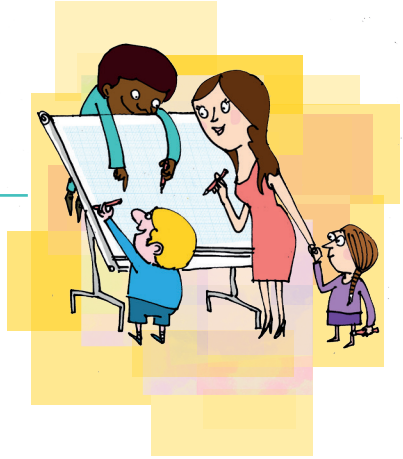
Engineering at Home

Challenge 1: Balancing Act



Have a Look!
Look in your kitchen cupboards and fridge. How many food packets can you find where weight is mentioned? Does anyone in your house do any baking? How do they measure out the amounts of flour and sugar that they need?

You Will Need:

- One coat hanger
- Two shopping bags – ideally, these would be identical
- One tin of baked beans/tomatoes/fruit (any tin will do – as long as it specifies the weight)
- Something to weigh – flour for example (but you won't be able to use it afterwards!). We'll call this your **sample**.
- String or sticky tape (you may not need these if your bags have handles that will tie)

Before You Start
Look at the weight marked on the tin of food. You can assume that the tin itself will weigh between 50 and 80 grammes – so round the weight up to the nearest 100 grammes. Call this **X grammes**.

The Challenge
You are going to create a set of scales that will allow you to weigh out exactly **X grammes** of your **sample**. Two things to think about:

1. how you will attach the shopping bags to the cost hanger (which is where string/sticky tape might come in handy). Look for any weak points!
2. where you will hang the coat hanger – again, look for any weak points!

How Will You Know if You've Succeeded?

- You will have measured out X grammes of the sample without the structure collapsing!

Understanding and working with the world of weights and measurements is really important for engineers. What can you find in your house that has been accurately weighed?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR STRUCTURE ON YOUR WORKSHEET!

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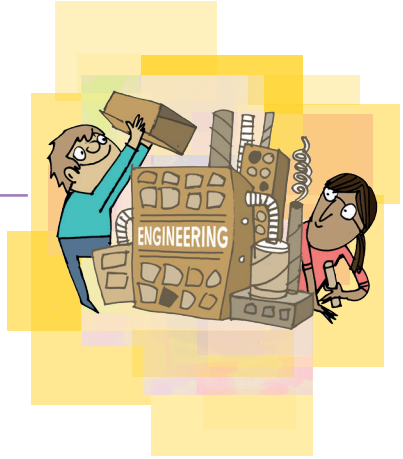
Challenge 2: Up and Over



Have a Look!
Look outside. How many wheeled vehicles can you see? How many do you think you might see if you sat and watched for an hour? Can you think of any vehicles where there is a bigger gap between the ground and the bottom of the vehicle than there is in a car? This is called the **clearance**.

You Will Need:

- Rolling pin
- Thick card
- Scissors
- Ruler
- Pencil
- Something to drive over – a book or shallow box, for example (make sure that it is at least 4cm narrower than the rolling pin's length!). This is your **obstacle**.

Before You Start
Clear a flat surface to test drive your vehicle. You'll be doing some cutting out – so make sure the surface is suitable for this, too. And you may want to ask an adult to help with this.

The Challenge
You are going to design and create two wheels that will turn the rolling pin into a vehicle – a vehicle with a high enough clearance to drive safely over the **obstacle**. Two things to think about:

1. how you will decide on the wheels you need.
2. how you will attach the wheels to the rolling pin.

How Will You Know if You've Succeeded?

- Your vehicle will have passed safely over the obstacle – without touching it, and without the wheels coming off!

If vehicles don't have enough clearance, things will only end in tears. Apart from potential obstacles, can you think of any other factors engineers have to bear in mind when thinking about clearance?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR VEHICLE ON YOUR WORKSHEET!

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Challenge 3: Ahoy There!

Have a Look!

Have a look in your bathroom. Are there any bath time toys in there? If not, can you find anything that would **float** if you put it in water? Do you know (or can you guess) what **materials** these objects are made from?

You Will Need:

- Thick card
- Scissors
- Sticky tape
- A cup
- Something to **load** your boats with – rice or lentils are ideal (it's likely to get wet – so check that it's ok to use it before you start!)
- Container of water (a washing up bowl, a sink – or even a bath!)

Before You Start

You'll be doing some cutting out – so make sure the surface is suitable. And you may want to ask an adult to help with this.

The Challenge

You are going to design and create an open-topped boat that will stay afloat with four cupsful of your load. The bottom of your boat should measure no more than 20cm x 12cm. You can even turn it into a competition, with each family member making their own boat – and seeing which one can carry the heaviest load! Two things to think about:

1. how you will make sure there are no gaps where water might get in.
2. how you will overcome the problem of the card getting so soggy that it either falls apart - or sinks!

How Will You Know if You've Succeeded?

- Your boat will have stayed afloat for five minutes whilst carrying four cupsful of your load.

Floatation is always uppermost in the minds of marine engineers. Most large boats are made from metal – which "wants" to sink. Can you think of any other strategies that engineers use when designing and building metal boats, to make sure that they float?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR BOAT ON YOUR WORKSHEET!

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Challenge 4: Standing Tall

Have a Look!
Have a look around your home. What pieces of furniture have got **legs**? What are they made from? What are they **supporting**? Are they designed to support any additional weight on top of this?

You Will Need:

- Five newspapers
- Scissors
- Sticky tape
- A cuddly toy

Before You Start
You're likely to make a bit of a mess – so make sure that the area you're working in is suitable! If your family doesn't get any newspapers, ask friends or relatives to collect some for you.

The Challenge
You are going to design and test your own unique chair. The seat of your chair should be at least 50cm above the ground – and the structure should be able to take the weight of your cuddly toy. Two things to think about:

1. how you will make sure that the legs of the chair are **strong** enough to hold the seat (as well as the back and arms, if you decide to incorporate these) – and the cuddly toy.
2. how you will make sure that the legs of the chair are **stable** enough to stand firmly when the cuddly toy is in place.

How Will You Know if You've Succeeded?

- The chair will not rock, buckle or sway when the cuddly toy is in place – and it certainly won't collapse!

Engineers are often interested in how things look as well as how they behave – form is sometimes as important as function! Look at some of the furniture in your home. How have engineers tried to make sure that they are attractive to look at as well as doing the job they've been designed for?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR CHAIR ON YOUR WORKSHEET!

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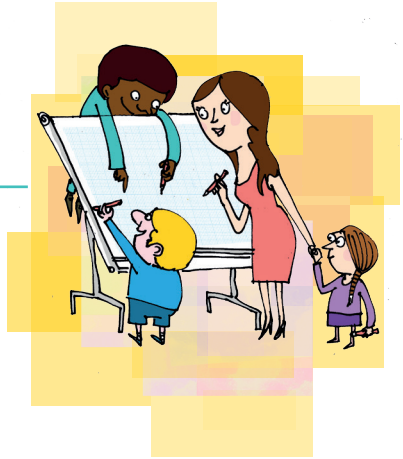
Challenge 5: Turn That Wheel!



Have a Look!

Have a look around one room - any room - of your home. What objects can you find that have **moving parts**? What sort of **force** needs to be **applied** to make them move? What might prevent or slow down the movement?

You Will Need:

- Thick card
- Pencil
- Scissors
- Sticky tape
- Marker Pen
- Tape Measure
- Marker Pen
- Empty squeezable bottle, with its nozzle intact (a washing up liquid bottle is perfect!)

Before You Start

You'll be doing some cutting out – so make sure the surface is suitable for this, too (you may want to ask an adult to help with this). And check that it's ok to use the bottle before you take it!

The Challenge

Part 1: Make a Cogwell

Put the roll of sticky tape on the card and draw round the outside of it – to make a perfect circle. Without moving the roll, draw round the inside of it to make a second, smaller circle. Cut out – around the large circle. Use a pencil to divide the outer ring into segments – about 2cm each. Cut out every other segment. Use the marker pen to number the "teeth" that you have created. Now carefully use sticky tape to neatly wrap the cogwheel so that it will be waterproof. Tape the pencil to the cogwheel so that it acts as a stalk, with cogwheel sitting horizontally on top of it.

Part 2: Control the cogwheel

Fill the bottle with water. Go outside and "plant" the end of the pencil in the ground so that it is held firmly. Working through trial and error, find the maximum distance from which you can squirt water at the cogwheel and make it turn a full revolution (make notes about your attempts on your worksheet). Once you've done that, find the maximum distance from which you can turn the cogwheel by just a couple of teeth (no more, no less!). Two things to think about:

1. how you will make sure that the structure stays in the ground.
2. how you will control the water flow – and know how to control it in the same way again.

How Will You Know if You've Succeeded?

- Your structure **won't** collapse – and it **will** behave the way you want it to!

Engineers are real control freaks – they want to be able to control the objects they design and build by taking as many other factors into consideration as possible. Look around your home. How have engineers accounted for other factors when designing objects with movable parts?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR STRUCTURE ON YOUR WORKSHEET!

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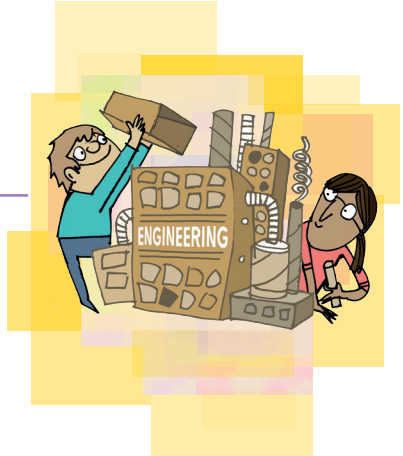
Challenge 6: the Iceman Cometh ...



Have a Look!
Have a look around your home – particularly, probably in the kitchen. What objects can you find that have been engineered to **keep things cold**? How do they do this? What materials do they use – and why?

You Will Need:

- Two plastic boxes
- Tin Foil
- Thick material (a jumper or fleece will do!)
- Ice cubes
- Timer

Before You Start
There's a chance that the material you use might get wet – so check that it's ok to use it first!

The Challenge
You are going to design, make and test a **cold box**. The idea is that your cold box should be able to keep ice frozen longer than ice left in the second box at room temperature. Two things to think about:

1. How you will use the tin foil – and whether the shiny side or the dull side is more useful to you.
2. how you will make sure that you conduct a fair test.

How Will You Know if You've Succeeded?

- The ice cube/s in the cold box will have retained much of its structure when your test cube/s is well on the way to melting!

Keeping things cold can be as important to an engineer as keeping them hot – and the engineering processes aren't actually all that different. Think about a supermarket. How many things have engineers done to make sure that the fresh fruit and vegetables stay cool?

REMEMBER: RECORD YOUR RESULTS ON YOUR WORKSHEET AS YOU GO ALONG – AND, ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR COLD BOX!

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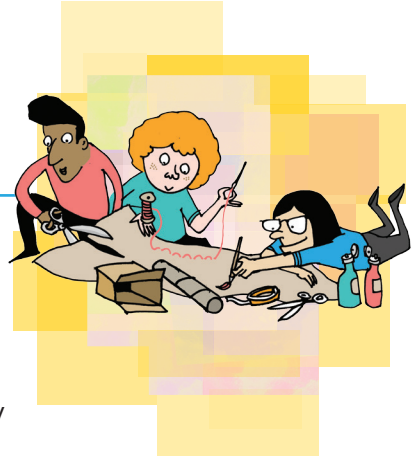
Challenge 7: Siphon Straws!



Have a Look!
Flush your toilet – and have a look at what happens to the water. What effect is **gravity** having? Now take a look at the pipe that carries the water away. It will be curved – making it difficult for gravity to do all the work. So it acts as a **siphon**, allowing flushed water to travel "up the hill" without ever completely emptying the toilet bowl.

You Will Need:

- Straws (including some of the "bendy" type)
- Sticky tape
- Scissors
- Two empty plastic bottles (bowls will do if you don't have any – but this will make the challenge a bit trickier)

Before You Start
It's possible that you and/or the area you're working in might get a bit wet, so think about what you're going to wear – and where you're going to work!

The Challenge
Pour water into one of the bottles (the **source**) until it's half full. The challenge now is to construct and test a **siphon** from the straws that will transport the water to the other bottle (the **destination**). Two things to think about:

1. how you will make sure you construct your siphon so that it is as **watertight** as possible
2. how you will start the water flowing (think about what you normally use a straw for!).

How Will You Know if You've Succeeded?

- Your siphon will transport most of the water from the **source** to the **destination**!

Moving things against the force of gravity is an everyday challenge for engineers. Think about a funfair or themes park – are there any examples there of objects having to move against gravity?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR CONSTRUCTION ON YOUR WORKSHEET!

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Challenge 8: Treasure Trove!

Have a Look!
Have a look around your home. How many objects can you find that have **hinges** on them? Which room has the most of these objects? How do the hinges work? And how do they get over the problem of **friction**?

You Will Need:

- Cardboard box
- Stiff Card (enough to make a lid for the box, with a bit left over)
- Straws
- Sticky tape
- Scissors

Before You Start
You'll be doing some cutting out – so make sure the surface is suitable for this. And you may want to ask an adult to help.

The Challenge
First of all, cut out a lid for your box – exactly the same area as the box itself. The challenge now is to design two hinges, make them - and attach them to the lid to make a Treasure Box. Two things to think about:

1. how you will help your hinges work by keeping friction to a minimum.
2. how you will make sure that the lid stays open when you open it – and closed when you close it!

How Will You Know if You've Succeeded?

- You will be able to open and close your lid easily – and smoothly.

Although engineers often want to work against friction, it can be quite useful too, sometimes. Think about the things that you wear – are there any where friction is a positive thing?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR HINGED LID ON YOUR WORKSHEET!

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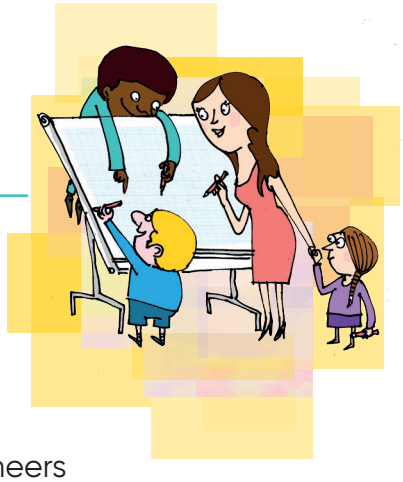
Challenge 9: On a Roll ...



Have a Look!
See if you can find any pictures of **prehistoric standing stones** – at Newgrange in County Meath, for example, or Stonehenge in England. Two of the many fascinating things about these stones are that they are much bigger than they look (they are buried quite deep in the ground) and that they have travelled a long way. The prehistoric engineers who built them didn't have anything with wheels on – so how did they move them? We'll probably never know for sure – but we can make a guess ...

You Will Need:

- Four, five or six tins of food (ideally all roughly the same size)
- Ruler
- Heavy book
- Tape measure

Before You Start
As long as you work on the floor (and you'll need to clear a space that is 2 metres long), the tins shouldn't get damaged – but it's best to check that you can use them (and the book!) before you get started.

The Challenge
Measure out your 2 metre "runway" – and mark the start and end points. Place all your resources **behind** the start. The challenge now is to use the tins as a set of **rollers** to move the book along. You are only allowed to touch the book with the ruler – and you'll have to **lever** it onto the rollers before you get going. Once the book reaches the last tin, you'll have to quickly move the first one to the front – and so on. If the book ever falls off, you'll have to lever it back into place. Two things to think about:

1. how you will operate the lever.
2. how you will control the speed at which everything moves.

How Will You Know if You've Succeeded?

- It might take a few goes – but you will transport the book from one end of the runway to the other!

Prehistoric engineers also had to get the stones across rivers – and couldn't use bridges, as they wouldn't be strong enough to take the weight. Can you think of a way they might have been able to do this?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A STORYBOARD TO SHOW THE WHOLE PROCESS!

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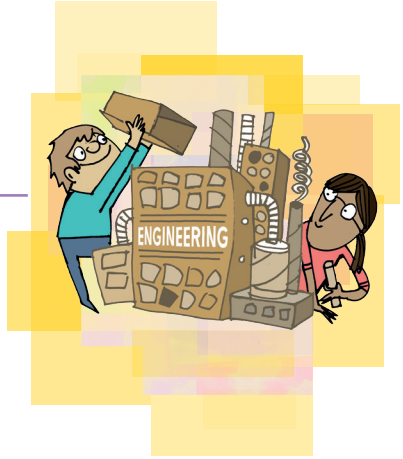
Challenge 10: Lift Going Up!



Have a Look!

See if you can find any pictures of **lifts** (if you can't, try to remember a time when you were in a lift – in a shop, perhaps). When the lift goes up, can you work out whether it is being pushed – or pulled?

You Will Need:

- A cardboard box (an empty cereal box is ideal)
- A cuddly toy (the passenger) – small enough to fit inside the box
- Scissors
- Two rulers
- Sticky tape
- Thick card
- Two heavy books

Before You Start

Make sure that it's ok to use the box that you've chosen – because it won't be the same once you've finished! You'll be doing some cutting out – so make sure the surface is suitable for this. And you may want to ask an adult to help.

The Challenge

The box will be your lift – so create a doorway for the passenger. The challenge now is to design and build a lift mechanism that will allow you to pull the lift safely up to a windowsill – and lower it again. You'll need to tape the two rulers securely to the windowsill so that they can act as basic **pulleys**. Two things to think about:

1. how you will make sure that the passenger can get safely in and out of the lift – and stay in it safely while it is in motion.
2. how you will anchor the whole mechanism at the beginning and end of its journeys.

How Will You Know if You've Succeeded?

- Your lift (and its passenger) will be able to move smoothly and safely from floor level to the window sill and back again.

Engineers love pulleys – because they allow heavy loads to be moved with only a small amount of energy (levers often work in this way, too). Can you think of any examples of pulleys in everyday life?

REMEMBER: ONCE YOU HAVE COMPLETED YOUR CHALLENGE, DRAW A DIAGRAM OF YOUR ENTIRE STRUCTURE ON YOUR WORKSHEET!

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