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Engineering Through the Ages

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Engineering Through the Ages

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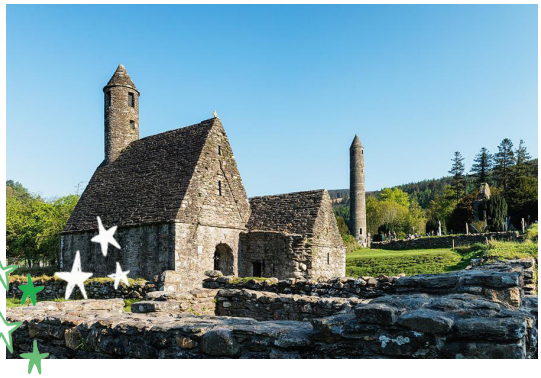
Glendalough: Long, Long Longboats!



Before You Start!

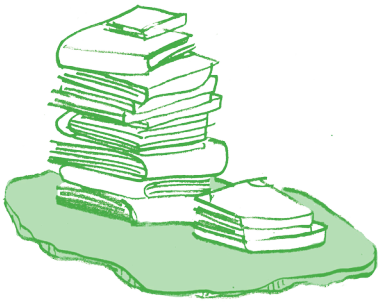
Resources	Apart from the wooden skewer, all should be readily available
Time Required	60 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need supervision or help with cutting and assembly – and with use of the wooden skewer
Curriculum Links*	Maths (2D shapes, fractions, measuring), Science (materials)
Notes	(1) You'll need to print out the templates provided. (2) If you decide to test the longboat, water will be involved – so things might get a bit messy!

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

Engineering Connection!

The Vikings were extremely ecological, using animal dung to waterproof their longboats – and insulate their longhouses! The engineers of the 21st century are learning from these people of old, by looking for more and more natural ways of insulating our homes – and helping in the battle against climate change!

Glendalough:
Long, Long Longboats!



Glendalough was home to oak trees long before St Kevin went there – and 7,000 years ago, it would have been completely wooded by them! It was in 1042, though, that oak from the area was used in the construction of the second longest Viking longboat in the whole of recorded history (there's a 21st century replica in Denmark!).

To celebrate that achievement, this challenge will see you constructing your own longboat– and making it as terrifying as you can!

You Will Need:

- Thick cardboard (the base and sides of a cardboard box – the type used for deliveries - are ideal)
- Paper
- Wooden skewer (with a pointed end)
- Small piece of modelling clay
- Waterproof paints and brushes - or crayons or waterproof felt tips
- Glue
- Scissors
- Masking tape

The Process:

Stage 1:

- Get your cardboard ready (if you're using a cardboard box, carefully cut out the base and side panels).

Stage 2:

- Print out the templates that you'll find with this activity – and cut them out.
- Draw around the templates on the cardboard. You will need two of the larger oval, four of the smaller oval – and two of the rectangles.

Stage 3:

- Cut out the six ovals you have drawn.
- On each of the ovals, make small cuts on the crosses.
  The cutting can be fiddly, so you might want to ask an adult for help!

Stage 4:

- Carefully, glue the two larger ovals together, one on top of the other. Leave to set firm. Then wrap in masking tape (apart from the area where you have cut the cross).
- Carefully, glue one of the smaller ovals on top of another. Glue the third on top of this – and the fourth on top of the third. Leave to set firm - then wrap in masking tape (apart from the area where you have cut the crosses).
- Glue the pile of small ovals on top of the pile of large ovals – making sure that the areas where you have cut the crosses match up.

Stage 5:

- Cut out the two rectangles. Glue one along one side of your construction – to make one side of the longboat. Glue the second along the other side of your construction.
- Use masking tape to cover these pieces of card (inside, outside, along the top and along the bottom). If necessary, use more tape to cover any gaps at the front of the ship (the *prow*) – or at the back of the ship (the *stern*).

Stage 6:

- Cut out a rectangle of paper for your sail. Decorate it in a way that will make it look terrifying!
- Glue the sail to the wooden skewer. The skewer will be your mast – and the sharp end will be at the bottom of the mast.
- Carefully, push the pointed end of your skewer (your mast) through your ship – down through the sections where you have cut a cross.
- Use masking tape to secure the areas around the mast.
- Paint your longboat – but make sure you use waterproof materials!

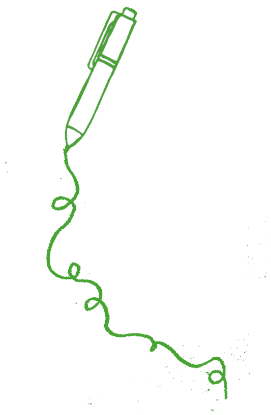
And now, if you're feeling brave enough, test your boat out on water!

Things to Think About:

- The more cardboard you leave exposed (ie untaped), the more waterlogged your longboat will get!

Recording Your Work

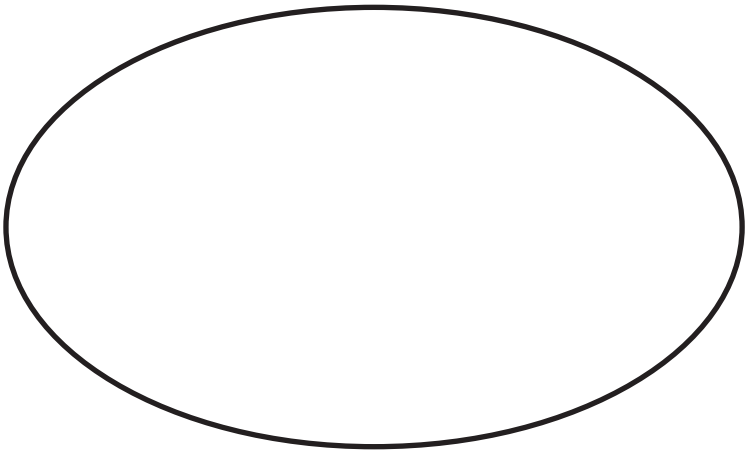
If you'd like to, you can print the worksheet accompanying this challenge – allowing you to keep a record of your work.

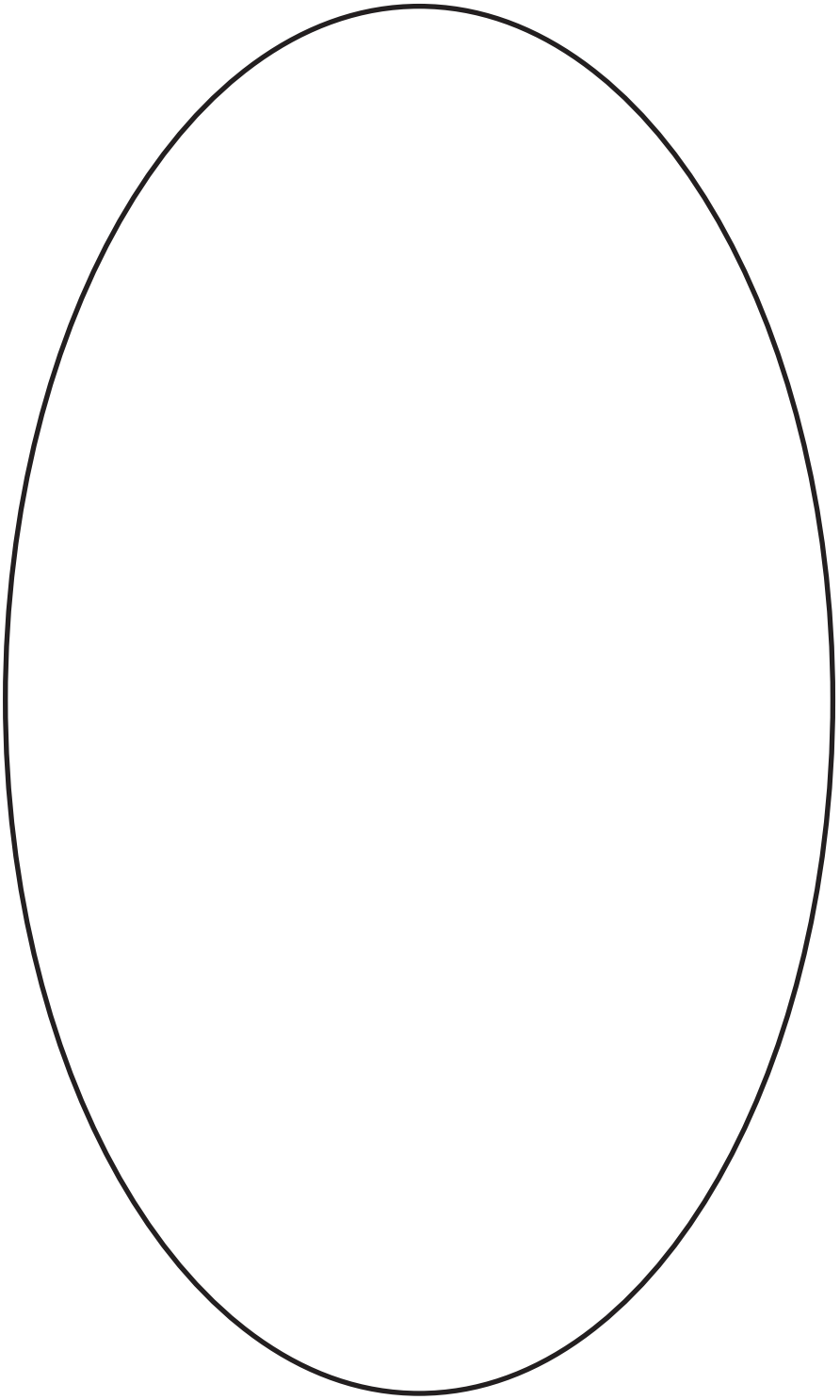


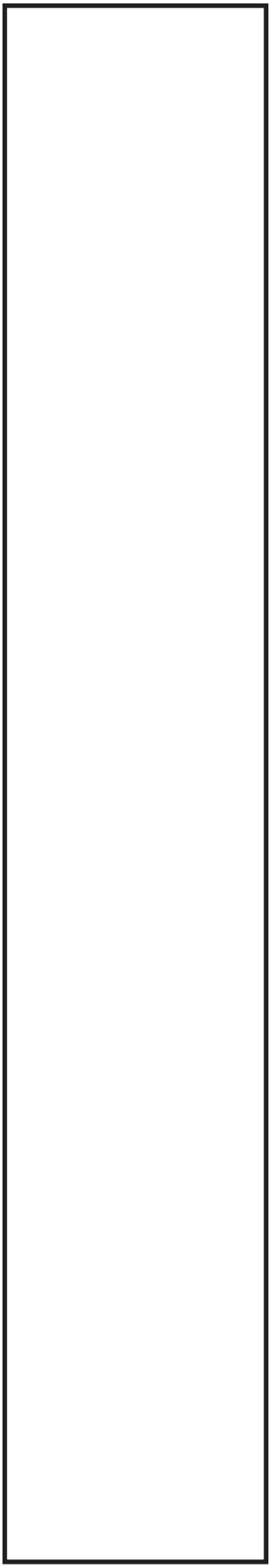
Bitter is the wind tonight
It tosses the ocean's white hair
Tonight I fear not the fierce warriors of Norway
Coursing on the Irish sea

Is acher ingáith innocht .
fufuasna faircggae findfolt
ni ágor réimm mora minn
dondláechraid lainn oua lothlind'

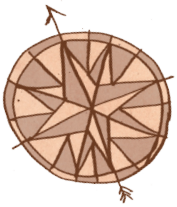
(*Tonight I Fear Not the Vikings*,
anonymous, 9th century)







Long, Long Longboats – the Worksheet!



1. Draw a labelled picture of your completed longboat in the box.

2. What was the trickiest part of the construction?

3. Sails were only of use in windy conditions, of course. When the wind dropped, the Vikings had to row. How would you make the oars – and fix them to your longboat? Use this box to write or draw your ideas.

ENGINEERS IRELAND
STEPS

Glendalough: The Knights of St Kevin

Before You Start!

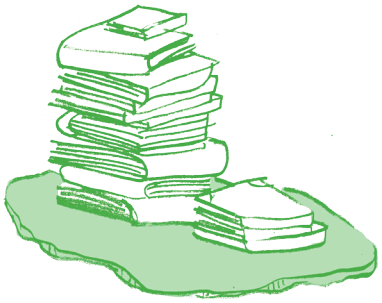
Resources	See the list below – you may need to hoard the inner tubes kitchen rolls for a while
Time Required	15 - 20 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Maths (problem solving), DT
Notes	Some parts of this activity are quite fiddly - testing both patience and resilience!

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

Engineering Connection!

In olden times, lances were anything from 3 to 5 metres long – and made from wood. This meant that knights actually had to be careful not to use too much force, otherwise the momentum would cause the lance to shatter! Today's engineers take this into account by designing products where momentum is taken into account to lengthen a structure's lifespan.

Glendalough:
The Knights of St Kevin



St Kevin talked of battling "knights" as he sat in silent reflection in his cave at Glendalough, about 1,500 years ago. This was probably a way of describing the struggles he had with his faith and some of the temptations he felt. So your challenge is to design and engineer, your very own small scale knights' jousting lance – using easy-to-source materials!

You Will Need:

- Cardboard tubes*
- Table tennis ball (or modelling clay)
- Cardboard coffee/tea cup
- Masking tape
- Pencil
- Scissors
- Felt tips

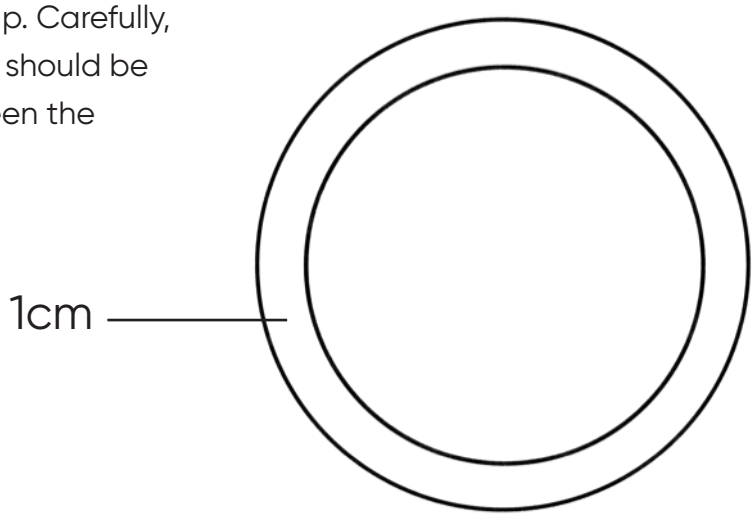
** the inner tubes of two kitchen rolls are ideal*

The Challenge:

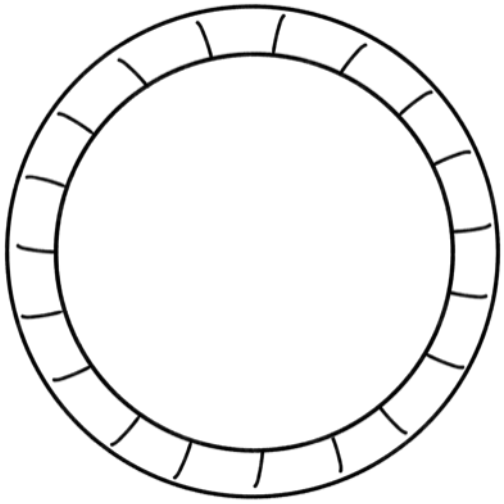
1. If you are using two cardboard tubes, use masking tape to fix them firmly together – end to end.

2. Put the cardboard cup on a flat surface, open end down. Place your tube on top of it – vertically and centrally. Draw around the tube – to get a circle.

3. Put the tube to one side, so that you can see the circle you have drawn on the cup. Carefully, draw a second circle inside it (there should be a gap of about a centimetre between the two circles) – to look like this …



4. Draw some lines from the edge of the inner circle –almost to the edge of the outer circle – to look like this …



5. Carefully, cut out the inner circle. This can be fiddly – so you might want to ask an adult for help.

6. Carefully (and again you may need help), cut along the lines going almost to the edge of the outer circle.

7. Push the cardboard tube up through the coffee cup (the flaps you have cut will allow you to do this) until only about 10 centimetres of its length remains inside the cup. Use the masking tape to fix the flaps to the tube to hold it firmly in place.

8. Place the whole structure on a flat surface, with the open end of the cup downwards. Place the table tennis ball on top of the open end of the tube, so that most of the ball is visible. Use the masking tape to fix it firmly in place*.

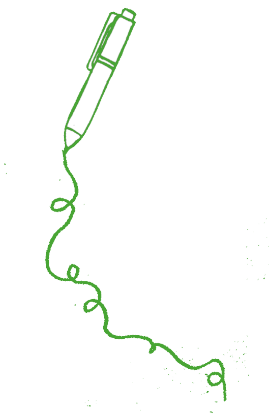
9. Use the felt tips to decorate your lance.

Your lance is now ready to use – by putting your hand inside the cup and using the end of the tube as a handle!

**if the tube you are using is too big for a table tennis ball (or if you can't get a table tennis ball), create a sphere of the correct size from crumpled newspaper, using masking tape to hold it in shape.*

Things to Think About:

- Because the cardboard tube is long and thin, it will tend to veer away from the vertical. What can you do to keep it rigid?.



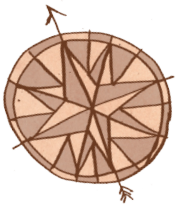
Recording Your Work

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

At Glendalough lived a young saint,
In odour of sanctity dwelling,
An old-fashion'd odour, which now
We seldom or never are smelling!

(from *St Kevin – A Legend of Glendalough*,
by Samuel Lover)

The Knights of St Kevin - the Worksheet!



1. Draw a labelled picture of your completed lance in the box.

2. How could you strengthen your lance and make it more rigid? Use this box to write about or draw your ideas.

Engineering Through the Ages

ENGINEERS IRELAND
STEPS

Glendalough: Mechanical Manuscripts

Before You Start!

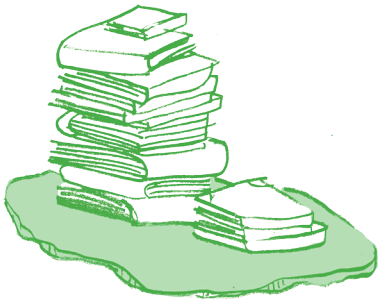
Resources	See the list below.
Time Required	60 – 90 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Science (forces)
Notes	This activity involves paint – so choose an appropriate space to work in (and suitable clothing!).

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

Engineering Connection!

The early printing presses used metal letters. Although these were fiddly to make, they were much better suited to surviving the forces involved in the process than ones made from wood – and so saved time in the long run. It wasn't until the development of vulcanisation (in the 19th century) that rubber letters became widely used.

Glendalough:
Mechanical Manuscripts



In the eleventh and twelfth centuries, the monastery at Glendalough was an important centre of the art of manuscript making. The Book of Glendalough was written there in about 1131 – and an earlier manuscript, going back to around 1106, gives instructions on the use of the abacus! Since the invention of the printing press, though, around three hundred and fifty years later, most books are produced mechanically – offering the gift of reading to us all. And your challenge is to build your own miniature printing press!

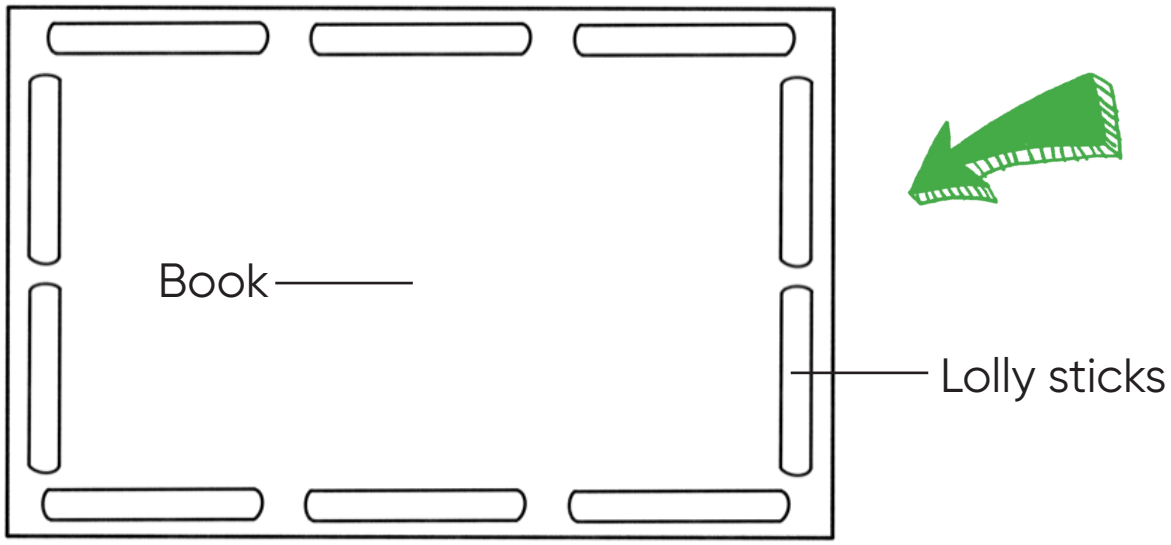
You Will Need:

- Hardback book (the heavier the better!)
- Cardboard
- Rubber bands
- Lolly sticks
- Glue
- Scissors
- Pencils (2)
- String
- Modelling clay
- Paint or ink
- Saucer or small bowl
- Paper

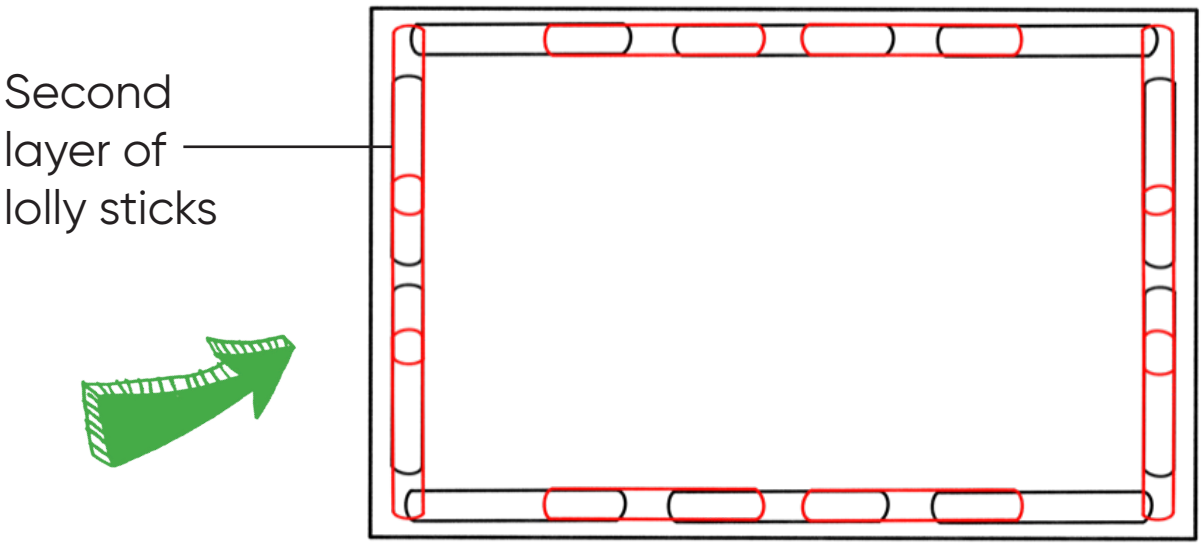
The Challenge – Part 1:

- Your first job is to create a frame to hold your book. You'll need to work on a flat surface...

    - Cut out a piece of cardboard so that it will almost wrap around the book lengthways – and secure it in place with strong rubber bands.
    - Place the book on the flat surface, so that the side that is entirely covered is face up. Glue lolly sticks along each edge of the cardboard (working them under the rubber bands where appropriate) – to look something like this ...



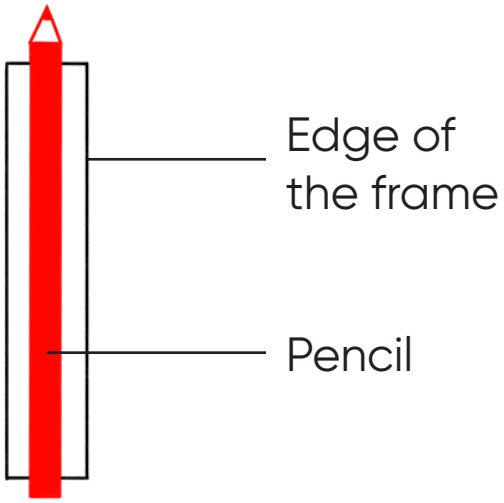
- Once the lolly sticks have set firmly, glue a second layer of lolly sticks on top of the first, to cover any gaps - to look something like this ...



- Two layers will normally be enough – but if the book you are using is particularly large or heavy, you may need to add a third.

- Glue the pencils to the two shorter sides. You may even want to add a bit of masking tape, to make things more secure!

- Tie string to the ends of each pencil – about 30cm of string on each side.



The Challenge - Part 2:

- You'll now need to create, fit and prepare your moulds ...

    - Place the book flat on the table, so that the frame is uppermost.
    - Make a shape, a number or even a letter from modelling clay.
    - Don't make it too small – as you are going to have to manipulate it. And it will certainly need to be deeper than the lolly sticks!
    - Make sure that the surface you want to print from is as flat as possible!
    - Put some ink or paint into the saucer /small bowl. Dip your mould into it – making sure that the flat surface is well covered. Then fix it firmly into the cardboard - within the frame of lolly sticks.

The Challenge - Part 3:

- Printing!

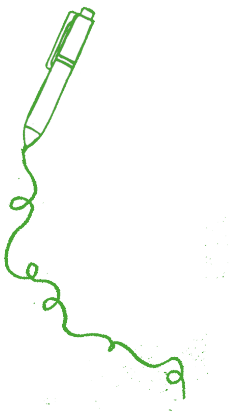
    - Carefully place the book so that it is resting on one of the longer edges – with the pencils sticking up vertically.
    - Place a sheet of paper in front of it – and in line with it. Ideally, the surface area of the paper should be larger than the surface area of the frame!
    - Hold the ends of the strings firmly – one in each hand. Pull quickly and firmly on the strings, trying to apply equal pressure to each one.
    - Using the strings if possible, return the book to its original position – and check your printing!

Things to Think About:

- How can you stop the book moving as you pull it downwards? The less it moves, the sharper your printing will be.
- How many sheets can you print before the paint/ink dries out to such an extent that the image deteriorates too much?
- If you want to print more than one shape at a time, what steps might you take to stop the paint/ink from drying out?

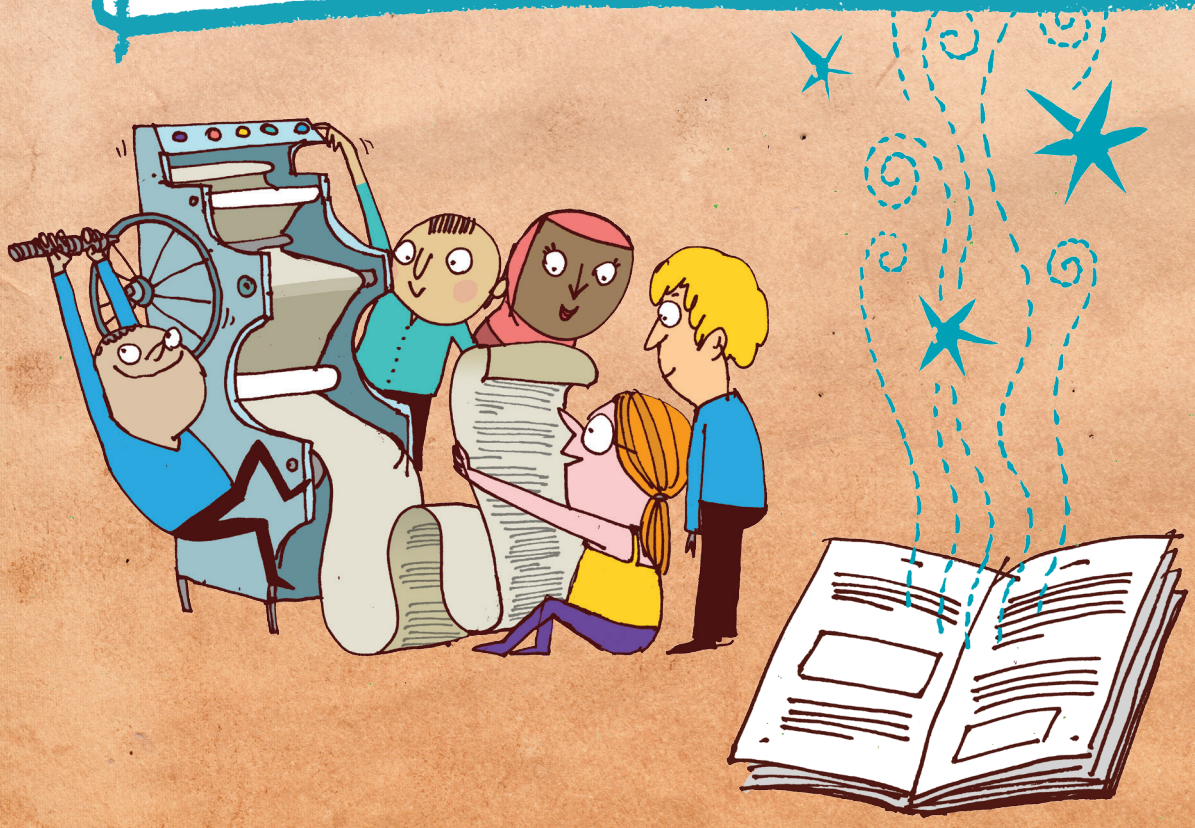
Recording Your Work

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

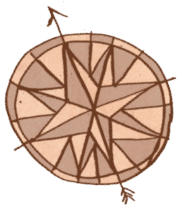


Is scíth mo chrob ón scríbainn;
ní dígainn mo glés géroll;
sceithid mo phenn gulban cáelda
dig n-dáelda do dub glégorm.

(from *Columcille the Scribe*,
ascribed to Columba)



Mechanical Manuscipts - the Worksheet!



1. Draw a labelled picture of your completed printing press in the box.

2. What shapes did you find worked best for your moulds? Draw some of them – and write some notes.

3. Can you think of any ways of improving the design? Use this box to draw some of your ideas.

Engineering Through the Ages

ENGINEERS IRELAND
STEPS

Glendalough: Leading to Lead!

Before You Start!

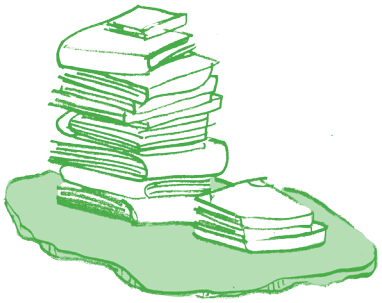
Resources	See the list below. If you don't have a hole punch, scissors will do. And make sure that the capacity of the cuboid container is greater than the capacity of the cup!
Time Required	30 - 45 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need some supervision with cutting
Curriculum Links*	Maths (units of measurement, 3D shapes, angles, estimation),
Notes	Water is involved in this activity!

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

Engineering Connection!

Lead is highly toxic – so it is used much more sparingly nowadays than in the past. However, engineers working in the medical fields make use of its property of withstanding radiation to provide safe environments for radiographers and other staff working with X rays!

Glendalough: Leading to Lead!



The land around Glendalough is naturally rich in galena – an ore of lead. So, from the end of the 18th century until the middle of the 20th century, the area was an important centre for lead mining and production.

The galena was mined by hand – a dangerous and unpleasant job for the miners of Glendalough. It was then smelted (a process a bit like roasting) – before other processes removed impurities, allowing the liquid lead to be poured into trays and allowed to solidify for use in industry. Your challenge is to design and build a waterproof chamber that can be swivelled and then tipped – so that the contents can be poured smoothly into a cuboid container. We have suggested one method – but why not try to find your own?

You Will Need:

- Cardboard coffee/tea cup
- Hole punch
- Four barbecue skewers
- Modelling clay
- Tape measure
- String (lots of it!)
- Scissors
- Cuboid container (a lunch box works well!)

Note: things (including you, probably!) are going to get wet in this challenge – so make sure you work in an appropriate space!

The Challenge

Stage 1 – Construction:

- Put a piece of modelling clay on each end of all four barbecue skewers. Arrange them to create the four vertices of a square-based pyramid – and stand the structure upright on a flat surface (the modelling clay you have used should allow you to do this).
- Cut the coffee/tea cup down so that it is about 8 centimetres tall. Cut from the top – otherwise it won't hold any water!
- Pour water into the cup – until it is about two thirds full. Then pour the water from the cup into a measuring jug. Record how much there is in there (remember to use units of measurement!).
- Using the hole punch, make four equally-distanced holes under the rim of the cup (not too close to the rim – otherwise the cup will tear later). If you don't have a hole punch, scissors will do – but you may want to ask for some help in this case, as the job will be fiddly.

- Hold the cup inside the pyramidal structure, in the centre, about 5 centimetres above the surface you are working on. Measure the distance from the holes you have made to the top of the structure (you might need some help with this!). Add 12 centimetres – and write this new distance down (remember to use units of measurement!).
- Cut four lengths of string – each measuring the length you have written down.
- Tie one end of one of the pieces of string tightly through one of the holes you have cut – and the other end to the apex of your pyramidal structure.
- Repeat for the other pieces of string – doing your best to keep the cup level.
- Punch (or cut) one more hole – halfway between two of those you have already made.

Stage 2 - Estimation:

- Place the cuboid container in front of – and close to – your pyramidal structure.
- Take a long piece of string (and we mean long!) – and tie one end through the new hole you have made. Experiment to see what length you will need so that, by pulling slowly and carefully on the other end, the cup can be pulled back and tipped. Cut the string at this length.

Stage 3 - Execution:

- Pour the water from the measuring jug carefully into the cup. Hold the free end of the long piece of string and pull it slowly and carefully until the water begins to pour (or trickle!) out – hopefully into the cuboid container. WARNING: this may not work at first – you'll probably need several attempts!
- Once you have poured out as much water as you can, pour the water from the cuboid container into the measuring jug. Compare the quantity you have collected with the quantity you started with.

Stage 4 - Refinement:

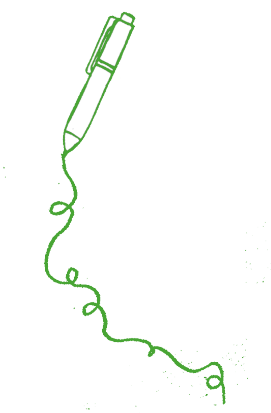
- Thinking about two things in particular, repeat the process to see if your design can perform any better ...
  - Is the "pulling string" the right length – or should it be longer? Or shorter?
  - Do you need to reposition the cuboid container?
  - How would cutting a slot in the cup help (or hinder?) the design?

Things to Think About:

- If the legs of your pyramidal structure start to slip, things are going to end catastrophically. Is there anything you can do to stop this happening?

Recording Your Work

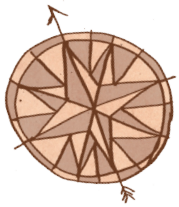
If you'd like to, you can print the worksheet accompanying this challenge – allowing you to keep a record of your work.



Each dawn as we rise,
Lord we know all too well,
We face only one thing –
A pit filled with hell.

(from *The Coal Miners' Prayer*,
by W.Calvert)

Leading to Lead – the Worksheet!



1. Draw a labelled picture of your completed design in the box.

2. What changes did you make to try to improve your design? Use the box to either make notes or draw illustrations.

3. Record your results in this table:

	Length of "Pulling String"	Position of Cuboid Container	Quantity of Water in the Cup	Quantity of Water Collected
Experiment 1				
Experiment 2				
Experiment 3				