

Bridges

Key Stage 2 Thematic Unit

Supporting the Areas of Learning and **STEM**



Contents

Section 1	Activity 1	Planning Together	3
Do We Need	Activity 2	Do We Really Need Bridges?	4
Bridges?	Activity 3	Bridges in the Locality	6
	Activity 4	Decision Making: Cantilever City	8
Section 2	Activity 5	Bridge Fact-File	13
Let's Investigate	Activity 6	Classifying Bridges	14
Bridges!	Activity 7	Forces: Tension and Compression	16
	Activity 8	How Can Shapes Make a Bridge Strong?	18
Section 3	Activity 9	Construction Time!	23
Working with	Activity 10	Who Builds Bridges?	25
Bridges	Activity 11	Gustave Eiffel: A Famous Engineer	26
	Activity 12	Building a Bridge and Thinking Like an Engineer	28
Resources			33
Suggested Additional Resources			60

This Thematic Unit is for teachers of Key Stage 2 children. Schools can decide which year group will use this unit and it should be presented in a manner relevant to the age, ability and interests of the pupils.

This Thematic Units sets out a range of teaching and learning activities to support teachers in delivering the objectives of the Northern Ireland Curriculum. It also supports the STEM initiative.

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Do We Need Bridges?

Planning together for the theme.

Discovering the reasons for having, and the impact of not having, bridges.

Writing a newspaper report about the impact of a missing bridge.

Researching bridges in the locality.

Grouping and classifying bridges.

Considering the impact on a community of building a bridge.

SECTION 1



Activity 1

Planning Together

New Words and Phrases

decision
planning
research
fact
learning
intentions

Suggested Learning Intentions

We are learning to:

- contribute to the planning for our learning;
- join in with class discussion;
- use what we have learned in other areas to help us with our learning;
- work with others to reach an agreement or come to a decision; and
- research to select an important fact about a bridge.

I Know, I Want to Know, I've Learned!

Create a large **KWL grid*** and display it so that the whole class can see (alternatively, children working in pairs could create their own KWL grid on A4 paper). Ask the class what they think they already know about bridges, such as what they are used for, what they are made of and who builds them. Record their responses in the 'K' (Know) section of the grid (or ask the children to record on their own grids).

Next, encourage discussion about what the class wants to learn about bridges. Provide the children with 'sticky note pages' and ask them to create a **Post-It Collection*** by recording questions that they would like to have answered about bridges. Share the questions with the rest of the class and record them on the 'W' (Want to know) section of the grid. Save the grid and add to it as the lesson and theme progresses. When the theme has ended, or at suitable points throughout the theme, return to the grid and fill in the 'L' (Learned) column. This is a good way of recapping on the progress of each lesson and recording the breadth of the learning experiences of the children.

To get the children thinking about the theme of bridges, set them a homework 'Detective Task' on finding out the **name** of and **one fact** about each of the following:

- the tallest bridge in the UK;
- the oldest bridge in Ireland; and
- the longest steel arch bridge in the world.

* see *Active Learning and Teaching Methods for Key Stages 1&2*

CONNECTED LEARNING OPPORTUNITIES

Add the information gathered from this activity to a 'Planning Board'. Discuss with the pupils how the theme of 'Bridges' could be linked to the Areas of Learning. Create a mind map on the planning board, showing these links.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Imaginary Number Line!

Get the children to picture an imaginary 1–10 number line running from one side of the room to the other. According to the amount of knowledge they feel they have about 'Bridges', ask them to position themselves on the line. Repeat this activity at intervals throughout the theme as a means of self-assessment.

Activity 2

Do We Really Need Bridges?

New Words and Phrases

aqueduct
landscape

traffic

congestion

Ordnance
Survey

location
impact

Suggested Learning Intentions

We are learning to:

- use an Ordnance Survey map to locate bridges;
- create mind maps to organise our ideas;
- work together to think of all the possible impacts of an event; and
- describe the impact of an event by writing a newspaper report.

Why Do We Need Bridges?

Bridges provide essential links between places – providing us with access to resources, other places and other people. Bridges allow roads to pass through many different types of terrain, over rivers and over mountains. They save time commuting and transporting and helping to connect places that would be inaccessible otherwise.

If children have ever placed a plank of wood over a stream, they have built a bridge. In groups, ask the children to brainstorm as many reasons as they can think of for needing a bridge, for example, crossing a river or crossing a railway line. These may include:

- to carry a road across a river or gap in the landscape;
- to carry a railway line across a river or gap in the landscape;
- to allow people to cross a river or gap in the landscape;
- to carry water (an aqueduct);
- to carry pipes (sewage, water, oil) across a river or gap in the landscape (a pipe bridge); and/or
- to relieve traffic congestion.

Using suitable search engines show the children a selection of images of the Foyle Bridge in Derry/Londonderry. Using Ordnance Survey maps, locate the bridge. You can access NI Maps (which provides a range of Ordnance Survey maps free of charge) at www.nimaps.co.uk or through LearningNI in the LINKS section.

In groups, ask the children to think about the reasons that the bridge was needed and why that specific location was chosen. For example, would it not have been better to place the bridge in a narrower part of the river or closer to the city centre?

CONNECTED LEARNING OPPORTUNITIES

The World Around Us

Using maps.

Language and Literacy

Writing a newspaper report.

Using ICT

Desktop Publishing.

Physical Education

Use P.E equipment to create a bridge which will enable children to move from one side of the hall to the other.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Peer Assessment!

Encourage peer assessment by allowing pupils time to give positive feedback to each other about their newspaper report.

News Flash!

Show the children the News Flash in Resource A. The report describes how the Foyle Bridge has disappeared overnight from the River Foyle. As a class, discuss what the impact of the bridge disappearing would be on all aspects of daily life.

Alternatively, the children, working in groups, could create a mind map of these ideas on large sheets of paper. Make a list of all of the children's ideas, which may include:

- traffic jams in the city with cars trying to get to the other bridge;
- everyone is late for work;
- people move house to be closer to the other bridge;
- friends who live on each side of the river stop visiting each other;
- everyone begins to get really fit as they start to walk more, rather than use their car and sit in traffic jams; and/or
- boat shops make lots of money due to a surge in business.

When you have discussed the impact this event has had on the city and surrounding areas, set the children the task of writing the next day's news report which describes the scene in the city. Ensure that the children are aware of how to write in the style of a newspaper report. They could even include quotes from 'eye witnesses' or 'photographs' of the scene in their report. The children could use ICT to produce their newspaper report using desktop publishing (*Using ICT Desirable Features: Desktop Publishing*).



Activity 3

Bridges in the Locality

New Words and Phrases

locality
access
group
classify
category

Suggested Learning Intentions

We are learning to:

- ask careful questions so we are clear about what we have to do;
- know where to look to find good sources of information; and
- use different categories to group and classify bridges.

Why There?

Working in groups, ask the children to think about the bridges that are located in the local area. Ask the groups to think about how they can find out more information about bridges in their locality. List their suggestions.

Provide the children with maps of the area and ask them to locate where a bridge appears on it. You could also use the opportunity to point out other significant features on the map, such as churches, hospitals, high land or main roads. When you have located a bridge on the map, ask the children to discuss in groups why they think the bridge was built at that particular location. Lead the children to consider things such as the width of the gap in the landscape, the height of the land and access to the two ends of the bridge.

Home Learning Activity

Ask the children to gather photographs, drawings or paintings of a bridge or bridges in the locality (if that is appropriate). Alternatively, they could download images from appropriate Internet sites.

It may be most effective if parents or carers can take the children around the locality to gather these images. Parents/carers may have a good knowledge of the locality and therefore be a good source of information about the bridges.

If necessary, widen the search to bridges in Northern Ireland, Ireland and/or the whole of the UK.

CONNECTED LEARNING OPPORTUNITIES

The World Around Us

Using maps and researching the history of a local bridge.

Using ICT

Use appropriate websites to locate images of local bridges.

The Arts

Produce a class portrait of a bridge by weaving strips of various types of textile through a grid of 'chicken wire'. Use different colours of material to create the image of the bridge with a background of grass, river, hills and sky.

Language and Literacy

Creative writing – writing a descriptive story based on the troll who lived under the bridge in 'The Billy Goats Gruff'.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Formative Feedback!

Give encouragement and motivation to pupils during their grouping and classifying activity, for example:

"I think this is a really clever way to have grouped these bridges. I bet you could get another way to classify them if you find the shapes used in the bridges!"

Group, Classify, Categorise

Gather all of the images of bridges which the children have created. Display these where all the children can see them and give each image a number. Ask the children to get into their groups. Ask the children to **group** the bridges by writing down the numbers of the bridges that 'go together'. When they have done this, ask them to discuss in their group how they would **classify** each set, for example, "this set of bridges are made of stone" or, "these are all footbridges" and so on. You may need to explain the word 'classify' prior to this activity. Discuss these classifications as a whole class. When all of the groups have had an opportunity to explain their classifications, ask them to start again, this time grouping and classifying the bridges in a different way.

When the children have tried sorting and classifying the bridges in several ways, summarise with the children the different **categories** they have used. Keep a note of these categories.



Activity 4

Decision Making

Cantilever City

New Words and Phrases

option

decision making

key

factor

environmental

social

economic

advantage

disadvantage

position

compromise

Suggested Learning Intentions

We are learning to:

- use a map and a key;
- listen to and respect other people's points of view, even if they're not the same as our own;
- consider the factors that might affect where a bridge is built; and
- clearly explain our reasons for making a decision.

Cantilever City

Give each child, or pair of children, a copy of Resource B, Cantilever City. Discuss the Key with the children, and talk about what each thing on the key represents on the map. Read the following scenario to the children:

This is Cantilever City. Over the past few years, the city has had to get bigger as more people have moved to live there. Lots of companies have moved to the city and they have built some fantastic new shops and facilities. The local government has even spent millions of pounds on a new hospital, a new school and a brilliant park and playground for everyone to enjoy! What they need now is to build a bridge because lots of the people live on the other side of the river! There's just one problem...

Where should they build the bridge?

Can you help?

Point out locations A, B and C on the map in Resource B. These are the options for where a bridge could cross the river. Set the children the task of coming to a decision about where to place the bridge. Before starting, begin a class discussion about what the issues are when deciding where to place the bridge. Encourage them to consider environmental, people (social) and cost (economic) factors that will affect the local and wider community.

CONNECTED LEARNING OPPORTUNITIES

Language and Literacy

Write a speech to debate which option to choose for the position of a bridge.

The World Around Us

Use maps and a key.

The Arts

Create a dramatisation showing the impact on the local community of placing the bridge at certain locations.

Personal Development and Mutual Understanding

Consider the impact of the building of

bridges, motorways or airports on people who live nearby. Discuss the rights and responsibilities of local governments in these issues.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Community of Enquiry!

During discussion, the children create a community of enquiry about the issues surrounding building a bridge in a specific location. They decide together on three or four key questions that they may wish to consider when making their decision.

Considering All Factors

Give each group a copy of Resource C, **Consider All Factors*** template as a means of structuring their thinking and helping them to come to a decision. For each option, A, B and C, the children should record one advantage, one disadvantage and one interesting factor about that option. This is also a good opportunity to use the Thinking Skills and Personal Capabilities 'Talking about Thinking' texts in the Introduction booklet and at www.nicurriculum.org.uk, to focus the children on the skill of decision making and how to ensure that they have considered all the relevant information.

When they have decided which option they will choose, get the children to draw it on the map, along with any additional roads that they may need to build. When they have completed the task, divide the class into groups based on who chose A, B or C. Allow each group the opportunity to discuss their reasons with each other and then with the rest of the class. See if the class can come to a consensus about which option is the best. Point out to the children that compromises often need to be made when trying to make a decision. For example, if a bridge is needed but will cause a playground to be destroyed in one position, but in another position it may be more difficult to build because of hills, which is the best option? Or if something makes lots of money for a town but is bad for the environment, which should be the deciding factor?

* see *Active Learning and Teaching Methods for Key Stages 1&2*

Let's Investigate Bridges!

SECTION 2

Researching a UK bridge and creating a fact-file using ICT.

Learning about the main types of bridge: beam, arch, truss, suspension, cantilever and cable-stayed.

Grouping and classifying bridges by their characteristics.

Comparing and contrasting two bridges.

Understanding forces (tension and compression).

Investigating how different shapes contribute to making a bridge strong.



Activity 5

Bridge Fact-File

New Words and Phrases

fact-file

success

criteria

locate

search terms

peer

assessment

feedback

Suggested Learning Intentions

We are learning to:

- decide on the criteria that will make our work successful;
- independently use the Internet to look for suitable images of a bridge in the UK; and
- create a fact-file about a bridge using desktop publishing.

UK Bridges and £1 Coins

With the class, look at the depictions of bridges on the 2004–2007 £1 coins in Resource D. Each one of these £1 coins has an image of a bridge from a country within the UK.

2004 £1 coin: Forth Bridge, Queensferry, Scotland

2005 £1 coin: Menai Bridge, Anglesey, Wales

2006 £1 coin: MacNeill's Egyptian Arch, Newry, Northern Ireland

2007 £1 coin: Gateshead Millennium Bridge, Newcastle Upon Tyne, England

Ask the children to create a fact-file about one of the four bridges. As a class, agree on the information that will be placed into the fact-file, for example, when it was built, length, height, materials used to build it and/or who uses it.

Work with the pupils to decide on the **success criteria** for their fact-file, for example:

I will be successful if I:

- locate good sources of information and select which I will need for my bridge fact-file;
- compare pieces of information to decide which is the most useful;
- use images, descriptive text and number facts to make my fact-file interesting; or
- present my information clearly so that others will understand.

Remember! Success criteria should reflect the learning intentions and be specific to the activity, while providing a scaffold for the pupil's work.

Research

In four groups, the children locate information about one of the four bridges using the Internet. Encourage them to discuss with each other suitable search terms they could use in order to find the information they require, as well as the way their information will be presented (presentation, leaflet, poster and so on). They should present their completed fact-files to the rest of the class. You may wish to use the **Two Stars and a Wish*** method to enable peer assessment.

CONNECTED LEARNING OPPORTUNITIES

The Arts

Designing a coin image that depicts a local landmark or marks a special occasion.

Mathematics and Numeracy

Money problems.

The World Around Us

Find out about the history of a local bridge.

Using ICT

Produce a fact-file as a presentation or 'flip-chart' to show the class on the interactive whiteboard.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Peer Assessment!

Use the **Two Stars and a Wish*** strategy to encourage positive feedback and ideas for improvement when children have completed their bridge fact-files.

* see *Active Learning and Teaching Methods for Key Stages 1&2*

Activity 6

Classifying Bridges

New Words and Phrases

structure
characteristic
beam
arch
truss
suspension
cable-stayed
cantilever
criteria
compare
contrast
pier

Suggested Learning Intentions

We are learning to:

- use different categories to group and classify bridges;
- locate and find good pieces of information;
- compare pieces of information to decide which is the most useful;
- identify types of bridges by their structure; and
- use criteria to compare and contrast bridges.

Bridge Structure

Remind the children of the ways they grouped the bridges in Activity 3, 'Bridges in the Locality'. Explain to the children that bridges can also be grouped and classified by the **type of structure** that it has. Reintroduce the four bridges that the children saw on the pound coins in Activity 5 (Resource D). Look at the image on the 2004 pound coin which shows the Forth Bridge in Scotland. With the children working in groups, ask them to create a brainstorm of words and phrases that they think describes the **structure** of the bridge and which may help to classify it. Gather words and phrases from each group and make a list of descriptions of the **characteristics** of the bridge.

pupils, ask them to decide together which type of bridge they think the Forth Bridge is, and why:

- beam
- arch
- truss
- suspension (two types: a modern suspension or a cable-stay); or
- cantilever.

When they have made their decision, record their responses, perhaps by getting each child to vote on which bridge type they each think it is. Repeat the activity for the other three bridges on the £1 coins. In the next activity, the children will find out more about these types of bridges and will discover if their answers were correct.

Which Type of Bridge?

Provide the children with simple representations of the main types of bridge (Resource F). Based on this resource and the words and phrases generated by the

CONNECTED LEARNING OPPORTUNITIES

Mathematics and Numeracy

Using Venn and Carroll diagrams to group and classify.

The Arts

Stick paper art straws onto card to create line images of the main types of bridge.

The Arts and Using ICT

Use junk materials to create a sound story about a bridge being built. Record the sounds and allow the children to mix it to background music using a program such as 'Garageband'.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Imaginary Number Line!

When the children have completed the 'Compare and Contrast' activity, get them to repeat the 'Imaginary Number Line' self-assessment activity from Activity 1. Remind them of the question in Activity 1 and ask the children to stand along the imaginary line where they did before. When you say 'change', ask them to move into the position where they now feel they belong. The children should see how well their knowledge and understanding has grown.

Create an Information Poster

In mixed ability groups, set children the task of finding out about one of these types of bridges. Ask the groups to find information about and images of the bridge-type and create an A3 poster on their chosen bridge, using art materials or as an ICT activity.

Review all of the posters as a class. At this point you may like to share the Bridge Information Sheets (Resource G) with the children so they can check whether the information they had found about their type of bridge was indeed correct. Allow them time to make any amendments to their work.

Review each group's work with the whole class, and get the class to discuss and agree a set of two or three **criteria** for each type of bridge, for example, a cantilever bridge has:

- two beams that are held together in the middle by a structure; and
- each beam supported on only one end.

Revisit the decisions that the pupils made previously about which types of bridge are depicted on the £1 coins and compare these with the correct answers:

2004 £1 coin: Forth Bridge, Scotland

(Cantilever)

2005 £1 coin: Menai Bridge, Wales

(Suspension)

2006 £1 coin: MacNeill's Egyptian Arch, Northern Ireland

(Arch)

2007 £1 coin: Gateshead Millennium Bridge, England

(Tilt Bridge – A special kind of arch)

Use copies of Resource H and appropriate Internet sites to show the children images of various bridges around the world. Ask them to decide, in groups, what kind of bridge each one may be, based on the characteristics they can see in the pictures. Discuss these decisions as a class.

The bridges shown in Resource H are:

- Golden Gate Bridge (Suspension)
- Sydney Harbour Bridge (Steel Arch)
- Humpback Bridge (Stone Arch)
- Battle River Train Bridge (Truss)
- Cable-Stayed Bridge

Compare and Contrast

Introduce the terms **compare** and **contrast** to the children. Working in small groups, ask the children to choose two bridges they have learned about so far. They may choose two local bridges, two bridges from the UK or two from elsewhere in the world. Tell the children that they will be trying to find all the things that are the same (compare), and all the things that are different (contrast) about the two bridges. You may find it useful to use the 'Talking about Thinking' texts in Appendix 1 of the Introduction booklet, to choose pupil success criteria for this task or to make explicit the skills the children will be required to show in the task.

Use the 'Compare and Contrast Template' in Resource I to help children to record their ideas. Alternatively, divide an A3 page into two columns with a picture of their chosen bridges at the top of each, and ask them to record their ideas for 'compare' at the top of the columns and ideas for 'contrast' at the bottom half of the columns.

Extension Activity

As an extension to these activities, ask the children to research other famous bridges around the world and then recreate the image of their favourite bridge in any media they choose (ICT, collage, charcoal, watercolours or 3D construction).

Activity 7

Forces

Tension and Compression

New Words and Phrases

dead load

live load

forces

tension

compression

Benjamin

Baker

Suggested Learning Intentions

We are learning to:

- understand what the forces working on a bridge are;
- describe 'tension' and 'compression' in terms of 'push' and 'pull';
- find different ways to see tension and compression working; and
- create models that will demonstrate what we know about tension and compression.

Introducing Forces

Bridges have to be very strong because many of them will need to carry very heavy loads. Explain to the children that a bridge has got two types of **load** that it needs to carry. These are:

- **Dead load** – this is the bridge's own weight, which doesn't change, its weight stays constant; and
- **Live load** – this is the weight of what the bridge is carrying, which changes continually.

These loads cause the bridge to have to deal with various **forces**. To design a bridge, an engineer must understand the forces of tension and compression that act on every bridge, and then design bridges to manage these forces without collapsing or failing in any way. **Tension** and **compression** are important forces that act upon structures. A balance of these forces is what helps a structure to stay strong. If these forces are not balanced, the structure will become unstable and maybe collapse.

Explain the terms 'compression' and 'tension' to the pupils and find some everyday examples to demonstrate these. For example, if you stretch an elastic band as far as it can go, the force that is working is called tension. When you squeeze a sponge or stand on a pile of books, that force is called compression. Explain to the children that while bridges have to be very strong to withstand these forces, they also use these forces to make them stronger.

Investigating Forces

– Push and Pull

During a P.E session, get the children to test out how tension and compression can make something stronger. In pairs, perhaps standing on a soft mat, get the children to stand facing each other, holding hands and leaning away from each other. They should see that the weight of each person **pulling** on the other makes both children very steady and strong. To demonstrate how tension can help a structure be strong, add

CONNECTED LEARNING OPPORTUNITIES

The World Around Us

Carry out investigations on forces. Use a newton metre to measure the force placed on a spring by numbers of small weights.

Personal Development and Mutual Understanding

Find out about the forces that muscles in the body use.

Physical Education

Ask the children to design a gymnastics sequence which has movements which use difference pushing and pulling forces.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Generate Pupil Questions!

Before beginning the activity, to promote pupil involvement and enthusiasm, ask the children to think of serious and silly questions about the forces acting on a bridge. For example, "How many elephants could stand on a bridge?" or "Does a bridge use pushing forces or pulling forces?"

a load to the outstretched arms of the children. For example, sit several books or quoits on top of the children's arms to allow the children to see that the tension helps to make the arms stronger.

Next, get the children to again stand facing each other, but this time get each person to put the palm of their hands against their partner's hands, and lean forwards. They should see that the weight of each other person **pushing** against the other makes both children strong and steady. Alternatively, they could demonstrate this by standing back-to-back and leaning their weight against each other.

Benjamin Baker and the Cantilever Model

With the class, look at the photograph in Resource J, Benjamin Baker and the Cantilever Principle, or alternatively, use a suitable search engine to find the image (search for 'Benjamin Baker, Cantilever') to show on a whiteboard. This picture shows how a Cantilever bridge works, using tension and compression. In groups, give the children the opportunity to recreate the model using materials such as lollipop sticks, blocks of wood, string, etc. On a large sheet of paper, ask each group to sketch out the model and mark on it how each part of the structure makes it work. Encourage the children to use words such as tension, compression, load and force in their explanations.

As a class, recreate the photograph yourself to see how the forces of tension and compression help a Cantilever bridge work. You should ensure appropriate adult supervision and test the structure yourself with the help of other adults before allowing the children to take positions on the structure. You could substitute the metal 'seat' in the middle of the structure for a flat piece of wood attached to the inner arms of the structure with rope. You will also need the following (or alternatives):

- two chairs of the same height;
- four long, strong lengths of wood (brush handles for example) or metal;
- two lengths of rope; and
- two equal stacks of bricks with approximately twelve bricks in each.

You will need to create a safe way of attaching the structure together. This could be done by testing out different elements of the structure with the children first, before putting the whole structure together.

Activity 8

How Can Shapes Make a Bridge Strong?

New Words and Phrases

supports
diagonal
Eiffel Tower
engineer
span
abutment

Suggested Learning Intentions

We are learning to:

- design and make structures that are tall and strong;
- add supports to structures to make them stronger;
- recognise where supports and shapes are used in bridges to make them stronger; and
- identify what features structures such as the Eiffel Tower have to make them stronger.

Tall, Wide, Strong and Attractive

In mixed ability groups, set the children a challenge of building a structure of any shape that is tall, wide, attractive and strong enough to hold a dictionary (for example). The catch is that they are only allowed to use paper art straws and sticky tape. Remind the children of the benefits of working as a team. Using the 'Talking about Thinking' texts in Appendix 1 of the Introduction Booklet or downloaded from www.nicurriculum.org.uk (for use on an interactive whiteboard), agree on success criteria for working in a team, for example:

- In a group, I can organise myself and others without the teacher's help;
- I listen to suggestions from others about how to make what I am doing better; and
- I can work with others to reach an agreement or come to a decision.

Set the children a suitable time limit for the task. When they have completed the challenge, or the allocated time has ended, test each structure against the criteria of being tall, wide, attractive and strong.

Discuss with the children how these are some of the criteria that an engineer also needs to consider when he/she is building a bridge. If any of the structures manage to meet all of the criteria, discuss whether there are any reasons why it has done so.

Lead the children to considering whether:

- any of the structures were built with added supports; and
- what shapes were used/can be seen within the structures.

Triangles and Supports

Show the children some images of bridges from around the world. Ask the children to see if they notice anything that is similar in many of the images. Lead the children to see that many of the structures are built with added supports and that many of them have a combination of triangle shapes within the structure. Demonstrate how this works by getting the children, in pairs, to make a square from four strips of card

CONNECTED LEARNING OPPORTUNITIES

Mathematics and Numeracy

Investigating 2-D and 3-D shape; Making nets of shapes to create 3-D structures.

Language and Literacy

Write poetry based on the Eiffel Tower. Use adjectives to begin each line or write the poem based on imagery, 'As tall as a giant with his head in the clouds'.

The Arts

Create 3-D pictures using triangles and arches.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Pupil Reflection!

Develop pupils' ability to look at their work critically and constructively. Allow them to create and use a WILF (What I'm Looking For) sheet where they can mark themselves on meeting set criteria for making a tall, wide, strong and attractive structure.

of the same length. They will also need four paper fasteners to join the ends of the strips of paper. When they have made their squares, get them to hold the square with one side resting on the table and experiment pushing or pulling on any side of it. They will see that the square will wobble and lose its shape immediately. For example, if you push the corner of a square, it produces a diamond shape.

Next, get the children to make a triangle (with equal sides) in the same way. When they apply the test to the triangle in the same way, they will see that it holds its shape. Triangles don't twist, bend, or collapse easily, in comparison with rectangles and other shapes. **A triangle is the only shape that cannot be pushed or pulled out of shape without changing the length of one of its sides.**

Finally, get the children to add one strip of card across the diagonal of the square and fasten it using the paper fasteners. Again, get them to test by pushing on or pulling the shape and see how much stronger it has already become simply by adding the strip and making the shape into two triangles. Alternatively, this activity can be completed using cocktail sticks with small jelly sweets as the fasteners.

Arches

Show the children an image of the Eiffel Tower in Paris. Notice how the Eiffel Tower has an arch at the bottom. This arch helps to support the tower. Use the Arch Bridge Information Sheet from Resource G to explain how an arch works to give strength to a structure, explaining to the children how the force of compression helps the arch. Explain to the children how this relates to the design of a bridge. Explain how the architects and civil engineers who design the bridge use strong materials like wood, stone, concrete or steel, and make the structure even stronger by using certain shapes, like triangles or arches. Ask the children to design an investigation which will allow them to find out how an arch helps to

make a structure strong. One way could be to create models using strips of cardboard, with and without an arch, and compare the strength of each.

What's the Problem with an Arch Bridge?

Tell the children that there is sometimes a problem with using an arch bridge. While an arch bridge is often a really good design, sometimes it's not the right one to choose. Set the children the challenge of finding out why.

The reason is this:

- The higher the arch, the more weight it can support; **BUT**
- As it gets higher, it spans a smaller distance, therefore making it unsuitable for some crossings.

In groups, get the children to find out what the reason is by allowing them to create their own versions of an arch bridge. By the end of the activity, the children, in their groups, should try to come up with a reason as to why an arch bridge is not always the most suitable type of bridge to build.

To create their arch bridge, the children could use a strip of thick cardboard, for example. They should ensure that they have **abutments** at each side of the arch, for example, some tins of beans or a stack of books. The abutments keep the arch from spreading out. They should measure the distance between the tins of beans and the height of the arch, from a centre point on the arch, to the floor or table (whichever the arch is sitting on) and record these in a table as shown on the page overleaf.

They should then find a way to allow the arch to carry a load. They could use marbles or cubes for example. They should record how many of the weights the arch was able to hold, before it began to sag. When they have recorded about five sets of measurements, ask

Distance between abutments (cm)	Height of arch (cm)	Load carried (no. of cubes)

the groups to stop and discuss their results with each other. You may need to give a clue, depending on the knowledge of the children, for example, "The answer is linked to the distance the bridge needs to cross".

It may be suitable to let the children refer to the Arch Bridge Information Sheet in Resource G.

Working with Bridges

Making bridge models to investigate what makes a structure strong.

Learning about some of the careers involved bridge building including structural and civil engineers.

Researching the famous engineer Gustave Eiffel, and his contribution to engineering.

Working in groups to design and create a solution to open and close the arms of a bridge.

SECTION 3



Activity 9

Construction Time!

New Words and Phrases

fair test
observations

Suggested Learning Intentions

We are learning to:

- investigate different ways to change the strength of a structure;
- work with others to solve a problem;
- persevere when we come across difficulties; and
- design and carry out a Fair Test.

Penny Bridge

Put the children into groups of three or four. Hold up a single piece of paper and ask the children how many 1p coins (or other small object) they think the page could hold. Position the page across the top of two piles of books or in a small gap between two tables. Place one coin at a time on the page, and ask the children to keep count. Ask the children what they think they could do to the page to make it stronger. Explain to the children that engineers need to make models of bridges when they are designing bridges, to see how to make the structure as strong as possible. Provide the children with one A4 page, six paperclips and a pair of scissors. Their challenge is to use the materials to make a bridge that will hold as many coins as possible. When the children have all had a try, discuss with the class the reasons why the bridges were, or were not, able to hold a larger number of 1p coins.

Lead the children to see that changing the shape of the materials, whether it is paper or steel, can work to make the material stronger. If none of the children have already used a concertina shape,

fold a page into a concertina shape and demonstrate how the weight of the pennies is spread across the structure, therefore making it stronger.

Truss Bridge Model

Remind the children about how they made a square stronger in the previous activity by adding a diagonal support and making the square into two triangles. Show the children again what a simple truss bridge looks like.

Using rolled up newspaper pages, set the children a group challenge of building a truss bridge that will sit across two chairs, one metre apart. The bridge should be able to support at least one thick book (a dictionary for example). Allow the pupils to use suitable Internet sites to look for images of truss bridges. If they made the A3 posters in Activity 6, they could use these posters for images and information.

CONNECTED LEARNING OPPORTUNITIES

Using ICT

Allow the children to take photographs as they are completing the bridge building activities. Import these still images into a program such as Comic Life or PhotoStory3 to present their investigation and results to the rest of the class.

Language and Literacy

Writing a report on the outcomes of the bridge investigations.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Self-Evaluation!

Reflecting on *how* they have learned as well as *what* they learned, is an important skill for children to develop. Help this evaluation process by giving them prompts to consider such as:

“What I have learned that is new is...”

“What surprised me was...”

“What helped me when something got tricky was...”

Spaghetti and Marshmallow Challenge

A further challenge could be that the children, working in small groups, will create a bridge using only dried spaghetti and marshmallows. The children can create any bridge they want, using the spaghetti and marshmallows in any way they wish. When they have made their spaghetti and marshmallow bridges, they will all be tested to see which is the strongest.



- each group will use the same amount of spaghetti and marshmallows (for example, one packet of spaghetti and one bag of marshmallows);
- each group will have the same amount of time to complete the task;
- each bridge will be tested for strength by the same item/in the same way; and
- the same person will place the item onto the bridges to make sure the same strength is used.

When all the bridges have been tested, discuss with the children any observations they made about which were strongest. Did the shapes used in the bridges make a difference? What was the best way to use the spaghetti and the marshmallows?

What Makes a Test Fair?

Discuss with the children how they can ensure that finding out which is the strongest bridge is a **fair test**. As a class, draw up a list of factors that will ensure it is a fair test. You may want to give the children various scenarios for them to consider when discussing this issue, for example:

"Group 1 have made a bridge using half a packet of spaghetti and eight marshmallows. Group 2 have made a bridge using a full packet of spaghetti and twelve marshmallows. The teacher tests the bridges by placing a book on each. Group 2 win. Was it a fair test?"

In order to plan a fair test for their own bridge building, get the children to agree on a set of criteria that will make sure that every group has an equal chance of passing the challenge. The list of criteria may include:

Activity 10

Who Builds Bridges?

**New Words
and Phrases**
structural
engineer
civil engineer

Suggested Learning Intentions

We are learning to:

- recognise the various careers that are involved in building bridges; and
- present information gathered from research to others, so that they can understand it.

Research

When a bridge is being designed, teams of engineers work together to decide on the best type of bridge to use for the crossing. To make this decision, they need to think about things such as:

- the length that the bridge needs to be;
- which materials to use;
- how much load the bridge will have to carry;
- who will use the bridge; and
- how the bridge will look.

Distribute copies of Resource K, Engineer Fact-Files, to the children. As a homework task, ask the children to find out more about structural or civil engineers. When they have completed their research, put children together in a group with others who have researched the same engineer as them.

Encourage the children to present all of the information about their engineer, in as creative a way they can. The children will need some time to prepare for this, and you may find that it will spread over a few sessions. For example, they could present their information in the following ways:

- **Drama** – create props and a scenario to act out a 'day in the life' of an engineer.
- **Collage** – use pictures found on suitable websites along with word-processed phrases.
- **ICT presentation** – create a multimedia presentation using images, text and sound files to tell the story of the chosen job.
- **Creative writing** – write a fictional story about an event that happens when an engineer goes to work, and what the engineer has to do and what skills he/she needs to use to solve the problem.

Arrange for an engineer to come into school to talk to the children. If you do not know anyone who is an engineer, you could contact an engineering company to try and arrange this. See the 'Useful Contacts' section at the back of this book for details.

CONNECTED LEARNING OPPORTUNITIES

The Arts

Present information from research using drama or art and craft.

Using ICT

Create a presentation using suitable software or by accessing images of people at work from LearningNI (LNI).

Language and Literacy

Write a story about a day in the life of an engineer.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Set targets for good teamwork!

Activity 11

Gustave Eiffel

A Famous Engineer

New Words and Phrases

Eiffel Tower
Gustave Eiffel
Statue of
Liberty
sculptor
sculpture
pedestal

Suggested Learning Intentions

We are learning to:

- appreciate the role that some engineers have played in the world;
- apply knowledge about how to make a structure strong, to our designs;
- distinguish between relevant and irrelevant information when we are carrying out research; and
- understand the concept of scale.

Alexandre Gustave Eiffel

Remind the children of the discussion they had (in Activity 8) about the Eiffel Tower and about how the arch at the bottom of it helps to support the structure. Give the children the following information:

Alexandre Gustave Eiffel was born in Dijon, France in 1832.

Using this information, set the children a group task to find out more about Gustave Eiffel and about what other structures he built. They can use suitable Internet sites or encyclopedias to find useful and relevant information. Ask each group to present their information as an ICT presentation of no more than ten slides. Encourage them to use images, text, slide transitions and, if possible, to record a voiceover to accompany the presentation.

When the children have had an opportunity to complete their presentations, allow the rest of the class to view them and together, create a list of facts about the engineer.

Statue of Liberty

If the children have not already made the connection between Gustave Eiffel and the Statue of Liberty, introduce it to them. The Statue of Liberty was built in 1886 and was a gift of friendship from the people of France to the people of the United States of America. A sculptor called Frederic Auguste Bartholdi was given the job of designing a sculpture that would celebrate the 100th year of the Declaration of Independence in America and Gustave Eiffel was given the job of designing the structure that would go inside the sculpture to support it. The Statue of Liberty measures 46.05 metres tall (92.99 metres with the pedestal) and weighs 156 tons!

Set the children the task of suggesting what the internal structure of the statue must look like in order to be able to hold that weight. Encourage the children to think about all of the different ways to make a structure strong which they have learned about during the theme. Give each child a copy of an image of the Statue of Liberty (Resource L). You may like to photocopy this onto A3 paper.

CONNECTED LEARNING OPPORTUNITIES

Using ICT

Create a presentation on a famous engineer or a famous structure such as the Eiffel Tower or the Statue of Liberty.

Mathematics and Numeracy

Investigate proportion by making to-scale models of the Statue of Liberty.

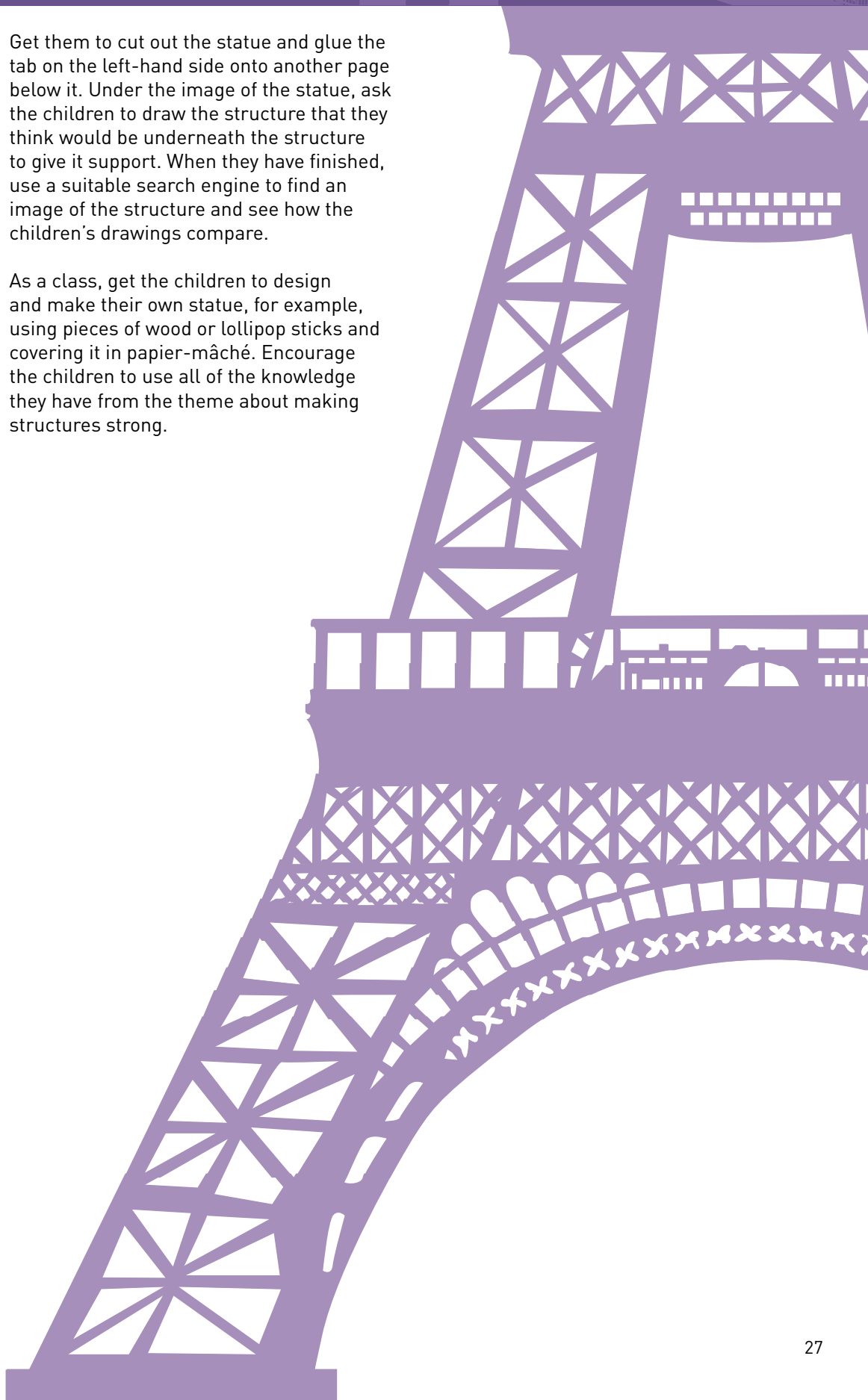
ASSESSMENT FOR LEARNING OPPORTUNITIES

Formative Feedback between peers

Encourage the children to make suggestions to their friends about what they are doing. Encourage them also, to accept feedback from others and to try and take their ideas on-board.

Get them to cut out the statue and glue the tab on the left-hand side onto another page below it. Under the image of the statue, ask the children to draw the structure that they think would be underneath the structure to give it support. When they have finished, use a suitable search engine to find an image of the structure and see how the children's drawings compare.

As a class, get the children to design and make their own statue, for example, using pieces of wood or lollipop sticks and covering it in papier-mâché. Encourage the children to use all of the knowledge they have from the theme about making structures strong.



Activity 12

Building a Bridge and Thinking Like an Engineer

New Words and Phrases

dilemma
control tower
structure
drawbridge
counterweight
hinge
circuit
switch
system

Suggested Learning Intentions

We are learning to:

- investigate the elements needed to make a drawbridge open and close smoothly;
- know what a counterweight is and how it works;
- persevere when things don't work as expected and solve problems when difficulties arise; and
- work with accuracy and skill to make things work as intended.

Ted's Dilemma

Discuss with the children what the word 'dilemma' means. Encourage discussion about any dilemma children may have experienced or know about. It may prove useful to refer to a few examples of your own. Ask the children to consider whether a dilemma is a pleasant experience or whether it is an experience they would prefer to forget. Read the story of Ted's Dilemma (Resource M) and show the children the image of Tower Bridge, London (Resource N), which is very similar to the bridge on which Ted works.

Discussion

In groups, set the children the task of exploring some of the issues raised in the story. Highlight what it means to be successful at working in a group. For this you may wish to ask the children to

adopt a particular role. Download the 'Job Role' texts from the 'Think Pack' at www.nicurriculum.org.uk to remind them of what a good manager, worker or timekeeper needs to do to be successful.

Ask the children to discuss the following:

- If you were Ted, how would you feel?
- How might you react to the situation?
- What choices do you think would be open to you?
- What might you do? Give reasons.
- Is there always one correct way to resolving a dilemma?
- How might the situation be prevented from happening?

CONNECTED LEARNING OPPORTUNITIES

Personal Development and Mutual Understanding

Discuss times when children have experienced a dilemma and had to make difficult choices. Consider what makes a choice 'difficult'. Is there such a thing as being equipped to deal with the unexpected? Do choices get easier as we get older?

Using ICT and The World Around Us

Model different circuit designs using ICT software or discrete components to research the design of a warning system.

Mathematics and Numeracy

Making nets of shapes to create 3D structures.

Language and Literacy

Using design drawings to explain and talk about their completed models – how well they work, difficulties they experienced, decisions taken or what changes they would make.

ASSESSMENT FOR LEARNING OPPORTUNITIES

Hold an 'Application of Learning' day in school. Invite parents/carers into the classroom to see the children completing their work on bridge design and demonstrate the knowledge and skills they have developed during the course of the theme.

Think About

In groups, get the children to create a mind map of how the situation might be prevented, for example, the train driver needs to be warned that the bridge is not in operation and the train needs to either stop or be diverted.

Encourage the children to create annotated drawings to show the layout of the tower and to speculate on what they might do to prevent the train from coming through. To help support and develop their thinking, ask the children the following questions and prompt them to give reasons for their answers:

- Should they create some kind of signalling or warning system that indicates danger? What might this involve? Where might this be located?
- Could sensors be placed along the track to inform the driver of action needed to avoid potential danger?
- Should all tracks have built-in sensors at specific places along the route for use in an emergency? How might they operate?

DESIGN CHALLENGE 1

Design and build a model bridge that will open and close like the one Ted operates.

Working in small groups, ask the children to think about and plan:

- How they will construct the control tower. What shape should they use (for example, a cylinder or a cuboid)?
- How they will create a hinge to let the drawbridge swing up and down?
- How they will enable the drawbridge to rise and fall easily, using a counterweight mechanism?

When they are planning, the children will also need to consider the following points in their design:

- the size of the opening on the side of the tower that allows the train through;
- the use of cables to allow the drawbridge to rise and fall easily;
- the counterweight mechanism that helps the drawbridge open and close easily. (Suggestion: get the children to find out how a sash window operates.)



When all the children have had an opportunity to plan and develop their ideas, ask each group to feed-back to the rest of the class on their designs. Encourage the rest of the class to give constructive criticism to each group about why they think their design will or will not work. Throughout the discussion, make a list of points that have been agreed by the class, about how the bridge needs to be built in order for it to work properly.

Provide the children with time over the next week or two to gather materials and build their working models of the bridge.

The diagram on the following page shows one method of putting the drawbridge together this could be used as a guide.

control mechanism
to operate switch

simple circuit
with buzzer,
bulb and switch

switch

dowel rod

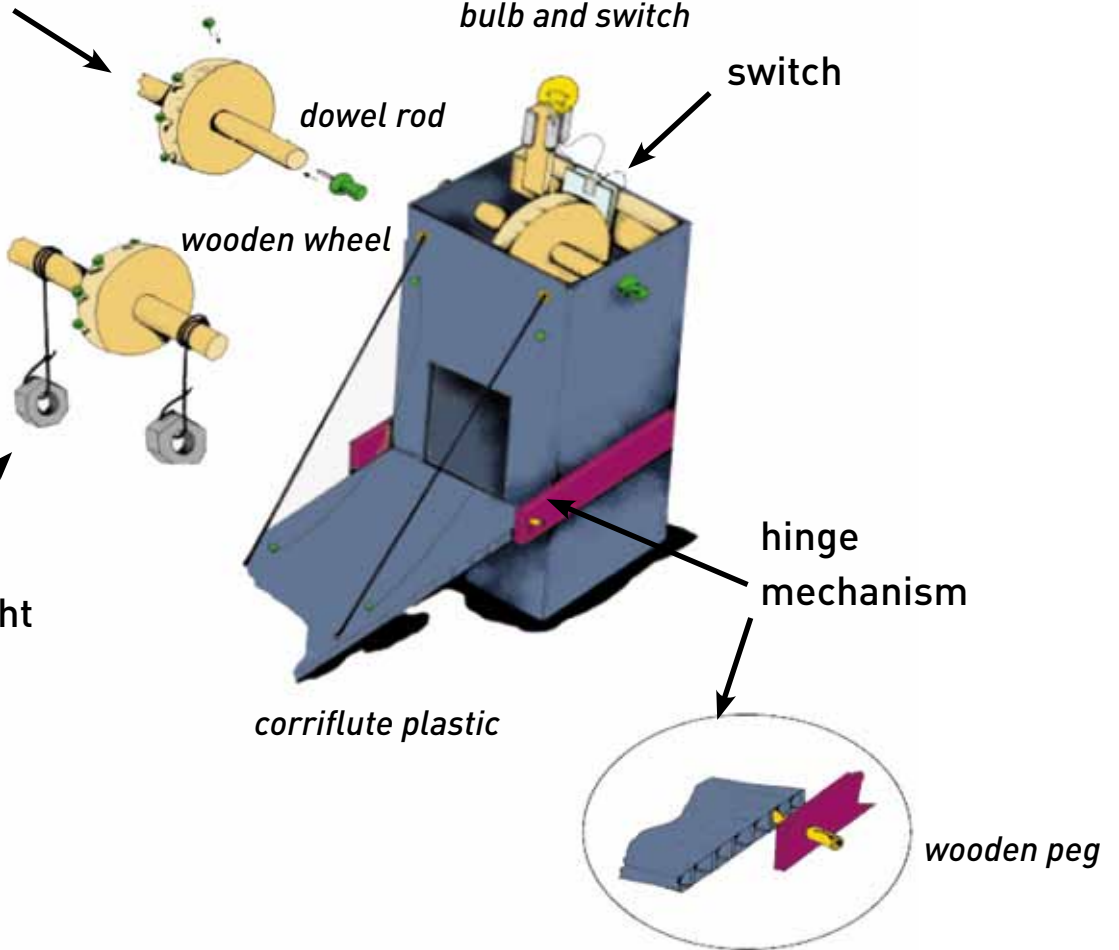
wooden wheel

counterweight
mechanism

hinge
mechanism

corriflute plastic

wooden peg



DESIGN CHALLENGE 2

Design and build a warning system that will alert an oncoming train.

Working in mixed ability pairs or small groups, the children will need to think about and plan for the following:

- where to place the warning system to alert the oncoming train;
- what form the warning system will take (a flashing light, a buzzer etc);
- how a bulb could be used as a warning system to flash ON and OFF when the drawbridge is in use and remain ON when the drawbridge is OPEN.

Depending on their experience and prior knowledge, the children may need time to investigate making circuits. They will need to know about types of circuits (for example, series and parallel), types of switches (and their use to suit different needs) and uses of motors.

When creating their designs, encourage the children to use annotated drawings as a means of communicating their ideas. Encourage the children to evaluate their work at different stages and make any necessary amendments. In pairs or small groups, encourage the children to decide on their own success criteria for evaluating their models. They could then use peer assessment, such as **Two Stars and a Wish*** to give each other feedback on their ideas and designs.

They should consider:

- How pleased are they with their designs?
- Can others understand their ideas?
- Would the design actually work?
- Have they given attention to detail?
- How effective is the warning system?
- Would it work in an emergency situation?

You may wish to invite parents/carers into the classroom to help the children to make their bridges and warning systems into working models. This could also be an opportunity to showcase the learning that has taken place throughout the course of the theme.

As a conclusion to the theme, the children could present their learning to another class or to the whole school during an assembly, by creating a presentation using ICT, or even by creating a class Wiki on the theme of 'bridges'.

* see *Active Learning and Teaching Methods for Key Stages 1&2*

Resources

Resource A

Newsflash!

Missing Bridge Causes Chaos!

People are reacting in shock this morning after the overnight disappearance of the Foyle Bridge!

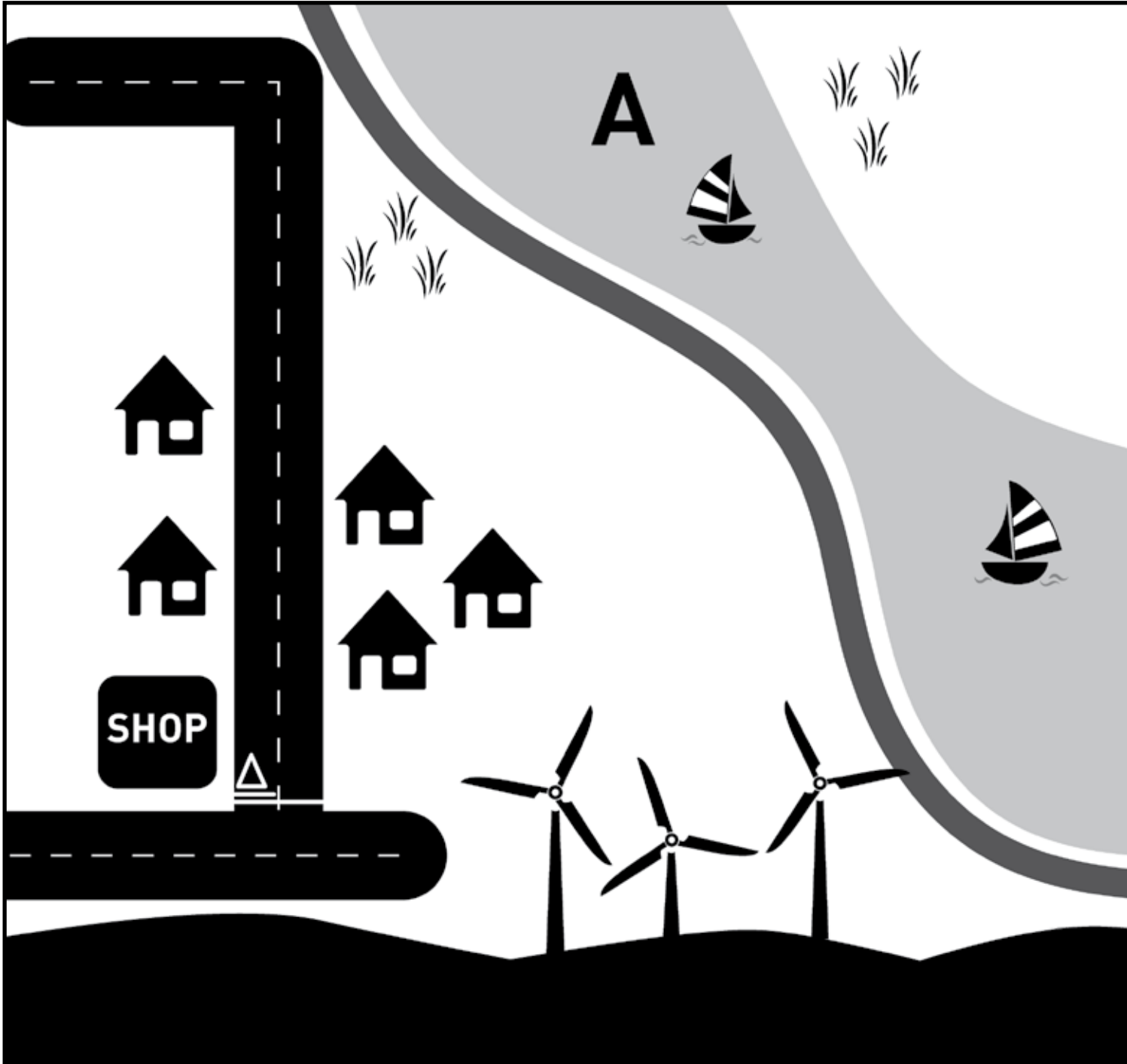
Experts believe the bridge could have been the victim of an alien attack. Several witnesses have reported sightings of small purple blob-like creatures in the area and unusual lights were spotted in the sky over nearby Donegal.

Derry City Council and the PSNI have called for an urgent investigation into what has happened to the missing bridge.

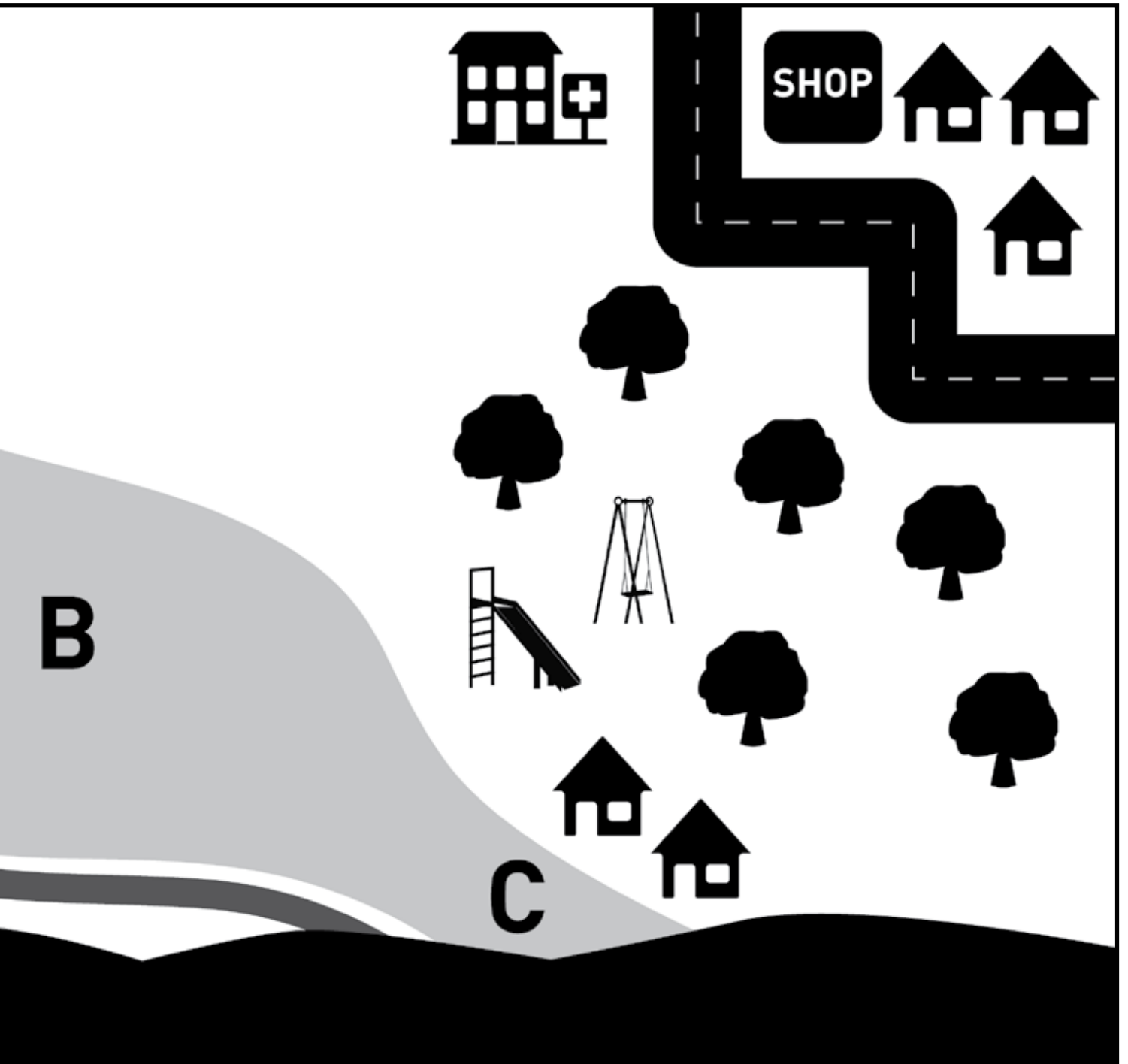
The bridge crosses the River Foyle to the north of the city and links the city centre to the Waterside area. More than 30,000 vehicles used the bridge every day. Widespread traffic disruption is now expected.

Resource B

Cantilever City Map



Key					
					
swamp land	wind farm	shopping centres	nature reserve	road	walk way
					
hills	houses	playground	sailing club	hospital	



Resource C

Consider All Factors Template

Issue:

Where to locate a bridge – A, B, or C?

A

Advantage

Disadvantage

Interesting Factor

B

Advantage

Disadvantage

Interesting Factor

C

Advantage

Disadvantage

Interesting Factor

My decision is:

Resource D

2004–2007 £1 Coin Designs

2004



© The Royal Mint Limited 2010

2005



© The Royal Mint Limited 2010

2006



© The Royal Mint Limited 2010

2007



© The Royal Mint Limited 2010

Resource E

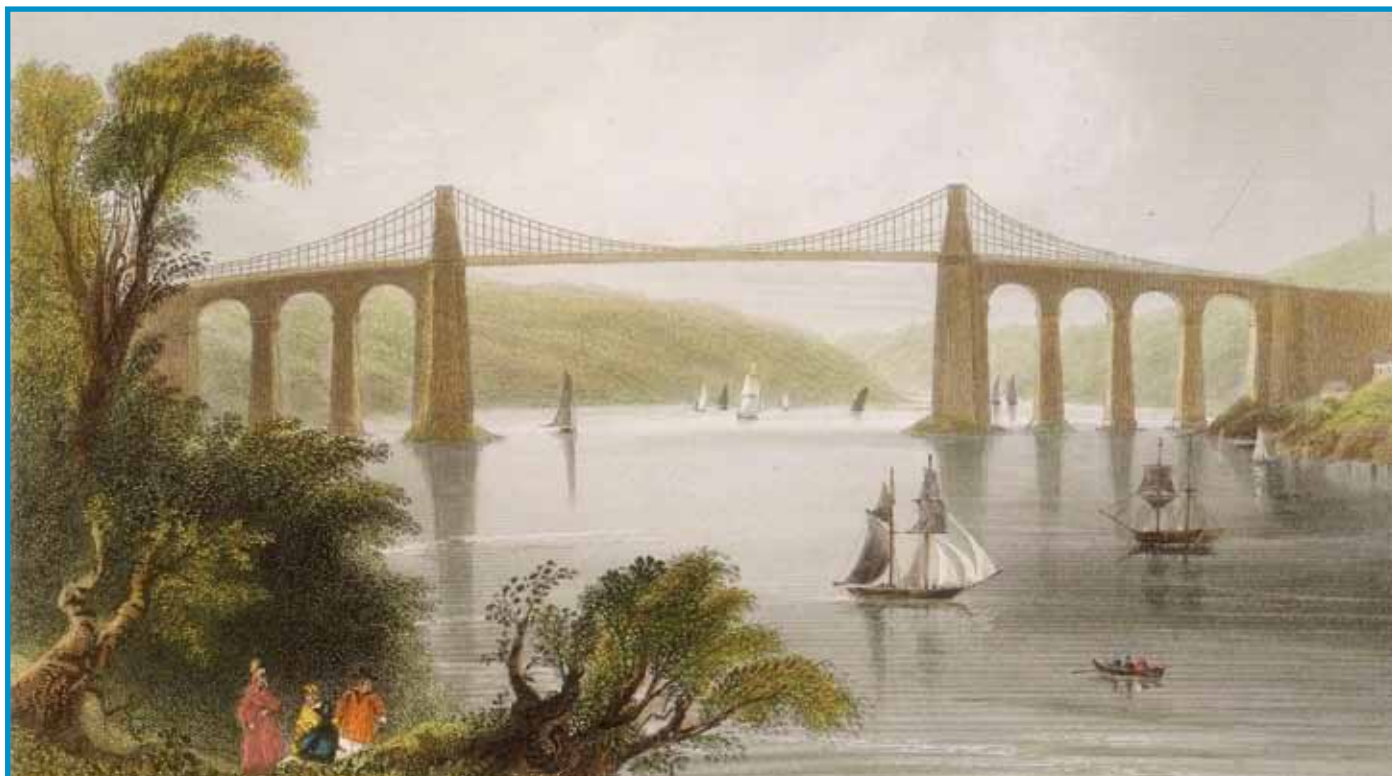
Images of Bridges in the UK

Forth Bridge, Scotland



AbleStock.com / © Jupiterimages.com

Menai Bridge, Wales



© <http://www.walesdirectory.co.uk>

Mc Neill's Egyptian Arch, Northern Ireland



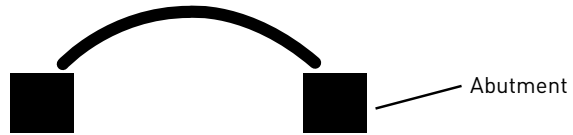
Gateshead Millennium Bridge, England



Resource F

Main Types of Bridge

Arch Bridge



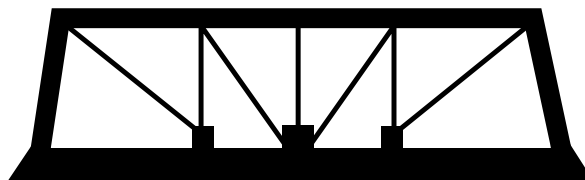
Simple Beam Bridge



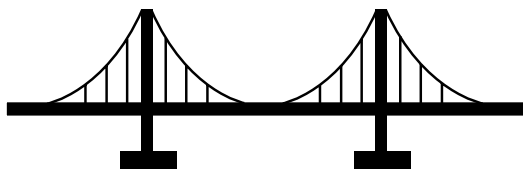
Cantilever Bridge



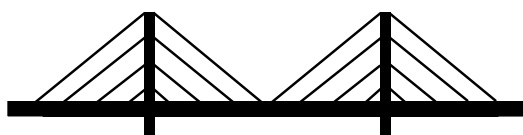
Truss Bridge



Suspension Bridge



Cable-Stayed Bridge



Resource G

Bridge Information Sheet

ARCH

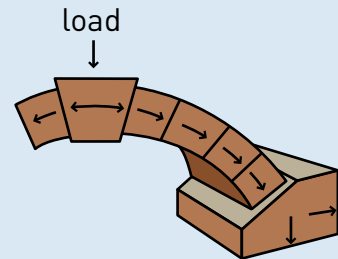
When an arch bridge is being built, it is built on top of a wooden frame. This allows the stones to be put in place. The stone in the middle of the bridge is called the keystone and is the most important part, without this, the arch would collapse. When the keystone is put in place, the wooden frame can then be removed.

An arch bridge is always under **compression**. An arch bridge works because instead of pushing straight down, the load of an arch bridge is carried out along the curve of the arch to the supports at each end. These supports are called the **abutments** and they carry the load and stop the ends of the bridge from spreading out.

How Does It Work?

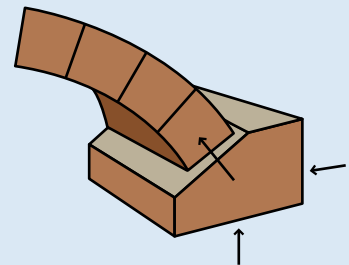
The weight from the load at the top of the keystone makes each stone on the arch of the bridge press on (compress) the one next to it. This happens until the force reaches the end abutments which are built into the ground.

Diagram 1



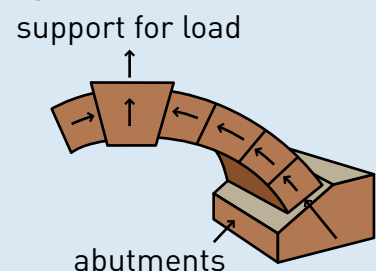
The ground around the abutments is squeezed and pushes back on the abutments.

Diagram 2



The ground which pushes back on the abutments and passes the force back up from stone to stone, until it is back pushing on the key stone which supports the load.

Diagram 3



Resource G

Bridge Information Sheet

BEAM

Beam bridges are the simplest type of bridge. It is just one beam that stretches across a gap in the landscape and is supported by columns or piers.

The weight of the beam pushes straight down onto the piers but the beam needs to be able to support the weight of the loads when they are between the piers. The further apart the piers are, the stronger the beam needs to be. For this reason, the beam bridge is usually used to span shorter distances.

To make a longer beam bridge, engineers can do a few things; join a few beam bridges together or use trusses.



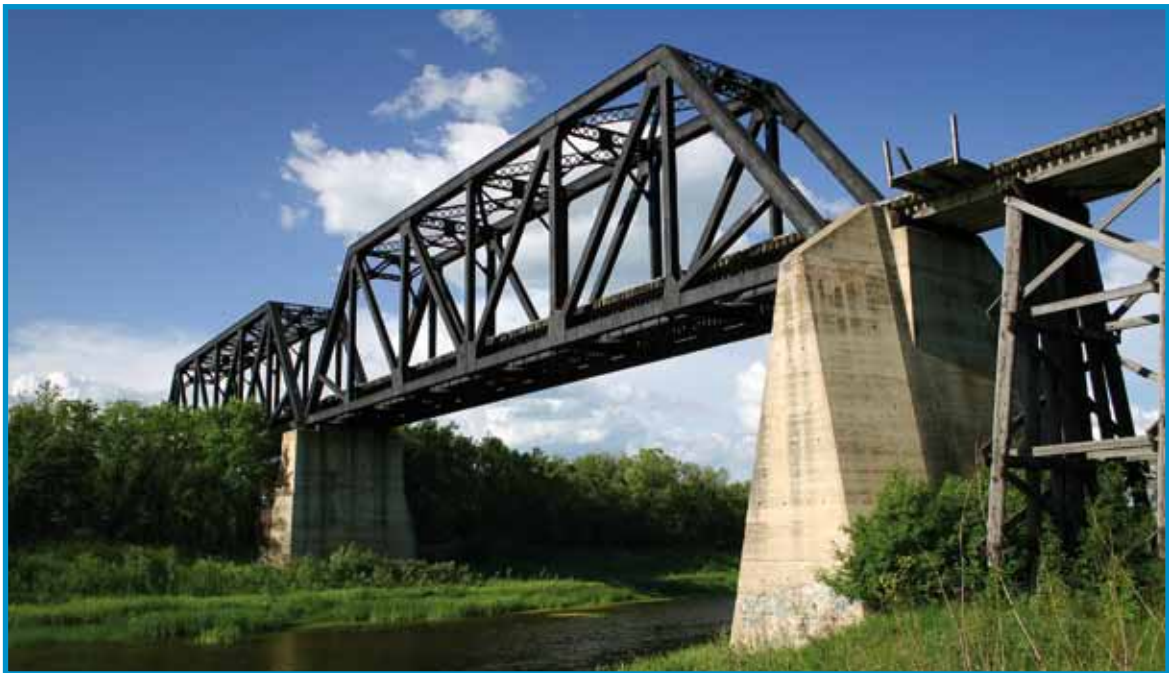
© Thinkstock

Resource G

Bridge Information Sheet

TRUSS

A truss bridge is created when triangle structures are added to a simple beam bridge. The triangles, or trusses, make the bridge stronger and so the bridge can span a longer distance. The trusses spread out the forces acting on the bridge along the beam. The open structure of a truss also allows the wind to pass through easily, which stops the bridge from feeling too much force from the wind.



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Resource G

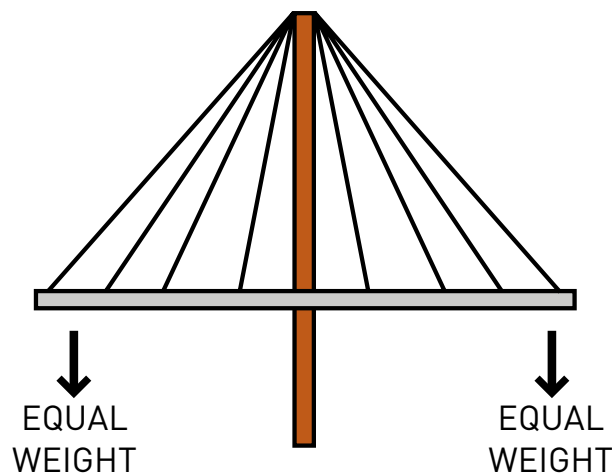
Bridge Information Sheet

CABLE-STAY

A cable-stay bridge is a type of suspension bridge. The other type of suspension bridge is a modern suspension bridge.

A cable-stay bridge supports the road with large steel cables. The cables go directly from the road up to a tower, making an 'A' shape, this shape makes a cable-stay bridge easy to recognise.

The cables are fixed to each side of the tower and pull down, helping to balance each other. This means that the weight of each side of the bridge counter balances the opposite side.



A modern suspension bridge also uses cables but in a different way.

Why would an engineer choose a cable-stay bridge instead of a suspension bridge?

- A cable-stay bridge is more stable in the wind.
- A cable-stay bridge needs fewer towers.
- The cables in a cable-stay bridge can be replaced if needed. Cables in a suspension bridge, cannot.
- A cable stay bridge is cheaper to build.

Cable-stay bridges span distances from 500 to 3,000 feet (152-914m).

Resource G

Bridge Information Sheet

SUSPENSION

A suspension bridge is really just a beam that hangs from steel cables. This type of bridge can be used where there is a long distance to be crossed. The steel cables are held in position at the two ends of the bridge by enormous concrete blocks which act like an anchor. This gives a suspension bridge an 'M' shape.

The anchor blocks need to be strong and heavy enough to not only hold up the deck of the bridge, but also to hold any vehicles that will pass over the bridge.

This is how a suspension bridge works: When vehicles go over the bridge, the weight pulls down on the cables causing **tension**. The cables then pass the load onto the columns. The columns feel this load as **compression**.

The steel cables of a suspension bridge are really thick, as tall as a man! Each cable is made up of smaller cables joined together to make one very strong cable.

A suspension bridge can span the furthest of all of the bridges - 2,000 to 7,000 feet (610 – 2134m). You will see trusses being used on most suspension bridges to strengthen them and to make them stronger and stiffer in the wind. A suspension bridge is the most expensive type of bridge to build because they need to be made of expensive materials that will make them both strong and light.



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Resource G

Bridge Information Sheet

CANTILEVER

A cantilever is any beam that is fixed to something at only one end and sticks out, like a diving board or a shelf. This end is what supports the beam.

A cantilever bridge is made up of two beams, called cantilevers, which are each attached to a pier at one end and joined in the middle by a connecting beam. This connecting beam is supported in the middle by a column.

A cantilever bridge isn't the strongest type of structure, but it is used when an engineer or designer doesn't want to have a support, such as a column, underneath.

Resource H

Bridges Around the World

Golden Gate Bridge



©Thinkstock

Sydney Harbour Bridge



©Thinkstock

Resource H

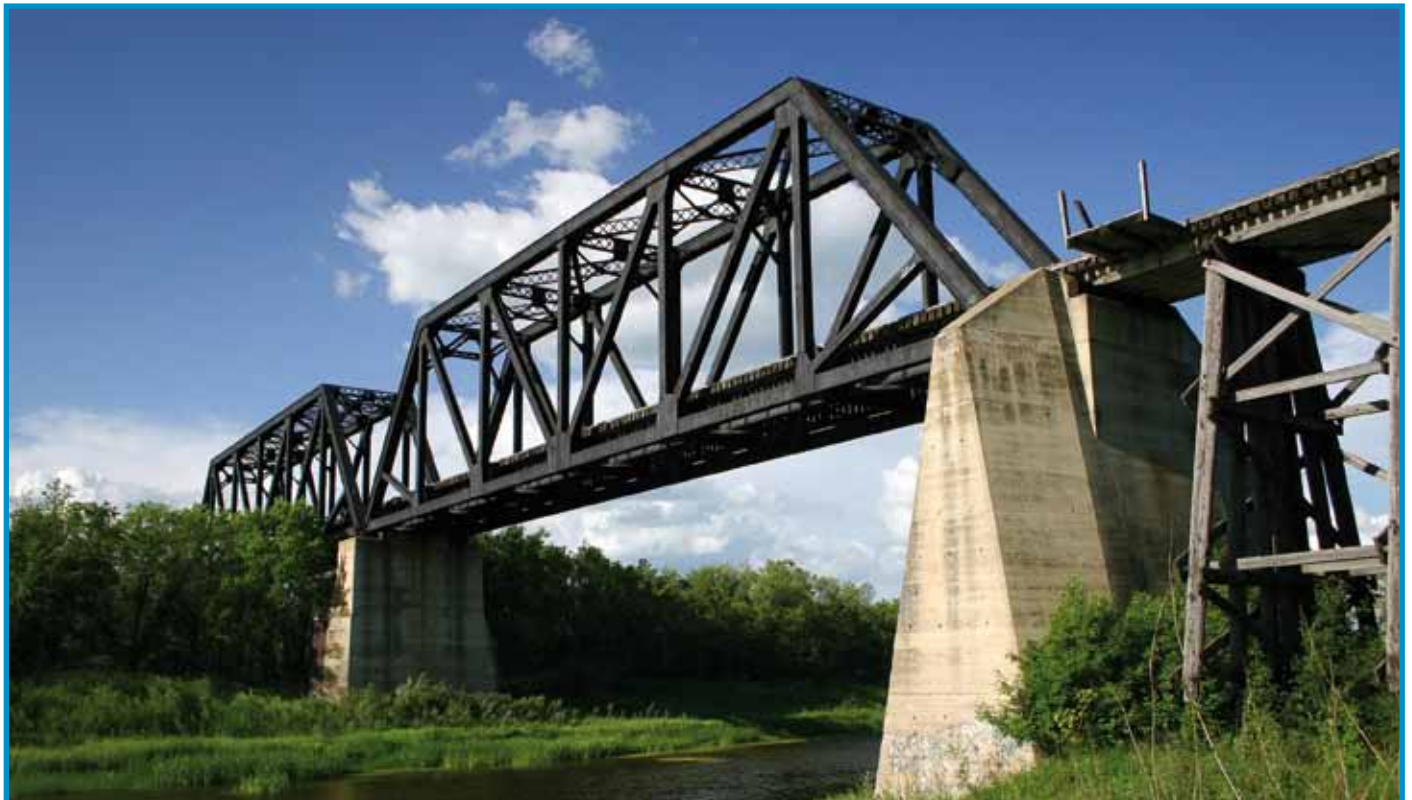
Bridges Around the World

Humpback Bridge



© Jupiterimages Corporation

Battle River Train Bridge



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Resource H

Bridges Around the World

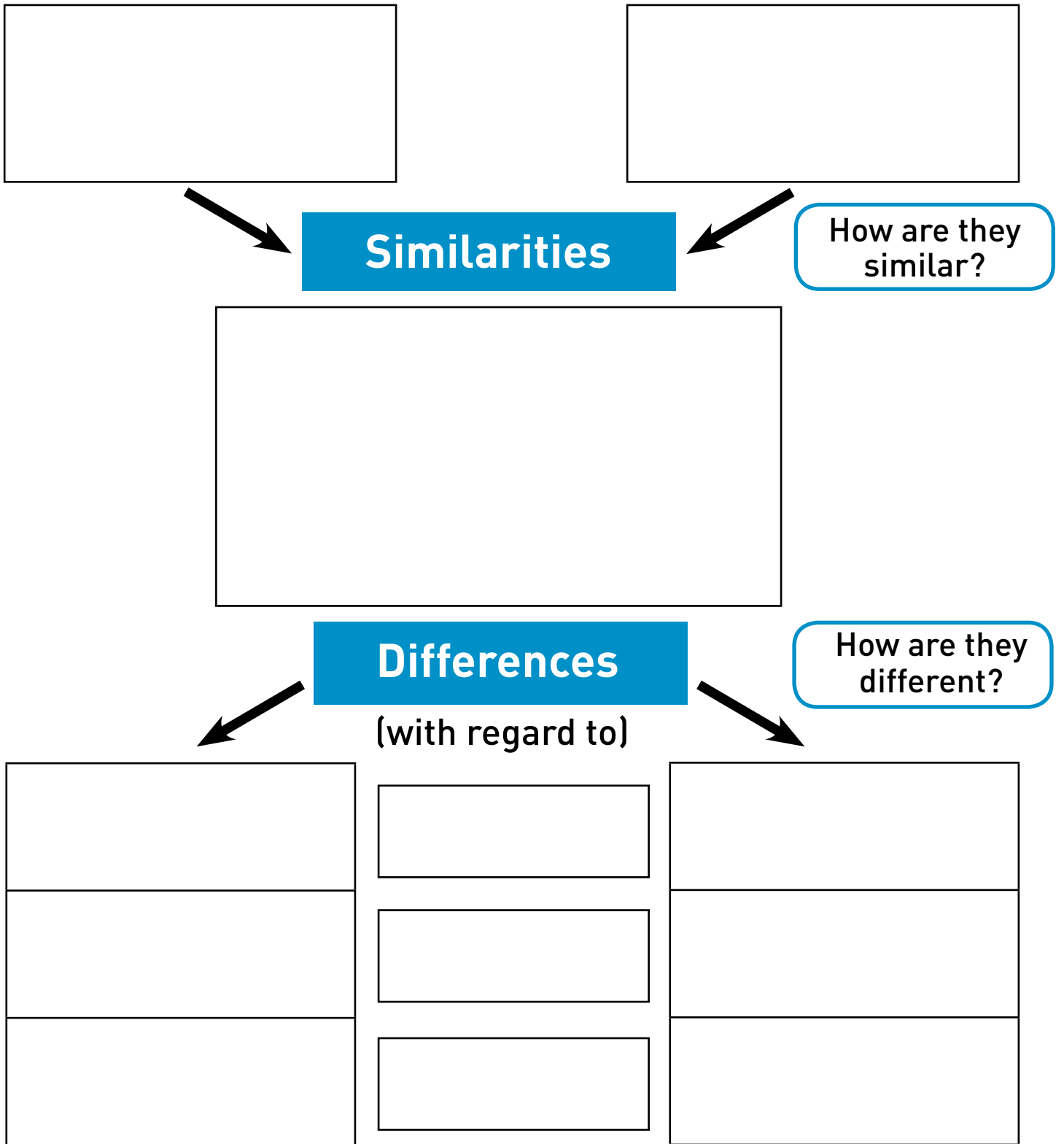
Cable-Stayed Bridge



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Resource 1

Compare and Contrast Template



Do you notice any patterns?

[Empty rounded rectangular box for notes]

Resource J

Benjamin Baker and the Cantilever Principal



© Courtesy of the Civil & Environmental Engineering Department, Imperial College London

Resource K

Engineer Fact-Files

Structural Engineer

Job:

Structural Engineers are involved in the design and construction of many structures, including large buildings, bridges, railways and tunnels. They are responsible for working out how structures will stand up to the many stresses and strains placed upon them.

Tasks and Duties:

Prepare drawings that explain how the structure should be built.

Investigate the ground condition to see if it is suitable for structures to be built there.

Working out the loads and stresses placed on structures.

Use computer models to test that the structure can withstand forces such as wind, gravity, earth tremors and the weight of people and traffic.

Skills Needed:

Excellent attention to detail.

Wide knowledge of different kinds of construction.

Good at analysing information.

Good problem-solving skills.

Good Maths and Numeracy skills.

Resource K

Engineer Fact-Files

Civil Engineer

Job:

Civil engineers are involved in the design, build and maintenance of **infrastructure**, the sorts of structures that help us every day. Examples of infrastructure include, bridges, roads, harbours, railways, airports, hospitals, schools and sports stadiums.

Tasks and Duties:

Guide a construction project from the very beginning to the very end, including the design, the building and maintenance.

Improve and protect the environment that we live in.

Visit the construction sites to check that the construction is progressing as it should.

Skills Needed:

Good at thinking creatively.

Able to make accurate plans and drawings.

Good at Maths and Numeracy.

Work and communicate well with a variety of people.

Able to make good decisions.

Interested in solving problems.

Resource L

Statue of Liberty Image



Resource M

Ted's Dilemma

This is a story about Jamie, who is ten years old and likes cool bikes, and his Dad, Ted, who works in the control room of a bridge.

Jamie was feeling really excited, he was getting a new bicycle on Saturday for his birthday. It was a mountain bike and the day he saw it in the shop he read the sign hanging on it. It said, "Built to take a beating, whether you're doing tracks or racing". Jamie thought this was really cool. His dad was also a bike enthusiast and he had recently changed his for one that had a suspension arm. Jamie knew that his next bike would be one like that.

Jamie's dad worked in a control tower of a railway bridge over a river. The bridge looked a bit like Tower Bridge in London. To allow the boats to pass underneath, Ted had to operate the mechanisms that raised the arms of the bridge. He then had to lower both sides of the bridge into position again to allow a train to pass over the bridge. If he was not in his control tower, Ted would be in the engine room looking after the big gearing system that was used to operate the bridge. He had always been fascinated by machinery.

On Saturday afternoon, Ted planned to bring Jamie with him to show him round the control tower, as a treat for his birthday. He knew that Jamie would be really interested to see the big gear wheels in the engine room and to see the size of them compared to those on his new bicycle!

Only one boat and one train were scheduled to pass through on Saturday afternoon. After the boat went through, there would be a gap of one hour before the next train arrived. Ted knew that there was enough time to show Jamie the engine room before the train passed through.

Jamie watched his dad use the controls to raise the arms of the bridge to allow the boat through. Then both of them went down the open steel staircase to the engine room. As he descended the steel staircase he could see the boat on the river down below; it was so exciting! Jamie knew that this was a really special birthday present and promised to stay close to his dad on the way down to the engine room.

The smell of engine oil and the sight of the huge machinery made Jamie's pulse quicken. There in front of him were gear wheels as big as his dad. This was amazing! He had never seen anything like these before. He had tried to imagine what inside the engine room would be like, but nothing had prepared him for what he was seeing. He could never have imagined it. Ted showed Jamie how the great big gears worked and how the cables were connected to the swinging arms of the bridge to make them rise and fall. Jamie was in awe of his dad and thought he had the best job anyone could have. What he really would have liked was to be in that room when the gears were actually moving; that would be really cool. Nobody in his class at school had ever seen anything like this before.

continued overleaf

Resource M

Ted's Dilemma (Continued)

Just then Ted's pager beeped. This meant that he must return to the control tower immediately as an important message would be coming through. He knew that there would not be enough time for Jamie to climb up the steep staircase to the control tower with him, so he decided to leave Jamie standing on the platform outside the engine room and instructed him not to move until he came back down again. Ted quickly climbed up the staircase. When he got to the top, he looked out over the steel staircase before he entered the control tower to wave down to Jamie and check he was standing at the spot they had agreed.

When Ted got the important message, he learned that an unscheduled train was going to pass through in less than five minutes time with three hundred people on board. Ted immediately felt sick. He put the phone down knowing that Jamie was standing on the platform outside the engine room. He only hoped that Jamie hadn't gone back into the engine room – it was a really dangerous place to be if the gears were working to let a train cross the bridge. Ted knew it could be fatal for Jamie! He had better check first that he was still on the platform. He looked down from the control tower and he felt his stomach heave. Jamie had moved from the spot where they had both waved to each other, moments earlier. Ted's senses were really pulsing. If he lowered the sides of the bridge to let the train cross the bridge, Jamie could get injured in the engine room. But, if he did not flick the switch to lower the bridge there would be a great train disaster. What was he to do?

Resource N

Tower Bridge, London



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Suggested Additional Resources

Useful websites

Thematic Units (CCEA)

Year 5 - Being and Belonging

Living.Learning.Together. (CCEA)

Year 5:

- **Valuing Self and Others** – Unit 5
- **Making Good Choices** – Unit 7

Year 6:

- **Decisions! Decisions!** – Unit 7

Year 7:

- **Says Who?** – Unit 5
- **New Horizons** – Unit 7

Useful websites

The Think Pack (Thinking Skills and Personal Capabilities)

www.nicurriculum.org.uk

Report of the STEM Review (Northern Ireland), 2009, DE & DEL

www.delni.gov.uk

Useful Contacts

The Institution of Civil Engineers Northern Ireland (ICE NI) conduct a fun learning activity for pupils aged 9-11, 'Bridges to Schools', in local schools throughout N.I.. Civil engineering ambassadors will visit the school and the children participate in bridge construction. Pupils work as a team to build a 14 metre long model cable-stay bridge from aluminium sections and plywood. On completion the pupils will be able to walk across the bridge they have built.

To bring this interactive learning resource to your school, or for further information please contact ICE NI on:

Tel: 028 90877157

Web: www.ice-northernireland.org.uk

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