# Exploring Engineering Challenge:

## Animal Crossing

ROCHESTER BRIDGE TRUST

# About the Rochester Bridge Trust

The first bridge at Rochester was built by the Romans soon after the invasion of Britain in AD43. Once the Romans left, their bridge was maintained by the local people of Kent until the 14th century. In 1381, the River Medway froze solid and, when the thaw came, the ice and floodwater swept away the Roman Bridge.

Two benefactors built a new stone bridge one hundred yards upstream which was opened in September 1391. Their names were Sir John de Cobham and Sir Robert Knolles. Together the benefactors also persuaded their friends and acquaintances to make donations of land and money for the perpetual maintenance of Rochester Bridge. In 1399, King Richard II granted letters patent which allowed the Rochester Bridge Trust to be set up to care for the bridge and its property. Two Wardens were appointed to manage the bridge.

For the next 457 years, the Wardens looked after the medieval bridge. Major improvements were carried out by the civil engineer, Thomas Telford, in 1827. However the increase in road and rail traffic as a result of the industrial revolution meant the stone bridge's days were numbered.

In 1856, the Trust completed a new cast-iron arch bridge on the line of the original Roman Bridge. It was designed by Sir William Cubitt who had been the civil engineer for the Crystal Palace built for the Great Exhibition in 1851. The old medieval bridge was then blown up for the Wardens by the Royal Engineers using gunpowder.

The Victorian Bridge was reconstructed in 1914 as a bowstring truss and is today known as the Old Bridge. A second road bridge, the New Bridge, was opened to traffic in 1970. Between the two road bridges there is the Service Bridge which carries pipes and cables across the river.

The Rochester Bridge Trust is a registered charity and still owns and maintains the two road bridges and the Service Bridge free of charge to the public. The Trust's money is derived from the land and money given by the benefactors in the 14th and 15th centuries. It receives no public money, does not charge tolls and does not raise funds. With any surplus funds, the Trust supports other charitable projects, primarily the preservation of historic buildings and education projects in the field of engineering, particularly civil engineering.

# How to use this book

**This book includes a copy of all of the resources you will need for running the challenge for your learners. The resources are designed for a class of 30-32 learners.**

There are PowerPoints (with explanatory notes) to explain the 'pre tasks', as well as the Challenge itself. The pre tasks are designed to develop the skills and knowledge needed to complete the Challenge. The notes on each slide explain what you would say and the points to draw out of the learners through questioning and hands-on activities.

If you wish to use these as a presentation, they will need to be downloaded as an electronic copy (links are included at relevant points). All downloads are free of charge. Some resources will need to be reproduced for learners to use: you can either photocopy directly from the book, or again, download the PDFs using the links.

**This pack includes:**

1. a document with guidance on how to structure and deliver the tasks for challenge leader(s);
2. an equipment list for the challenge, allowing you to print one list of everything you need, listed in the order of the sessions;
3. the testing base working drawing for making up the test rigs, including a technical drawing and cutting list;
4. the pre tasks on PowerPoint (with notes), broken down into two pre tasks to enable them to be used for shorter twilight sessions. Within an hour, it should be possible to complete one of the pre tasks, with sufficient time for the children to clear up and pack away after;
5. Pre task 1 testing materials handout;
6. 'The Challenge' on PowerPoint (with notes);
7. 'The Challenge' guidance for learners;
8. a sheet of the Rochester Bridge Trust logo for printing. This can be cut up into separate logos;
9. testing notes and a log to help document the results;
10. 'Animal Crossing Challenge' certificate for learners completing the challenge;
11. a risk assessment template with suggested risks for the challenge. (Please note, this is not extensive and each Challenge leader should undertake a full risk assessment for their individual setting.)

# How to use this book

**There are different ways in which you can use this Exploring Engineering Challenge, based on the circumstances in your location. It has been designed to be suitable for 8-11 year olds and could be delivered as:**

- a whole day, with one class in a Primary School, in a classroom or hall;
- two half days, with one class in a Primary School, in a classroom or hall;
- four twilights, with one class in a Primary School, in a classroom or hall (a twilight would tend to be about an hour, however where possible, negotiate slightly more than an hour to allow for arrivals and packing away e.g. 15.15 – 16.30);
- alternatively, you could scale it up to work with many teams or scale it down for use at home or in a club.

### How to use this in your school:

Some schools will recognise the term STEM (Science, Technology, Engineering and Maths) and be keen to have support to enrich their STEM learning. This is a STEM Learning Day and can form part of your enrichment days.

These resources are aimed at children in Key Stage 2 and especially sit within the Year 5 Science Curriculum. You may also want to use it with Year 6 children, after their SATs have been completed.

### National Curriculum Mapping:

This Challenge maps to the National Curriculum Programmes of Study as follows:

**Design & Technology:** the whole concept of the Exploring Engineering Challenge is design process in action. It encourages children to design something, for someone, for a specific purpose.

**KS2 (8-11 year olds):** Design, Make and Technical Knowledge Criteria.

**Maths: KS2 (8-11 year olds):** 'Number and Place Value', 'Addition and Subtraction', 'Measurement', 'Geometry – Properties of Shapes'.

**Science: KS2 (7-11 year olds):** 'Living Things and their Habitats', 'Uses of Everyday Materials', 'Properties and Changes of Materials' and 'Forces'.

### Using the Resource in a Club or at Home:

Of course, this material could be used with a local community group/club, e.g., Guides and Scouts, or home education groups, and families. All you need to do is to adapt the quantities of materials you need.

**And finally... Enjoy this! It's easy to get started, with just one child or class.**

# Resources

1. **Leaders' guidance**

   This document provides guidance on how to structure and deliver the tasks. It is an essential guide and contains the same notes included in the digital PowerPoint presentation. As a challenge leader you can use this as a reference document.

2. **Equipment list**

   This document lists all the materials and tools you need to run this challenge, listed in the order of the sessions, sufficient for one class of 30-32 students, whether structured as a single day, or split into shorter sessions.

3. **Test base working drawing**

   This document includes a Technical drawing with cutting list for making the test rigs.

4. **All pre tasks PowerPoint**

   These slides guide your group through the creative pre tasks. These hands-on pre tasks provide them with vital learning to help them make the most of the challenge. The digital version has notes for your guidance for each slide.

   **Please adapt the colour of the background to suit your projection equipment so it is not too white.**

5. **Pre task 1 testing materials handout**

   A copy of this document is needed for each team so they can log their test results in pre task 1.

6. **The Challenge PowerPoint**

   This PowerPoint guides your group through the actual engineering challenge.

7. **Guidance for learners**

   This guidance for learners can be copied and provided to teams as a reminder of what they need to do and the criteria they are working towards.

8. **Logo samples**

   This document includes multiple copies of the Rochester Bridge Trust logo and can be copied and cut up individually for each team to use in the challenge.

9. **Challenge testing notes**

   These notes offer guidance on carrying out the testing itself.

10. **The test log**

    This document provides a simple way for you to record results from the final whole group challenge.

11. **Certificate**

    This is suitable for each participant and can be presented as part of your results ceremony at the end of the challenge.

12. **Risk assessment template**

    A starting point for the challenge leader(s)' own risk assessment for their setting. Please note, this is not extensive and should only be used as guidance.

**All of the above documents can be downloaded here: http://www.rochesterbridgetrust.org.uk/exploring-engineering/exploring-engineering-challenges/the-animal-crossing/**

# Leaders' guidance

1. **Introduction**

   What is Civil Engineering? How does it make a difference (including Civil Engineering roles)? How engineers design and model things that help balance forces.

2. **Pre task 1**

   Explore the properties of different materials and consider how materials can be strengthened.

3. **Pre task 2**

   Explore how to effectively join materials while considering how to make them stronger, bearing in mind the forces at work around them.

4. **Challenge**

   Apply everything discovered so far to design and model an animal crossing, which will span a 40cm-wide path (4 metres in real life) and be at least 20cm (2 metres in real life) above the path for adults and children to walk underneath.

Most of the guidance you need can be found on the notes section under each PowerPoint slide, which can be printed, or used with 'presenter view' when displaying the slideshow.

## Introduction to Civil Engineering

There are many different types of engineers. In this challenge, learners are going to explore a range of engineering roles, including civil engineers. Very often, people are not aware of civil engineers, and don't understand what they do, but their work is all around us. Civil engineers design the BIG things that make our lives easier. They design water treatment plants, so that we can flush the toilet and get washed in the morning. They design roads but not cars, harbours but not boats, airports but not planes, stations but not trains. They build the big stuff that makes our lives flow more easily.

Whilst designing these large one-off structures, teams of different engineers must work together and this is what you are going to be doing today. But, what does it mean to work in a team? What different types of engineers might work together in a team to design something like an airport, bridge or rollercoaster? What do you think each type of engineer does within the team?

**Civil Engineers** - choose the best designs for the job, they call this design 'fit for purpose';

**Structural Engineers** – work out how the shapes of materials might fit together, to look right and fit together properly;

**Materials Engineer** – work out what types of materials to use and whether they are strong, flexible, rigid or soft enough; and

**Value Engineer** - work out how to make the design better value for money. For example, if builders use 1mm less concrete all over a structure, will it save money? But, they also have to make sure if they less concrete, that the design is still safe.

Civil Engineers have an important job to do to make our lives flow more easily. One of the things they have to think about when designing big things are the forces which will affect their designs. They have to balance the forces and consider the loads that must be supported by the structure. Without doing so, structures could fail and not be fit for purpose.

When designing a structure, the mass of the structure itself is called the 'Dead Load'. Ask students "What could affect the size of this load?" The amount of material in it, the design, the material that it is made from. "What is the impact of having a large Dead Load?" Too many materials = cost, time to build; impacts the remaining amount of load the structure can support.

"What do you think we mean by 'Live Load'?" This is a combination of the users of the structure, for example, vehicles and/or pedestrians crossing a bridge, as well as environmental factors, such as wind, or even snow. "When engineers design large structures, they must think about not just the size of the Live Load, but also the fact that it is moving – what is the impact of the load moving across a bridge?" Encourage students to think about the position of the load and the effect this might have.

Two effects of forces which engineers have to think about are tension and compression. Tension is a stretching force and compression results from two forces opposing each other, creating a squashing effect. If the pulling force/tension is greater in one direction than another, the forces aren't balanced and the structure will pull in that direction, which may lead to collapse. To stay up forces need to be equal/balanced. The same for compression, the pushing force on each side needs to be balanced to keep it upright and not fall over. In the presentation, there is a demonstration of tension and compression involving participation from the learners. You could invite learners to try this, just make sure they know they are not trying to make each other fall over, they are trying to balance and also clear the area so they can't knock into anything if they do fall.

# Leaders' guidance

## Pre-Tasks Guidance

### Pre task 1 – Properties of Materials

Different materials have unique properties – "properties" means "what something is like or what it can do". The properties that a material has can make it good for a particular function or job.

For example, a toilet roll is quite strong in compression if you hold it vertically and push it from above, but if you lay it horizontally and push from above it squashes really easily. So, it is strong in compression one way, but not another.

String, in comparison, is wobbly and floppy and doesn't have high compressive strength (it can be squashed easily). However, if pulled tight, it has very high 'tensile' strength.

Therefore, the materials which we select for a particular function will depend on the properties we need them to have.

Each team will have a pack of materials and a table so that they can write down testing results. Ask learners "Why do we write down the findings from our testing?" Answers could include – so we don't forget what we found out, so we can share our findings with others, even others in another country.

Ask teams to select one member who is good at writing, who can scribe for the team, and then instruct them to take each of the materials one by one, stretch them and squash them and see how they work in tension and compression. Ask them to consider if is there another way to use them that will make them stronger? What if you change the direction you are holding them in, or if you fold or change their shape?

### Pre task 2 – Learning to Join Materials

Structural Engineers have to think about how they will shape and structure materials, including how they will join them together.

The main focus here is helping the learners experiment with joining materials together using cable ties, string, elastic bands and double sided tape, whilst making a tower. The experimentation is more important than the outcome. This is especially important if those you are working with have not had much experience of making and junk-modelling.

Do demonstrate how to use double sided tape by joining materials together inside a join rather than around the outside. It is unlikely the learners will have had the opportunity to use double sided tape before.

Encourage learners to make predictions about their experimentation and to evaluate their findings, within the teams and between groups.

### Top Tips for learners

Encourage learners to recognise certain structural features that might be relevant to their designs. For example;

- Cables to help stabilise larger structures;
- Wide bases of piers and pylons;
- Secure foundations;
- Triangular structures

When a bridge is needed across a very short span, it can be possible to just use a Beam Bridge. As the span gets longer, engineers can add piers in the water or on the road to support the beam. If the beam has to be very strong, say for a lot of cars or trains, then triangular supports can be added above or below the beam and these can help distribute the forces across the whole length of the bridge and on to the land on either side. These triangular structures are called trusses and we call this a 'Truss Bridge'.

Suspension Bridges look very dramatic and are needed to span the widest distances. However, they can be difficult and expensive. The very long cable which goes across the top of the bridge is held down tight (in tension) on either side of the bridge into huge anchors. Cable Stayed bridges are more common because they are cheaper to construct than Suspension Bridges but can still span long distances. The cables are in tension, pulling up the deck of the bridge, to attach each cable to the top of the pylons.

## Challenge Guidance

### Introducing the Challenge

1) In the room, you will need to ensure that:
   a) each team has a table or work space in which to complete the challenge
   b) testing areas at the front of the room, accessible for learners to use as a resource during their construction phase, as well as for the testing phase
   c) if possible, a cutting mat and Stanley knife will be accessible to learners, but (age dependent) an adult will need to use the knife to cut materials to size
2) each team should be provided a copy of the Challenge guidance for learners on their tables
3) explain the following Health & Safety rules:
   i) do not run in the room;
   ii) to pick things up off the floor that people might slip on;
   iii) to tie back long hair;
   iv) hold scissors safely and instruct them not walk around the room with them.

# Leaders' guidance

### Using Test Bases

Explain that the learners are allowed to come up in teams to explore and measure the test base, but only a few minutes at a time. NB: if they don't have a whole test base each, then it is easier to ration the time and it is also easier to ensure they design something that is fitted not fixed.

### Questions from Learners

When the learners ask for help, you can prompt them with things they have learned in the pre tasks, or refer to their guidance sheets on their tables.

### Structuring the Challenge Time

The groups are likely to need a reminder every 10-15 mins what they should be doing to keep them on task. This can include reminding them about:

- comparing ideas and combining the best parts of each person's design into a final design;
- having everyone involved, if you don't have a job to do you can be designing the decoration as points are awarded for this during testing;
- remind them how much time they have left;
- give them a last 5 minutes warning at the end;

At the end, tools are to be put down and tidied away into packs, scraps to be put in the bin and, finally, to sit down ready for testing.

**Make sure you leave 40 minutes for testing and awarding certificates and prizes.**

### Context:

You are members of a team of environmental civil engineers working for Rochester Bridge Trust. You have been asked to design and model an animal crossing over a busy pathway in an animal sanctuary. Your crossing will need to be wide enough for red squirrels to cross from one side of the path to the other to collect food. It must be high enough to allow adults and children to walk under it.

### Brief:

Your Challenge is to design, scale model and test an animal crossing which will span a 40cm wide path (4 metres in real life) and be at least 20cm (2 metres in real life) above the path for adults and children to walk underneath.

### Specification:

1. The crossing must be fitted to the test rig on either side – fitted not fixed.
2. The model crossing must span the 40cm wide path and be at least 20cm above the model path.
3. The crossing must allow people to pass under the crossing whilst the squirrels move freely from the ground up onto the crossing and down the other side.
4. The crossing must be suitable for outside conditions including wind, rain and snow.
5. The crossing must look like it fits into the animal sanctuary environment and include a sponsor badge for Rochester Bridge Trust.

### A simple portfolio must be produced as part of your design and planning and should include:

1. All labelled drawings.
2. Notes on how your team is being organised.
3. Notes/labels on how ideas were thought of and developed.
4. Notes about the challenges you have overcome.
5. Reasons for choosing the final design.

### Plenary of the Learning

The beginning and end of the event will be most memorable to learners, so do help them to summarise what they have learnt today.

A certificate has been included within this book: this is suitable for each participant and can be presented as part of your results ceremony at the end of the challenge. The participants will be very excited by simple prizes like lollies or erasers.

# Equipment list

## Listed below is everything you will need for one group of 32. Please adjust the list according to the group you are working with.

**For each session:**

- Class set of "Civil Engineers Make My Day" postcards (available from Rochester Bridge Trust, request the quantity you need from: education@rbt.org.uk);
- a room with tables, chairs etc;
- AV equipment for presentation and presentation on USB stick, extension lead;
- a risk assessment for the space and learners in your setting.

**Pre Task 1: Testing Materials**

- Ball of string and a toilet roll inner tube;
- a class set of packs of these materials in a poly pocket (for 32 learners, this would equate to 8 packs), contents should be:

| Materials | For each team pack | For a class of 8 packs |
|---|---|---|
| Poly pocket | 1 | 8 |
| Rubber bands | 1 | 8 |
| String | 20cm length | 1.6m length |
| Paper | 1 A5 sheet (A4 cut in half) | 4 A4 sheets cut in half |
| Sheet card | 1 A5 sheet (A4 cut in half) | 4 A4 sheets cut in half |
| Candy floss sticks | 2 | 16 |
| Handout 'Pre Task 1 - Testing Materials' | 1 | 8 |

**Pre Task 2: Joining Materials**

Pack of joining materials for each team in a poly pocket:

| Materials | For each team pack | For a class of 8 packs |
|---|---|---|
| Poly pocket | 1 | 8 |
| Rubber bands | 2 | 16 |
| String | 20cm length | 1.6m length |
| Glue stick | 1 | 8 |
| Small cable ties | 4 | 32 |
| Hole punch | 1 | 8 |
| Clothes pegs/bulldog clips | 2 | 16 |

**Optional: Visual aid of Beam and Truss Bridges – e.g. K'nex Beam Bridge and Truss Bridge.**

# Equipment list

**The Challenge:**

- A hall or large room, with tables set up for 8 team areas;
- AV presentation equipment;
- The Challenge guidance for learners, one per team

**Team set of tools:**

- pencils;
- rulers;
- scissors;
- felt tip pens or pencils;
- strong glue stick / UHU glue;
- paper stapler and staples;
- paper hole punch;
- 6 plastic sprung clothes pegs or bulldog clips;
- sticky tape pack in dispenser/small reel;
- a highlighter (for highlighting instructions that are important).

**Team set of materials (for 32 learners in teams of 4, this equates to 8 sets):**

| Item | Detail | Quantity/team | Quantity/ class |
|---|---|---|---|
| Paper for designing | A4 | 4 | 32 |
| Kebab stick | Approx. 3mm dia. x 200mm | 4 | 32 |
| Candy floss sticks | Approx. 3.5 x 3.5mm x 280cm | 4 | 32 |
| White string | 2m length | 1 | 8 |
| Elastic bands | 63 x 1.5 mm (No.16) | 4 | 32 |
| A4 card | 200gsm A4 | 2 | 16 |
| Paper clips | 30mm | 4 | 32 |
| Garden netting | 500x500mm square sheet | 1 | 8 |
| Cable ties | Small cable ties | 6 | 44 |
| RBT logo samples.doc | Different sizes | 2 logos | 1 sheet cut up |
| Paper | A3 | 1 | 8 |

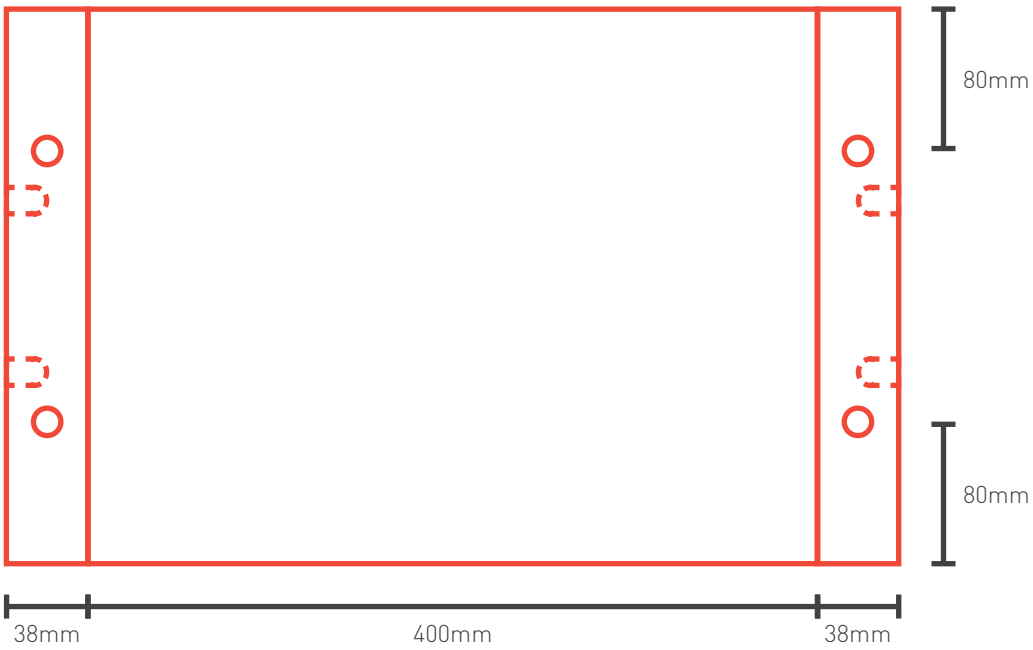
**Equipment for testing:**

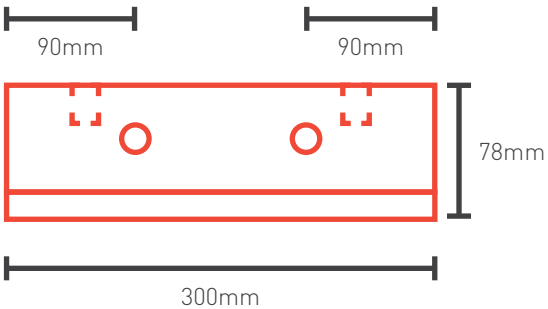
- At least 4 test rigs;
- a fan/hairdryer (for the wind test, to simulate wind);
- an extension lead;
- a doll (20cm high is shorter than Barbie);
- pompom squirrels or similar small soft toys (to actually test the squirrels crossing and waiting on the crossing);
- a copy of the Challenge test log; pen;
- prizes.

# Test base working drawing

**Cutting list for each part in mm:**

| Material | No. of | Length | Width | Depth |
|---|---|---|---|---|
| White furniture board | 1 | 476 | 30 | 15 |
| Wood lengths | 2 | 300 | 63 | 38 |




**Drill holes:** 4mm diameter, depth of 20mm

Holes in the top, drilled 90 degrees (see dashed lines)

Holes in the sides, drilled at 45 degree (see dashed lines)

Wooden lengths, countersunk, screwed onto the white board bases.

# Animal Crossing pre task slides

## Exploring Engineering Challenge

Today you are going to be Engineers!

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## Civil Engineers – Make My Day!

| Civil Engineers design: | But not these: |
|---|---|
| Stations | Trains, signals or tracks |
| Roads, tunnels and bridges | Cars, lorries or bikes |
| Airports | Planes |
| Water treatment plants | Taps/toilets |
| Harbours | Boats |
| Flats and large structures | Houses |

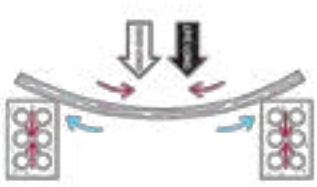
# Animal Crossing pre task slides

## Team Roles for Engineers

Science, design, maths, teamwork, creativity, geography and problem-solving, working together:

**Architect** – how the new design will look
**Structural Engineer** – how it will be made
**Materials Engineer** – what it will be made from
**Value Engineer** – which design is best value, based on criteria

## Issues for Engineers - Forces and Loads



Forces in a beam bridge

Image: BalfourBeatty/Connect Plus

# Animal Crossing pre task slides

## Tension and Compression

**Tension**
Stretching Force

**Compression**
Squashing Force

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**Pre Task 1:**

## Material Engineers, are you ready?

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# Animal Crossing pre task slides

## Test, like Material Engineers

| Material: | How well does it cope with a Compression Force? | How well does it cope with a Tension Force? | How might we make it stronger? |
|---|---|---|---|
| Rubber bands | | | |
| String | | | |
| Paper | | | |
| Sheet card | | | |
| Candy floss stick | | | |

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**Pre Task 2:**

## Structural Engineers

How might we join these materials together?

Which tools might we need?

Which joining methods might we need to use?

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# Animal Crossing pre task slides

## Think, like Engineers - Prediction

1. What do you think will happen?
2. Test and see what happens.
3. Was your prediction right?

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## Evaluate, like Engineers

What surprised you?

What do you now know that you didn't before this session?

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# Animal Crossing pre task slides

## Work together, like Engineers

Get together with another team and compare findings

## Certain shapes, cables, deep foundations and anchors all help structures stay more stable.

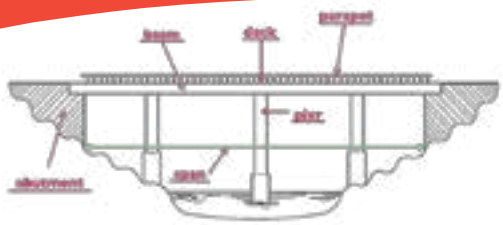
https://www.outdoormegastore.co.uk/outwell-tennessee-6-tent.html

https://www.geograph.org.uk/photo/163258

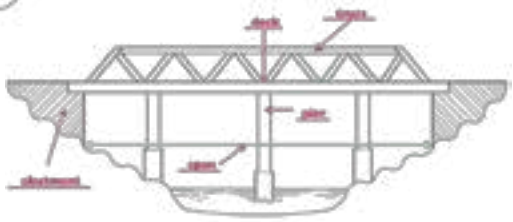
https://jonpeters.com/how-to-make-build-a-clothesline/

# Animal Crossing pre task slides

## Beam and Truss Bridges



https://www.pbs.org/wgbh/nova/tech/build-bridge-p3.html



ROCHESTER BRIDGE TRUST

## Suspension and Cable Stay Bridges

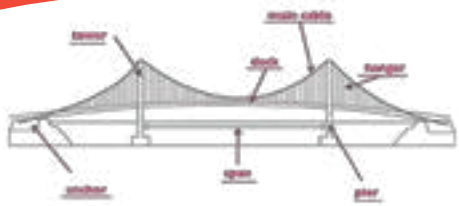


Image: BalfourBeatty/Connect Plus

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# Testing materials

| Material | How well does it cope with a Compression force? | How well does it cope with a Tension force? | How could we make it stronger? |
|---|---|---|---|
| Rubber bands | | | |
| String | | | |
| Paper | | | |
| Sheet card | | | |
| Candy floss stick | | | |

# Animal Crossing Challenge slides

**Animal Crossing Exploring Engineering Challenge**

Are you ready?

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## Context

You are members of a team of **environmental civil engineers** working for Rochester Bridge Trust.

You have been asked to **design and model** an animal crossing, over a busy pathway in an animal sanctuary.

Your crossing will need to be wide enough for red squirrels to cross from one side of the path to the other to collect food. It must be high enough to allow adults and children to walk under it.

ROCHESTER BRIDGE TRUST

# Animal Crossing Challenge slides

## Brief

Your Challenge is to design a scale model and test an animal crossing which will span a 40cm-wide path (4 metres in real life) and be at least 20cm (2 metres in real life) above the path for adults and children to walk underneath.

ROCHESTER BRIDGE TRUST

## Specification

1. The crossing must be fitted to the test rig on either side – fitted not fixed.
2. The model crossing must span the 40cm wide path and be at least 20cm above the model path.
3. The crossing must allow people to pass under the crossing whilst the squirrels move freely from the ground up on to the crossing and down the other side.
4. The crossing must be suitable for outside conditions, including wind, rain and snow.
5. The crossing must look like it fits into the animal sanctuary environment and include a sponsor badge for Rochester Bridge Trust.

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# Animal Crossing Challenge slides

## Testing Base

The simple base has vertical holes on the top of the abutments and angled holes on the sides.

Which of your materials might fit in these to create your structure?

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## Materials and Tools

- You are only allowed to use the tools and materials provided.
- You do not have to use all the materials supplied.
- You can cover your tables with newspaper to protect them.
- All cutting, and gluing must be done with great care to keep you safe.

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# Animal Crossing Challenge slides

## Materials and Tools

| MATERIALS: | TOOLS: |
|---|---|
| Wooden dowels/kebab sticks | Pencils and rulers |
| Candy floss sticks | Scissors |
| White string | Coloured pens/pencils |
| Elastic bands | 5 sheets A4 paper for the portfolio. |
| A4 card | Strong glue stick |
| Paper clips | Paper stapler and staples |
| Garden netting | Paper hole punch |
| Cable ties | 6 bulldog clips |
| RBT sponsor logo | Sticky tape |
| Paper | A highlighter |

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## Your portfolio must include:

All labelled drawings.

Notes on how your team is being organised.

Notes/labels on how ideas were thought of and developed.

Notes about the challenges you have overcome.

Reasons for choosing the final design.

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# Animal Crossing Challenge slides

## Timings for this challenge

**10 mins** Introduction to the Task and Testing Criteria

**20 mins** Planning and drawing/ labelling, at least one design each

**50 mins** Modelling

**30 mins** Testing

**10 mins** Prizes and Certificates

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**The Challenge is designed to be fun!**

**Enjoy the Challenge...**

**Enjoy the team work ☺**

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# Animal Crossing Challenge slides

## 5 MINUTES LEFT!

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## TOOLS DOWN!

### Time to pack away

- All scrap and rubbish in the bin.
- Clear away rubbish on the floor, too.
- Spare materials and tools go into your packs in the middle of your table.
- Sit down ready for testing.

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# Animal Crossing Challenge slides

## Testing (0,1 or 2 points for each criteria)

1. Does the crossing fit to the test rig on either side?
2. Does the crossing span the 40cm path?
3. Is the crossing at least 20cm above the model path?
4. Does the crossing allow people to pass under the crossing whilst the squirrels move across from one side to the other?
5. Does the crossing cope with wind?
6. Does the crossing look like it fits into the animal sanctuary environment and include a sponsor badge for Rochester Bridge Trust?

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Animal Crossing Exploring Engineering Challenge

**THE RESULTS!**

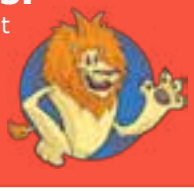
Are you ready?

# Animal Crossing Challenge slides

Animal Crossing Exploring Engineering Challenge

**Today you were Engineers!**

Keep asking questions like why, how, what and you can be like Engineers everyday!



# Guidance for learners

## Remember the pre tasks at the start of this Challenge, and you can look back at these notes to remind you.

**Materials:**

- You have a pack of materials for making your crossing model.
- Do not use any other materials.
- You do not need to use all the materials supplied.

**Tools:**

- You are only allowed to use the tools provided.
- You can cover your tables with newspaper to protect them.
- All cutting and gluing must be done with safety in mind.

**Challenge Materials/Tools List for All Teams**

Please check that you have the following materials on your table and report any shortages to your challenge leader.

| Item | Detail | Quantity/team |
|---|---|---|
| Paper for designing | A4 | 4 |
| Kebab stick (cut off sharp ends with scissors) | Approx. 3mm dia. x 200mm | 4 |
| Candy floss sticks | Approx. 3.5x3.5mmx280cm | 4 |
| White string | 2m length | 1 |
| Elastic bands | 63 x 1.5 mm (No.16) | 4 |
| A4 card | 200gsm A4 | 2 |
| Paper clips | 30mm | 4 |
| Garden netting | 500x500mm square sheet | 1 |
| Cable ties | Small cable ties | 6 |
| RBT sponsor logo (provided for printing) | Different sizes | 2 |
| Paper | A3 | 1 |

**Tool List**

- 2 pencils and 2 rulers;
- 1 pair of paper scissors;
- 4 Felt tip pens, various colours;
- Strong Pritt stick / UHU glue;
- Paper stapler and staples;
- Paper hole punch;
- 6 plastic sprung clothes pegs or bulldog clips;
- Sellotape pack in dispenser/small reel;
- Highlighter (for highlighting the instructions that are important).

# Guidance for learners

**Context:**

You are members of a team of Environmental Civil Engineers working for Rochester Bridge Trust. You have been asked to design and model an animal crossing over a busy pathway in an animal sanctuary. Your crossing will need to be wide enough for red squirrels to cross from one side of the path to the other to collect food. It must be high enough to allow adults and children to walk under it.

**Brief:**

Your Challenge is to design, scale model and test an animal crossing which will span a 40cm wide path (4 metres in real life) and be at least 20cm (2 metres in real life) above the path for adults and children to walk underneath.

**Specification:**

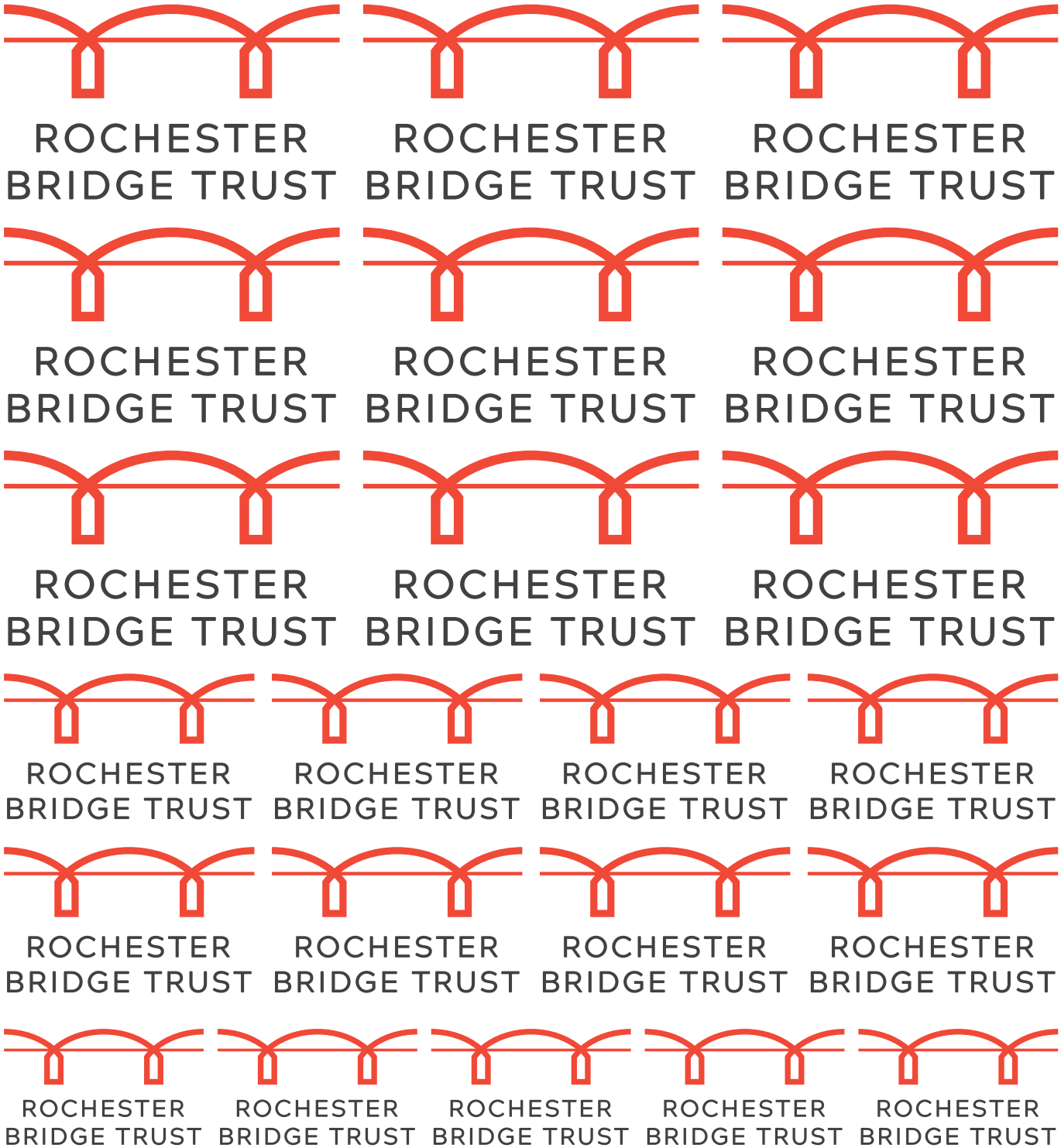
1. The crossing must be fitted to the test rig on either side – fitted not fixed.
2. The model crossing must span the 40cm wide path and be at least 20cm above the model path.
3. The crossing must allow people to pass under the crossing whilst the squirrels move freely from the ground up onto the crossing and down the other side.
4. The crossing must be suitable for outside conditions including wind, rain and snow.
5. The crossing must look like it fits into the animal sanctuary environment and include a sponsor badge for Rochester Bridge Trust.

**A simple portfolio must be produced as part of your design and planning and should include:**

1. All labelled drawings.
2. Notes on how your team is being organised.
3. Notes/labels on how ideas were thought of and developed.
4. Notes about the challenges you have overcome.
5. Reasons for choosing the final design.

**The day is designed to be fun! Enjoy the challenge and the teamwork.**

# Rochester Bridge Trust logo samples



# Testing notes

## The test log provides you with the six tests and space to log results for each team.

**Each test is worth 0, 1 or 2 points:**
**0 = doesn't do this**
**1 = does this somewhat or just about**
**2 = yes, does this.**

NB: for most of the tests, it will be obvious if the criterion has been met. We are trying to give points to the teams rather than trying to penalise them during each test.

Most tests are visual tests against the criteria: does the bridge fit the rig, thus spanning 40cm? Does a doll that is 20cm tall fit under the bridge, or does it sit at 20cm against a ruler?

If you can, use some pompom squirrels or little soft toys to add to the top of the model. This might make it sag and then the crossing might not allow a 20cm clearance anymore.

Use a fan or hairdryer with some squirrels on top. Do the model and the squirrels hold up to the wind?

The final specification requires camouflage or decoration to be added to make it fit into a natural environment: this will be down to the judges' discretion.

**Testing Criteria:**

Our tests are based on the Specification provided at the start of the Challenge:

1. The crossing must be fitted to the test rig on either side – fitted not fixed.
2. The model crossing must span the 40cm wide path and be at least 20cm above the model path.
3. The crossing must allow people to pass under the crossing whilst the squirrels move freely from the ground up onto the crossing and down the other side.
4. The crossing must be suitable for outside conditions including wind, rain and snow.
5. The crossing must look like it fits into the animal sanctuary environment and include a sponsor badge for Rochester Bridge Trust.

# Test log for whole group

**No = 0  Somewhat = 1  Yes = 2 points**

| **Team names:** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. Does the crossing fit to the test rig on either side? | | | | | | | | |
| 2. Does the crossing span the 40cm path? | | | | | | | | |
| 3. Is the crossing at least 20cm above the model path? | | | | | | | | |
| 4. Does the crossing allow people to pass under the crossing whilst the squirrels move across from one side to the other? | | | | | | | | |
| 5. Does the crossing cope with wind? | | | | | | | | |
| 6. Does the crossing look like it fits into the animal sanctuary environment and include a sponsor badge for Rochester Bridge Trust? | | | | | | | | |
| Total/12 | | | | | | | | |

# Certificate

## CERTIFICATE

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This is to certify that _____

worked hard taking the first steps to become a
Civil Engineer
Congratulations and well done

# Risk assessment

**Activity:** Exploring Engineering Challenge – Animal Crossing **Date written:** September 2019

**Brief overview of activity:** Designing and Construction of an animal crossing using small craft materials and tools – FOR INFORMATION ONLY

| Potential hazards? | Who might be harmed and how? | Level of risk (low/ medium/ high) | What will be done to manage this risk? | Action by whom? | Action by when? | New risk | Action plan for untoward occurences |
|---|---|---|---|---|---|---|---|
| Physical activities | Individuals – falls during pushing / pulling activity | Medium | Choose individuals of equal size.<br>Clear demonstration area so no sharp edges.<br>Clear safety instructions to individuals involved. | | | Low | Administer first-aid / call for emergency medical assistance as required |
| Craft activities | Learners – splinters & cuts from broken wood; cuts from using sharp implements. | Medium | Safety instructions and supervision.<br>n.b. no carrying sharp implements around the room | | | Low | Administer first-aid / call for emergency medical assistance as required |
| Movement around space | Falls, slips, trips. | Medium | Safety instructions – walk don't run; pick up anything which falls on the floor; no carrying sharp implements around the room.<br>Tuck chairs & bags under tables during making activities.<br>Clear items which have fallen onto the floor asap. | | | Low | Administer first-aid / call for emergency medical assistance as required |

**Please note: this risk assessment sample is to be used as information only. You must ensure that you carry out your own full risk assessment for your particular setting and participants.**

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