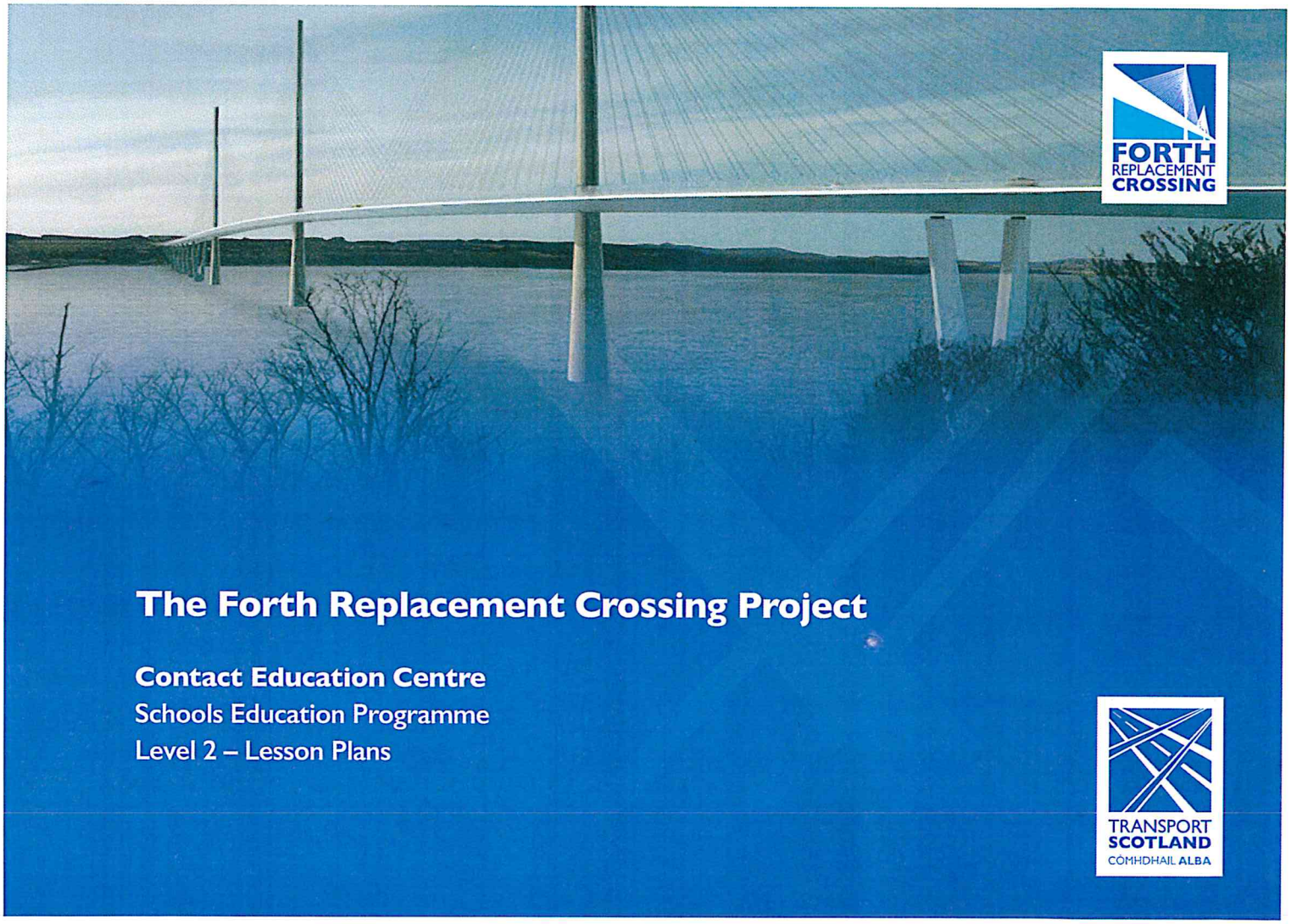

The Forth Replacement Crossing Project

Contact Education Centre
Schools Education Programme
Level 2 – Lesson Plans

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Foreword

The Forth Replacement Crossing (FRC) Project is the largest transport infrastructure project in a generation. The project is delivering the new Queensferry Crossing and connecting roads, designed to safeguard the vital cross-Forth connection in Scotland's transport network and to replace the current Forth Road Bridge as the main crossing for all general cross Forth traffic.

The project has an ongoing commitment to engage with the people of Scotland throughout the construction phase and the purpose built FRC Contact and Education Centre (CEC) has been designed as a focal point for ongoing community engagement and education during the project's construction.

The main aims of the CEC are to provide high-quality contact and education services while emphasising the project's purpose, investment value and innovation in construction, as well promoting science, technology, engineering and mathematics, as well as the potential benefits a career in engineering can provide.

In September 2013, the CEC began delivering a Schools Education Programme providing the opportunity for school pupils to view the Project Exhibition, hear a talk or presentation about the Queensferry Crossing and undertake science, technology, engineering and mathematics (STEM) related activities.

Based just south of the Forth Estuary, the CEC offers panoramic views of the Forth Bridge and Forth Road Bridge and provides a perfect platform to view construction of the Queensferry Crossing.

To support the FRC Schools Education Programme delivered at the CEC and educational legacy objectives of the project, the following linked series of lessons is provided to set a context prior to your pupils' visit and/or to be used to support learning in the classroom.

Pupils' prior knowledge of bridges will form a baseline for the teacher, in order to decide how best to introduce the topic. Prior to the visit or undertaking the engineering challenges in class, the lessons, found herein, are intended to engage and motivate the pupils and extend their knowledge of the construction of the Queensferry Crossing.

Personalisation and choice will also play a key role throughout the lessons. Pupils will be given the opportunity to ask and seek answers to their own questions, both in class and during their challenges. In this way pupils will acquire knowledge appropriate to their own interests as well as the enquiring minds of others, thereby fully developing their awareness and understanding of the importance and scale of the construction of the Queensferry Crossing.

FRC Schools Level 2 Lessons Package

Pre-Engineering Challenge
with 4 lessons (contained herein)

Lesson 1
Technological Developments in Society – Bridges
SOC 2-13a, TCH 2-01b, MTH 2-16a, LIT 2-09a, EXA 2-03a.

Lesson 2
Research Forth Bridges
TCH 2-03b, LIT 2-15a.

Lesson 3
Delivering a Presentation
LIT 2-09a, TCH 1-043a, TCH 2-04a, TCH 1-04b, TCH 2-04b, LIT 2-10a, LIT 3-10A.

Lesson 4
Formulating Questions to Deepen Understanding
LIT 2-26a.

Engineering Challenges
Visit or Challenges in classroom

Contact and Education Centre Visit
- Engineering Challenges:
  - Construction of towers and decks.
  - Health & Safety.
  - Engineering professions.
  - Environment.
  - Construct a bridge.
  - Queensferry Crossing Facts.
- View scale of the bridges / construction.
- Experience a bridge walk.

Outreach Engineering Challenges
- Engineering Challenges:
  - Construction of towers and decks.
  - Health & Safety.
  - Engineering professions.
  - Environment.
  - Queensferry Crossing Facts.

Post-Challenge Lessons
Construction of a Cable Stay bridge with 4/5 lessons

Lesson 1
Cutting and Folding
LIT 2-02a, TCH 1-14a, TCH 2-14a, MTH 2-16b.

Lesson 2
Calculating, Measuring and Cutting
MNU 2-03a, TCH 1-14b, TCH 2-14b.

Lesson 3
Designing a Logo
EXA 0-01a, EXA 2-01a, EXA 0-05a, EXA 1-05a, EXA 2-05a, TCH 1-03a.

Lesson 4
Assembling your Bridge
TCH 2-12a, TCH 3-12a, TCH 1-14a, TCH 2-14a.

Lesson 5
Calculate and Compare

Lesson 1: Technological Developments in Society – Bridges

Four Feature Lesson Plan Level: Second

<table>
<tr><td colspan="2">Experiences and Outcomes</td><td>Term</td></tr>
<tr><td colspan="3">SOC 2-13a
I can explain how the physical environment influences the ways in which people use land by comparing my local area with a contrasting area.

TCH 2-01b
I can investigate how an everyday product has changed over time to gain an awareness of the link between scientific and technological developments.

MTH 2-16a
Having explored a range of 3D objects and 2D shapes, I can use mathematical language to describe their properties and, through investigation, can discuss where and why particular shapes are used in the environment.

LIT 2-09a
When listening and talking with others for different purposes, I can share information, experiences and opinions.

EXA 2-03a
I can create and present work that shows developing skill in using the visual elements and concepts.</td></tr>
<tr><td colspan="3">Planning for Assessment (What will you be assessing? Assessing the learning can happen at the beginning, middle and end).</td></tr>
<tr><td colspan="2">SAY: Verbal explanations and quality of contribution.</td><td>MAKE: Draw a picture of a bridge showing appropriate attention to mathematical shapes, scale and symmetry.</td></tr>
<tr><td colspan="2">WRITE:</td><td>DO: Use Success Criteria to give formative feedback to peers.</td></tr>
<tr><td colspan="3">EVALUATION AND REVIEW: Indication of overall success, group or individual progress or further reinforcement required.</td></tr>
</table>

Lesson 1: Teaching Activities

Learning Intentions

1. Pupils will understand the cause and effect that bridge building has on local communities as well as national and international.

2. Pupils will use their knowledge of Mathematics to explore basic shapes and discuss some of their technological uses in the construction of Suspension, Cantilever and Cable Stay bridges.

Success Criteria (written as 'I can' statements)

I can:

- discuss the importance that bridges play in changing communities.
- identify variations of different types of bridges.
- re-create a drawing of a Suspension, Cantilever or Cable Stay bridge showing awareness and recognition of mathematical shape, scale and symmetry.

Resources

- Photographs/web images of Suspension, Cantilever and Cable Stay bridges.
- A3 drawing paper.
- Pencil, ruler.

Notes for Teachers (to introduce the topic of bridges)

- To introduce the series of lessons and to generate enthusiasm for the topic of 'Bridges', inform pupils that they are going on a visit to 3 significant bridges – the Forth Bridge, the Forth Road Bridge and the new Queensferry Crossing. The Queensferry Crossing will be the longest three-tower, Cable Stay bridge in the world and the Forth Bridge has been nominated for as a World Heritage Site.

  (Use the notes below to establish their significance and to engender enthusiasm.)

  What is World Heritage? – World Heritage is the designation for places on Earth that are of outstanding universal value to humanity and as such, have been inscribed on the World Heritage List to be protected for future generations to appreciate and enjoy. Places as diverse and unique as the Pyramids of Egypt, the Great Barrier Reef in Australia, Galápagos Islands in Ecuador, the Taj Mahal in India, the Grand Canyon in the USA, or the Acropolis in Greece are examples of the 1007 natural and cultural places inscribed on the World Heritage List to date.

- Internet photographs of the above sites could be shown.
- Tell pupils about the Forth Bridge's nomination as a World Heritage Site.
- Tell pupils that during their visit they will not only see these **two** bridges but **three** bridges that stand side by side:
  - The Forth Bridge.
  - The Forth Road Bridge.
  - The Queensferry Crossing which is currently under construction and will be completed in 2016.

Lesson 1: Teaching Activities

Introduction (to establish prior knowledge)

- Introduce the topic by discussing other bridges that pupils know/have seen – from small to large, local, national and international.
- Establish names of **known/famous** bridges.
- Establish the reasons **why** bridges are built.
- Explore the **effect** bridges have on individuals and the community at large e.g.
  - Travelling from A-B more easily (time).
  - The effect on movement to see – e.g. friends/family.
  - The effect on people travelling to work and the type of work they can do.
  - The build up and extension of communities in the vicinity and surrounding areas.
- Discuss materials bridges may be made of – past and present.
- Ask "Do all bridges look the same?"

Learning

- Tell pupils that the Forth Bridge and Forth Road Bridges and the Queensferry Crossing are excellent examples of some of **the most common bridge** types i.e. Cantilever, Suspension and Cable Stay bridges.
- Show images of the Forth Bridge (Cantilever) and have a general discussion of its overall **shape.**
- As a **comparison**, show images of other cantilever bridges.
- Show images of the Forth Road Bridge (Suspension) and have a general discussion of its overall **shape.**
- As a **comparison**, show images of other Suspension bridges.
- Show images of what the Queensferry Crossing (Cable Stay) will look like on completion and have a general discussion of its overall **shape.**
- As a **comparison**, show images of other Cable Stay bridges.

Teacher now chooses to have EITHER a whole class OR group discussion

Whole Class Discussion

1. Using an image of the Forth Bridge, **identify** the names of mathematical shapes e.g. angles, symmetry, etc. used in the bridge building process.
2. Using an image of the Forth Road Bridge, **identify** the names of mathematical shapes e.g. angles, symmetry, etc. used in the bridge building process.
3. Using an image of the Queensferry Crossing, **identify** the names of mathematical shapes e.g. angles, symmetry, etc. used in the bridge building process.
4. Discuss the reasons and the possible **importance** for the use of such shapes, and symmetry in the bridge building process.

* See note at Final Activity.

Group Discussion

1. Divide class into 3 'bridge' groups and give each group a photograph/computer image to study of:

- the Forth Bridge.
- the Forth Road Bridge.
- the Queensferry Crossing.

Note: Large 'bridge' groups can be subdivided.

2. Using an image of the Forth Bridge, 'bridge' groups **identify** the names of mathematical shapes e.g. angles, symmetry, etc. used in the bridge building process.
3. Using an image of the Forth Road Bridge, 'bridge' groups **identify** the names of mathematical shapes e.g. angles, symmetry, etc. used in the bridge building process.
4. Using an image of a Cable Stay bridge, 'bridge' groups **identify** the names of mathematical shapes e.g. angles, symmetry, etc. used in the bridge building process.
5. Groups present their findings and hypotheses to the rest of the class.

Note: The teacher may wish to expand on each group's conjectures.

Final Activity

Pupils draw the bridge from their 'bridge' group, paying particular attention to shape, scale and symmetry.

* **Note:** If the discussion was done as a whole class activity the class should now be divided into 3 groups, each with a bridge to draw.

Plenary

Pupils self/peer assess their drawing according to Success Criteria.

Lesson 2: Research into the Forth Bridge (Cantilever), the Forth Road Bridge (Suspension), and the Queensferry Crossing (Cable Stay) bridge

Four Feature Lesson Plan Level: Second

Experiences and Outcomes	Term
TCH 2-03b Throughout all my learning, I can use search facilities of electronic sources to access and retrieve information, recognising the importance this has in my place of learning, at home and in the workplace. **LIT 2-15a** I can make notes… ( ) and use them to understand information, develop my thinking, explore problems and create new texts, using my own words as appropriate.	
Planning for Assessment (What will you be assessing? Assessing the learning can happen at the beginning, middle and end).	
SAY:	**MAKE:**
WRITE: Make notes in 'fact' form by skimming and scanning texts and writing information in own words.	**DO:** Pupils can access information using suitable books/websites based on a 'key word' search.
EVALUATION AND REVIEW: Indication of overall success, group or individual progress or further reinforcement required.	

Lesson 2: Teaching Activities

Learning Intentions

1. Pupils will be able to search appropriate texts and websites to find specific information related to the bridge they are researching.
2. Pupils will be able to write facts in their own words.

Success Criteria (written as 'I can' statements)

I can:

- skim and scan appropriate texts.
- use **key words** to find and research information from books and a search engine.
- understand what I read (by using other sources to help me, e.g. dictionary) and write information in my own words.

Resources

- Access to books about bridges.
- Internet access.
- Post-it notes.
- Pencil.

Lesson 2: Teaching Activities

Introduction (to establish prior knowledge)

- Names of some famous bridges.
- The effect that bridges have on communities.
- Name the types of the 3 bridges on the Forth near Edinburgh, Scotland – Cantilever, Suspension and Cable Stay bridge.
- The importance of World Heritage status.
- Why is the Queensferry Crossing unique?
- The importance of shape, symmetry and scale play to the bridge building process.
- Materials used in bridge construction – past and present.

Learning

- Divide the class into the same 3 groups as per previous lesson (i.e. their 'bridge' group).
- Tell pupils they are going to find out as many facts as possible about their bridge, i.e.
  - Forth Bridge (Cantilever).
  - Forth Road Bridge (Suspension).
  - Queensferry Crossing (Cable Stay).
- **Individually,** pupils research their allocated bridge type and write down as many short facts as they can (minimum of 6-10 facts) about their bridge type (one fact per post-it).

Note: Dictionaries should be made accessible to support pupils' understanding of facts read and in order that they can, more easily, rewrite them in their own words.

Possible key word/phrases that could be researched using a search engine:

- Facts about Forth Bridge/Forth Road Bridge/Queensferry Crossing.
- How do Suspension, Cantilever and Cable Stay bridges work?
- Materials used in the construction of the Forth Bridge/Forth Road Bridge/Queensferry Crossing.

Tell pupils these facts will be kept for a follow up lesson.

Plenary

Pupils share ONE interesting fact about their bridge with a peer from the same research group. Peer asks questions about the fact to reinforce thinking and ensure understanding.

Lesson 3: Delivering a Presentation – Cooperative Learning – 'Expert' Groups

Four Feature Lesson Plan Level: Second

Experiences and Outcomes	**Term**
LIT 2-09a When listening and talking with others for different purposes, I can: • share information, experiences and opinions. • explain processes and ideas. • identify issues raised and summarise main points or findings. • clarify points by asking questions or by asking others to say more. **TCH 1-04a / TCH 2-04a** I explore and experiment with the features and functions of computer technology and I can use what I learn to support and enhance my learning in different contexts. **TCH 1-04b / TCH 2-04b** I can create, capture and manipulate sounds, text and images to communicate experiences, ideas and information in creative and engaging ways. **LIT 2-10a / LIT 3-10a** I am developing confidence when engaging with others within and beyond my place of learning. I can communicate in a clear, expressive way and I am learning to select and organise resources independently.	
Planning for Assessment (What will you be assessing? Assessing the learning can happen at the beginning, middle and end)	
SAY: Individuals will ask relevant questions to clarify points.	**MAKE:** Groups of pupils make a presentation to the rest of the class.
WRITE: Pupils take notes/sketch how their final presentation will look.	**DO:** Pupils will: • listen while someone else is talking. • share knowledge with others. • work collaboratively.