

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.

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.

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.

The Ground Beneath Your Feet

CREST Bronze Practical/Investigation Project Student Brief

What's the background?

Your school is expanding due to a new housing development nearby, and there is a need for new buildings. The only available land, however, is a brownfield site on the other side of a busy road, which runs past your school.

To ensure the safety of students, teachers and visitors, the school governors have proposed that a tunnel be built under the road, to directly link the two sites of the school.

Understandably, the planning authorities have asked to see plans of the tunnel before coming to a decision. They want to know whether the ground is suitable for tunnelling, what the tunnel will be made of, what it will look like and how long it will take to build.

Your practical/investigation challenge:

- Plan a tunnel that will reach at least 20 metres below the surface, and be at least 100 metres long
- The tunnel must start inside your current school building, go under the road outside your school, and emerge on the other side of the road
- Produce a report. This could be a poster or presentation including:
 - diagrams and plans
 - details of any research and experiments you conducted
 - recommendations of materials to be used
 - suggested lighting
 - proposed art work/decoration for the inner walls.

Some things to think about...

- Where would you start with this project? Perhaps a one-page project proposal would help?
- Would the geology of the ground under your school be suitable for tunnelling, using a TBM (Tunnel Boring Machine)?
- Where would you find information about the geology of your school grounds?
- How could you investigate the soil type under your school? What tests and experiments could you carry out? How would you be sure that your results are valid and reliable?
- What route would the tunnel take?
- What would be the fastest a TBM could bore through the 100m to make the tunnel?
- How else might you construct your tunnel instead of using a TBM?
- How wide/high would your tunnel need to be?
- What materials would the tunnel be made from?
- How will you light the tunnel?
- How would users get down to the tunnel at either end?

- Is your tunnel accessible to disabled users?
 - How will you decorate the inside of the tunnel, as well as the entrances?
 - How will you know if you have met the aims and objectives of 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.

The Ground Beneath Your Feet

CREST Bronze Practical/Investigation Project Teachers

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

Practical/Investigation focus

Students should design and complete some simple physical soil tests as part of this challenge, which also combines research and design elements. They should create detailed scale plans of their ideas, basing these on both reference mapping of your school and community and their design concepts.

Possible equipment, materials and resources

These will depend on the report, poster or 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
- Paper, card and foam core board for design models
- Desktop publishing and slide presentation software
- A suitable audience, if students are to present their ideas.

Prompts

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

- Where will students' tunnel start and end?
- What existing infrastructure (pipes and cables) might exist on their planned route, and how can they avoid or re-route these?
- What physical tests would help students learn about the ground underneath their route?
- How can students create a detailed map of their tunnel's location and route?
- What should the aims and objectives be for this project?
- What criteria would help students evaluate their ideas?

Suggestions for supporting students

This challenge combines research, practical investigation and design elements.

Students may wish to create scale design models of their tunnel concept and could also build a scale architectural model of their proposed location.

You may wish to identify a suitable location next to your school to designate as the 'brownfield site' on which the new buildings will be constructed. This need not be free of existing buildings.

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 civil engineering and town planning 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.

Internet search

Students should research a range of Tunnel Boring Machines (TBMs) to find their bore diameter and tunnelling rate.

'Cut and cover' is another tunnelling method that may be more cost effective than using a TBM. Students can search for detailed online mapping of your school and community. They could find online geological mapping or use an app such as iGeology for iPad (from the British Geological Society).

Students could research physical soil tests including the standard penetration test, grain size analysis and hydrometer analysis and design simple versions to carry out using samples from your school grounds.

Students could plot their route using GPS and then use their GPS data files to create a digital map using online tools such as http://www.gpsvisualizer.com/map_input.