

# TUNNELWORKS

## CREST INTRODUCTION FOR TEACHERS

*Tunnelworks includes ideas for student projects that can lead to a CREST Award.*

### About the Thames Tideway Tunnel

39 million tonnes of untreated sewage overflows into the River Thames each year from London's Victorian sewerage system. The Thames Tideway Tunnel is a major new sewer that will tackle this problem, protect the River Thames from increasing pollution for at least the next 100 years, and enable the UK to meet European environmental standards.

Find out more about the Thames Tideway Tunnel here: <http://www.thamestidewaytunnel.co.uk/>

### What is CREST?

CREST is a project-based awards scheme for the STEM subjects (Science, Technology, Engineering and Maths), managed by the British Science Association. It links the personal passions of students aged 11-19 to curriculum based learning.

UCAS endorse CREST Awards for inclusion in students' personal statements – they're well regarded, high quality and a tangible recognition of success.

Find out more at: <http://www.britishscienceassociation.org/crest>

### What can my students do?

There are CREST projects that build on Tunnelworks across all three levels; Bronze, Silver and Gold.

**Bronze Awards** focus on fun, teamwork and transferable skills. They are typically completed by 11-14 year olds; around 10 hours of project work is expected from each student. Students experience the project process, improving their enquiry, problem solving and communication skills.

**Silver Awards** stretch students and enrich their studies. They are typically completed by 14-16 year olds; around 30 hours of project work is expected from each student.

## How do I get started?

Awards are organised and administered through a network of Local Coordinators. You can find your Local Coordinator by visiting the contacts page on the CREST website, above. They'll help you register and provide expert guidance throughout the scheme.

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## How should students tackle a project once I've registered them?

Use the Thames Tideway Tunnel web link above to make sure that students are aware of the background to their project.

Students can work alone or in a team of 2-4 students to complete their project. Students can share the work in their teams and split into pairs or individuals to complete parts of it, coming together to share and combine their work. **However, every student needs to complete the minimum time and meet the requirements of the award.**

Your Local Coordinator will guide you through the process and will show you what's expected of each student, including the minimum time they should spend working on their project, how they should plan and document their work and the award requirements at Bronze and Silver level.

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## How are projects assessed?

To gain their CREST awards students must spend a sufficient amount of time on their project and produce original work at an appropriate intellectual level. The requirements at Bronze and Silver level are laid out clearly in the CREST Award Requirements PDF which you can access via this link to the CREST website: <http://www.britishtscienceassociation.org/crest-awards>

The teacher usually assesses Bronze awards while Silver awards are assessed externally. Your CREST Local Coordinator will be happy to advise you on Bronze assessment, especially if you are new to the scheme.

Why does London need the Thames Tideway Tunnel?

## CREST Bronze Research Project Student Brief

### What's the background?

Increasingly, when it rains in London there is not enough capacity in London's Victorian sewerage system to convey all the rainwater as well, as foul water, from homes and businesses. The system was designed to overflow into the River Thames so that peoples' homes and streets are not flooded with untreated sewage when the system is full. This means that in an average year 39 million tonnes of untreated sewage, combined with rain water, overflows into the River Thames each year.

The Thames Tideway Tunnel is a major new sewer that, in conjunction with the Lee Tunnel and upgrade of sewage treatment works along the Tidal Thames, will help to tackle this problem. These will help protect the River Thames from increasing pollution for at least the next 100 years and enable the UK to meet European environmental standards. The Thames Tideway Tunnel project will address the sewage overflows from these combined sewer overflows (CSOs), either by intercepting the flows and diverting them to the Tunnel, or by making other alterations to the sewerage system which will make more effective use of the existing capacity. The flows diverted into the Tunnel will be stored and pumped out for treatment at Beckton Sewage Treatment Works. But what changes in the environment and the way we live mean that we now need a solution like the Thames Tideway Tunnel?

### Your research challenge:

**How is the weather changing over London? How is our water use changing? How are these things coming together to create the need for an upgrade to London's sewer system?**

**Research the reasons behind the planned Thames Tideway Tunnel and create a poster, leaflet or presentation to explain what's changing.**

### Some things to think about...

- What is the rainfall over London? How does this change with the seasons, and how has it changed over time?
- Does London experience more extreme weather events than it used to?
- What happens to rainwater during a rainstorm over London?
- What's the history of London's sewer system?
- How has London's population changed since its sewer system was first built?
- What is London's annual water use, and how has this changed?
- What changes to natural drainage have taken place, for example due to new developments and gardens being paved?
- How could you survey local front gardens to find out how many are paved over?
- How can you best communicate the data and facts you uncover?
- Remember to present scientific information, rather than emotive arguments
- Use the correct scientific language and terminology

- You can choose to present your project in a CREST Bronze workbook (electronic versions are available) or through your own project report and student profile.
  - List any websites you use in your workbook or in your report and show where you have used each source of information in your project.
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### Health and Safety

Before you carry out any experiment:

**(a) find out if any of the substances, equipment or procedures are hazardous**

**(b) assess the risks (think about what could go wrong and how serious it might be)**

**(c) decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on)**

**(d) make sure your teacher agrees with your plan and risk assessment**

**NOTE: Your teacher will check your risk assessment against that of your school. If no risk assessment exists for the activity, your teacher may need to obtain special advice. This may take some time.**

**(e) if special tools or machines are needed, arrange to use them in a properly supervised D&T workshop.**

Why does London need the Thames Tideway Tunnel?

## CREST Bronze Research Project Teachers

The Tunnelworks CREST Introduction for Teachers provides important information you will need alongside this document.

### Research question

What changes mean that London now needs a solution like the Thames Tideway Tunnel? Students should create a poster, leaflet or presentation to explain their research findings.

### Possible equipment, materials and resources

These will depend on the presentation format(s) chosen by the students. They might include:

- Internet and public library access for research
- Local town planning or other local government contacts
- Desktop publishing and slide presentation software
- A suitable audience, if students are to present their research.

### Prompts

The student brief gives ideas to start students' thinking. Each one implies several items to research and students should identify these themselves. If necessary, use the prompts below to point students in suitable directions.

- What organisation might gather rainfall data for London? (eg Met Office, Environment Agency, Thames Water)
- How has London's population changed since its sewer system was first built?
- What do people use water for at home and in businesses?
- What organisation might gather water use data for London?
- What is natural drainage?
- How does natural drainage change when a place is developed?
- How might London's population, water use and rainfall change in the future?
- How would you plan and carry out a survey of local front gardens to find out how many are paved over?

### Suggestions for supporting students

Students must research and select information for themselves and demonstrate their understanding and application of the information they have identified as relevant. However, they may need some direction from you to identify suitable sources of relevant information at an appropriate level.

Although Bronze Award students are not expected to have an official Mentor for their project, access to expert advice makes students feel their work is important. Also, if the topic is not in your area of expertise, you may find a Mentor valuable. Your CREST Local Coordinator may be able

to suggest suitable contacts. Depending upon the nature of the project, someone with knowledge and/or experience of meteorology or water management could be ideal.

If you live in Southwark, Wandsworth, Hammersmith and Fulham, Newham or Greenwich, you may be able to access a Thames Tideway Tunnel STEM ambassador who can help. Please contact [\*\*education@tidewaytunnels.co.uk\*\*](mailto:education@tidewaytunnels.co.uk)

Discuss with students how they will manage their time (after school clubs, working during lunch hours, homework). Agree a completion date with them.

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### Internet search

Combine 'London' with terms such as: rainfall data, sewers, population, water use data, floods, extreme weather, drainage, paved gardens.

Why does London need the Thames Tideway Tunnel?

## CREST Bronze Practical/Investigation Project Student Brief

### What's the background?

Engineers rely on accurate mapping. Modern digital maps include vital information that engineers need when they plan, construct or renew the built environment around us. Building locations, the positions of drains or underground pipes and cables, and even information about the soil and rock types under our feet – if an engineer needs to know it, there is a map with this information. The digital age has transformed how maps are created and used but can traditional ways to find distances and directions still compete with modern methods like GPS?

### Your practical/investigation challenge:

Create two maps of your school grounds and buildings in as much detail as you can, using GPS for one map and a trundle wheel and compass for the other. Find out how to get the best from each technology and identify the strengths and limitations of each one.

### Some things to think about...

- How should you use each piece of equipment?
- How can you get the best performance from the equipment?
- What are each one's strengths and limitations – and how can you tell?
- How accurate and precise can each one be, and what is the difference?
- What reference maps can you use to compare and evaluate your maps?
- Which method is the best, and why?
- How can you best sum up and present your confidence in each approach?
- How can you best communicate the data and facts you uncover?
- Remember to present scientific information, rather than emotive arguments
- Use the correct scientific language and terminology
- You can choose to present your project in a CREST Bronze workbook (electronic versions are available) or through your own project report and student profile.
- List any websites you use in your workbook or in your report and show where you have used each source of information in your project.

### Health and Safety

Before you carry out any experiment:

- (a) find out if any of the substances, equipment or procedures are hazardous
- (b) assess the risks (think about what could go wrong and how serious it might be)
- (c) decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on)
- (d) make sure your teacher agrees with your plan and risk assessment

**NOTE:** Your teacher will check your risk assessment against that of your school. If no risk assessment exists for the activity, your teacher may need to obtain special advice. This may take some time.

- (e) if special tools or machines are needed, arrange to use them in a properly supervised D&T workshop.

Why does London need the Thames Tideway Tunnel?

## CREST Bronze Practical/Investigation Project

### Teachers

The Tunnelworks CREST Introduction for Teachers provides important information you will need alongside this document.

#### Research question

Students should create two maps of your school grounds and buildings in as much detail as they can, using GPS for one map and a trundle wheel and compass for the other. They must find out how to get the best from each technology and identify the strengths and limitations of each one, using reference mapping to evaluate their own results.

#### Possible equipment, materials and resources

- Handheld GPS or smartphone with GPS capacity, preferably with outputs as OS grid references if students will create their map manually
- An explanation of OS grid references, especially to small scale (eg 8 or 9 figure)
- Good-quality compass, preferably a sighting compass
- Trundle wheel (manual or with digital display)
- Access to detailed local mapping of your school (eg from your local authority or school leadership team)
- Access to a free GPS map-creation tool (see below)
- Computer or manual methods for recording data
- Computer or manual methods for creating maps

#### Prompts

The student brief gives ideas to start students' thinking. Each one implies several items to research and students should identify these themselves. If necessary, use the prompts below to point students in suitable directions.

- How can students learn to use their equipment and test their skills?
- How can they identify and gather ideas for best practice?
- What's the best way to gather and organise reliable data to create their maps?
- How can students determine the precision and accuracy of their equipment?
- How best can students create and present their maps (eg scale, size, key etc)?
- How can students evaluate their results using existing detailed maps?
- How could students present findings and share their conclusions?



## Suggestions for supporting students

Although primarily a practical challenge, students may need to research how to use some equipment and how to create their maps. Students may need some direction from you to identify suitable sources of relevant information at an appropriate level, and to ensure that their practical procedures are appropriate, feasible and safe (for example with regard to traffic and other hazards within your school grounds).

Although Bronze Award students are not expected to have an official Mentor for their project, access to expert advice makes students feel their work is important. Also, if the topic is not in your area of expertise, you may find a Mentor valuable. Your CREST Local Coordinator may be able to suggest suitable contacts. Depending upon the nature of the project, someone with knowledge and/or experience of GPS, mapping and compass use/navigation could be ideal.

If you live in Southwark, Wandsworth, Hammersmith and Fulham, Newham or Greenwich, you may be able to access a Thames Tideway Tunnel STEM ambassador who can help. Contact [education@tidewaytunnels.co.uk](mailto:education@tidewaytunnels.co.uk).

Discuss with students how they will manage their time (after school clubs, working during lunch hours, homework). Agree a completion date with them.

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## Internet search

Combine 'how to use' with GPS, trundle wheel, and sighting compass. Search also for 'OS grid references', 'make a GPS map'.

Students can use GPS data files to create a digital map using online tools such as [http://www.gpsvisualizer.com/map\\_input](http://www.gpsvisualizer.com/map_input).