ice
Institution of Civil Engineers

Civil Engineering

Girlguiding London and South East England

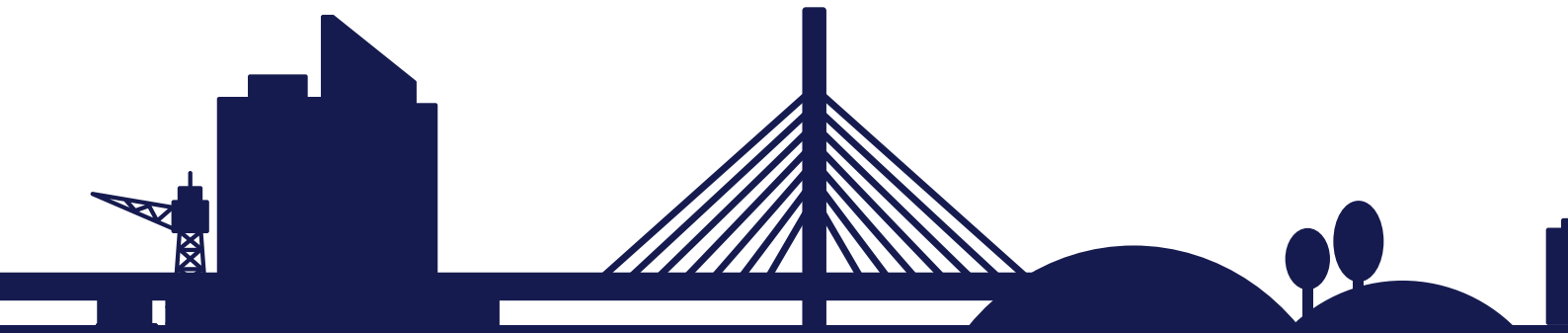
# Civil engineering challenge

## For Guides & Rangers

Girlguiding
London and
South East England

# Contents





# Introduction

**Welcome to the Civil Engineering Challenge Pack! Within this pack, you have the opportunity to select from eight activities.**

**To earn the Civil Engineering badge, participants must successfully complete a minimum of 2 activities over at least 2 unit meetings.**

Each activity is introduced by a real Civil Engineer, this can be read out to the participants before the activity. The activity aim also provides some background information that might be useful for the participants.

If you would like to invite an ICE STEM Ambassador to come to the meeting place to speak to the participants or run one of the challenges, then please fill out this form **https://bit.ly/ICE-meet-STEM-ambassador** We will do our best to find a volunteer but this will always be subject to availability.

In addition to gaining knowledge about the career, participants will have the chance to explore their local area and identify instances of civil engineering.

The Institution of Civil Engineers is dedicated to inspiring the next generation of civil engineers. Through this challenge pack, participants will gain valuable insights into the exciting world of civil engineering and discover what a career in this field truly entails.

Once you have completed the challenge follow this link to the feedback survey: **www.surveymonkey.co.uk/r/9FDJP5V**

To order your civil engineering badges please visit this link: **https://girlguiding-laser.myshopify.com/collections/partnership-challenges**

# Outline of activities

## 1. Bridge building challenge

The move to more sustainable, active forms of travel can mean that we need new civil engineering infrastructure like bridges for our pedestrian and wheeled travel. In this activity, the challenge is to build a bridge, using the materials given, to span a set distance (500mm) and carry a specified load.

**Duration: 30 – 45 minutes**

## 2. Communication challenge

Civil engineers use tools like AI to help optimize their designs, improve project times and costs, and analyse big data. However, AI is only as good as it's data, so we need to make sure that whatever tool we use, we are communicating as accurately as we can. In this activity, the challenge is to communicate a design from one end of the room to the other, so that the builder is given enough information to build it correctly even if they have not seen the original object.

**Duration: 30 - 45 minutes**

## 3. Jelly geotechnics challenge/Flour tower challenge

Ground improvements can reduce the need for deep foundations, saving carbon and improving the sustainability of projects whilst helping ensure they are resilient to the effects of climate change. In this activity, working in small groups, participants are challenged to build the tallest tower they can on jelly (representing unstable ground conditions). The participants are expected to initially try building with only the building blocks to see what happens (it falls over!). They can try different designs but tell them it has to be as tall as possible.

**Duration: 15 minutes**

## 4. Water distribution challenge

Climate change means more severe weather events around the world and civil engineers can be called upon to help when there has been damage to the infrastructure that people need to survive, often affecting our most vulnerable communities. In this activity a hurricane has hit the country of Honduras in Central America. The participants are now part of the Emergency Response Engineering team sent out to restore essential infrastructure to local communities.

Each team must design and build a water distribution system that will allow water to flow from the clean water source (at bucket 1) to a local village (at bucket 2) using only the materials provided.

**Duration: 45 minutes**

## 5. Shelter building challenge

Civil engineers need be able to adapt to a situation and use the resources available rather than those they would really like to have. The hurricane has passed and destroyed most of the houses in the town. It will soon be dark and more rain is expected tonight, so the teams must build a shelter. As materials are scarce they have become very expensive; they must try to build their shelter as cheaply as possible, using the materials available to them.

**Duration: 30 minutes**

## 6. Water use activity

Water is a precious resource and conserving its use calls for civil engineers to develop innovative solutions but we can all play our part. This activity is to get us thinking about what we use water for each day and how much we use.

**Duration: 10 minutes**

## 7. Railway route activity

One of the ways that we can move to more sustainable travel is to make better use of our railways. When planning new transport routes, civil engineers need to take into account everyone affected and try to find the best compromise. In this activity, participants have to plan a railway track layout minimising the cost (both financial and environmental) and passenger journey times.

**Duration: 30 minutes**

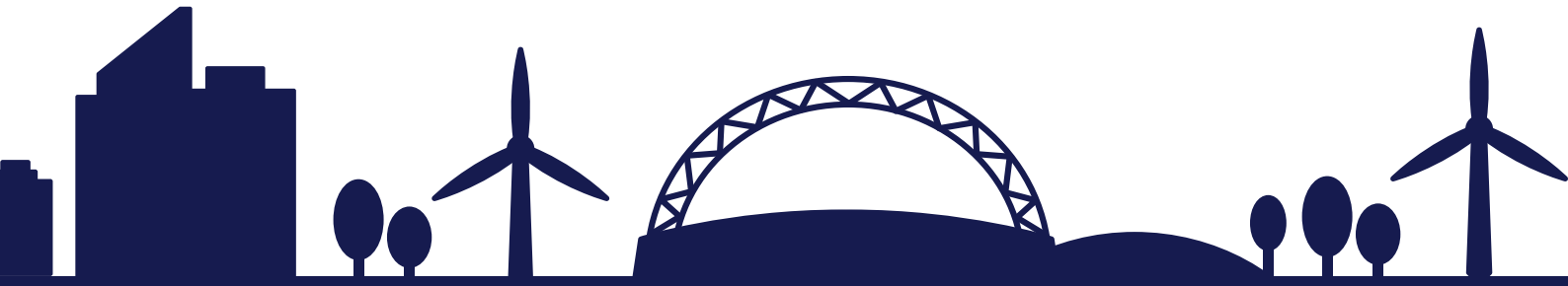
## 8. Out and about: Civil Engineering in your community challenge

Civil engineering infrastructure is all about helping our communities to stay safe and connected. In this activity Guides/Rangers explore the community surrounding their meeting place. How many bridges can they identify? Do they go over or under them? If none of them existed, could they still travel to all the places they wanted to in a typical day? If they could design a new bridge linking two places, where would they choose?

**Duration: 45 – 60 minutes**

## Talk with a Civil Engineer Activity Aim

It may be possible to arrange for an ICE STEM Ambassador to come to the meeting place to speak to the girls. They could possibly also run one or more of the activities in this resource.



# Bridge building challenge


## Introduction

**by civil engineer**

Hi, I'm, Sandhya, I work for Tony Gee and Partners as a Design Engineer. Civil engineering affects all of our built environment - since I started working, I've undertaken design work on railways, bridges, buildings, highways, drainage, and structure demolitions. Though I have a lot of variety in my work, there are some fundamentals that I need to consider in any project I undertake. It's important to gather as much information as you can before the design begins e.g. what do we know of the soil layers on site? We need to consider the impact that engineering works will have on the natural environment too. It's also important to think about how works will affect people, those who use the final project and those who are affected by construction works. As you undertake this bridge building activity, try to have a think about, where you would build it? Who will it affect? How can you reduce pollution and waste during the build if you make it in real life?

## Duration

30 to 45 minutes

## Activity aim

The move to more sustainable, active forms of travel can mean that we need new civil engineering infrastructure like bridges for our pedestrian and wheeled travel. In this activity, the challenge is to build a bridge, using the materials given, to span a set distance (500mm) and carry a specified load.

## Equipment required

You can use either material, depending on what you have available. The scrap paper/ newspaper version will take longer and need a bit more skill to manufacture the components, whereas the straws are a bit easier and quicker to work with but may need you to buy them.

Per group:

- The same number of straws (avoids arguments)
- Scissors
- Masking tape

**or**

- The same number of sheets of paper (newspaper works well)
- Scissors
- Masking tape

Both paper bridges and straw bridges can be recycled at the end of the activity.

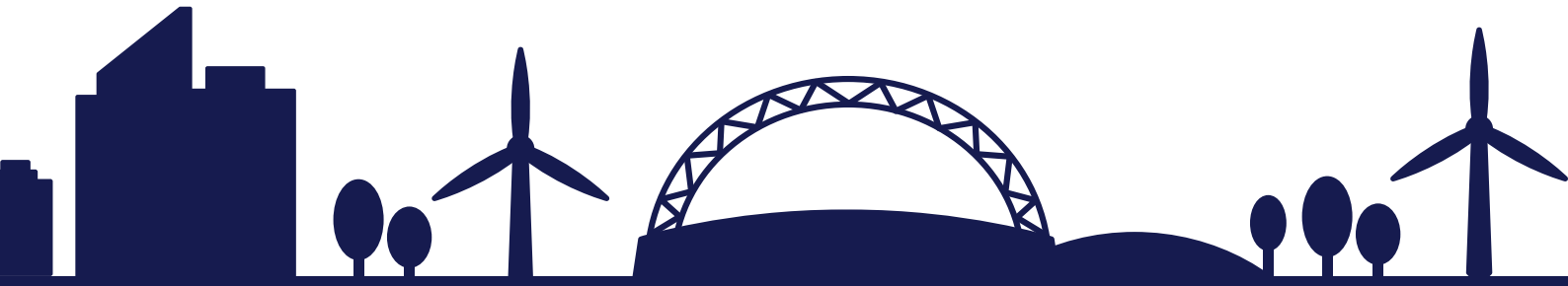
## Method

The participants should work in small teams (ideally around 4 or 5 per team).

Explain some background about bridge building (refer to the STEM Ambassador introduction).

Give the groups a set time to build their bridge and let them know how far it has to span (we suggest 500mm) and what load it has to carry (a toy test vehicle or a maximum weight which can be done with coins, etc,).

You can declare a winner if you want to make it competitive – e.g. the bridge that holds the heaviest load or the one that uses the least material.



# Alternative bridge building challenge


## Introduction

**by structural engineer**

I work for Fairhurst in Inverness as a Graduate Structural Engineer. I design lots of public buildings such as houses, schools and industrial facilities along with taking an interest in the conservation of historic buildings. In each of my projects I need to consider who is going to be using them, how the use will affect the loads that are applied to the structure and the suitability of materials. While living in the North of Scotland the weather is always a major factor in design and material choice, therefore, I take time to ensure that the most economical and best suiting materials are chosen for a project knowing that the appearance and cost of the structure is very important to the user.

## Duration

30 to 45 minutes

## Activity aim

Civil engineers are investigating the use of novel materials like plant based polymers and bacteria produced concrete to reduce the environmental impact of structures. This activity uses a “different” building material to construct a bridge to span a set distance (200mm).

## Equipment required

Per group:

- Approximately 16 long thin chocolate bars – Twirls are ideal
- A ruler
- A glass bottle with a tightly fitting lid
- Kettle filled with hot (not boiling) water

For testing the bridges:

- 1-2 small yoghurt pots (the kind you get Petit Filous or Munch Bunch in are ideal)
- Lots of 1p or 2p coins or a mix, or other small heavy weights like pebbles
- Several short lengths of string (15-20cm approximately)

## Method

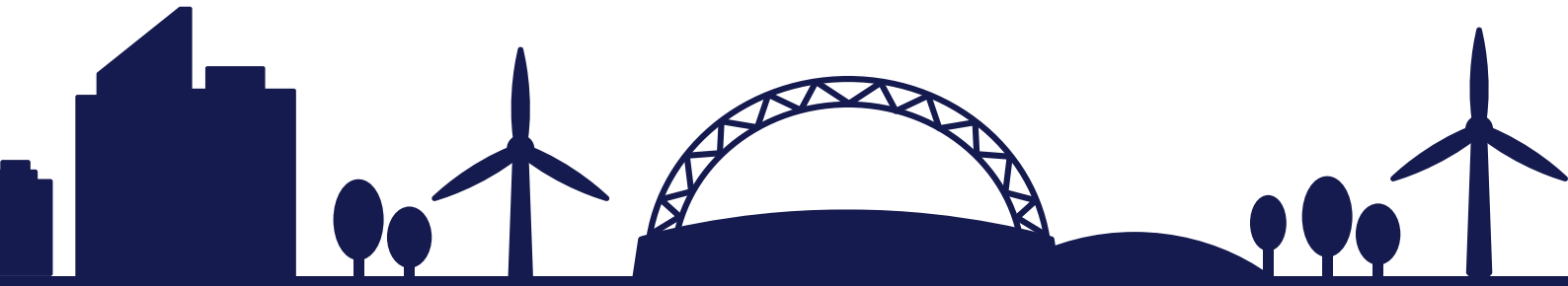
The participants need to build their bridge using the chocolate bars. This will require joining them - fill a glass bottle with hot water (NOT BOILING) and press the end of two chocolate bars against the glass. Wait for the chocolate to start to melt. Once this has happened you can attach them together and leave to set hard for a few minutes. Continue to build the bridge in this way.

Top tip: create your bridge in sections rather than trying to add single bars to the main structure in one go – this will mean you can let many smaller sections set properly before assembling them into the finished bridge. Use this process to build a bridge to span 200mm.

## Testing

Raise up your bridge (after checking the chocolate 'welding' has set firmly) across a 200mm gap. You can use two upturned items like books or shoeboxes. Test the bridge with weights. Use an empty yogurt pot filled with coins to test the bridge once it is complete. Pierce two small holes in your yogurt pot near the lid and thread through some string to make a loop that goes over the bottom middle of your bridge span. Fill it with coins, starting with a small number and slowly increasing it one coin at a time until your bridge breaks. Hang an additional weight pot if needed.

Optional but recommended: eat your bridge sharing equally between your whole engineering team!



# Communication challenge


## Introduction

**by structural engineer**

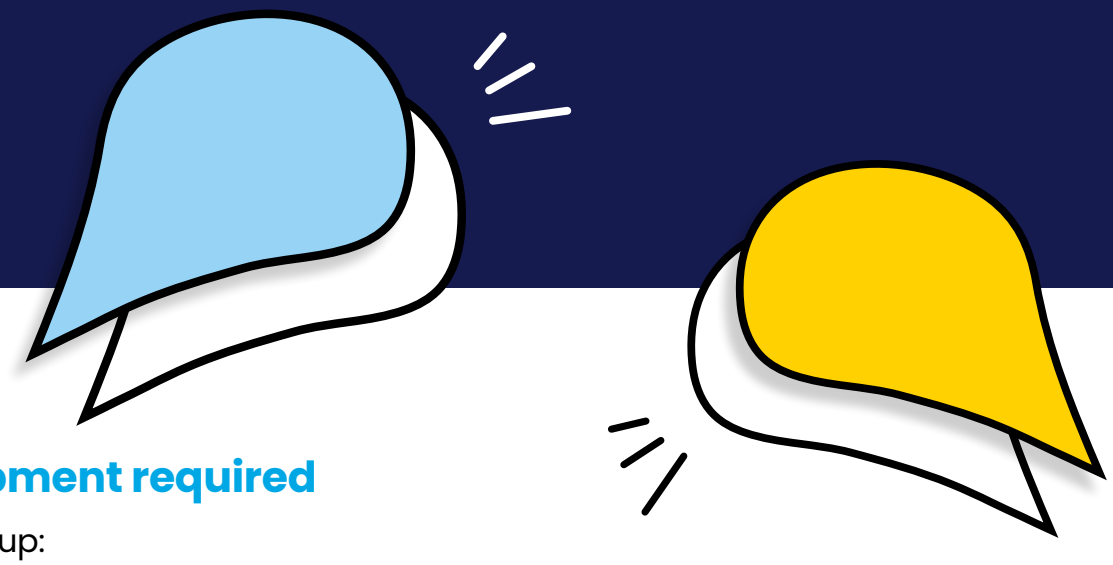
Hello, I'm Elaine. I used to be a Rainbow, Brownie, Guide, and a Brownie leader. Nowadays, my 'day job' is in offshore oil and gas as a Structural Engineer and team lead. Good communication with colleagues and clients is important. One challenging yet rewarding day was explaining to non-engineering senior management the poor condition of a stair tower and the need to build a scaffold under it so that it could continue to be used as an escape route. Thankfully, they understood, and we all got what we needed thanks to good communication. Lots of my team work remotely (one from Paris!), and heavily rely on messaging and video calls for planning, organising, and presenting our work including 3D modelling and analysing results to clients in detailed reports.

## Duration

30 to 45 minutes

## Activity aim

Civil engineers use tools like AI to help optimize their designs, improve project times and costs, and analyse big data. However, AI is only as good as it's data, so we need to make sure that whatever tool we use, we are communicating as accurately as we can. In this activity, the challenge is to communicate a design from one end of the room to the other, so that the builder is given enough information to build it correctly even if they have not seen the original object.



## Equipment required

Per group:

- Two sets of matching building materials – these could be wooden building blocks, Lego, etc. As long as the sets are identical and can be used to construct something that can be replicated
- Screen to hide the design – this can be as simple as a folder or box

## Method

The participants need to be in groups of least three, taking the roles of the Design Engineer, Project Manager and Construction Engineer.

At one end of the room an object should be built out of blocks or Lego or similar and hidden from view. At the other end of the room there should be a pile of blocks (the blocks needed to build the hidden object and some spares).

The teams work, in accordance with the rules, to communicate to each other the information required to recreate the object hidden from view.

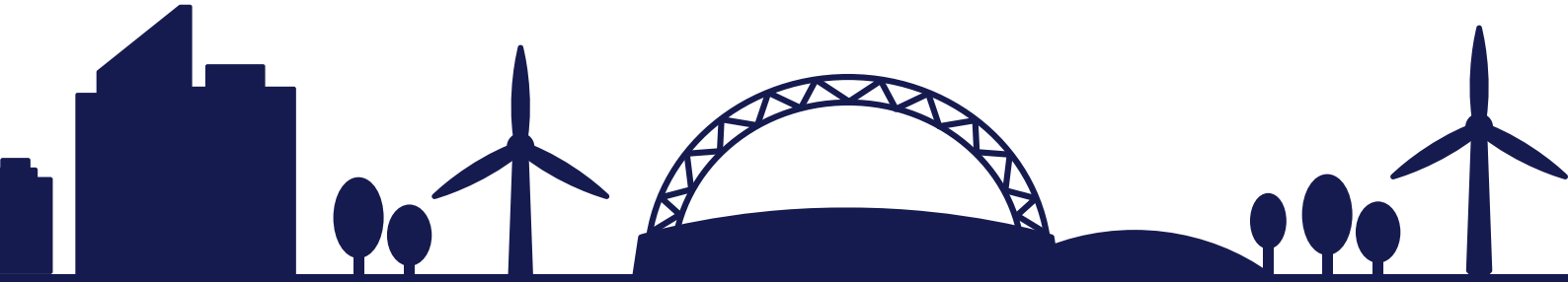
At the end of the allocated time, the team who have most accurately recreated the design are declared the winners.

## Rules

The Design Engineer is the only one who can look at the object and must describe what it looks like to the Project Manager.

The Project Manager must remember what they have been told and accurately pass the message on to the Construction Engineer.

The Construction Engineer is the only one that can touch the blocks from the pile and so must build what is described to them.



# Jelly geotechnics challenge


## Introduction

**by civil engineer**

Hello! My name is Rachel and I'm a Civil Engineer. I work as a Design Co-ordinator for a construction company in the highways sector. Whilst highways upgrades are being designed, I make sure that everyone's needs are being met. I work together with lots of different people to find answers to challenging problems and to find the best ways of achieving our aims - to make journeys quicker, easier and safer for people alongside protecting the local environment. I work with the contractors to solve any problems that come up – one example is that it can be very difficult to understand exactly what is going on below ground before you start digging. Sometimes we find that the ground is harder or softer that we thought it was, or that there are water or gas pipes or electricity cables underground that we didn't know were there.

## Duration

15 minutes

## Activity aim

Ground improvements can reduce the need for deep foundations, saving carbon and improving the sustainability of projects whilst helping ensure they are resilient to the effects of climate change. In this activity, working in small groups, participants are challenged to build the tallest tower they can on jelly (representing unstable ground conditions). The participants are expected to initially try building with only the building blocks to see what happens (it falls over!). They can try different designs but tell them it has to be as tall as possible.

Then give the participants a selection of materials and ask them to rebuild their tower using whatever they like (you can introduce some "red herrings" if you like). They should now successfully build a taller tower.

## Equipment required

- Tray of jelly – this can be any size and depth you like.
- A layer of Plasticine "bedrock" at the bottom of the tray is an option.
- Building blocks – these can be wooden construction blocks, Jenga, Kapla, etc.
- Foundation materials – the possibilities here are endless but straws or sticks that can represent piles and pieces of card to represent raft foundations are useful. Feel free to introduce a few "red herrings" if you like!

Sample materials

The above tub was approx. 230mm by 170mm (2litre capacity) and required 5½ packs of plasticine for a 10mm deep layer. Two packets of jelly making approx. 1 litre, gives a sufficient depth of "unstable ground".

**Please advise the participants not to eat the jelly.**

The following illustrations on the next pages can be useful when discussing foundation types with participants.

# Pad/strip foundation

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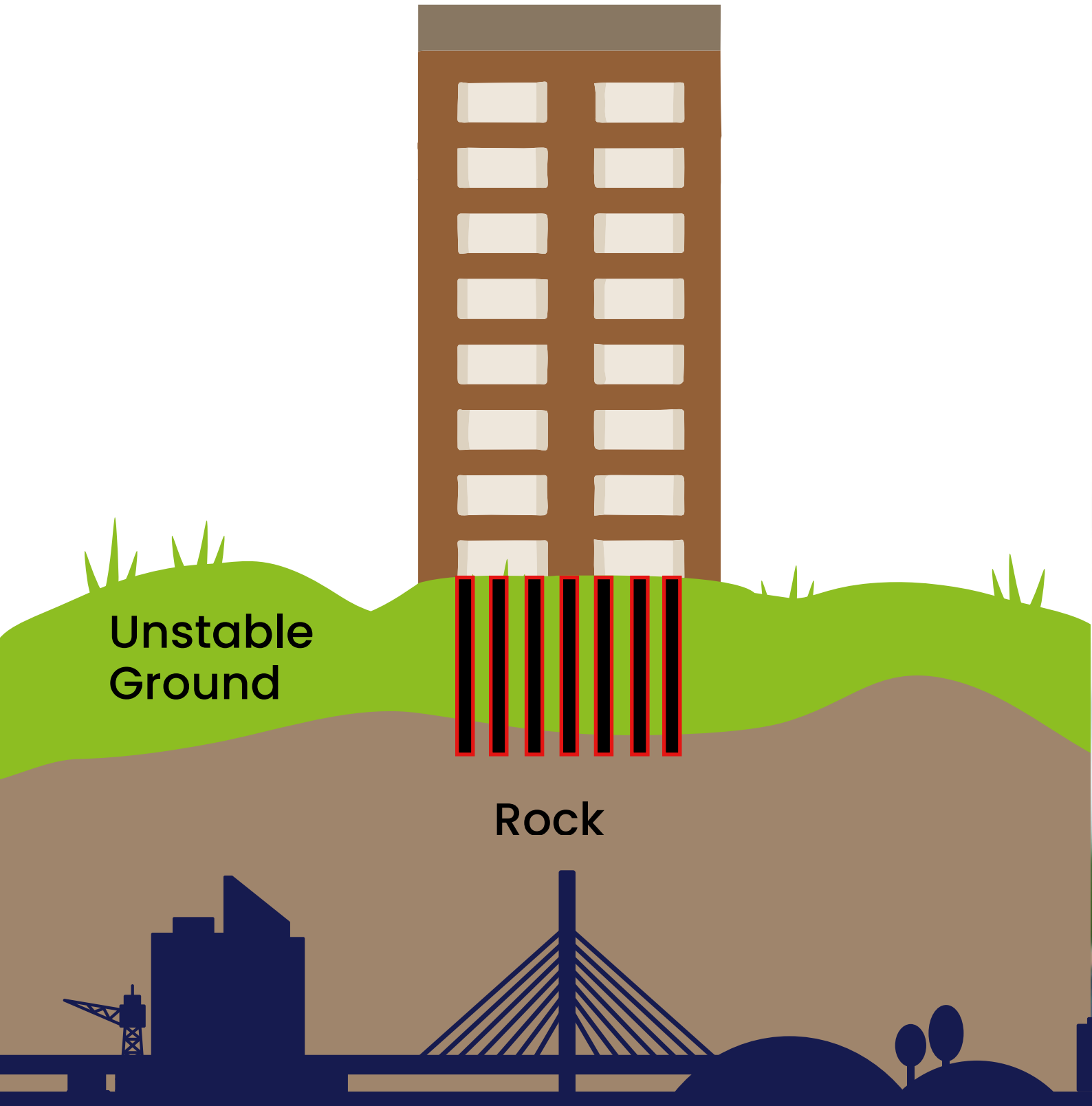
# Raft foundation

# Piled foundation




ARUP
ARUP

# Flour tower challenge


## Introduction

**by geotechnical engineer**

Hello, I'm Beth and I am a geotechnical engineer. My job involves looking at the soils and rocks below the ground surface to understand how stable they are. Soils and rocks have different strengths and we need to understand how strong the ground is before we can build anything on top of it. If the ground is weak, a geotechnical engineer comes up with a solution to help strengthen the ground, this could include building a foundation or digging out weak soil and replacing it with something stronger. Geotechnical engineers work on the construction of bridges, roads, railways, buildings and many more. Anything that will be built on the ground requires a geotechnical engineer's help!

## Duration

15 minutes

## Activity aim

Civil engineers use nature-based solutions like reforesting with native tree species to help improve unstable slopes and prevent landslides. Sadly, the participants don't have that option! In this activity, working in small groups, they are challenged to remove sections of the flour tower without causing the "building" on the top to fall.

## Equipment required

Per group:

- Bowl
- Tray
- Flour – pack tightly into the bowl
- Sweet/chocolate of some type
- Dice
- Blunt knife/spatula/spoon

## Method

Fill the bowl with flour and compact it well. Invert it out onto a tray and place a sweet/chocolate on the top. Each participant in the group takes a turn to roll the dice. If they roll a six, they have to cut away a slice of the flour.

If the chocolate falls off the top they need to get the chocolate out of the flour, without using their hands!

# Water distribution challenge

**Ruth Brown,** Student Engineer

## Introduction

**by student engineer**

My name is Ruth and I work in the structures department of a consultancy civil engineering company called Tony Gee. There is so much to think about during engineering, the effects on people, the planet and then the practicality side. Will you be able to construct it? Consider your day and what time you first interact with water, this allows you to appreciate how fundamental it is. The ability to easily access water means we have more time for education. Having clean water means we don't get sick and are able to live long lives. Eco-systems and livestock rely on safe water too. Water needs to be treated, transported, and protected from pollution. This is all engineering!

## Duration

45 minutes

## Activity aim

Climate change means more severe weather events around the world and civil engineers can be called upon to help when there has been damage to the infrastructure that people need to survive, often affecting our most vulnerable communities. In this activity a hurricane has hit the country of Honduras in Central America. The participants are now part of the Emergency Response Engineering team sent out to restore essential infrastructure to local communities.

Each team must design and build a water distribution system that will allow water to flow from the clean water source (at bucket 1) to a local village (at bucket 2) using only the materials provided.

## Equipment required

Per group:

- 3no. 2m length half-round gutter
- 3no. 1.4m length garden cane

- 7no. 1m length garden cane
- 1 box of elastic bands
- 2 buckets
- Plant pots or similar for mountains
- Mats or similar for marches

## Method

The water distribution system must transport water from bucket 1 to bucket 2 without going over any part of the mountains or the marshes.

When each team has completed their structure, they can have one cup of water to test it.

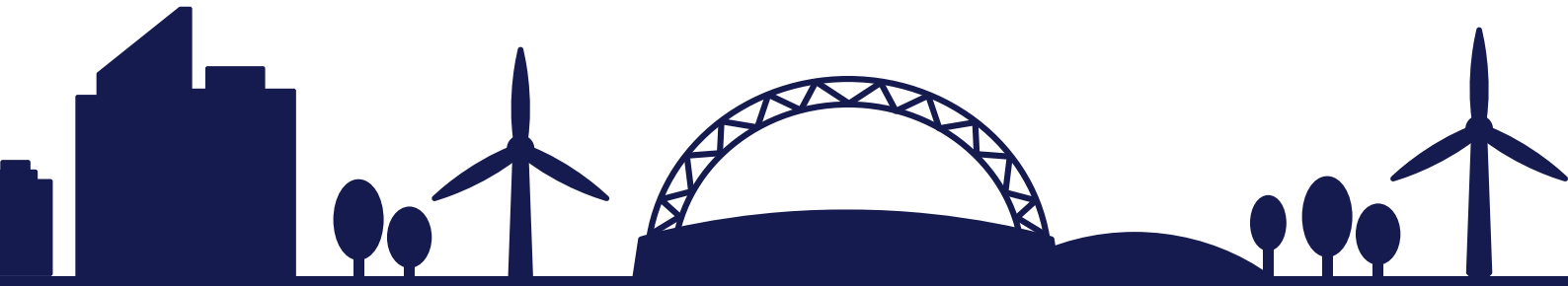
When all teams have completed their systems, you can get them to race, emptying bucket 1 into their system, one cup at a time. During the race they may use only the plastic cups to pour the water into their system, they are not allowed to pour directly from the bucket.

You can then measure how much water actually gets into bucket two. The fastest team with the most water in bucket 2, are the winners (if you choose to have a winner).

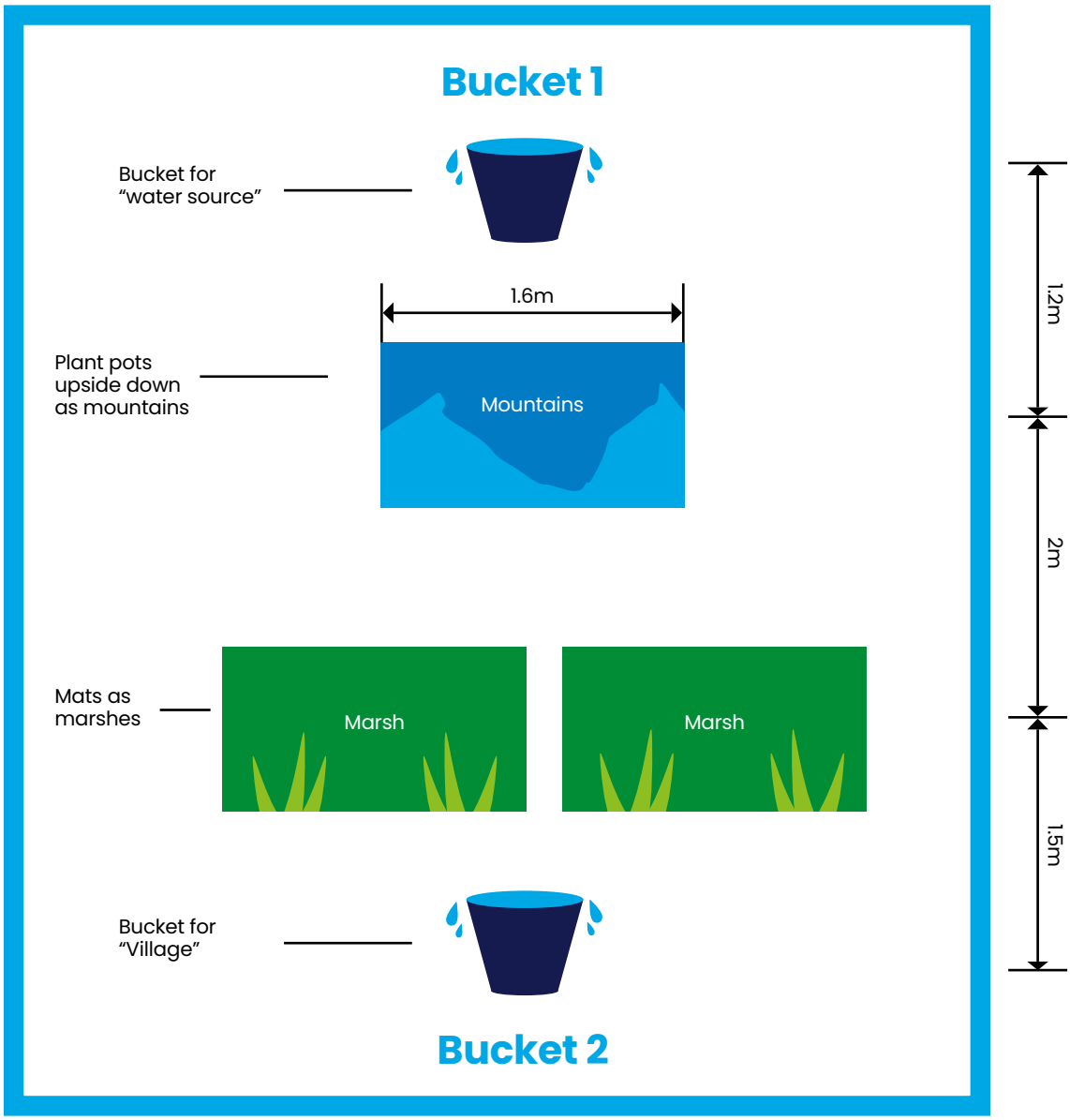
If this activity is carried out indoors, the water can be substituted with small balls (ping pong balls, marbles, etc.)

## Alternative water distribution challenge

If this activity needs to be on a smaller scale, then a similar system can be built as using cardboard tubes, boxes etc. and tested with a marble.



# Water supply set-up instructions




Dimensions approximate – discretion to be used to make the activity challenging but not impossible!



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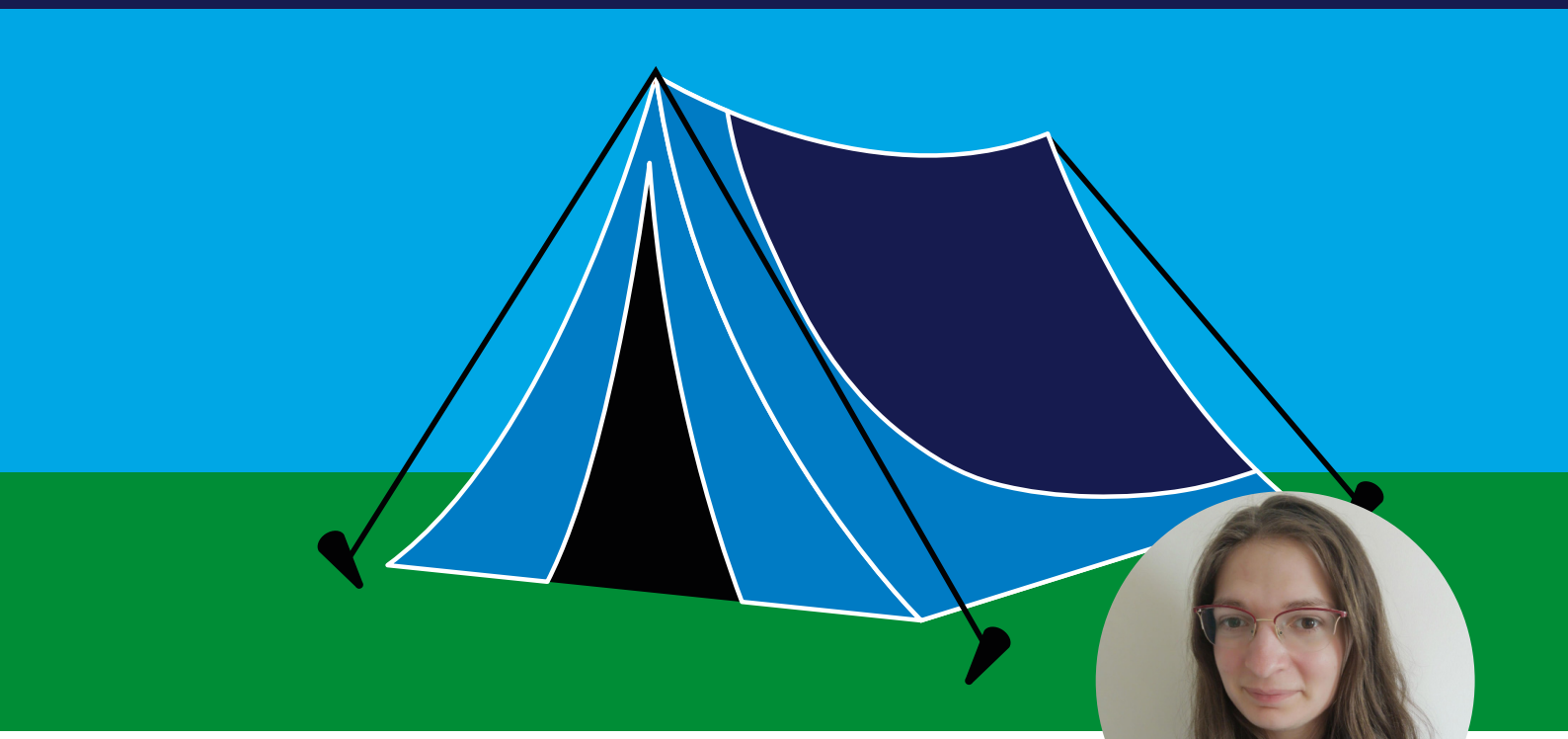
# Shelter building challenge





**Kalina Dimitrova,** Civil and Structural Engineer

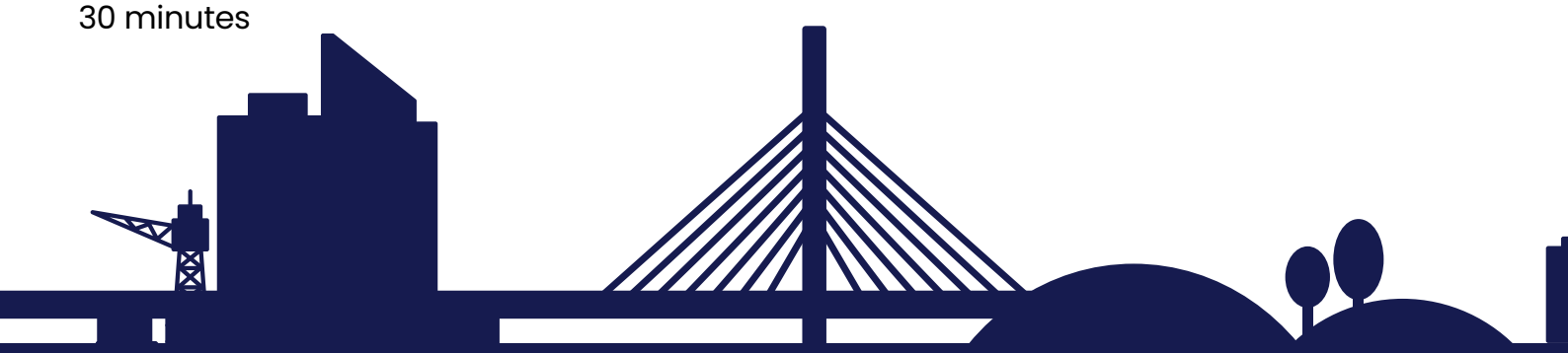
## Introduction

**by civil and structural engineer**

Hello, I'm Kalina, a civil and structural engineer. My job is to design and construct functional spaces for work, study, and living. I consider the purpose of the structure, its location, and whether it will be permanent or relocated. I ensure it can withstand loads, such as people and equipment, and remain stable against elements like wind and snow. My work includes residential projects, shops, offices, bridges, offshore rigs, theatres, museums, hospitals, and space satellites. I strive to create structures that last fifty years for buildings and over a century for bridges, benefiting thousands or even millions of people. Above all, my priority is to ensure the safety of all buildings and infrastructure.

## Duration

30 minutes



## Activity aim

Civil engineers need be able to adapt to a situation and use the resources available rather than those they would really like to have. The hurricane has passed and destroyed most of the houses in the town. It will soon be dark and more rain is expected tonight, so the teams must build a shelter. As materials are scarce they have become very expensive; they must try to build their shelter as cheaply as possible, using the materials available to them.

## Equipment required

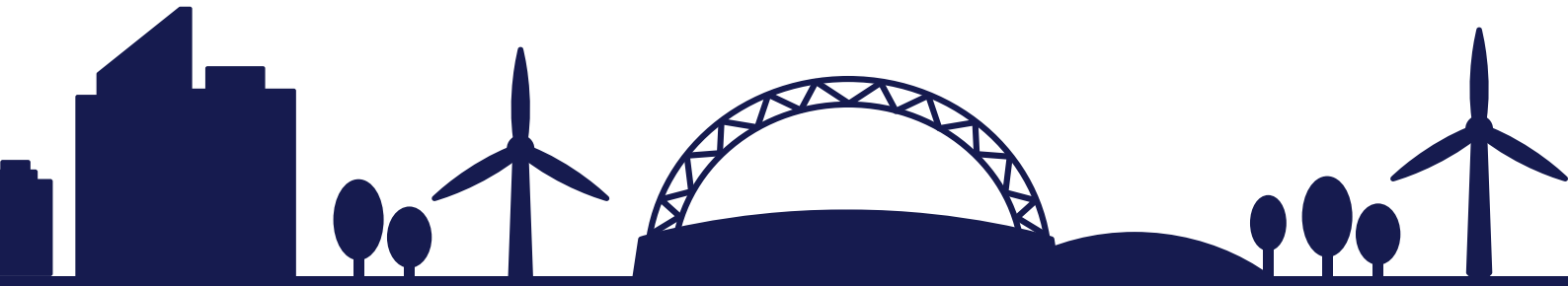
Per group:

- 3no. 1.5m length garden cane (or similar)
- 7no. 1m length garden cane (or similar)
- 1 box of elastic bands or string & scissors
- Masking tape if you're feeling kind
- Polythene sheet or old plastic carrier bags
- Watering can

## Method

The participants should work in small teams of 4 or 5. Each team has to construct a shelter that can stand up by itself and protect at least one member of the team from the rain. Once the build time is complete, test each shelter with a watering can of water to see if it leaks. The participants can have as many of the team inside the shelter as they wish but there must be at least one team member inside.

If this activity needs to be carried out indoors, omit the testing and challenge them to try and get as many of their team inside the shelter as possible.



# Water use activity

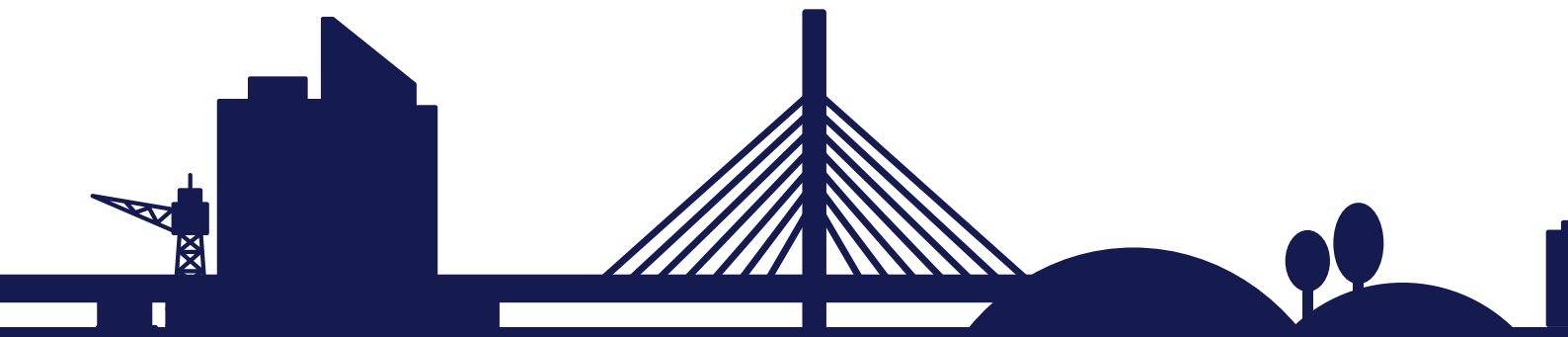


**Lottie Ashcroft,** Civil Engineer

## Introduction

**by civil engineer**

My name is Lottie and I'm Civil Engineer from Brighton. I work at a consulting firm on projects in the water industry. The projects that I work on are usually designing and building water and wastewater treatment works. However, there are lots of different things that civil engineers help with when it comes to water – not just treating it! We also have to think about storing it (dams & reservoirs) transporting it (pipelines, canals, tunnels, & bridges), and protecting against it (sea & river defences). I really enjoy my job because I get to be involved in lots of varied and exciting projects and get to see things that I've designed get built! It's also rewarding knowing that we're making sure that people have access to safe, clean water.



## Duration

10 minutes

## Activity aim

Water is a precious resource and conserving its use calls for civil engineers to develop innovative solutions but we can all play our part. This activity is to get us thinking about what we use water for each day and how much we use.

## Equipment required

- 1 set of water usage cards (see next page)
- Scrap paper
- Pencils

## Method

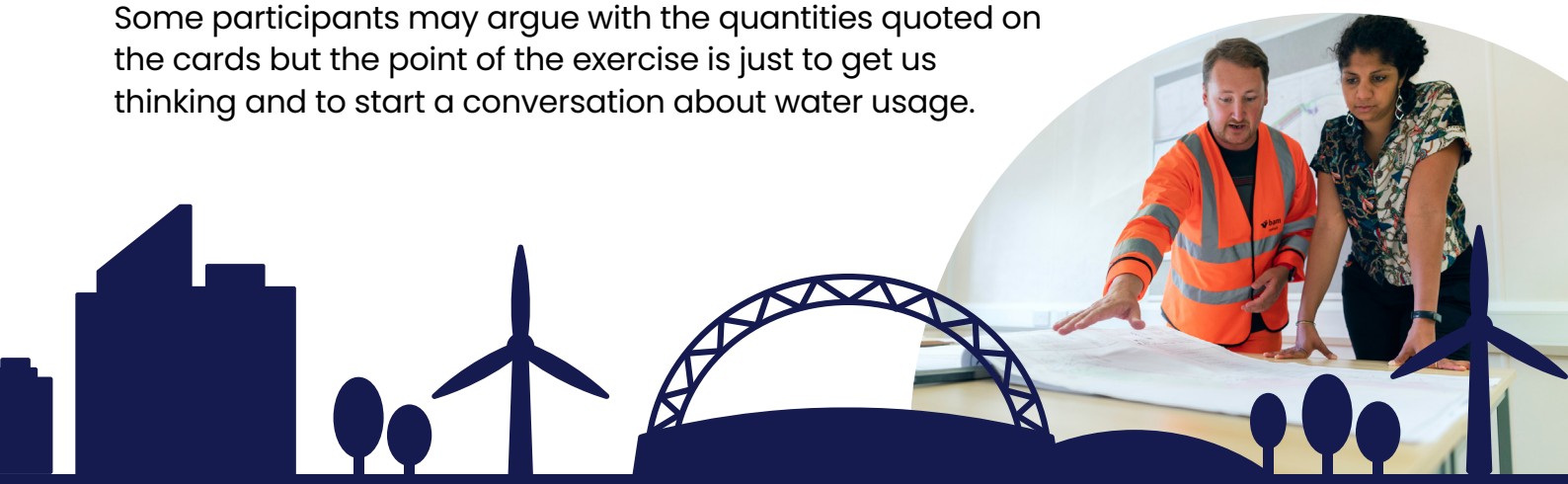
In advance of running the activity, print off the "cards". These can be printed on paper or card and do not need to be in colour.

The participants should work in small teams of 4 or 5. Ask them to consider what they use water for in one day, from the time they get up in the morning until they go to bed at night. They are asked to choose from the cards provided, one for each time they will carry out that activity (e.g. two "brush your teeth" cards for morning and night).

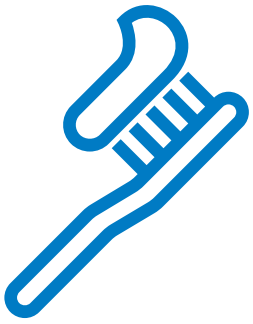
Ask them to count up all the amounts of water on the cards to get their total for one day.

This is usually an alarmingly large number. Ask them to consider what they really need to use drinking water for and what sources could be used to get water for other activities? e.g. rain water harvesting on buildings for toilet flushing etc.

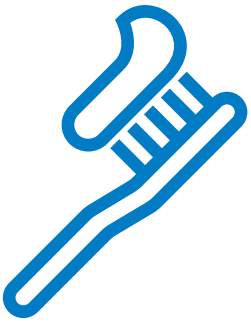
Some participants may argue with the quantities quoted on the cards but the point of the exercise is just to get us thinking and to start a conversation about water usage.



# Water use activity cards



Brushing teeth – 1 litre



Brushing teeth – 1 litre

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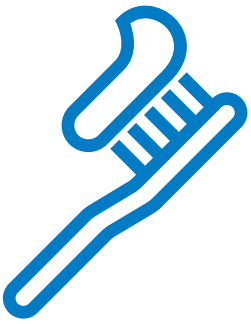
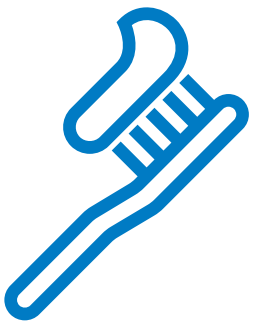
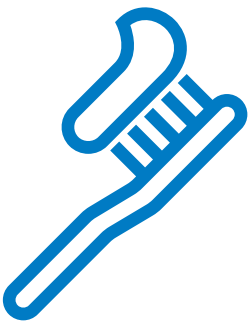


Brushing teeth – 1 litre



Brushing teeth – 1 litre



Brushing teeth – 1 litre

# Water use activity cards

5min shower - 65 litres

5min shower - 65 litres

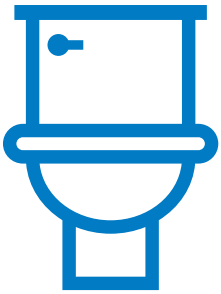
5min shower - 65 litres

5min shower - 65 litres

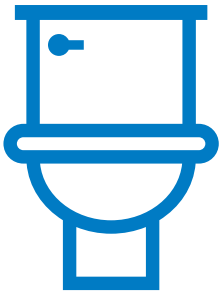
Bath - 100 litres

Bath - 100 litres

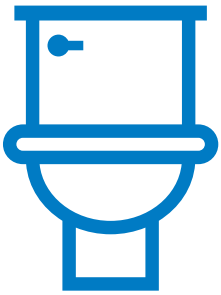
# Water use activity cards



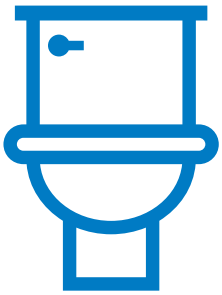
Toilet flush - 8 litres



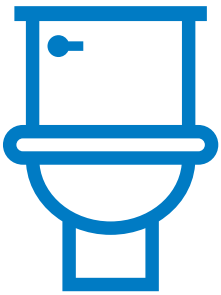
Toilet flush - 8 litres



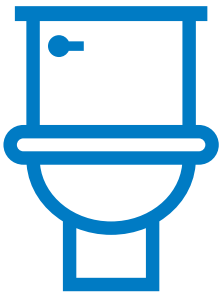
Toilet flush - 8 litres



Toilet flush - 8 litres

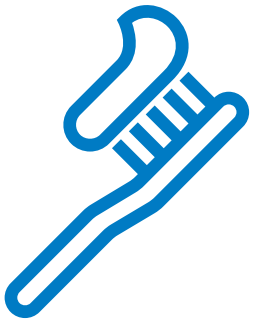


Toilet flush - 8 litres

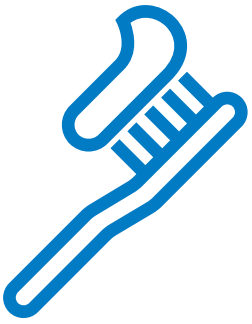


Toilet flush - 8 litres

# Water use activity cards



Brushing teeth - 1 litre



Brushing teeth - 1 litre

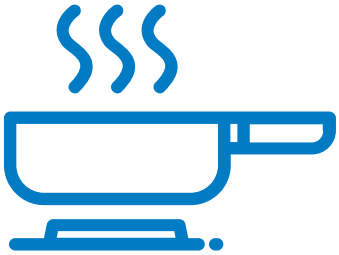
Drinking water
2 litres per day

Drinking water
2 litres per day

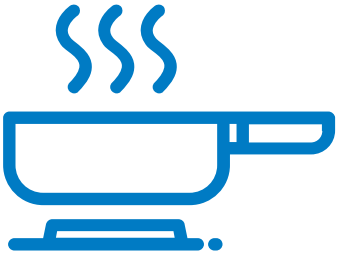
Drinking water
2 litres per day

Drinking water
2 litres per day

# Water use activity cards



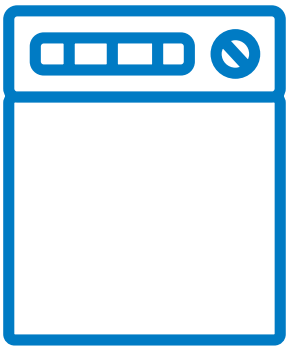
Cooking - 4 litres



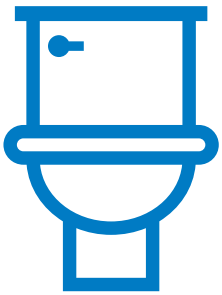
Cooking - 4 litres

Washing dishes by hand - 9 litres

Washing machine - 50 litres



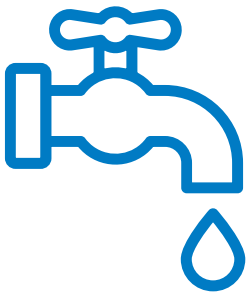
Dishwasher - 9.5 litres



Toilet flush - 8 litres


**Did you know that cold water costs the person who pays the bill about 3 pence for every 10 litres of water you use? Imagine what it would cost to heat the water too...**

Using the cards, can you limit the daily water use for a family of four people to 349 litres?



The Energy Saving Trust estimates that the average home consumes 349 litres of water each day.

# Railway route activity

**Ada Nwadigo,** Civil Engineer

## Introduction

**by civil engineer**

Hello! I'm Ada a civil engineer and I'm currently working on the biggest transport project in the UK. I'm deeply passionate about infrastructure and transport and I believe that transport is the lifeline of our society, it connects people, places, and communities, making our lives easier and more enjoyable. Did you know that the first modern railway opened in 1825, and trains have been an integral part of human progress ever since? Today, rail networks move millions of passengers and tons of goods daily, all while being one of the most energy-efficient modes of transport.

Now, let's imagine a world without railways, no quick commutes to cities, no overnight delivery of goods, and no scenic train rides through beautiful landscapes. Pretty inconvenient, right? Railways are more than just tracks and trains; they are a symbol of connectivity, innovation, and sustainability.

From this activity, you'll step into the shoes of transport engineers, tasked with designing a railway route that balances cost, environmental concerns, and passenger satisfaction. Let's see how your creativity and problem-solving skills can shape the future of transport!

## Activity aim

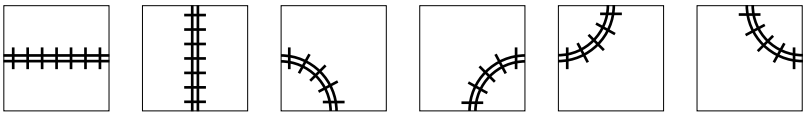
One of the ways that we can move to more sustainable travel is to make better use of our railways. When planning new transport routes, civil engineers need to take into account everyone affected and try to find the best compromise. In this activity, participants have to plan a railway track layout minimising the cost (both financial and environmental) and passenger journey times.

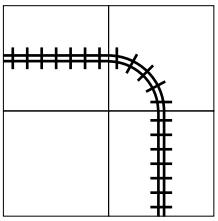
## Method

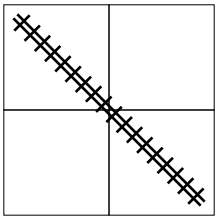
As part of decarbonising our railways, your engineering team have to plan a track layout for new electric trains to travel from Station A to Station B. You should try and plan the most direct route possible – the longer your track is, the more expensive it will be to construct and the longer the passenger journey will be. We want to keep our

passengers happy, our costs reasonable and we need to make sure that we are being as environmentally sensitive and sustainable as possible.

You need to count each "box" of track that you build. You can make left and right turns (though in reality the trains would need a much longer, smoother curve) but you cannot go diagonally.

Allowed 

e.g. 

Not allowed 

If you cross a road, river or other obstruction, you will need to decide whether to build a level crossing, bridge or tunnel.

For every decision, you will need to take into account the financial cost, the environmental or carbon cost and the satisfaction of your passengers.

Plan your route and calculate your final score. Can you manage to keep:

- Financial cost below 500 (£M)
- Carbon cost below 250 (hundreds of tonnes of $CO_2$)
- Passenger satisfaction above 500

If not, try again and see if you can find a better route!

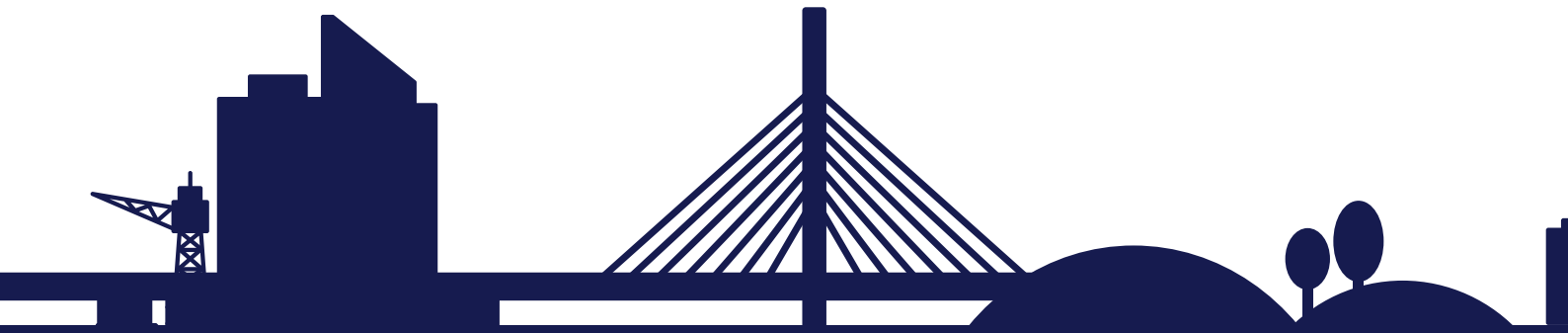
## Extension activity

If some groups finish before others, they could extend their railway track route to Station C, or even complete a loop back to Station A.

# Railway route activity

| | Financial cost (£M) | Carbon cost (hundreds of tonnes of $CO_2$) | Passenger Satisfaction |
|---|---|---|---|
| Track cost (per box) | 10 | 15 | 10 Journey time |
| Bridge cost | 100 | 4 | +10 Faster journey time |
| Level crossing cost | 20 | 20 | -200 Safety concerns |
| Tunnel cost | 200 | 40 | 10 Faster journey time |
| Ground improvement cost | 25 | 30 | -150 Delay to new railway |
| Deforestation cost | 15 | 40 | -150 Public outcry |
| Disturbing wildlife | 2 | - | -150 Public outcry |
| Golden Eagle habitat -waiting until appropriate to build | - | - | -100 Delay to railway but public understand why |
| Introducing new biodiversity habitat | 1 | -30 | +150 Public appreciation |

| | Number of boxes (a) | Cost £ (b) | (a x b) | Cost $CO_2$ (c) | (a x c) | Satisfaction (d) | (a x d) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 500 |
| Track | | 10 | | 15 | | -10 | |
| Bridge | | 100 | | 4 | | -10 | |
| Level crossing | | 20 | | 20 | | -200 | |
| Tunnel | | 200 | | 40 | | -10 | |
| Ground improvement | | 25 | | 30 | | -150 | |
| Deforestation | | 15 | | 40 | | -150 | |
| Wildlife loss | | 2 | | - | | -150 | |
| Wildlife gain (max. 3 allowed) | | 1 | | -30 | | 150 | |
| **Totals** | | | | | | | |





Girlguiding
London and South East England


## Map key

**Existing community** – if you plan your route through an existing community you will need to issue a compulsory purchase order to demolish their homes

**Rocky terrain** - If the track goes through this area, you will need to build a tunnel

**Marshy area** - If the track goes through this area, you will need to do some ground improvements. This may affect the local eco-system and will be expensive.

**Wildlife habitat** – take care when working in this area as you will need to take into account the nesting season of Golden Eagles

**Wildlife habitat** – these areas are home to endangered species such as the red squirrel or the marsh fritillary butterfly, which should not be disturbed if possible

**Wooded area** – if you plan your route through this area you will need to take down trees for both construction and also for maintaining the track. This will have a financial and carbon cost

**Mountains** - If the track goes through this area, you will need to build a tunnel or you can take a longer route around

**Biodiversity habitat** – You can choose to create some biodiversity habitats next to your track which might help balance some of your other choices.

# Out and about: civil engineering in your community challenge

**Svetlana Joao,** Structural Engineer

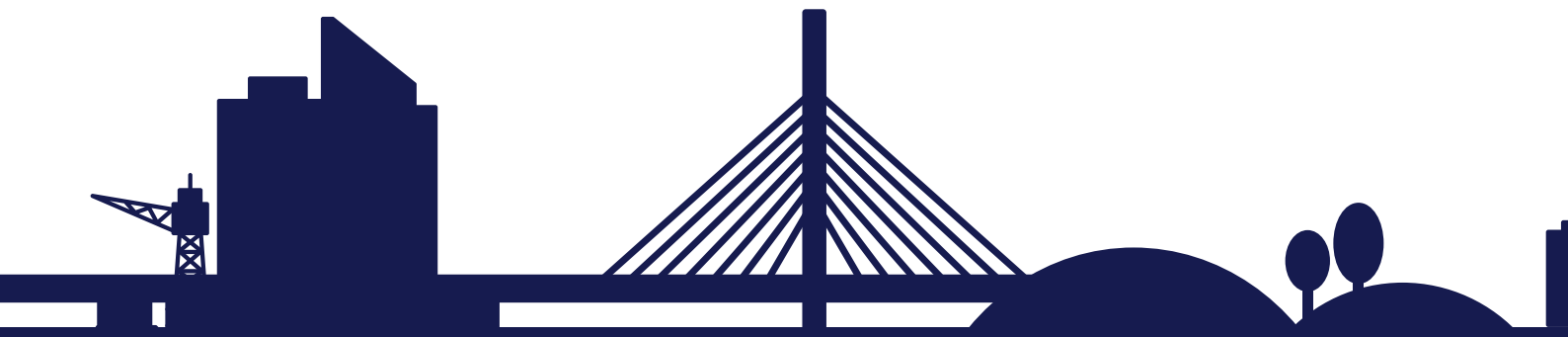
## Introduction

**by structural engineer**

I am Svetlana, I am Angolan-Portuguese, living and working in London. I am a civil engineer and specialise in structures. When I'm doing my job designing structures, I need to make sure that the structure will be stable. I need to consider what will be the main purpose of the structure, the functionality, and then consider what type of loads it will carry. Civil engineering is a profession which makes a major contribution to society. Since past centuries, civil engineers donate their lives to work on projects that help to improve people's lives significantly. For example, people have a place to live, a place to study, a place to treat themselves medically like hospitals, and we are able go from one place to another through roads, trains, bridges, etc. All these advances are due to the work of the construction industry.

## Duration

45 to 60 minutes



## Activity aim

Civil engineering infrastructure is all about helping our communities to stay safe and connected. In this activity Guides/Rangers explore the community surrounding their meeting place. How many bridges can they identify? Do they go over or under them? If none of them existed, could they still travel to all the places they wanted to in a typical day? If they could design a new bridge linking two places, where would they choose?

## Equipment required

- Paper & pencils
- Map of local area

## Method

This activity can be done either indoors as a map-based activity or outdoors exploring the local community around the meeting place.

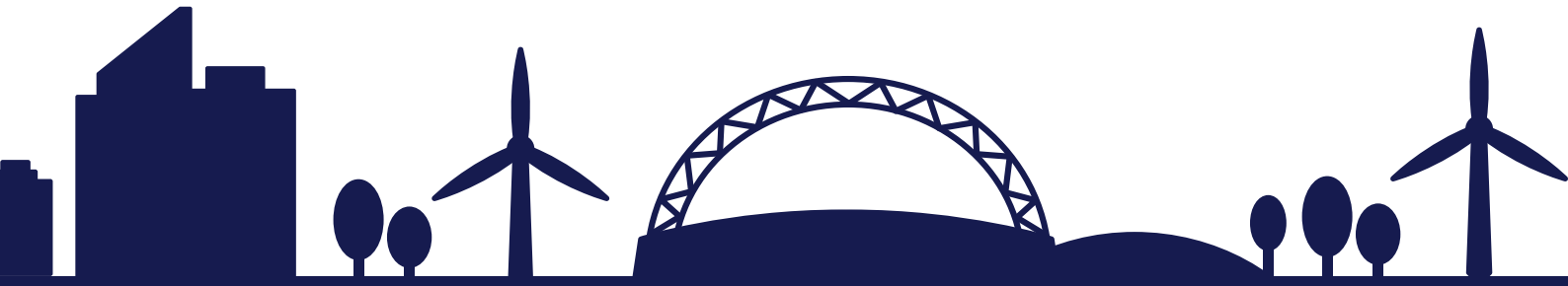
**Indoor only**

Working in small teams of 4 or 5, ask the participants to look at a map of their local area and try to identify where the bridges on it are. It will help if you have already done this in advance so that you can guide them if required. They should try and identify if the bridges go over waterways or roads, railways, etc. Are they bridges for pedestrians or vehicles? Are there bridges that people can't cross? These may be for pipes or services only. Are there bridges that carry water over an obstacle? These are called aquaducts.

Ask the participants to imagine that they have been asked to design a new bridge linking two places in their community. What two places would they like to link and why? And what would they like their bridge to look like?

**Indoor/outdoor**

As above, but the participants could go out into the community surrounding the meeting place to identify the bridges in reality and see if they can match them up with those on their map. Do they find any that they hadn't noticed on their map?



# Activities can support other badges

## Some of the activities in this pack could be used to support Skill Builder badges or Unit Meeting Activities, e.g.

- Lead Stage 4 – Tell them how it's done
- Lead Stage 4 – Rule changer
- Innovate Stage 5 – Bridging the gap
- Lead Stage 5 – Pick your battles
- Lead Stage 5 – That's not fair
- Live Smart Stage 5 - Budget Builder
- Live Smart Stage 6 - Figure it out
- Rangers UMA - Your skills are multiplying
- Rangers UMA - Resist this
- Rangers UMA - Balance it out
- Rangers UMA - What's the logic?

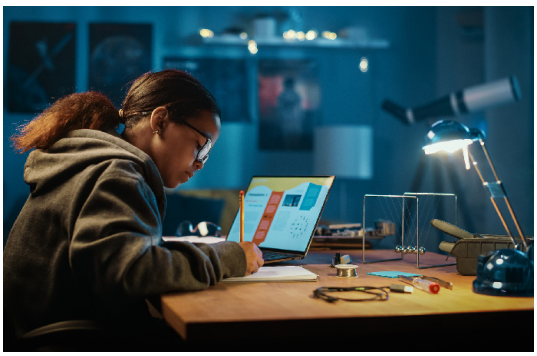
# Additional activities

## ICE Education Resources

Discover a range of inspiring activities and resources from the Institution of Civil Engineers (ICE) to spark curiosity and creativity. These materials are designed to support learning, develop problem-solving skills, and introduce young people to the exciting world of civil engineering. Perfect for enhancing activities, skill-building, and exploring real-world challenges!

Visit here: **bit.ly/ICE-education-resources**

## Virtual work experience



The *Civil Engineers Shaping the World* programme is free, on-demand, and designed for young people aged 14-18. It's an excellent addition to CVs and personal statements and can be accessed through the Springpod platform.

Visit here: **bit.ly/ICE-virtworkexp**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bam
Mott MacDonald
SONY

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Images from campaign 'This is Engineering'.

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