

# LONDON ROCKS KS3 SCIENCE / GEOGRAPHY

### Lesson context, approach and purpose

This lesson is aimed at KS3 students to focus on the diverse types of materials that a tunnel under London would produce, encounter and dispose. The resource focuses on rocks and natural materials link to the key stage 3 science curriculum, for example exploring the differences between igneous, sedimentary and metamorphic rocks, and KS3 geography curriculum: how human and physical process interact to influence and change landscapes, environments and the process of urbanisation.

The resources link well with the classroom activities, for example, KS3 STEM activity 1: Rock Investigation.

The activity can be introduced using the TBM app and a short presentation to introduce the Thames Tideway Tunnel to give context to students' learning.

### Learning objectives

- To explore the practical implications of the different types of rocks under the river.
- To introduce scientific and geographical concepts in real world situations, e.g. urbanisation.

### **Curriculum links**

The activities in the lesson are ideal for cross-curricular learning in science, chemistry or geography.

### Science (KS3):

Students should:

- Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience.
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.

### Chemistry:

Students should:

• Understand the rock cycle and the formation or igneous, sedimentary and metamorphic rocks.

### Geography (KS3):

Students should:

- Develop contextual knowledge of the location of globally significant places both terrestrial and marine – including their defining physical and human characteristics and how these provide a geographical context for understanding the actions of processes.
- Understand the processes that give rise to key physical and human geographical features of the world, how these are interdependent and how they bring about spatial variation and change over time.

[Taken from: National curriculum in England: geography programme of study - key stage 3]



**Teacher's notes** 

### What you will need:

- London Rocks introductory PPT
- London Rocks lesson plan

### For the extension:

- Rock Investigations Introductory PPT
- KS3 STEM activity 1: Rock Investigations
- London Rocks Sample Box
- Careers: jobs relating to rock!
  - Geotechnical / Geological Engineer
  - Civil Engineer
  - Plant Operative
  - Quantity Surveyor
  - Environmental Advisor
  - Logistics Coordinator
  - Apprentice Tunnelling Operative



### Preparation

Review the presentation, presenter's notes and worksheets.

Note: before you start the lesson ensure you have downloaded the Tunnelworks AR app onto your device and printed the AR key poster.





#### **Teacher's notes**

How will the sewer be excavated?	<b>Screen 1.6</b> The tunnel will be excavated by tunnel boring machines – huge tunnelling tools that simultaneously excavate ground material, construct the tunnel rings and remove waste material using mechanical systems. These machines are driven by trained tunnel operatives, who work on the machine underground. These images show two types: an earth pressure balance machine on the left (used in the west and central sections of the tunnel) and a slurry shield machine (used on the east section of the tunnel) on the right.
Who will be working on this?	Screen 1.7 Discuss the different job roles available on a construction project like Tideway.
LONDON'S SUPER SEWER ONLINE EDUCATION RESOURCES	<b>Screen 1.8</b> For further information, visit the Tunnelworks website or download the Tunnelworks AR app, where you can explore tunnel boring machines using AR technology using the AR trigger found on the classroom poster and post cards. Careers information can also be found on the website and on the app.
Further information visit www.tideway.london/tunnelworks/	



**Teacher's notes** 

### **Lesson Plan PPT**

This lesson is based on a 20-minute lesson and mixed ability KS3 group.

Screen	Notes
LONDON ROCKS PRESENTER UPPERCASE DATE UPPERCASE REMEMBER	
<ul> <li>Quick starter: true or false</li> <li>Look at each of these statements in turn and decide if it is true or false:</li> <li>1. Rocks and minerals are basically the same thing.</li> <li>2. Mudstone is rock made of mud.</li> <li>3. Granite is an igneous rock; wherever it is found, there must once have been a volcano.</li> <li>4. A lot of ground under London is London Clay, which is not a rock.</li> <li>5. If you're tunnelling through a very hard rock, the only way of getting through it is to blast it.</li> </ul>	Screen 1.2 Ask students to review quick starter statements and provide answers.
<ol> <li>Quick starter: answers</li> <li>FALSE. A mineral is a single substance, whereas a rock is made up of several different minerals.</li> <li>TRUE. It is a sedimentary rock formed from clay or mud.</li> <li>FALSE. Granite is igneous rock and was therefore once liquid but slowly crystallised beneath the Earth's surface.</li> <li>FALSE. It is a 'weak' rock, though it is also found in soil.</li> <li>FALSE. Tunnel boring machines can drill through any type of rock.</li> </ol>	Screen 1.3 Answers
Quick refresh – three types of rock         Image: sed in a star in the sed	Screen 1.4 Explain and describe the three types of rock.
Three types of rock	Screen 1.5 Ask students to draw the diagram and insert labels provided and arrows to complete.



#### Teacher's notes

Screen	Notes		
Dees your diagram look something like this?	Screen 1.6 Explain the diagram and discuss further with students.		
Challenge         • You have now been supplied with a rock sample or an image of a rock sample. Look at it closely and see if you can answer these questions:         • Do you think it is most likely to be a sedimentary, an igneous or a metamorphic rock?         • Explain why you made that decision.         • Imagine that you were in control of a tunnel boring machine (TBM), digging a turnel through material like this. Do you think it would be fairly easy or do you imagine this would be hard going?         • The material the TBM removes would then have to be removed. Do you imagine that shifting this would be fairly straightforward or do you think it would be quite a challenge?	Screen 1.7 Explain to students that they now have to study a rock sample and complete the challenge.		
<ul> <li>Testing materials</li> <li>Take three different materials; sand, chalk and clay.</li> <li>These represent the three types of rocks that the Thames Tideway Tunnel is built through. All three are sedimentary.</li> <li>Take a sample of each and see what happens when water is poured onto it. Make a note of what happens in each case.</li> <li>Then try testing the chalk with some other liquids. Make a note of what happens in each case.</li> </ul>	Screen 1.8 Explain to students that they will be undertaking some testing on three difference types of materials: sand, chalk and clay.		
SAND         You should have found that the water drains through the sand very easily.         Wou should have found that the water drains through the sand very easily.	Screen 1.9 Discuss the student's findings when using water.		
Testing the chalk         When chalk is put im coke, you should per some fizzing.         • When chalk is put im coke, you should per some fizzing.         • This suggests that a reaction is taking place.       • This is more of a reaction.	Screen 1.10 Discuss the student's findings when using acid-based liquids.		



#### Teacher's notes

Screen	Notes
<ul> <li>Thinking about what we've learned</li> <li>Some materials are much better at draining than others. We refer to these as being permeable. Put the three rocks into order of permeability.</li> <li>Chalk wasn't affected chemically by water but it was by coke, lemon juice and vinegar. What have those three got in common that is not true about water?</li> <li>Statuse in cities often end up looking like this. What have you learned from these tests that might help explain this?</li> </ul>	Screen 1.11 Reflect on what the students have learnt.



**Teacher's notes** 

### **Extension Activity**

**Rock Investigations - KS3 (1 Hour)** 

### Learning objectives:

- To understand the properties and formation of igneous, sedimentary and metamorphic rocks.
- To understand how to test for hardness and permeability.

### Preparation:

• Rock samples, steel nails, water supply, access to computers or textbook, presentation.

### Sequence:

- Starter: Students list as many types of rock at the back of their books (5 mins)
- Introduce the Thames Tideway Tunnel context using presentation (10 mins)
- Introduce and demonstrate practical (5 mins)
- Students draw a table of results and complete practical (Q1) (15 mins)
- Student research properties, formation of types of rock, completed for homework (Q2) (20mins)
- *Plenary:* Group discussion students discuss the difficulty of tunnelling throughout waterlogged chalk (Q3) (5 mins)

### Differentiation

Easier:	Harder:
Students could be supplied with pre-drawn table.	Students should design their own tests for hardness and permeability.

### Answers to Classroom Worksheet

**Q1**.Students should produce an appropriate table, with a title. Tables should be ruled in pencil, including ample space to record their results.

Q2. The water content of chalk causes the following problems:

• The water makes the chalk unstable, which makes the tunnels liable to collapse.

There is a surprising amount of water trapped within the microscopic pore spaces of the actual chalk itself (whereas most of our drinking water is from within the fissures between blocks and chalk material).

• The water can leak into the tunnels, causing them to flood When the chalk is crushed / broken up during excavation, this releases the pore water and the excavated material becomes very "sloppy" and sometimes difficult to handle (especially on a TBM conveyor belt).



KS3 Science / Geography

# **ROCK INVESTIGATION**

### Introduction

The Thames Tideway Tunnel is a major new sewer, being built to protect the tidal River Thames from pollution and meet London's sewerage demands until well into the 22nd century. Navigating London's complex geology, it will run 66m below the Thames and be 25km long, running through clay, sand and chalk, layers of sedimentary rock.

### Activity 1: Rock Investigation



Chalk





Slate



Limestone

Constructing the Thames Tideway Tunnel, London's new super-sewer, requires geological understanding of the ground beneath the city. Geologists compare the properties of rocks, which inform the decisions about tunnelling processes.

- 1. Perform experiments on granite, chalk, slate and limestone pebbles. Compare the permeability, hardness, structure and appearance. Record your results in an appropriate table.
- **Permeability:** Drip a droplet of water onto the rock. If it leaves a damp mark, the rock is permeable.
- **Hardness:** Scratch each rock with a steel nail. Which scratches the most easily? Which does not scratch at all?
- Colour and texture: How do the rocks vary in appearance and structure?



**Resource sheet 2** 

1. Rocks can be split into three categories: igneous, metamorphic and sedimentary rocks. Fill in the following table, describing the formation, properties and examples for each type of rock.

Type of rock	Properties	Formation	Examples
Igneous			
Metamorphic			
O a dias a stars a			
Sedimentary			

**2.** The east section of the Thames Tideway Tunnel passes through a layer of chalk. Chalk contains lots of water. Why might this property of chalk be a problem for tunnel operatives?