one crop on the local ecosystems?*

Proposed solutions

Explain how your solutions solve your problem area:

- *Is the genetic modification of crops a sustainable practice and if so, how? For example, do genetically modified crops require less water or fertiliser to grow?*
- *Will it affect how much food we have to eat? Can you harvest them more frequently? Are they more resistant to disease and climate changes?*
- *Does it make food production easier or harder? Can they be grown in different environments?*

Discussion

Consider the wider impact of your solution:

- *What are the advantages and disadvantages of genetically modifying crops? (Pros and cons)*
- *What are the long-term impacts of producing genetically modified crops? Do they impact the local biodiversity?*
- *How much will this solution cost?*
- *How practical is this solution? How long will it take to implement?*
- *Are there any examples of genetic modification of crops working well in other places?*

Conclusion

- *What makes this solution better than other options? How do the benefits outweigh the cost or drawbacks?*
- *How would you convince the UK government to take this approach?*

Problem statement two: How will you improve the sustainability of space activities? Or, how can you use space technology to improve sustainability on Earth?

If you are considering '*sustainable removal of space debris'* as a possible solution, have a think about the below questions as you work through the challenge:

Abstract

Set your project aims and summarise what you will do:

- *What is the problem you are being asked to solve?*
- *How will your idea solve the problem?*
- *What will your report set out to do? (Inform? Persuade?)*
- *What are you going to cover? (List of possible solutions, your conclusion).*

Introduction

Explain why solving this problem is important*:*

- *How much space debris is currently in Earth's orbit, and what kind of problems does this cause?*
- *What are the incentives to clean up space around the Earth? What would be the benefits of this?*
- *How would removing space debris contribute to the sustainability of space activities?*
- *How can we remove space debris sustainably? What are the methods used?*

Consider how this problem may affect you and others in the future:

- *What are the long-term impacts of leaving debris in space? For example, does this prevent important space exploration/travel? Is the debris bad for the environment?*
- *What are the potential impacts of removing space debris from the Earth's orbit?*
- *How difficult is it to remove space debris sustainably?*

Reference what the scientific community is currently doing to tackle this problem:

- *Are there any examples of this working well in other places? Can you find examples of space debris being removed in a sustainable way?*

- *Is there an appetite anywhere in the world for space debris to become a focus?*
- *Can you find examples of scientists, universities or charities who are currently tackling this problem? What are they doing to tackle the problem?*

Narrowing the topic

Consider why this specific area is important:

- *How can removing space debris contribute to sustainability in the UK?*
- *What kind of technology is needed to remove space debris sustainably?*
- *How many people could be impacted by this? How would this affect people's lives, if at all?*

Proposed solutions

Explain how your solutions solve your problem area:

- *How would removing space debris sustainably improve the environment around the Earth? Why does this matter?*
- *What negative impact does space debris currently have on Earth's environment?*

Discussion

Consider the wider impact of your solution:

- *What are the advantages and disadvantages of sustainably removing space debris? (Pros and cons)*
- *How much will this solution cost?*
- *What kind of technology is required?*
- *How practical is this solution? How long will it take to implement?*

Conclusion

- *What makes this solution better than other options? How do the benefits outweigh the cost or drawbacks?*
- *How would you convince the UK government to take this approach?*

Problem statement three: How will you make the UK's transport system more sustainable?

If you are considering '*renewable energy for transport'* as a possible solution, have a think about the below questions as you work through the challenge:

Abstract

Set your project aims and summarise what you will do:

- *What is the problem you are being asked to solve?*
- *How will your idea solve the problem?*
- *What will your report set out to do? (Inform? Persuade?)*
- *What are you going to cover? (List of possible solutions, your conclusion).*

Introduction

Explain why solving this problem is important*:*

- *What type of energy is currently used for UK transport and how does it negatively impact the environment?*
- *What are some renewable forms of energy for transport? Are they sustainable and if so, how?*
- *How would these renewable forms of energy make UK transport systems more environmentally-friendly and why is this important?*
- *Would these renewable forms of energy be better for people's health?*

Consider how this problem may affect you and others in the future:

- *What are the long-term impacts of using renewable forms of energy for transport? For example, are they more difficult to use/expensive to produce?*
- *What are the potential impacts of these renewable forms of energy on the environment?*
- *How would renewable forms of energy for transport help the UK reach its goal of net zero emissions by 2050?*

Reference what the scientific community is currently doing to tackle this problem:

- *Are there any examples of this working well in other places? Can you find examples of renewable energy for transport being used elsewhere?*
- *Can you find examples of scientists, universities or charities who are currently tackling this problem? What are they doing to tackle the problem?*

Narrowing the topic

Consider why this specific area is important:

- *How can renewable energy for transport contribute to sustainability in the UK?*
- *How does renewable energy for transport compare what we currently use? For example, do they run better? Are they easier to produce?*
- *How many people could be impacted by this? How does this benefit the consumer?*
- *Will people need to change their travelling habits to adapt to the use of renewable energy for transport?*

Proposed solutions

Explain how your solutions solve your problem area:

- *How would using renewable energy for transport improve sustainability?*
- *How does it affect the transport system overall? What kind of changes would need to be made in the UK to encourage companies to use renewable energy for transport?*

Discussion

Consider the wider impact of your solution:

- *What are the advantages and disadvantages of these renewable forms of energy? (Pros and cons)*
- *How much will this solution cost? Are these renewable forms of energy an expensive option?*
- *What kind of technology is required?*
- *How practical is this solution? How long will it take to implement?*

Conclusion

- *What makes this solution better than other options? How do the benefits outweigh the cost or drawbacks?*
- *How would you convince the UK government to take this approach?*

Reflection Activity

An important part of any project, including scientific and policy projects, is reflecting on the lessons learnt whilst undertaking the project. This includes both the successes and the points to improve. To help develop this skill of reflecting and giving constructive feedback, we have provided some discussion points to help start and structure a class discussion, but please feel free to add your own.

Please let us know any feedback from the class discussion in the STEM Challenge 2023 participant feedback form that will be shared at the end of the challenge.

Discussion points

- ☐ What was your favourite thing about doing the challenge?
- ☐ What was the most challenging part of the challenge?
- ☐ If you could change one thing you did in the challenge, what would it be?
- ☐ What specific part, or parts, of STEM did you learn the most about?
- ☐ Has this challenge made you think differently about STEM?
- ☐ Do you think you have improved any STEM skills (e.g., writing, research, problem solving)

Contact us

If you have any questions about the challenge which are not answered in the FAQs, please contact:

stemchallenge@faststream.civilservice.gov.uk

Privacy Notice

- **Entries must NOT include any personal information**, including names of team members to ensure anonymity in the judging process is maintained.
- School names are permitted in entry titles as we will anonymise these before the judging process begins.

This statement covers the STEM Challenge. The Data Controller for submissions and general enquires submitted through the STEM Challenge mailbox (stemchallenge@faststream.civilservice.gov.uk) is the Cabinet Office.

The purpose of this statement is to inform individuals about what information is collected about them, how this information is used, if it is disclosed and the ways in which we protect users' privacy. This privacy statement only covers the STEM Challenge.

Purpose

The purpose for which we are processing your personal data is to run, promote and manage the STEM Challenge. These include:

- Collecting contact details of teachers from the public domain to invite their schools to participate in the STEM Challenge
- To respond to email enquiries and receive STEM Challenge submissions from members of the public, in this case specifically the teachers of the schools participating in the STEM Challenge.
- To make decisions about winners and to inform schools about those winners.
- To send consent forms to schools that can be completed by willing participant winners if they are happy for their details to be published.

The data

We will process the following personal data of teachers:

- Your name
- Email address

We will also:

- Collect details of any enquiries raised in your correspondence
- Process any other information you volunteer about yourself

We are only collecting this information to allow the judging of the STEM Challenge entries and for queries related to this to be responded to.

Lawful basis

The legal basis for processing your personal data is that processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the data controller. In this case that is promoting STEM engagement and attainment. This is achieved through demonstrating how STEM is relevant to real world policy in the STEM Challenge.

Schools with winning entries will be approached to pass on consent forms to the winning children and their parents. If those parents and children are happy to consent, then their winning entry, name, school, and photograph will be collected and published on our website, and also potentially on the websites of STEM Challenge partners. A separate Privacy Notice will be provided that covers that data collection. Even if parents and children do not wish to consent, they can still receive their prizes, which will be provided via the school.

Recipients

Your information will be shared with the STEM Challenge team to allow enquiries to be responded to.

As personal data will be stored on our IT infrastructure it will also be shared with our data processors who provide email, and document management and storage services.

Retention

Personal information will usually be deleted 1 calendar year. With individuals' consent, we may share and/or publish data of individuals (such as the names of individuals, schools, and photographs of individuals receiving prizes) for the purpose of advertising the STEM Challenge and recognising prize sponsors. This published data, and accompanying consent forms, will usually be retained for 2 calendar years.

Your rights

You have the right to:

- Request information about how your personal data are processed, and to request a copy of that personal data
- Request that any inaccuracies in your personal data are rectified without delay
- Request that any incomplete personal data are completed, including by means of a supplementary statement
- Request that your personal data are erased if there is no longer a justification for them to be processed
- In certain circumstances (for example, where accuracy is contested) to request that the processing of your personal data is restricted
- Object to the processing of your personal data

International transfers

As your personal data is stored on our IT infrastructure, and shared with our data processors, it may be transferred and stored securely outside the UK. Where that is the case it will be subject to equivalent legal protection through an adequacy decision, the use of Standard Contractual Clauses or a UK International Data Transfer Agreement.

Contact us

If you have any questions about this, please contact: stemchallenge@faststream.civilservice.gov.uk

The contact details for the data controller's Data Protection Officer are: dpo@cabinetoffice.gov.uk

The Data Protection Officer provides independent advice and monitoring of Cabinet Office's use of personal information.