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| **Lesson Ten: Thomas Telford** |
| Lesson Ten focuses solely on Box 4 and the life of Thomas Telford. Telford was a designer and civil engineer who over a twenty year period embarked on a building project that involved constructing over nine hundred miles of roads and over a thousand bridges to create links between towns across the Highlands. He designed and oversaw the construction of the Caledonian canal as well as hundreds of harbours and slipways. Telford’s impact on the Highlands is immeasurable and hopefully this lesson can form an introduction to a hugely important figure in Scottish history.  |
| **Curriculum Links - Social Subjects (People, Past Events and Societies)** |
| Experiences and Outcomes | Benchmarks |
| I can use primary and secondary sources selectively to research events in the past. SOC 2-01aI can interpret historical evidence from a range of periods to help build a picture of Scotland’s heritage and my sense of chronology.SOC 2-02a**I can investigate a Scottish historical theme to discover how past events or the actions of individuals or groups have shaped Scottish society.** **SOC 2-03a**I can compare and contrast a society in the past with my own and contribute to a discussion of the similarities and differences.SOC 2-04a**I can discuss why people and events from a particular time in the past were important, placing them within a historical sequence.****SOC 2-06a** | * Uses both primary and secondary sources of evidence in an investigation about the past.
* Places an event appropriately within a historical timeline.
* **Describes at least two ways in which past events or the actions of individuals or groups have shaped Scottish society.**
* Describes and discusses at least three similarities and differences between their own life and life in a past society.
* **Contributes two or more points to the discussion (in any form) as to why people and events from the past were important.**
* **Places those people and events on a timeline.**
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| **Wider Curricular links** |
| **Technologies (Application of Engineering)**I can extend my knowledge and understanding of engineering disciplines to create solution. **TCH 2-12a** |

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| **Learning Objectives** |
| I can describe how Thomas Telford’s work contributed to and changed Scottish/Highland life. |
| I can build/simulate solutions to engineering problems. |
| I can explain how bridges work. |
| I can explain how Telford’s bridges were constructed. |
| **Resources and Suggested Reading** |
| **Required Resources - Supplied in the boxes or from ARCH website** |
| Allt na Fearna Mor bridge model, Arch blocks (Box 4)Information Sheets: Thomas Telford, Allt na Fearna Mor Bridge, Additional images: Thomas Telford’s Road Network, Thomas Telford Bridges in the HighlandsLesson Resources: Thomas Telford Timeline Activity Sheet, Thomas Telford Quiz Sheet |
| **Additional Required Resources** |
| Dried spaghetti, midget gems or marshmallows, cardboard, Sellotape, paper, tea tray or Tupperware container, tennis ball or sponge ball, ICT equipment, google maps, Post-it notes |
| **Essential Reading - Information sheets supplied in the box or from ARCH website** |
| Thomas Telford object sheet |
| **Suggested Additional Reading - Information sheets supplied in the box or from ARCH website** |
| None |

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| **Introduction** | **15 minutes** |
| **What is engineering?** (5 minutes) | Resources: None |
| * This introduction focuses on what engineering is and the role of the engineer.
* There is scope to expand this introduction and conduct research on local feats of engineering.
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| Write the word **engineering** on the board. As a *think-pair-share* exercise, ask the class ***What do you think the term engineering means?*** Collate their answers on the board. Display the following definition of engineering on the board: **“The branch of science and technology concerned with the design, building, and use of engines, machines, and structures.”** Explain that engineering refers to the science that ensures buildings, bridges and other structures stay standing.Ask ***Knowing what engineering is, what does an engineer do?***Finally finish by asking the class what special buildings, bridges, canals or other structures they have noticed in their local area, some of which could possibly have been designed by an engineer. |
| **Portrait** (10 minutes) | Resources: Thomas Telford object sheet |
| * This section is a brief introduction to Thomas Telford.
* The portrait of Telford by S. Lane has a number of small details that, when studied closely, hint at some of Telford’s achievements.
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| Show the class the portrait of Thomas Telford by S. Lane (on the back of the Thomas Telford object sheet). Don’t tell the pupils who the person is. Instead split them into pairs.As *a think-pair-share* exercise, ask the class ***What is the most interesting thing about this portrait?*** Have some of the pairs share their answers. Explain to the pupils that you can learn a lot from a portrait. Ask all the following questions as *think-pair-share* tasks and have the pupils share their answers with the class. Remember to encourage the pupils to explain their reasoning:* ***When do you think this person lived?*** (Around two hundred years ago - b. 1757 & d. 1834)
* ***What can you see in the picture?*** (A viaduct in the background, sheets of paper on a desk)
* ***How old do you think he is when he sat for this portrait?*** (It was published in 1831 when Thomas Telford was 74)
* ***What do you think his job was?*** (Engineer)

Explain to the class that the subject of the portrait is Thomas Telford, a notable civil engineer who left a lasting legacy on the Highlands of Scotland and was responsible for some of the most ambitious civil engineering projects of his age. |

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| **Main** | **1 hour & 20 minutes** |
| **Who was Thomas Telford?** (15 minutes) | Resources: Information Sheets: Thomas Telford object sheet; Additional Image: Thomas Telford Bridges in the HighlandsLesson Resources: Thomas Telford Timeline Activity SheetOther Resources: Paper |
| * These activities are designed to introduce the work of Thomas Telford to the class. It is possible some pupils have never heard of him and therefore will know nothing about his life and work.
* Thomas Telford had a huge impact on life in the Highlands.
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| Ask the class ***Who has heard of the Caledonian Canal?*** Hopefully most, if not all, pupils will raise their hands. Explain that Thomas Telford designed and oversaw the construction of the Caledonian canal. This was just one of the numerous civil engineering projects Telford completed in the Highlands.*OPTIONAL: Telford was also involved in the construction of the Dingwall canal (as well as other canal projects across the British Isles and Sweden). It was not a commercial success and was relatively short lived. It would make an interesting short research task for the pupils to consider.*Tell the class that the Caledonian canal is sixty miles long and links the east coast of Scotland at Inverness to the west coast near Fort William. It has 29 locks, four aqueducts and ten bridges which were all built as part of the project. Ask the class ***Given all that was needed to build the canal, how long do you think it took?*** The canal took nineteen years to complete. Ask the class ***Can you tell me what an aqueduct is?*** A bridge for carrying water.Show the class bridges designed by Thomas Telford. A sheet with four bridges is supplied, and a simple internet search of the term “Thomas Telford Bridges” will bring up other examples. It is worth focusing on these three:1. Telford Bridge, Invermoriston
2. Menai Suspension Bridge
3. Pontcysyllte Aqueduct

Two of these bridges are in Wales but are excellent examples of impressive structures design by Telford.When looking at these pictures ask the class to choose a favourite. Have some pupils share their favourite bridge and explain why they have chosen it. Divide the class into mixed ability groups of four (three will also work). Hand out the Thomas Telford information sheet. Give each pupil in the group a number from one to four. If you have pupils who need additional support with their reading make sure they are number one which will mean that you can support this group.Number ones are to read the first paragraph. Number twos are to read the second and third paragraphs, number threes the fourth and fifth paragraphs, and number fours the sixth and seventh paragraphs. Give the pupils a reasonable time limit (two minutes usually works but it depends on the reading level of the class). During this time the pupils are to read their section and summarise the information. When the time has run out give each pupil thirty seconds to summarise their section to the rest of the group. Hand each group a large piece of paper. Have them create a poster, presentation, infographic or any other group-based piece which will work with your class. They are to transfer the information they have summarised to the large paper. Have some groups share, briefly, the information they have summarised. *OPTIONAL: There is the opportunity to conduct further research into the life of Thomas Telford. Using ICT, the pupils could add further information to the above piece of work. There are links and suggested further reading provided below in the “Links and Further Information” section.*Hand out the Thomas Telford timeline activity sheet. The pupils are to research the life of Thomas Telford and use that research to complete the timeline. This could be completed by cutting and sticking the information on the timeline or copied out onto paper or into an exercise book. |
| **Thomas Telford in the Highlands** (15 minutes) | Resources: Information Sheets: Additional Image: Thomas Telford’s Road NetworkLesson Resources: Thomas Telford Quiz SheetOther Resources: ICT, google maps |
| * Telford’s impact on the Highlands is difficult to quantify. However, many of the structures he created are still in use today.
* This activity is a self-led research task with the pupils required to find the information to complete a quiz.
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| Thomas Telford had a huge impact on life in the Highlands. His various projects and innovative designs have left a lasting legacy across Scotland.This next exercise is a research task based around a quiz format. Split the class into pairs or small groups. Hand out the Thomas Telford Quiz Sheet. Read the questions with the pupils.The pupils are to research the answers to the questions using information available on the internet. There are also other puzzles such as word searches and anagrams of his famous bridges.Allow ten minutes for the groups to complete the quiz and other puzzles and then go through the answers together. This is designed to form an introduction to Thomas Telford’s role in developing the infrastructure of the Highlands.Show the class the image of the map taken from Thomas Telford’s autobiography showing the roads he built in red. Show the class (side by side on the board) the A82 between Inverness and Fort Augustus using google maps. Ask the class ***What do you notice about the modern roads shown on google maps, and the roads created by Telford?*** A lot of the roads Telford built form the basis of the modern road network. Follow up with the question ***What does this tell you about the roads and bridges Telford created?*** His methodical surveying and engineering prowess have meant his creations have lasted hundreds of years. |
| **Engineering** (50 minutes) | Resources: Objects: Allt na Fearna Mor bridge model, Arch blocks (Box 4)Other Resources: dried spaghetti, midget gems or marshmallows, cardboard, Sellotape, paper, tea tray or Tupperware container, tennis ball or sponge ball |
| * This is a practical session which challenges the pupils to complete some engineering type tasks.
* One group will work with the teacher to discuss the Allt na Fearna Mor Bridge model and the constructions of arches.
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| *Depending on numbers, split the class into three or six groups (groups of three or four pupils is ideal). This part of the lesson features three separate activities which the groups rotate around. These activities are to be completed at the same time and repeated as the groups move around. Explain each activity at the beginning so all pupils know what they are to do at each point. These activities can be split up and completed in separate lessons if you wish. All three are designed to challenge pupils to create structures and consider engineering principals when designing solutions.*1. **Spagetti and Midget Gem bridge**

In this task pupils are to try and span an 80cm gap between two tables with a bridge made entirely from dried spaghetti and midget gems (marshmallows will work as well). It is important to store the midget gems in a warm space (near a radiator is perfect) as this will make them a little softer and make it easier to push the spaghetti into the sweet.The bridge needs to be free standing and cannot be attached to the tables in any way (usually pupils will try and use sellotape); instead the bridge will need to “rest” or “hang” on the table surface. The bridge also needs to include a 5cm wide cardboard “road” for a vehicle to travel across.To test the bridge you can either:* Run a vehicle (there is one supplied in the box, but you may want to try some heavier ones) of a certain weight over the bridge to see if it survives. Record the number of spaghetti pieces that have been used in the bridge (broken pieces still count as one). The bridge that survives and uses the least pieces is the winner.
* Add weights to the base of the bridge until it collapses. The bridge that could hold the most weight is the winner.
1. **Ball run (analogous to slipways)**

This activity requires A4 paper and sellotape, but it can be completed with scrap paper or old worksheets to ensure paper is not being wasted.Each group is to try and move a ball (either a tennis ball or sponge ball) from on top of a classroom table to a container, resting on a pupil chair one metre away, without the ball touching the floor. A tea tray with low sides works really well for this activity because if the ball hits the tea tray too quickly it will bounce out and therefore hit the floor. This means the group will need to think of the angle of their slipway. If you want to make this activity slightly easier using a Tupperware container will also work.Give each group one metre of sellotape and ten sheets of paper (again if you wish to make the task easier give each group more paper and sellotape). Only the supplied sellotape and paper can be used. If any other material is used in the construction then the group are disqualified.If more than one group manages to complete the ball run then the team who used the least material is the winner.1. **Allt na Fearna Mor bridge**

This activity is teacher-led and involves the bridge model and the wooden arch pieces from Box 4. Show the pupils the model bridge. Ask ***What type of bridge is it?*** Explain that the stones of the arch have been shaped to fit into place. Show the pupils the wooden “former” under the archway. Explain that this was used to shape the archway, and would have been made up of a framework of cut timber. The stones would be built on the former until the final central stone (keystone) was placed at the top of the arch. Once it was in place the former could be removed. You can demonstrate this with the model.Give the group(s) the pack of large wooden blocks. Ask the group(s) to build an arch using the wooden blocks. When the archway is complete, ask the groups to test how strong it is. Have one pupil push down on the middle top stone (given enough force the archway should collapse). Have the pupils rebuild the arch. Ask ***How can we stop that happening?*** Demonstrate the strength of a correctly built arch by asking two pupils to hold the bottom stone on each side. Make sure they are only holding the bottom block. Have a pupil push down on the middle stone again. It should be obvious, if done correctly, just how strong an archway is.Explain to the class groups that arches are incredibly strong. All the load pressing down on the bridge is directed down either side of the archway. The lower stones are supported by abutments which prevent the bottom stones from being forced outwards.Return to the model. Show the key stone and the abutments on the model. Explain that this was a typical arched bridged designed by Thomas Telford and is a model of Allt na Fearna Mor bridge near Invershin (south of Lairg). It is one of thousand plus bridges that Telford built during his Highland road project in the early 1800s.*Ten to fifteen minutes is a reasonable length of time for each activity. Show a timer on the board and when it has elapsed move each group to the next activity. During the changeover you can inspect each group’s work. This is a good time to test the bridge and ball run. The results can then be recorded on the board and collated at the end of the lesson. You could incentivise the groups with a prize but that is obviously up to you.*  |

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| **Plenary** | **5 minutes** |
| **Ask a question** (5 minutes) | Resources: Post-it notes |
| * This plenary is simply a reflective exercise to generate discussion of the pupils’ learning.
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| Give each pupil a post-it note and have them write a question they would like to ask Thomas Telford if they could. Once the pupils have written their question they are to stick it on the white board. Share some pupils’ questions with the rest of the class. Following that, as a *think-pair-share* exercise, ask the pupils ***What is the most surprising fact you learnt during this lesson?*** Collate the class’s answers. |

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| **Total Lesson Time: 1 hour & 40 minutes** |
| **Links and Further Information** |
| ARCH Experimental Archaeology Project: [www.archhighland.org.uk/experimental-archaeology.asp](http://www.archhighland.org.uk/experimental-archaeology.asp) There is a video about Telford and a blog. The ICE (Institute of Civil Engineers) booklet “Invisible Superheroes” can be found in the box (until they run out) and can be downloaded from the Lesson Resources . More information about ICE can be found at <https://www.ice.org.uk/>On line Resources[Biography](http://doi.org/10.1093/ref%3Aodnb/27107) by Roland Paxon of ICE in Oxford Dictionary of National Biography, updated in 2013. This gives details about Telford and his works.There are also a wealth of articles, pictures and other material about Telford on line – too many to list here! The [Highland Historic Environment Record](http://her.highland.gov.uk) (HER) and [Canmore](http://canmore.org.uk) both record information about Telford buildings, piers, harbours etc.Books and articlesCommissioners for Highland Roads and Bridges Reports. The full set is in Inverness Reference Library, while Reports 1-9 and 20 onwards are in Highland Archive Centre. This is an invaluable source detailing progress and developments through the years.Curtis, G.R. 1978-80. ‘Roads and bridges in the Scottish Highlands: the route between Dunkeld and Inverness’, Proceedings of the Society of Antiquaries of Scotland vol. 110, 475-96. Although focussing further south, it still has a good summary of Telford’s activities and a typology of his bridges. Available Inverness Reference Library, Dingwall Library or [on-line](file:///C%3A%5CUsers%5CDave%5CAppData%5CLocal%5CPackages%5Cmicrosoft.windowscommunicationsapps_8wekyb3d8bbwe%5CLocalState%5CFiles%5CS0%5C1622%5CAttachments%5Carchaeologydataservice.ac.uk%5Carchives%5Cview%5Cpsas%5Ccontents.cfm%3Fvol%3D110%26CFID%3D92dd8541-1bcc-466f-8542-ac59539107bd%26CFTOKEN%3D0).Haldane, A.R.B. 1962.New Ways through the Glens. The best overview of Telford’s activities. Available in some Highland Libraries.MacLean, Allan 1989. Telford’s Highland Churches. Available in some Highland Libraries.Paxton, Roland (ed.) 2007. Thomas Telford: 250 years of Inspiration. A very useful booklet published by ICE and available from their bookshop. Many of the articles are available on line. Southey, Robert 1929. Journey of a Tour in Scotland in 1819. London: John Murray. Also available on the internet. Invaluable account of travels just after Telford had completed his works – but biased, because Southey was a close friend of Telford. Telford, Thomas ed. John Rickman 1838. Life of Thomas Telford, Civil Engineer. Telford’s autobiography completed after his death by John Rickman. Contains large atlas with many drawings. Available Inverness Reference Library.ArchivesThe Highland Archive Centre in Inverness has a wealth of archive material on the Caledonian Canal, as well as some Telford plans and other materials. It also houses the local council roads committee minutes which often mention Telford and his work.Other archives relating to Telford’s work are scattered throughout the country but include National Records of Scotland in Edinburgh, The National Archives at Kew and the Parliamentary Archives at Westminster. |

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