ISAMBARD KINGDOM BRUNEL

The content relating to Isambard Kingdom Brunel consists of three episodes, each about 6 minutes long, which can be listened to individually or sequentially. A synopsis of each episode clip is below.

Lesson plan:

Learning intention 'We are learning to...'
We are learning to understand key developments in engineering that occurred during the Victorian era.

Assessment criteria 'What I'm looking for...'
As an outcome I am looking for a labelled picture describing key features of a railway bridge and a steam ship.

Share and discuss a listening focus for each episode by asking the key question and instructing the children to make the following notes.

Resources needed: note-making paper and pencil.

1. 'The shield' - the Thames Tunnel

Before listening: one key fact to discuss

- Machinery. In the Victorian era there were no powered diggers or drilling machines. All the work had to be done by men with spades and pick axes.

Discussion question: 'How long do you think it would take you to dig a tunnel using only hand tools?'

During listening: one question to focus on

- Key question: 'What were the problems of digging a tunnel under a river and how were the problems solved?'

- Instruction: 'Write a list of problems and solutions that occurred during the building of the Thames Tunnel.'
- (Answers: Difficulty digging through mud – solved by the 'shield'; risk of flooding - tunnel lined with watertight stone and pumped out with a steam pump; poisonous gasses from sewage - problem went unsolved.)

2. The Great Western Railway

Before listening: one key fact to discuss

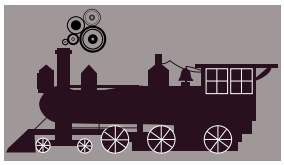
- Railways. The GWR was built to join London with Bristol and other cities in the west.

Discussion question: 'Why did people want to build railways?' (There were no cars only horse drawn carriages; the railway was the fastest, safest and most comfortable way to travel across land.)

During listening: one question to focus on

- Key question: 'Why was the GWR the best railway of its time?'

- Instruction: 'Write notes to explain what was unusual about the GWR.'
- (Answers: Expensive design for stations; very comfortable carriages and a smooth ride; the bridge at Maidenhead had an unusually flat design with the widest arches in the world at that time.)



3. The 'Great Babe' (the SS Great Eastern)

Before listening: one key fact to discuss

- Steam ships. Before the Victorian era ships were built of wood and powered by wind pushing the sails. Steam ships were usually built of metal and powered by steam engines that ran on coal and turned paddles or propellers.

Discussion question: 'What are the advantages of powering a ship with an engine?' (Ships could be made larger and heavier because they did not rely on the wind; ships could go faster and move when there was no wind at all.)

During listening: one question to focus on

- Key question: 'What made the Great Eastern a special ship?'

- Instruction: 'Write down and sketch things that make the Great Eastern a special ship.'
- (Answers: At the time it was built it was the biggest ship in the world; it was so big Brunel wanted to launch it sideways; it had a double hull, an extra shell of metal inside the sides and bottom of the ship - this meant it would not sink if the outer hull was cracked.)

After listening

Activity: A photograph of any Victorian steam ship would be useful to support this activity. Draw and label a steam ship. Make sure you label:

- sails - although the SS Great Eastern was usually powered by her steam engines, the ship also had huge sails that could be hoisted up masts to take advantage of favourable winds or to move the ship in case the engines did not work
- smokestacks - large metal chimneys on steam ships or steam trains to carry away smoke from coal fires in the steam engine
- paddles or propellers – how steam engines moved a ship through the water.

Differentiation and teacher support for SEN / Focus group / Whole class

Teacher to demonstrate drawing a scene featuring steam ship on a piece of paper or a whiteboard to provide hints and starting points for the children's own drawings.

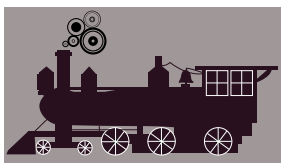
Challenge for gifted and talented learners
Can you draw how you imagine the steam engines were set up inside a steam ship? They needed to be fed coal to make them run. They needed a chimney to carry away the smoke from the fires and they needed to be linked to paddles or a propeller with 'drive shafts' so the ship could be pushed forward.

Plenary and assessment

In table groups or as a class, share and compare labelled diagrams. Give the children an opportunity to improve their drawings or after making comparisons.

Episode synopses

This programme explores three of the achievements of the engineer, Isambard Kingdom Brunel: the building of the **Thames Tunnel**, the first ever tunnel under a river; the construction of the **Great Western Railway**, a new railway network in the west of England and the best railway of its time; and the building of the ship, **The Great Eastern**, launched in 1858 and the biggest ship in the world.



1. 'The Shield' - the building of the Thames Tunnel

Richard Beamish, an engineer, tells of the time when he was employed by Isambard Kingdom Brunel and his father, Marc, to work on the Thames Tunnel. It was 1825 and no one had ever dug a tunnel under a river before. Beamish wanted to know how this would be achieved and Isambard explained the theory behind the 'Shield', a device that his father, Marc, had invented. The Shield was a huge metal disc with doors in it, which enabled the workmen to stand on it, open the doors and dig out sections of soil to create the tunnel, while the shield kept the rest of the earth in place.

However, the River Thames contained a lot of sewage and many workmen working underground collapsed from breathing in the fumes, and there was a further problem with water constantly entering and flooding the tunnel. On one occasion Isambard himself was caught up in such a flood. He was badly hurt, but he survived; others were not so fortunate.

It was seven years before work resumed on the tunnel and it was finally finished. And, although Isambard never returned to work on the tunnel after he had recovered, he went on to other challenges and even greater achievements.

2. The Great Western Railway

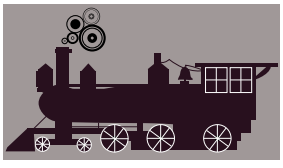
George Clark is an engineer, who has been working with Isambard Kingdom Brunel on the building of the Great Western Railway. In 1851 he is taking his assistant, Arthur, on the train from Bristol to London to visit the Great Exhibition. As they walk up to the station in Bristol, Arthur is amazed by the grandeur of the building, which was designed by Isambard.

The station cost a great deal of money; the directors had been appalled at the amount, but Isambard persuaded them that this would be no ordinary railway, it would be the finest railway in the world - and Isambard got his way.

Amid the smoke, noise and steam, Arthur grows nervous about travelling on the train. George manages to reassure him, and the journey goes smoothly until George tells him the story behind Maidenhead Bridge. Isambard had wanted to build a bridge that was low and flat, but the directors were worried about whether the bridge would bear the weight of the trains travelling over it. The directors agree to Isambard's plans, as long as the scaffolding under the bridge remained in place. Isambard agreed, but then lowered the scaffolding slightly so that it wasn't actually touching the bridge, and in fact the scaffolding was eventually washed away when the river flooded. Arthur panics about travelling over an unsupported bridge, until George points out to him that the train has already passed over it, and Arthur didn't even notice.

3. The 'Great Babe' - the SS Great Eastern

John Russell, a shipbuilder, talks of the time when Isambard Kingdom Brunel asked him to build his latest ship, The SS Great Eastern (or his 'Great Babe' as he called it) which was to be the biggest of all the ships he had designed and would be capable of sailing around the world without refuelling. Russell had been shocked to hear that Isambard wanted to launch his ship sideways, instead of the usual lengthways, because of her size. Russell pointed out that he was the one with the greater experience of launching ships, but Isambard was insistent and would not be dissuaded.



The day of the launch was a huge occasion with important people in attendance. When the moment arrived for the ship to be launched, to the consternation of all assembled, the ship refused to budge and it took several attempts before the ship eventually slipped into the water. However, The Great Eastern was soon sailing regularly across the Atlantic.

Then one day in 1862 on the way to New York she struck a rock, which caused a huge gash down one side. But, instead of taking on water and sinking, as the crew expected, the ship stayed afloat. Any other ship would have sunk, but Isambard had designed the ship with a double hull, and only the outer hull had been damaged. More proof of Isambard's extraordinary expertise in ship design.