

  
**Rainbows**

  
**Brownies**

# STEM Stars

A STEM focused pack for Rainbows and Brownies



**Girlguiding**  
North West England



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## Introduction

Welcome to Girlguiding North West England's STEM Stars challenge pack! This pack includes a wide range of STEM activities, aimed at Rainbows and Brownies. We know that challenging the stereotypes of women in STEM is important to our members, and we want to teach them from an early age that they can aspire to do anything they set their minds to.

In this pack you will explore different activities which all have STEM in mind, but what is STEM?

STEM is an acronym for the four related fields of; science, technology, engineering and mathematics. These fields are historically linked with male stereotypes, and we want to help challenge this.

This challenge pack is divided into three sections: **Sensational Structures**, **Exciting Environment** and **Intriguing Inventions**. To complete the challenge and become a 'STEM superstar' you will need to complete four activities, one from each section then one other activity.

We'd really love to see what you get up to as part of the challenge. Be sure to send your pictures to [northwesthq@girlguidingnwe.org.uk](mailto:northwesthq@girlguidingnwe.org.uk) or connect with us on social media:



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To purchase your badges once you have completed this pack please head to the Girlguiding North West England webshop and search "STEM Stars" or click the link: [here](#).

# Sensational Structures

You might not realise but there is a lot of planning that goes into creating a structure. Engineers use science, mathematics and technology to plan not only how the structure will look, but also make sure it is safe and long lasting. In this section there are various activities which all involve ways for you to build and think about the process of creating a structure.

Did you know, the first woman to win the Pritzker Prize for architecture was Zaha Hadid. She was awarded the prize in 2004 when she was 54 years old. She was the architect behind the London Aquatics Centre.

## First Female Architect in the UK

Ethel Charles (1871–1962) is considered the first woman to officially qualify as an architect in the UK. She passed the architectural exams in 1898, making history as one of the first women to break into a male-dominated profession.

Ethel's achievements were groundbreaking at a time when few women were allowed to study architecture.



# Build a tower that is taller than you!

Quite often, in construction, the client (the person or company who is paying for the project), sets out various criteria as to what they require, this is known as their specification. For you today, the specification is that the tower must be taller than you!

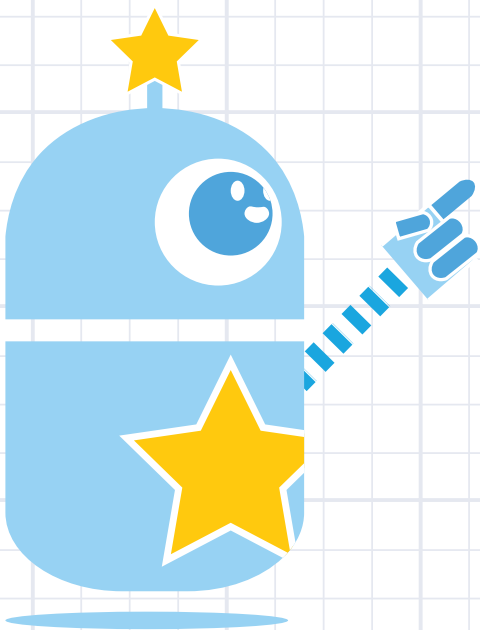
**Estimated time:** 20 minutes

## Equipment:

- Newspaper/magazines/scrap paper
- Sticky tape
- Glue

## Method:

1. In your small group, think about how you are going to build your tower to make it stand up on its own. Does it need 'legs' to be able to stand up on its own?
2. Work as a team to make the tower. The tower needs to be taller than the tallest person in your group and stand up all on its own!
3. As you are building you might want to think about how many points will need to touch the floor and how it might need extra support the taller it gets. Can you think of the best shapes to support a structure?



# Earthquake-proof buildings

In some parts of the world, earthquakes are a common occurrence. Engineers building in these areas have to think a lot about how the earthquakes might damage the building and if there is a way to prevent this from happening. Have a go at making an earthquake proof structure out of spaghetti and marshmallows!

**Estimated Time:** 20 minutes

## Equipment:

- Marshmallows
- Spaghetti (uncooked)
- Two similar sized sheets of flat cardboard or 2 hardback books which are the same size
- Four bouncy balls or marbles
- Two large rubber bands (and spares)
- One sheet of plain card

## Method:

1. Think about which shapes might be stronger and more likely to withstand earthquakes, you may want to look at images of buildings which have been built with earthquakes in mind.
2. In small groups, use spaghetti and marshmallows to build a tower. You can use as many materials as you need, and you can build it as tall as you want, just try to make sure it is as 'earthquake-proof' as possible.

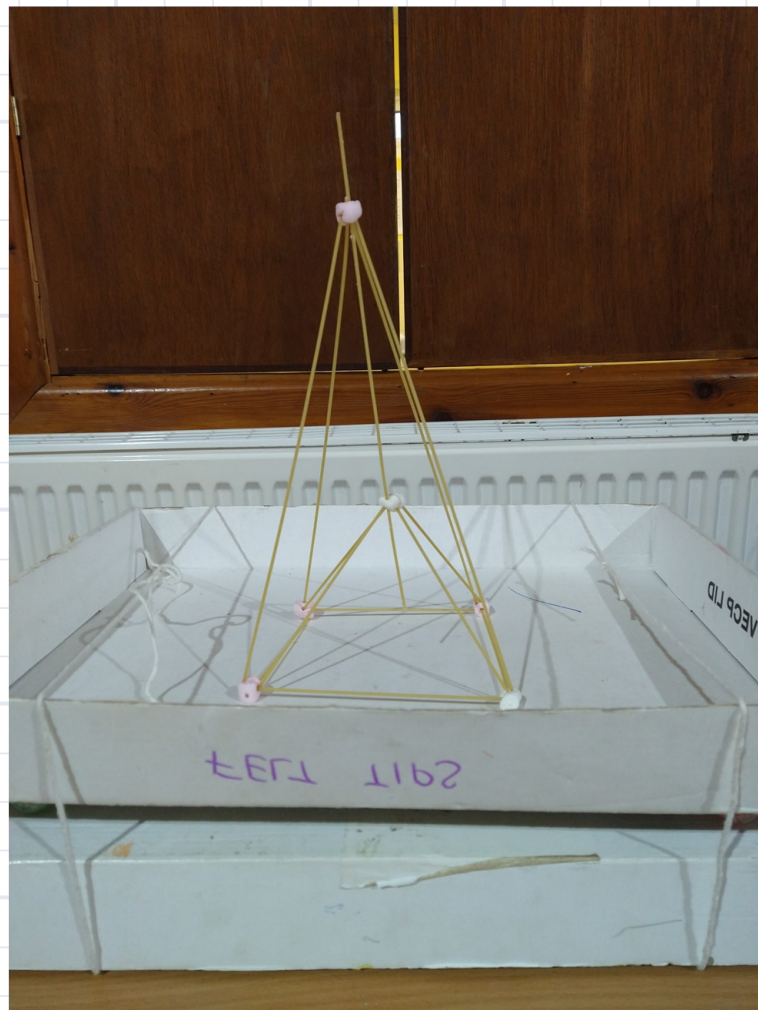
You should then build a shake table in order to test your structure, leaders can build these in advance if they wish:

- a. Cut two pieces of cardboard into two squares of the same size. You could also use two hardback books which are the same size.
- b. Place the bouncy balls/marbles between the two layers. Put the balls close to the corners but not so close that they could fall out.
- c. Using the rubber bands, attach the two layers together, keeping the balls between.

Once your structure is complete, place it onto the shake table, and shake it as hard as you can! After 30 seconds stop and look at any damage the 'earthquake' caused. Do you think your tower would have survived a real earthquake?

**Tip:** You may wish to build your tower directly onto a piece of card, or spare piece of cardboard, so that it can be easily lifted onto the shake table when you come to test it.

# Earthquake-proof buildings continued



# What works well?

Everyone knows the story of the three little pigs, one built their house from straw, one from wood and one from brick, but which materials work best? Do this activity to learn how different materials are suited to different purposes.

**Estimated Time:** 20 minutes

## Equipment:

- Various materials you could use to make a 'sandcastle'. You need at least two, one which will hold the shape and one which will not. These could include:
  - Sugar
  - Flour
  - Sand
  - Small stones
- Container to make a 'sandcastle', a yoghurt pot would work
- Surface to build your 'sandcastle' on, this could be a tray, plate or bowl

## Method:

1. Different materials work better for making structures, you are going to make 'sandcastles' from different materials and see which work best.
2. Using the first material, fill the container, you need to make sure it is packed tightly like you are making a sandcastle.
3. Tip your container over quickly onto your surface.
4. Remove the yoghurt pot and look at your castle, did it work?
5. Try the different materials and see which work and which don't.

**Top Tip:** The sugar and small stones shouldn't be able to hold the shape of the 'sandcastle'. The flour and damp sand should be successful.





# Exciting Environment

The environment is made up of so many different things, from rainforests to deserts and even volcanoes! We want to explore the environment and the ways in which we can help it.



Planet earth is home to over two million animal species

Indonesia has the most active volcanoes in the world - 147

Forests cover 30% of the world's surface



# Exploding volcano

Volcanoes are an amazing part of the natural world. They can look like small mountains or hills and are an opening in the earth's surface where hot magma can escape. Volcanoes can sometimes erupt which means the hot magma can come pouring out of the earth's crust with ash and gasses. Follow these instructions to make your own volcanic eruption.

**Estimated time:** 1 ½ hours (or over two unit meetings)

## Equipment:

- Baking soda
- Vinegar
- Warm water
- Measuring jug
- Teaspoon
- Deep baking tray to prevent spillage (if inside)
- A 500ml plastic bottle
- Food colouring (optional)
- Newspaper
- PVA glue
- Washing-up liquid
- Paints

## Method:

### Creating the volcano

1. Remove the lid from the bottle and place in the centre of the tray, if you are using one
2. Create a papier mâché paste, we recommend two parts glue to one part warm water. Then tear the newspaper into strips
3. Using the papier mâché, begin to build the body of the volcano round the bottle, to speed things up you might want to start with scrunched up newspaper taped around the base of the bottle to form the shape and then cover this with the papier mâché
4. Allow the volcano to dry (you may need to come back to this at the next unit meeting)
5. Once the volcano is dry you can use paints to decorate it

### Making your volcano erupt

- a. Pour some warm water into the bottle inside your volcano. You want to add around 100ml
- b. To the warm water, add one squirt of washing up liquid and about 300ml of vinegar. If you want to colour the eruption, add a few drops of the optional food colouring in this step
- c. When you are ready for your volcano to erupt, quickly add around two teaspoons bicarbonate of soda to the bottle then step back and watch

**Top tip:** As it needs to be done quickly, with younger girls the leaders may want to add the bicarbonate of soda in the final step and let the girls watch.



# Exploding volcano continued

1



2



3



4



5



a



b



c



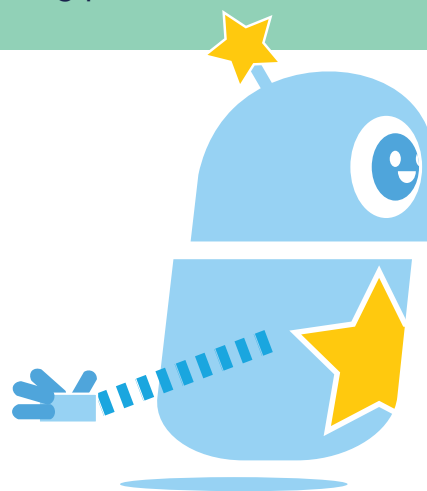
# Wind power

There are lots of ways that we create electricity to power our homes. Some of these aren't very good for the environment as they release harmful chemicals into the atmosphere. Thankfully, there are many ways which don't hurt the environment, including power from wind which we collect with wind turbines.

**Estimated Time:** 10 minutes

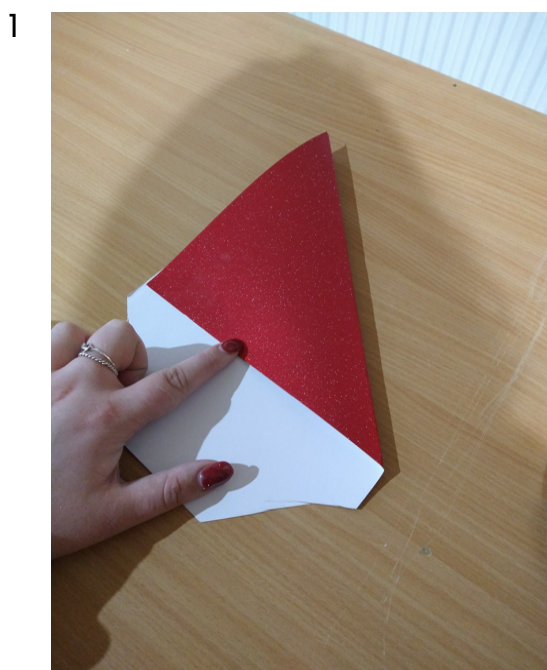
## Equipment (per windmill):

- 1x wooden lollypop stick
- 2x sheets of coloured paper (different colours)
- 1x push pin/drawing pin/tack
- Scissors
- Blu tack



## Method:

1. With a leader's help, cut both of your coloured sheets of paper into squares. A trick to doing this is to fold one corner of the sheet down diagonally, and that will show you how much of the rectangle to cut off
2. With one coloured sheet on top of the other, fold them across diagonally both ways (like you have just done, but with the other corner too) and then open them back up
3. Now, with a leader's help, cut about halfway along each of the folded lines (remembering to keep both sheets on top of each other)
4. Next, take one corner of each triangle, and pull the tip into the centre, so that you've got one tip of each triangle overlapping in the middle of the square. Then ask a leader to help push the pin through all four triangle tips, into the centre of the squares
5. Now, ask a leader to help you push the pin into the top of the lollypop stick; making sure that the hole in the windmill is big enough (wiggle it around a bit) so that the windmill spins freely.
6. Your windmill is complete! Try blowing on it and watch it spin round!



# Wind power continued

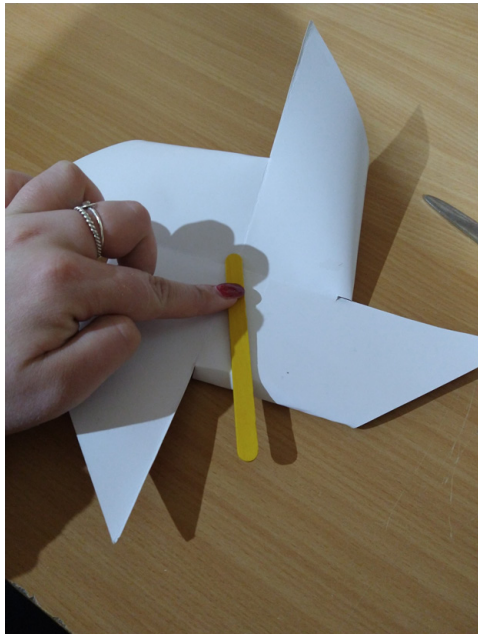
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4



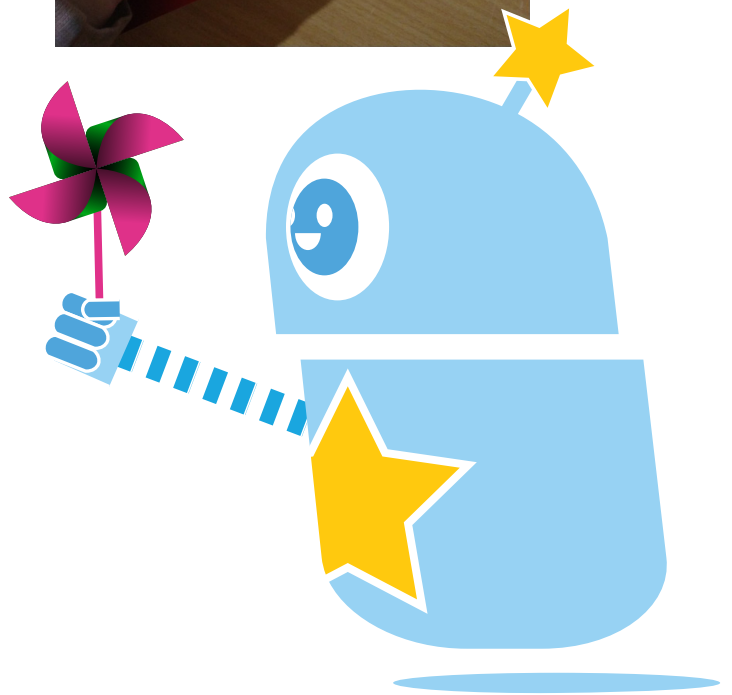
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6



7



# Neighbourhood spill: how does pollution affect our water?

The way we do things in our homes can have an impact on the environment. If we introduce something to the environment that isn't supposed to be there, it can have a negative effect. Have a look how these houses might have a negative impact on their environment just by changing a couple of things.

**Estimated Time:** 30 minutes

## Equipment (per group):

- Washing up tub/large, deep baking tray
- Bag of gravel/small stones/grit
- Three different coloured bottles of food colouring (a few drops of each)
- Jug of water
- Four small glass jars/beakers or pipette
- Something to represent three little houses (e.g. board game tokens, marbles, dice)

## Method:

1. First, you need to set up your neighbourhood. Fill your tub/tray with gravel/grit, so that it is about 3cm deep; leaving a portion at the end of the tray free of gravel/grit. Then, place your little 'houses', spaced out on the gravel
2. Now, add some water to your neighbourhood. Take your jug of water and pour it evenly over the gravel until you've got about 2cm of water in the gap you've left without gravel (judge this based on how much gravel you've got). Be careful not to add too much water, otherwise your houses will flood!
3. Take a sample of the water using your little glass jar/beaker/pipette - it should look nice and clear. As you can see, the houses are all using eco-friendly products and detergents, so the water in the neighbourhood is nice and clean
4. Now, one of the houses decides to start using a different detergent, which has harmful chemicals in it. With the help of a leader, add a few drops of food colouring (one colour) to where one of the houses is sitting
5. Take another sample of the water using a different glass jar/beaker/pipette. Can you see how the harmful chemicals are contaminating the water? Do you think this is nice for everyone else living in the neighbourhood?
6. Now, a second house decides to start using a more powerful bleach when they are cleaning their bathrooms. With the help of a leader, add a few drops of food colouring (a different colour) to another house
7. Take another sample of the water using a different glass jar/beaker/pipette. Is the water getting worse as more pollutants are being added to it? What do you think is starting to happen to the fish living in the water?
8. Now, a third house decides to wash their car with some harmful chemicals. With the help of a leader, add a few drops of food colouring (a different colour again) to the third house



# Neighbourhood spill: how does pollution affect our water? continued

## Method:

9. Take a final sample of the water. What does it look like now? Do you think you would want to use this water to wash with, or brush your teeth?
10. Compare your water samples side-by-side and see how the water quality has worsened with the addition of more pollutants.
11. Talk to your group about what could happen to the local wildlife if they had to use this water to wash in and drink from.
12. What do you think the houses could do differently to stop contaminating the water in their neighbourhood?
13. How do you think engineers could help to reduce the effects of water pollution?

1



2



3



4



# Intriguing Inventions

Inventions are new things or ideas that people create to make life easier, better, or more fun. They can be anything from toys to machines, like the light bulb or a scooter! Inventions help solve problems and can make our everyday tasks faster or more exciting. They start with someone's imagination, and with a little creativity, they can turn into something that changes the world!

## Interesting fact:

Many inventions we couldn't think of living without were made by women! Have a look at a few below:



Ruth Graves Wakefield  
- chocolate chip  
cookies

Anne Connelly -  
the fire escape

Marie Van Britan  
Brown - home security  
systems



# Egg parachutes

Parachutes were first conceived as an idea in the 1400's by Leonardo da Vinci, an amazing inventor of his time. Although he sketched the idea, the parachute wasn't successfully made until the first recorded jump in 1783 when Louis-Sébastien Lenormand jumped out of a tree using two parasols to help break his fall. Although this seems very different from the parachutes we have today, the concept was formed and then developed into the parachutes we all know now.

We all know eggs can be fragile with the shell being easy to crack. You need to make a parachute device to stop your egg cracking when it is dropped.

**Estimated Time:** 45 Minutes

## Equipment:

- Card
- Paper
- String
- Scissors
- Sticky tape
- Cocktail sticks
- Lollipop sticks
- Straws
- Raw eggs
- Zip lock bags
- Any other construction materials you would like to use (use some recycling!)



## Method:

Design and build a structure that can encase an egg and protect it from shattering if it is thrown in the air or dropped from a first storey window. You may want to think about which materials will cushion the egg to stop it from breaking.

**Tip:** *Wrap your egg in a zip lock bag before you build your structure around it so that, if the egg does break, it will not cause a mess. Or, if you're not comfortable using a raw egg, you could always hard-boil it.*

## Guidance for Leaders:

Younger girls may find this activity quite challenging but do encourage them to be creative and think about ways to keep the egg safe. To make the activity easier, you could always limit the number of materials you provide and suggest some ideas to them, such as making a parachute.



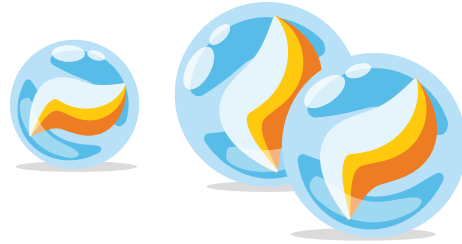
# Marble run timer

Timers can be used to count time, either how long something may take, or count down a set period of time. You are going to create a count down timer using recycling and a marble. How long can you make your count down timer? What could you use your count down timer for?

**Estimated Time:** 1 hour

## Equipment:

- Marble (1 per group)
- Variety of different sized bottles/containers/boxes/toilet rolls
- String
- Scissors
- Sticky tape
- Card
- Pipe cleaners
- Lollipop sticks



## Method:

1. In a group, using household items and recycled materials, design a marble run. Try to include as many interesting features as you can e.g. loops and see-saws!
2. Make your marble run as long as you can and time it to see how long it takes for the marble to get to the end
3. Test the time it takes the marble to get to the end a few times. Does it take roughly the same amount of time each go?
4. You have now made a timer! However long it takes for your marble to complete the run is how long your timer lasts
5. Can you think of any occasions where you need a timer?



# Invent a new sport

Inventions can also be made to make your life more fun. Why not try creating a new sport!

**Estimated Time:** 30 minutes

## Equipment:

- Pens
- Paper

## Method:

1. Think about the sports you enjoy, what makes them so fun?
2. Now imagine you have a friend who wants to play but they have a disability.
3. Think about how you can change your sport to be accessible to your friend.
4. You should consider the following things when designing your sport:
  - What are the rules, scoring system and winning criteria?
  - How is it specifically suited to those with a disability?
  - Will players require any specialist equipment?
  - Where will your sport be played?
5. Once you have finished designing your sport, explain its rules to your Leader or have a go at playing it!

## Guidance for Leaders:

Some girls may need this activity to be a bit more 'hands-on'. Rather than using a pen and paper, they might find it easier to play a game or sport they enjoy and try different adaptations. For example, can they think of a way to play 'Splat!' with their eyes closed?

