

# The Heritage Trail

## Engineering Through the Ages

The Rock of Cashel



**Downloadable  
Engineering Activities**

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## The Rock of Cashel: Banishing the Demon!



### Before You Start!



Resources	Apart from those in italics in the list below, all should be readily available
Time Required	30 minutes
Group Sizes	Individuals or pairs
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Maths (2D shapes, fractions, measuring), Science (levers, fulcrums)
Notes	The activity involves glue – so things might get a bit messy!

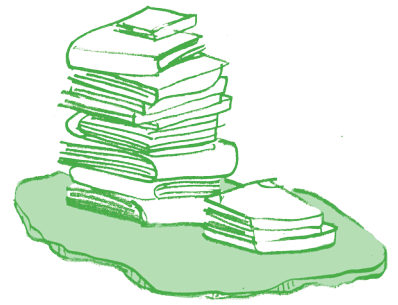
*\*all of the activities have links to both Irish history and Irish geography.*

### Engineering Connection!



This activity uses levers – which can be found all over the place! A seesaw is a lever, and so is a car jack. And so, believe it or not, is a light switch!

# The Rock of Cashel: Banishing the Demon!



According to legend, in St Patrick's early days Tipperary was pretty much flat as a pancake. Until he came across the devil, living in a cave in a mountain. St Patrick didn't hold with the devil, of course – and catapulted him away from his crevice. In his fury, the devil bit off part of the mountain and spat it out. It flew a good thirty kilometres through the air before landing at Cashel – and so the Rock was born!

To commemorate that moment, this challenge will see you engineering your own catapult – and seeing how accurately you can hurl your demon!

## You Will Need:

- Modelling clay
- Wooden teaspoon\*
- Lolly sticks (2)
- Strong glue
- Small yoghurt pot
- Ping pong ball
- Cotton wool
- Pen
- Scissors
- Paper
- Dinner plate, side plate and saucer\*

*\* you can get these from cafes/takeaways. Otherwise, a metal teaspoon will do – but you might want to tape it to the lolly stick, rather than glue it. Remember, too, that a metal teaspoon will affect the overfall weight of your throwing arm.*

## The Process:

### Stage 1:

- Use the modelling clay to make your demon. It needs to be small enough to sit in the teaspoon.

### Stage 2:

- Make your target.
  - Draw around the dinner plate on the paper.
  - Place the side plate inside the circle you have drawn – and draw around it.
  - Place the saucer inside the smaller circle – and draw around it.
  - Carefully cut out the larger circle.

You now have a target with three areas (feel free to colour these in!).

### Stage 3:

- Make your throwing arm.
  - Glue the end of the handle of the teaspoon to the end of one of the lolly sticks. Leave it to set.
  - Glue the end of the lolly stick to the end of the other lolly stick. Leave it all to set.

### Stage 4:

- Place the ping pong ball by the yoghurt pot. Mark the yoghurt pot to indicate half of the height of the ping pong ball.
- Repeat this at different points on the yoghurt pot – then join all the marks together in a circle.
- Carefully cut along the line you have drawn (this can be tricky, so you might want to ask an adult for help).
- You want the bottom of the pot (the "cup"). The rest can be recycled appropriately.
- Place the ping pong ball in the cup, in the centre. Pack cotton wool around it to keep it in place. Ideally you'll still want it to be able to rotate, though, inside this "nest" that you've built.

### Stage 5:

- Make a mark on the throwing arm – about two thirds along from the spoon.
- Place a drop of glue on top of the ping pong ball. Place the throwing arm on the glue so that it fixes to the mark you have made. Leave it all to set firm.
- Once it has set, push down on the spoon (the ping pong ball should rotate to allow you to do this), until it reaches the ground.

### Stage 6:

- Place the target about a metre from the catapult.
- Place the demon in the teaspoon.
- Press down on the other end of the throwing arm – trying to hurl the demon into the centre of the target.
- Adjust the position of the catapult and/or the target until you can achieve pinpoint accuracy.

And now you're done, why not challenge family/friends to a catapult challenge? You could have three rounds, with the target set at different distances – winning five points if the demon lands in the inner circle, three if it lands in the middle circle, and one if it lands in the outer circle.

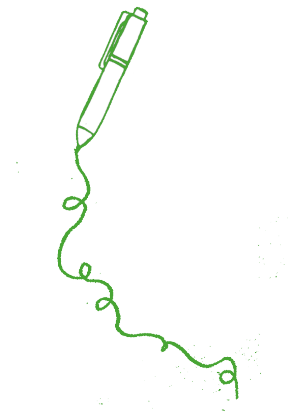



### Things to Think About:

- It's really important that the ping pong ball is secured firmly within its cup, whilst still being able to rotate. How are you going to achieve this?
- The way you depress the throwing arm will affect your levels of accuracy – how will you take this into account?

### 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.





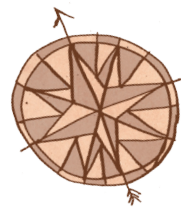
I sprang where the bones  
of thy fathers repose ...  
'Ere the world threw around thee  
its wiles and its woes!

(from *St Patrick's Day: With an Irish Shamrock*,  
by Charlotte Elizabeth Tonna)





# Banishing the Demon – the Worksheet!



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



2. What was the trickiest part of the construction?

3. Which factors affected the accuracy of throwing? How did you account for these?

Use this table to record any competitive activity!

	Points/Distance 1	Points/Distance 2	Points/Distance 3
Player 1			
Player 2			
Player 3			

## The Rock of Cashel: The Vicars Choral



### Before You Start!



Resources	Possibly paper and scissors
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)
Notes	You may want to print out page x.

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

### Engineering Connection!



This is called a **sliding block puzzle**. Manufactured wood and plastic versions of this type of puzzle keep everything in place through mortice-and-tenon channels along the edges of the pieces.











# The Rock of Cashel: The Vicars Choral







The Cathedral on the Rock of Cashel was built in the second half of the thirteenth century – with the Hall of the Vicars Choral being added two hundred years later. Cashel had eight Vicars Choral, whose job it was to help with the chanting at services! To make sure there were no arguments, each of the vicars had his own seat. Something like this ...



Vicar 1 	Vicar 2 	Vicar 3 
Vicar 4 	Vicar 5 	Vicar 6 
Vicar 7 	Vicar 8 	

In our Hall of the Vicars Choral, though, the vicars have all got themselves into the wrong places – which is going to cause no end of ecclesiastical trouble!



	Vicar 5 	Vicar 8 
Vicar 2 	Vicar 6 	Vicar 7 
Vicar 1 	Vicar 4 	Vicar 3 

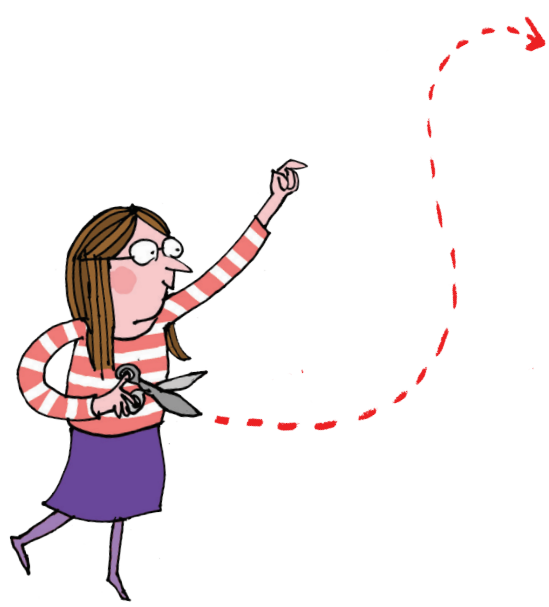
And all the priests and friars in my realm  
Shall in procession sing endless praise!

(from *Henry VI Part I*, by William Shakespeare)





	Vicar 5	Vicar 8
Vicar 2	Vicar 6	Vicar 7
Vicar 1	Vicar 4	Vicar 3



# The Vicars Choral: Solution



Here's one way of completing the challenge – in twenty moves ...



1. Slide Vicar 2 Up	11. Slide Vicar 3 Up
2. Slide Vicar 1 Up	12. Slide Vicar 5 Right
3. Slide Vicar 4 Left	13. Slide Vicar 8 Down
4. Slide Vicar 6 Down	14. Slide Vicar 2 Right
5. Slide Vicar 7 Left	15. Slide Vicar 1 Up
6. Slide Vicar 3 Up	16. Slide Vicar 4 Up
7. Slide Vicar 6 Right	17. Slide Vicar 7 Left
8. Slide Vicar 7 Down	18. Slide Vicar 8 Down
9. Slide Vicar 5 Down	19. Slide Vicar 5 Left
10. Slide Vicar 8 Left	20. Slide Vicar 6 Up



## The Rock of Cashel: Cormac's Barrels



### Before You Start!



Resources	See the list below – you may need to hoard the inner tubes from toilet/kitchen rolls for a while
Time Required	30 minutes
Group Sizes	Pairs or small groups
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Maths (fractions), Science (forces)
Notes	You'll need quite a lot of space for this – so you may want to clear tables beforehand!

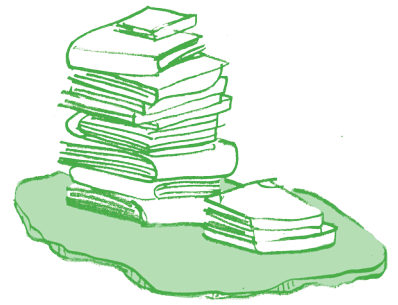
*\*all of the activities have links to both Irish history and Irish geography.*

### Engineering Connection!



Barrel vaults aren't just things from the past – modern day engineers and architects use them, too. Vaults with open frameworks can accommodate large, curved sheets of glass – so you'll often see them in shopping malls!

# The Rock of Cashel: Cormac's Barrels



It's around nine hundred years now since work first started on one of the Rock's most amazing structures: Cormac's Chapel. And it's still standing strong today, thanks to some clever engineering – including a barrel-vaulted roof. A barrel-vaulted roof is really just a series of arches laid either end to end (as with Cormac's Chapel) or side by side (which gives added strength). And this challenge will see you creating your own barrel-vaulted roof!

## You Will Need:

- Cardboard tubes\*
- Scissors
- Something to hold your structure in place (you'll choose this yourself!)
- Books (plenty of them!)

*\* either the inner tubes of two kitchen rolls or the inner tubes of four toilet rolls.*

## The Challenge – Part 1:

- Your first job is to cut each of your cylinders in half lengthways – to create semicylinders.
- On a flat surface, arrange them to make a rectangle consisting of ...
  - four semi-cylinder kitchen rolls, side by side ... or
  - Two rows of four semi-cylinder toilet rolls, side by side.

You'll now need to secure your structure – and this is where you have absolute choice! Will you use glue, sticky tape, rubber bands – or something entirely different?

## The Challenge – Part 2:

The next job is to see how much weight your barrel vault can bear – by laying the books on top of it! If you get to a point where you fear the vault is about to collapse, take the books off and see if you can think of any improvements to your overall design and/or method of putting the books in place.

## Things to Think About:

- The material you choose to hold your structure will be partly governed by what you have available. You'll still need to consider, though, the best way of lending your barrel vault both strength and rigidity.
- How are you going to lay the books out in a way that best "evens out" the downward forces they will apply to your barrel vault?
- a record of your work.

## 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.



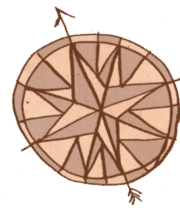
The birds their dear voices are turning all to song,  
The calves are bleating aloud for their mother's side,  
The fish are leaping high where the midges throng –  
And I alone with young Cormac here must abide!

(from *Cormac Óg*, by Thomas MacDonagh)





# Cormac's Barrels – the Worksheet!



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



2. Use this box to show the best way you discovered to arrange the books on top of the vault.

3. How many books did you manage to put in place before the vault collapsed? If it didn't collapse, ask someone to stand on top of it. Who will you ask – and how should they stand?

## The Rock of Cashel: Weathering the Weather!

### Before You Start!



Resources	See the list below – you may need to collect a few bathroom sponges (although you can cut these up to make more!).
Time Required	15 minutes or so of activity on each of two days – then a gap of a day or more to allow the sponge to dry thoroughly.
Group Sizes	Pairs or small groups
Supervision	Younger children may need some help (to reduce mess!)
Curriculum Links*	Maths (units of measurement), Science (absorbency, density)
Notes	Water is involved in this activity!

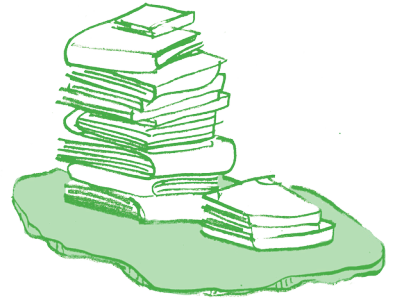
*\*all of the activities have links to both Irish history and Irish geography.*

### Engineering Connection!



Although you might not realise it, engineers sometimes seek out absorbent materials. Think of the mechanical engineer designing shock absorbers for cars, for example!

# The Rock of Cashel: Weathering the Weather!



For a nine hundred year old structure, Cormac's Chapel is doing pretty well. But it has suffered the ravages of the weather over the centuries. And some of the paintings on the chapel's walls (the frescoes) have done particularly badly. Partly because, high up on a hillside, it is battered by the wind and the rain ... and partly because of the material it is built from – sandstone. This challenge will explore how absorbent materials are affected by water and "weathering".

## You Will Need:

- Bathroom sponge (dry!)
- Measuring jug
- Watercolour paints and paintbrush

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

## The Process:

### Stage 1:

- Paint something on the side of your sponge. It might be a flower, a face or an animal – or something abstract. It's completely up to you!
- Put the sponge somewhere to allow your fresco to dry (don't put it anywhere too warm!).
- Don't move onto Stage 2 until the fresco is dry! If you can, take a photo of the fresco.

### Stage 2:

- Put enough water in the measuring jug so that, if your sponge was in there (it won't be!), lying flat, the water would just cover it. Make a note of how many millilitres this is.
- Place the sponge on a flat surface. You might want to place another absorbent material under it – a towel, for example.
- Pour the water evenly over the sponge. What happens? Does the sponge seem to be absorbing the water – or is some of it running away?

### Stage 3:

- Working quickly, pick up the sponge – and squeeze as much water as you can into the measuring jug. Measure how much there is. We're going to call this the "absorbed" water.
- Work out roughly what fraction of the water you poured onto the sponge was absorbed.

**Stage 4:**

- Add more water to the measuring jug – until it is twice as full as in Stage 1.
- Place the sponge back on its flat surface.
- Pour the water evenly over the sponge. What happens this time?

**Stage 5:**

- Working quickly, pick up the sponge – and squeeze as much water as you can into the measuring jug. Measure how much there is.
- Work out roughly what fraction of the water you poured onto the sponge was absorbed. Has the fraction changed?

**Stage 6:**

- Add more water to the measuring jug – until it is three times as full as in Stage 1.
- Place the sponge back on its flat surface.
- Pour the water evenly over the sponge. What happens this time?

**Stage 7:**

- Working quickly, pick up the sponge – and squeeze as much water as you can into the measuring jug. Measure how much there is.
- Work out roughly what fraction of the water you poured onto the sponge was absorbed. Has the fraction changed?

**Step 8:**

- Leave the sponge to dry thoroughly.
- Once it has dried, examine the fresco – and compare how it looks now, compared with when it was freshly painted (if you did take a photograph, now is the time to use it!). You are looking for any changes in ...
- the quality of the fresco itself ... is the image still clear, for example? Are the colours as bright as they were?
- The condition of the sponge – are there any changes here?

**And Finally ...**

What can this tell us about the suitability of sandstone (an absorbent material) for building ... and for painting on? And could this allow you to make an predictions about the future of Cormac's Chapel?




**Things to Think About:**

For this to be a fair experiment, you'll need to try to make sure that, as far as possible, apart from the amount of water, all other conditions are constant throughout the challenge.

**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.



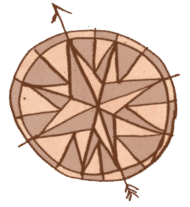


The silver-slanting Irish rain,  
all warm and sweet that fills  
The little brackened lowland pools,  
and drifts across the hills!

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



# Weathering the Weather – the Worksheet!



1. Record your results in this table:



	Experiment 1	Experiment 2	Experiment 3
Water poured onto sponge			
Absorbed water			
Fraction of water absorbed			

2. Did the fraction of water absorbed change for the different experiments? What conclusions can you draw from this?



3. Did the quality of your fresco change by the end of the experiment? If so, what changes did you notice?

4. Did the quality of the sponge change by the end of the experiment? If so, what changes did you notice?

## The Rock of Cashel: Round and Round We Go!



### Before You Start!



Resources	See the list below – you may need to hoard or collect newspapers for a while. And be prepared to go through a few tins of baked beans!
Time Required	30 – 60 minutes
Group Sizes	Pairs or small groups
Supervision	Younger children may need supervision or help with cutting
Curriculum Links*	Maths (measurement), Science (forces)
Notes	You'll need quite a lot of space for this – so you may want to clear tables beforehand!

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

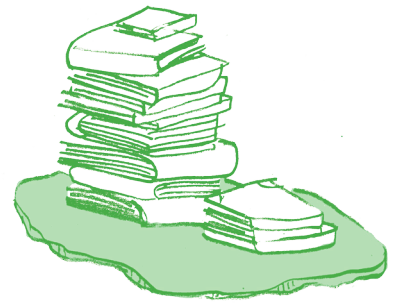
### Engineering Connection!



One of the limiting factors will be that, unlike civil and structural engineers, you won't be able to create foundations (or substructures) for your towers.



# The Rock of Cashel: Round and Round We Go!



One of the most unusual features of the Rock of Cashel is that its cathedral has its very own round tower. Built from sandstone and limestone, it's nearly 30 meters tall (with another metre buried underground, as a foundation)! Circular structures are difficult enough to build in the 21st century, let alone the 12th – so the engineers of the day must have been very determined!

Like all round towers (or **cloigtheachs**), the Rock's was a bell tower – although the bells themselves have long disappeared. This challenge will see you building your very own round tower – but it will have a bell!

## You Will Need:

- Newspapers (maximum of five)
- 20 Straws (maximum of twenty)
- Masking tape (one roll)
- String (one length)
- Scissors
- Empty tin can (the bell!)
- Tape measure

## The Challenge:

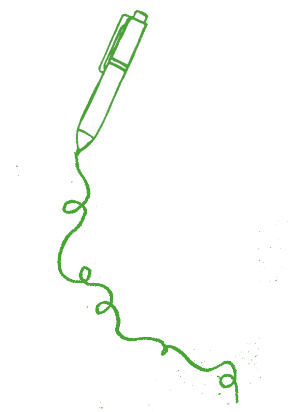
Using only the materials provided, design and construct as tall an operational round tower as you can.

## Top Tips:

1. You might like to start by considering how to allow for the mass and movement of the "bell".
2. *Stability* will be key to this design – but remember that *rigidity* isn't always the best route to stability!

## 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.



(He dreamed) of sun and moon  
that a good hour  
Bellowed and pranced  
in the round tower!

(from *Under the Round Tower*,  
by WB Yeats)

