As Creatives

Engineers Ireland

STEPS

The Heritage Trail

Engineering Through the Ages

Downloadable Engineering Activities

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The Hill of Tara: The Mound of Hostages – in Papier Mâché!

Before You Start!

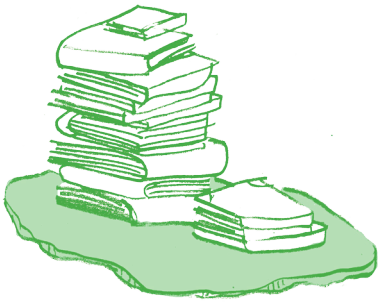
Resources	See the list below. Apart from possibly balloons, all should be readily available
Time Required	15 – 30 minutes a day, for several days!
Group Sizes	Individuals, pairs or small groups
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Maths (fractions, measuring), Science (materials)
Notes	The activity involves paste – so things might get a bit messy! You'll also need some space to allow the "mounds" to dry between applications.

**all of the activities have links to both Irish history and Irish geography.*

Engineering Connection!

Laminating allows engineers to create strong structures from relatively well materials. Many car windscreens are manufactured using laminating processes!

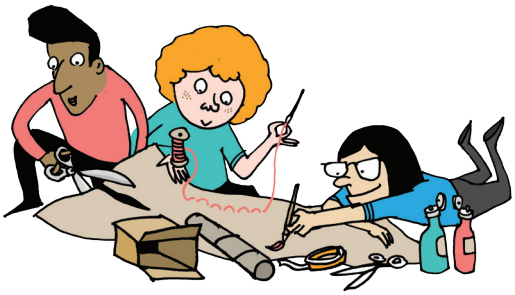
The Hill of Tara: The Mound of Hostages - in Papier Mâché!



There are lots of ancient monuments on the Hill of Tara – but the Mound of the Hostages is the oldest visible one. And it certainly is old – dating back more than 5,000 years! The prehistoric peoples didn't just dig into a pre-existing hillock, though – this was a carefully crafted and engineered design. And this challenge will see you building your own!

You Will Need:

- Balloon
- Large bowl
- Paste
- Tea towel
- Felt tip pen
- Newspaper
- Scissors
- Pin
- Green paint (or some green cloth)
- Time!



The Process:

Stage 1:

- Tear the newspaper into strips – about 3 – 5cm long and 1 – 2 cm wide.

Stage 2:

- Make your paste – using the large bowl. Flour and water paste costs almost nothing – and is very effective!
- Place a tea towel over the bowl whenever you're not using the paste.

Stage 3:

- Inflate the balloon so that it is taut (but not too taut!) – and tie it off securely.

Stage 4:

- Lay the balloon on its side – on another sheet of newspaper.
- Carefully (very carefully!), use the felt tip pen to draw a line all the way around it – dividing it in half lengthways.

Stage 5:

- Take a strip of newspaper – and immerse it in the paste.
- Lay the strip along the line you have drawn.
- Repeat with another strip – so that it slightly overlaps the first one.
- Repeat the process until you have covered one half of the balloon.
- Tidy up (!) – and leave the balloon to dry.

Stage 6:

- Twenty four hours later, repeat the process of laying – and overlapping – newspaper strips on top of the layer you have already created.
- Repeat the process daily until you have laid at least five layers.

Stage 7:

- Once everything has dried after your final application, use the pin to pop the balloon.
- Use the scissors to cut a doorway into your Mound of hostages (you may want to ask an adult to do this for you).
- Paint your Mound green (or use green cloth to cover it).

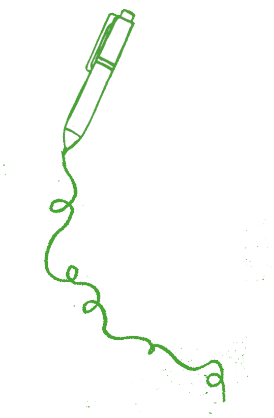
And your Mound of Hostages is complete! So why not use it, as the ancients did, to store some of your most precious objects …?

Things to Think About:

- This challenge requires patience – if you rush things, you're almost certain to fail.?
- Don't worry if the balloon bursts (or deflates) after the first two or three layers have been applied – by then your Mound should have enough structural integrity for you to complete the challenge. But how will you reduce the chances of it bursting or deflating in the first couple of days?

Recording Your Work

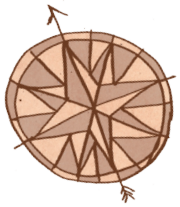
If you'd like to, you can print the worksheet accompanying this challenge – allowing you to keep a record of your work.



No more to chiefs and ladies bright
The harp of Tara swells;
The chord alone that breaks at night,
Its tale of ruin tells!

(from *The Hill of Tara*, by Thomas Moore)

The Mound of Hostages – in Papier Mâché! – the Worksheet!



1. Draw a labelled picture of your completed Mound in the box.
Show the dimensions of all parts of your Mound.

2. What difference do you think it might have made if you had divided your balloon in half in a different way?

Engineering Through the Ages

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The Hill of Tara: The Eternal Figure of 8!

Before You Start!

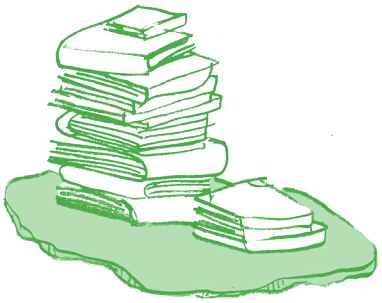
Resources	All should be readily available
Time Required	20 – 40 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Maths (2D shapes, measuring), Literacy (writing), Fine Motor Skills
Notes	

**all of the activities have links to both Irish history and Irish geography.*

Engineering Connection!

Mobius strips are more commonly used than you might think. They have been used in the design of certain types of resistor – and resistors are common electrical components in nearly every electronic appliance you'll find!

The Hill of Tara:
The Eternal figure of 8!



Both the Mound of the Hostages and the Royal Seat are bound by double-ditched enclosures. They're roughly circular in shape – and from the air combine to make a figure of 8! And as the figure of 8 is connected in many mythologies with ideas of eternity, this challenge will see you creating your own eternal journey – one you can take both forwards and backwards!

You Will Need:

- A4 paper (1 sheet)
- Ruler
- Scissors
- Pen or pencil
- Paperclip

Print off pages x and x of this document – as a single, double-sided sheet (in which case the two rectangles with words in them will match up). Cut along the dotted lines (you may want to ask an adult for help with this).

Recording Your Work

If you'd like to, you can print the worksheet accompanying this challenge – allowing you to keep a record of your work.

The Process:

Note: if you don't have time for the writing and cutting out, print off pages x and x of this document – as a single, double-sided sheet (in which case the two rectangles with words in them will match up). Cut along the dotted lines (you may want to ask an adult for help with this). Then go to Stage 5!

Stage 1:

Cut out a strip of paper – about 30cm long (the length of an A4 sheet of paper) and 3cm wide.

Stage 2:

Lay the strip out lengthways. Starting 1cm from the left hand side, write the following words (you are aiming to finish the last word 1cm from the right hand side!) ...

Oh, Tara, home to glories past our memories our stories

Stage 3:
Take the bottom edges of the strip and flip it over backwards.

Stage 4:
Starting 1cm from the left hand side, write the following words (you are aiming to finish the last word 1cm from the right hand side!) ...

our memories our past glories to home, Tara, Oh

Stage 5:
Use the paperclip to join the two short edges of the strip together. You will have created a bracelet – with the two lines of the verse on different surfaces.

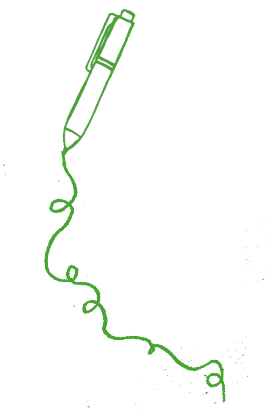
There is a way, though, to join the two ends of the strip together in a way that creates just one surface – and joins the two lines together. Can you work out how to do it? You'll find the answer on the next page – but try a few ideas out before looking!

The Mobius Strip
Hold one edge of the strip in one hand – and the other in the other. Give the strip a twist – and then join the edges with the paperclip. If you've done this correctly, you will have created a Mobius Strip – with just one surface. And this will allow you to read the verse in one go ...

Oh, Tara, home to glories past our memories our stories
our memories our past glories to home, Tara, Oh

The Eternal Verse
Starting with the words "Oh, Tara", read the verse in the other direction. If you've written the words out correctly, it will read exactly the same backwards as forwards. It's a palindrome – your very own Eternal Figure of 8!

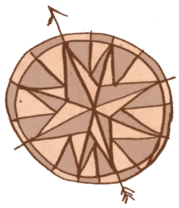
The Twist in the Tale
What happens when you twist the strip of paper twice before joining the ends together? What about three times? Try it and see!



Consume my heart away … and gather me
Into the artifice of eternity!

(from *Sailing to Byzantium*, by WB Yeats)

The Eternal Figure of 8 – the Worksheet!



1. Draw a 3D representation of your Mobius strip. Use arrows to indicate how the surface works.

2. Draw a 3D representation of how the chain looks when you twist the strip twice before joining the ends. How many surfaces does the figure have? Use arrows to indicate how any surfaces work.

3. Draw a 3D representation of how the chain looks when you twist the strip three times before joining the ends. How many surfaces does the figure have? Use arrows to indicate how any surfaces work.

Engineering Through the Ages

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The Hill of Tara: King Nuada's Arm

Before You Start!

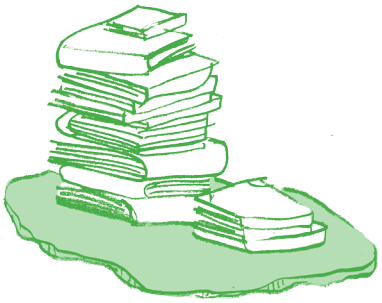
Resources	See the list below. Apart from possibly split pins, all should be readily available
Time Required	45 – 60 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need supervision or help with cutting – and with inserting the split pins
Curriculum Links*	Maths (2D shapes, measuring), Science (pivots), Fine Motor Skills
Notes	

**all of the activities have links to both Irish history and Irish geography.*

Engineering Connection!

Engineers use **pivots** all the time – how many picture hooks can you find at home or at school?

The Hill of Tara: King Nuada's Arm



According to legend, the ancient and godlike people of the Tuatha Dé Danaan made Tara their capital of Ireland when they arrived on the island – but not until they had won a battle or two! The First Battle of Moyturao saw their king, King Nuada, badly injured – when he lost his arm. Luckily for him, though, he had a doctor called Dian Cecht – who built him a new arm made from silver!

This challenge will see you engineering your very own King Nuada's Arm – and trying it out!

You Will Need:

- Cardboard – the thicker the better
- Pencil
- Ruler
- Scissors
- Split Pins*

** if you don't have any split pins, drawing pins and modelling clay will do!*

Recording Your Work

If you'd like to, you can print the worksheet accompanying this challenge – allowing you to keep a record of your work.

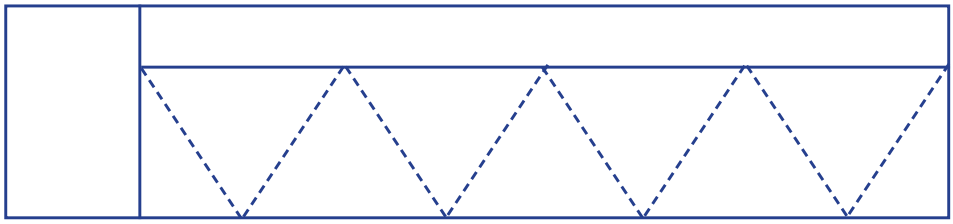
The Process:

Stage 1:

- Using a pencil and ruler, mark out four rectangles on your cardboard. These should be identical and measure between 10 and 15cm long … and between 3 and 4cm wide. The thicker and more rigid your cardboard, the larger your rectangles can be.
- Cut the rectangles out (you might want to ask for an adult's help with any cutting).

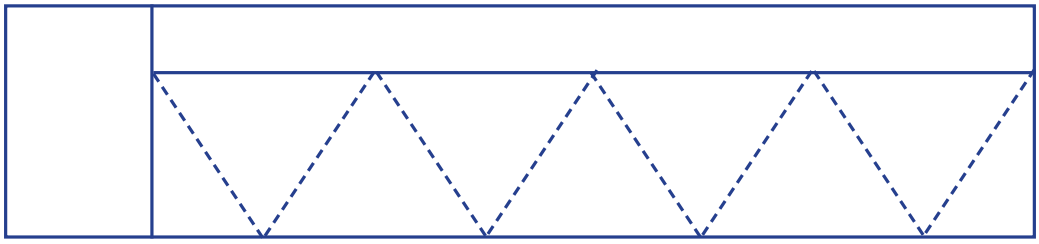
Stage 2:

- Mark and cut out a fifth rectangle – working to the same dimensions. Use the diagram below to help you cut out some teeth. This is the first of your "claws".



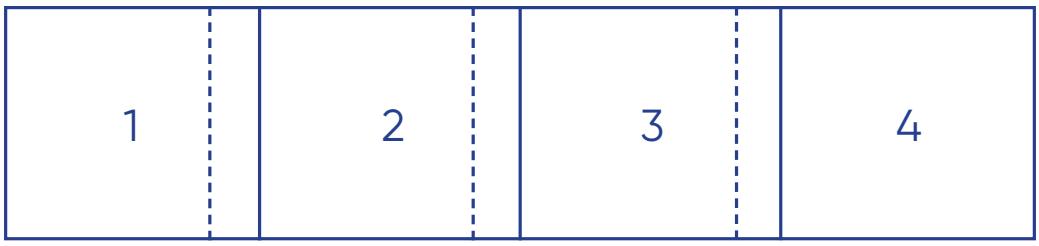
Stage 3:

- Mark and cut out a final rectangle – working to the same dimensions. Use the diagram below to help you cut out some teeth. This is the second of your "claws".



Stage 4:

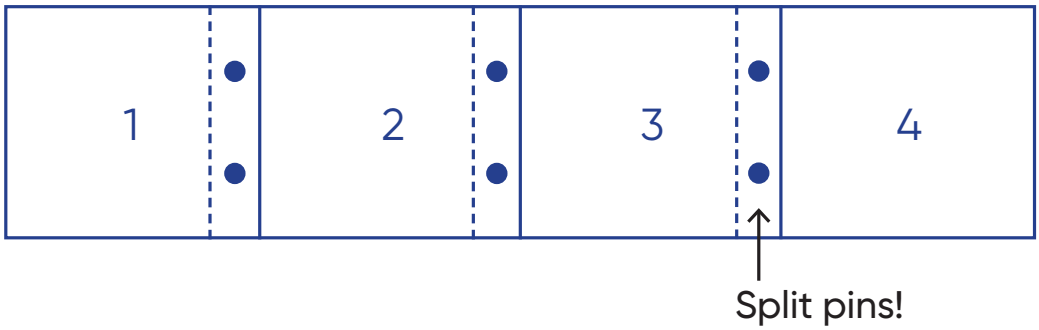
- Use the diagram below to help you arrange the four rectangles. You'll need to use as flat a surface as possible!



Stage 5:

- Very carefully, use split pins* to hold the rectangles together. The diagram below shows you where they need to go – and you might want to ask for an adult's help.
- Don't make things too tight – ideally you want the cardboard rectangles to be firmly connected but with some independent movement.

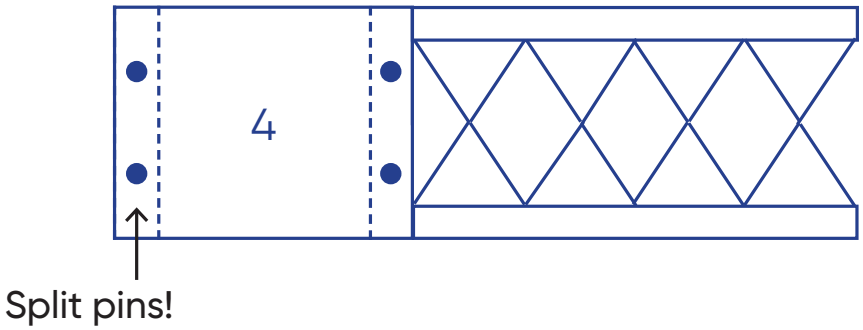
** if you don't have any split pins, use drawing pins, securing the pointed ends with modelling clay.*



Stage 6:

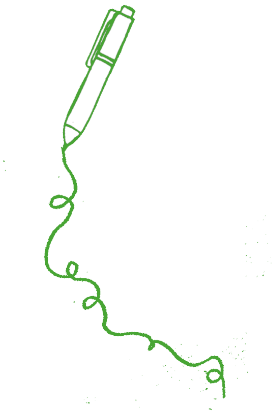
- Very carefully, use split pins* to attach the two "claws" that you have made. The diagram below show you where they need to go – and you might want to ask for an adult's help.
- Don't make things too tight – ideally you want the claws to be firmly connected to the rectangles, but with some independent movement.

** if you don't have any split pins, use drawing pins, securing the pointed ends with modelling clay.*



Testing the Arm

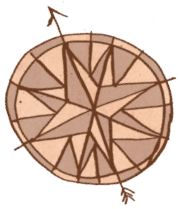
And your Arm is complete! Like King Nuada himself, you'll find it's more limited than a real arm – so think about what you can use it for. Will you be able to pick up a paper bag with it, for example? Could you use it to comb someone's hair (get permission first!)? Come up with at least five tests – and try them out!



Kings arise to meet the battle ...
Honours are given ...
Battles are observed ...
Poems are recited!

(from *The First Battle of Moytura*,
in Cath Maige Tuired, by the Morrigan)

King Nuada's Arm - the Worksheet!



1. Use this box to draw a labelled diagram of your completed Arm.

2. Come up with five "tests" for your arm. Make a prediction for each one – and test them out!

Task	Prediction	Outcome

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The Hill of Tara: The Lia Fáil (The Great Coronation Stone)

Before You Start!

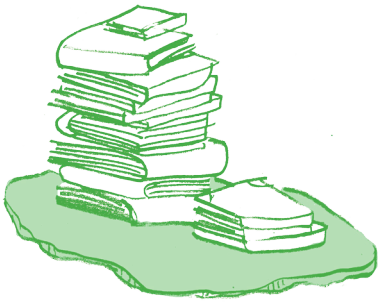
Resources	See the list below. You'll probably want to source the house brick and trowel beforehand!
Time Required	60 minutes +
Group Sizes	Individuals, pairs or small groups
Supervision	Younger children may need supervision or help with creating their "rollers" – and with handling their brick!
Curriculum Links*	Maths (measuring)
Notes	This challenge involves digging – you'll probably want to specify exactly which areas the participants can dig in!

**all of the activities have links to both Irish history and Irish geography.*

Engineering Connection!

Ancient engineers had to find ingenious solutions to difficult problems – with only basic technology to hand. Interestingly, ancient engineers in different countries seem to have come up with the same or similar solutions. The construction of Stonehenge in the UK probably used similar methods as the Coronation Stone!

The Hill of Tara: The Lia Fáil (The Great Coronation Stone)



Note: this challenge involves a bit of digging – so don't start until you know exactly where you're allowed to dig!

The Lia Fáil is one of the four legendary treasures of the ancient and godlike people of the Tuatha Dé Dannan - and stands proudly at Tara, around a metre tall.

According to legend, it was the site at which every High King of Ireland was crowned – giving it its other name: the Great Coronation Stone.

No-one knows quite where the Stone comes from. Some stories say Spain, others Scotland – and one even claims it came from Egypt! One thing is certain, though – whatever the Stone's origin, it would have taken a great deal of effort to get it to Tara!

This challenge will see you attempting to transport and erect your own Lia Fáil – using only primitive technology!

There is no particular "right or wrong" approach to this challenge – your level of success will tell you how "right" or "wrong" yours was! If your first attempts don't succeed, though, at any point in the process (and there are lots of points at which things can go wrong!), try to work out what the issue is, solve the problem – and try again.

Note: this is an outdoor challenge. Don't do any digging until you are sure you have permission!

You Will Need:

- House brick (or something of a similar size and weight)
- String (half a metre or so should do)
- Trowel
- A4 card (four sheets)
- Sticky tape
- Lolly sticks (up to four)

The Challenge

- Use the card to create four "rollers" to transport the brick (your Lia Fáil). Roll the card tightly – and secure the rollers with sticky tape.
- Use the string to create a "cradle" for your Lia Fáil – leaving enough loose string for you to pull on.

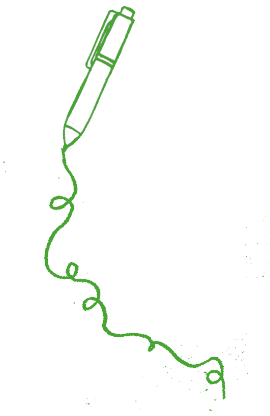
- Dig a hole that is big enough to fit the narrow end of your brick. You'll need to use your judgement to decide how deep it needs to be to support the brick securely!
- Place your Lia Fáil (in its cradle) and the rollers about 2 metres from the hole you have dug. Make sure there are no obstructions between the Lia Fáil and the hole!
- Use the rollers to transport the Lia Fáil (you'll need to keep moving the one at the back of the Lia Fáil to the front). You are allowed to use the lolly sticks as levers.
- Once the Lia Fáil arrives at the hole, find a way to tip it in and stand it upright – using only the materials you have been provided with (not including the trowel).
- Pack the soil you have dug out around the Lia Fáil to secure it. How secure is it? If it topples over too easily, you may need to start again!

Things to Think About:

- How will you control the speed as you transport your Lia Fáil to its resting place to reduce the chances of it falling/sliding off its rollers? Remember – if it does fall off, you're only allowed to use the materials you've been provided with to reposition it!
- How will you get the Lia Fáil into its hole – and how will you get it straight?

Recording Your Work

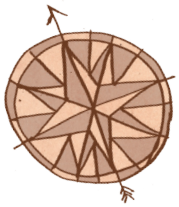
If you'd like to, you can print the worksheet accompanying this challenge – allowing you to keep a record of your work.



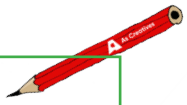
This King bade this Simon take
That Stone, and into Ireland go –
And win that land and occupy
And hold that Stone perpetually!

(from *In Irish Rain*, by Martha Haskell Clark)

The Lia Fáil (The Great Coronation Stone) - the Worksheet!



1. Use this storyboard to show your designs – and the journey of your Lia Fáil.



1.	2.
3.	4.
5.	6.

2. Which parts of your design do you think worked the best?

3. Which parts of your design do you think worked less well?

4. Can you think of any other monuments which were built/engineered/created with primitive technology?

Engineering Through the Ages

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The Hill of Tara: Five Roads Arithmagons

Before You Start!

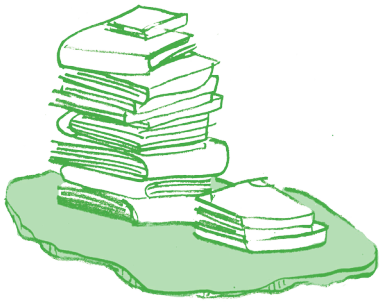
Resources	See the list below. Everything should be readily available.
Time Required	10 – 15 minutes
Group Sizes	Individuals or pairs
Supervision	None required
Curriculum Links*	Maths (number operations)
Notes	If participants get stuck, suggest they start at the square with the "4"

**all of the activities have links to both Irish history and Irish geography.*

Engineering Connection!

The relationships between numbers are really important when it comes to "engineering" in the natural world. The Fibonacci Sequence of numbers where each number (from the third onwards) is the sum of the two that came before it. So it goes: 1, 1, 2, 3, 5, 8, 13, 21 ...etc. astonishingly, the structures of all sorts of plants, including roses, pineapples and pine trees, are governed by the Fibonacci Sequence!

The Hill of Tara:
Five Roads Arithmagons



Do all roads lead to Rome? Not in Ireland, they don't – because in ancient times it was said that all roads lead to Tara! Which isn't surprising, since the Hill of Tara was where the High Kings of Ireland were crowned – and it's certainly true that the island's five most important roads actually did all take you to the Hill, creating a roughly pentagonal shape.

This challenge turns the area of the Five Roads into an arithmagon (you'll learn what this s later!) - an arithmagon that you have to solve ...

You Will Need:

- Pencil
- Rubber (because you're almost certain to make mistakes!)

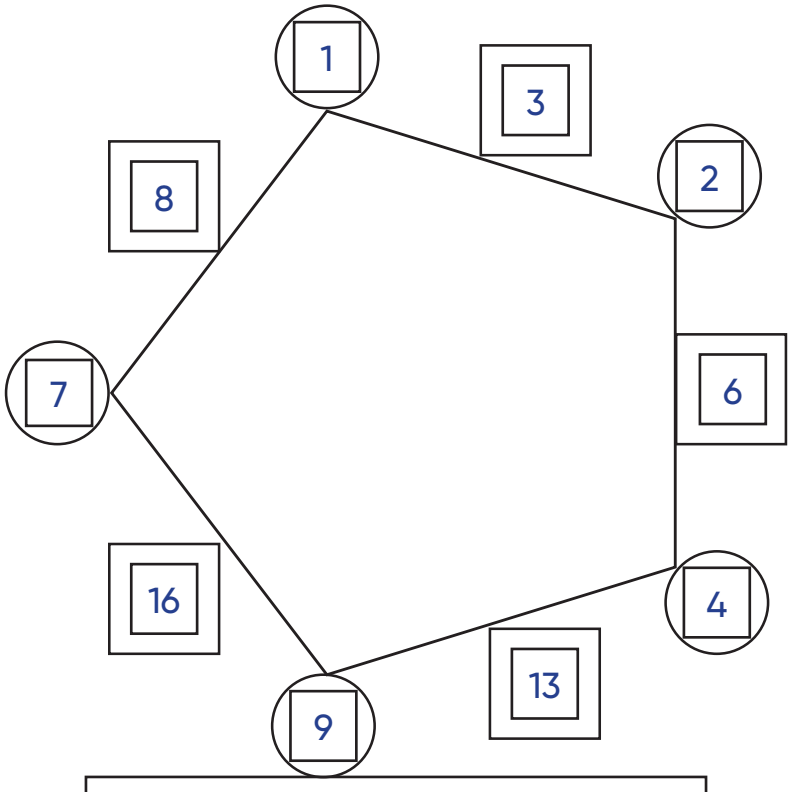
** you might prefer to print out the arithmagon – and you'll find a large version towards the end of this document.*

The Challenge:

Using only the materials provided, design and construct as tall an operational round tower as you can.

Arithmagons

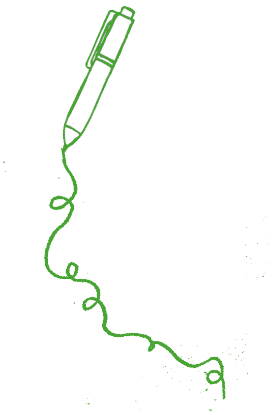
As you can see from this diagram, a pentagaonal arithmagon has circles at each of the five points of the pentagon ...



- It has squares in between the circles – and a number in each of the squares.
- The number in a square is the sum of the numbers in the two circles either side of it. You are not allowed to use zero, and you cannot repeat a number …
- So if a square contains the number 3, one of the circles must contain a 1, and one must contain a 2 …
- But if a square contains the number 5, the circles surrounding it could contain a 1 and a 4 – or a 2 and a 3!

Look at this arithmagon. Your challenge is to work out what numbers go in each of the circles. The numbers you need are all between 1 and 10. Remember: it might be easier if you print out the large copy of the arithmagon on the next page. Good luck!

Once you've completed it, why not have a go at creating your own arithmagon – and testing it on family and/or friends? There's a blank arithmagon at the end of this document.



A little lane, the brook runs close beside
And spangles in the sunshine
while the fish glide swiftly by!

(from *On a Lane in Spring*, by John Clare)