

# FUN SCIENCE EXPERIMENTS



Whether we are drilling holes to determine the structural strength of the soil or surveying endangered plants and animals, we use science every day at RSK to explore the world around us. And we all started out as curious kids like you.

## CLICK ON A TOPIC BELOW...

1. Centre of gravity

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2. Pinhole camera

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3. Blind spot

-----

4. Binocular vision

-----

5. Optical illusions

-----

6. Air pressure

-----

7. Water pressure

-----

8. Acids and alkalis

We've teamed up with our friends to help budding explorers find out about our world.



# 1. FINDING THE CENTRE OF GRAVITY

## WHAT IS GRAVITY?

Gravity is a force of attraction between all objects, everywhere in the universe. It's what pulls you to the ground, whether you're in the UK or on the other side of the world in New Zealand.

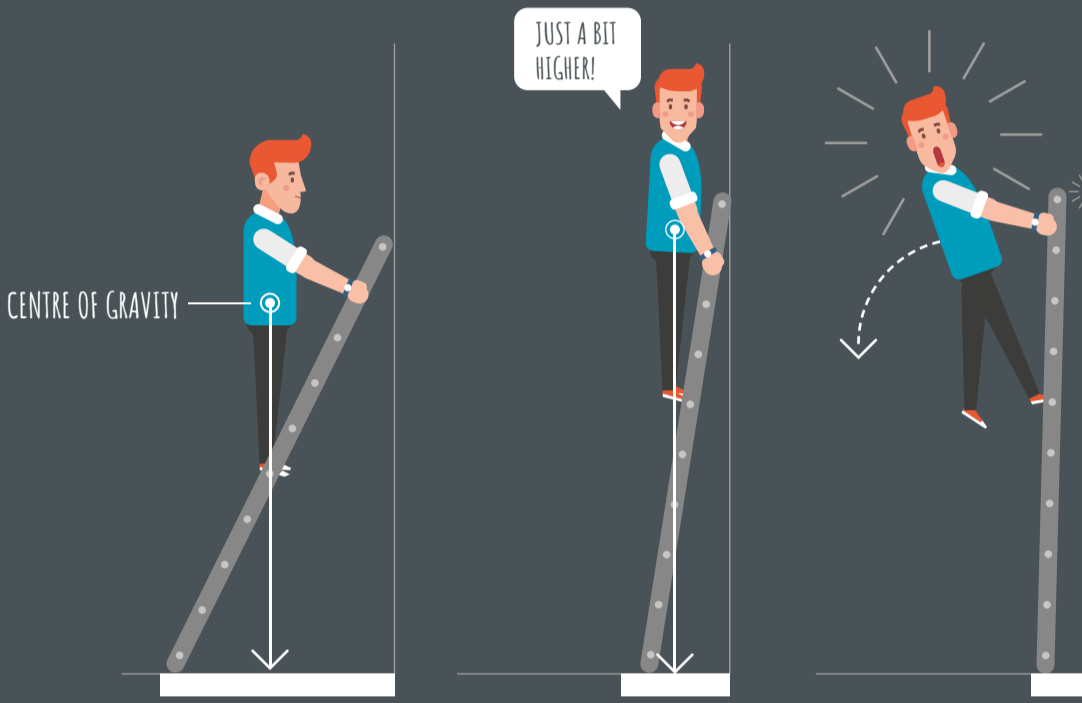
## WHAT IS THE CENTRE OF GRAVITY?

The centre of gravity is the average location of the weight of an object. (Weight describes the force between an object, or mass, and the centre of the Earth.) Think of an oil drum. As long as its centre of gravity lies inside the base of the drum, it will right itself. If its centre of gravity lies outside the base, it will topple over.



## WHY DOES IT MATTER?

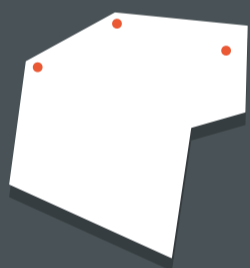
Here's one reason. Can you think of other examples?



## CAN YOU FIND THE CENTRE OF GRAVITY?

1. Cut a piece of card into an odd shape.
2. Hang the card from a pin near its edge.
3. Hang a weight on a piece of thread suspended from the same pin and use the pencil to mark the position of the thread on the card.
4. Hang the card from a position further round your shape and repeat. Do this several times.
5. The lines should cross in the same place. This marks the centre of gravity of your card and you should be able to balance your shape at this point.

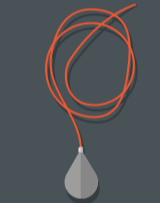
### START



ODD-SHAPED PIECE OF CARD



PIN



WEIGHT ON A STRING

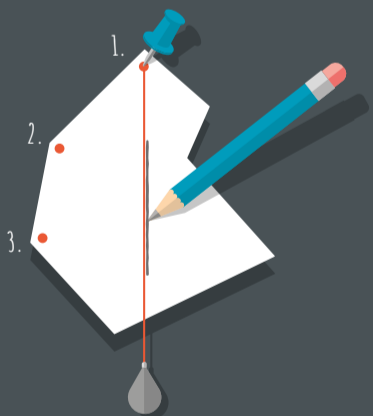


PENCIL

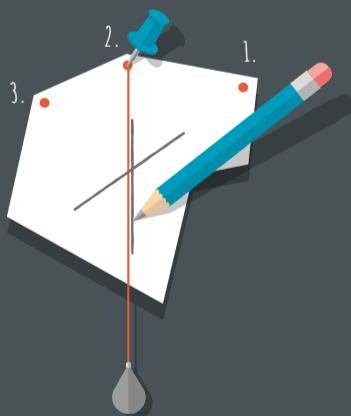


SCISSORS

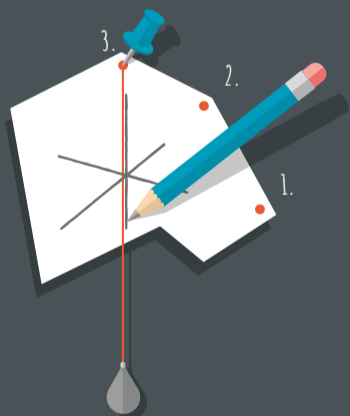
### FIRST POINT



### SECOND POINT



### THIRD POINT



### CENTRE OF GRAVITY



## CAN YOU...

design a shape where the centre of gravity falls outside the shape?

BACK TO THE START



NEXT EXPERIMENT THIS WAY



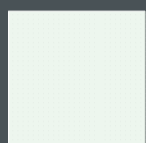
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## 2. MAKING A PINHOLE CAMERA

### CAN YOU MAKE A PINHOLE CAMERA? YOU WILL NEED...



CARDBOARD BOX WITH LID (SHOEBOX)



SHEET OF GREASEPROOF PAPER OR WHITE TISSUE PAPER



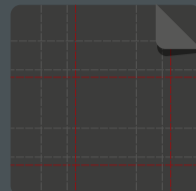
PIN / NEEDLE / NAIL



SCISSORS



STICKY TAPE



A LIGHT-PROOF SHEET / BLANKET

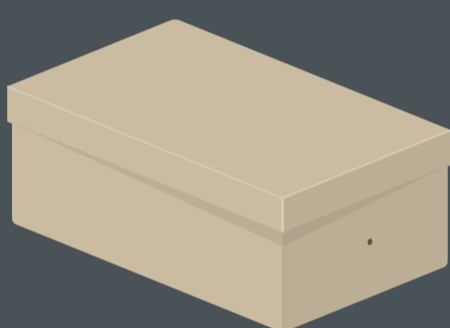
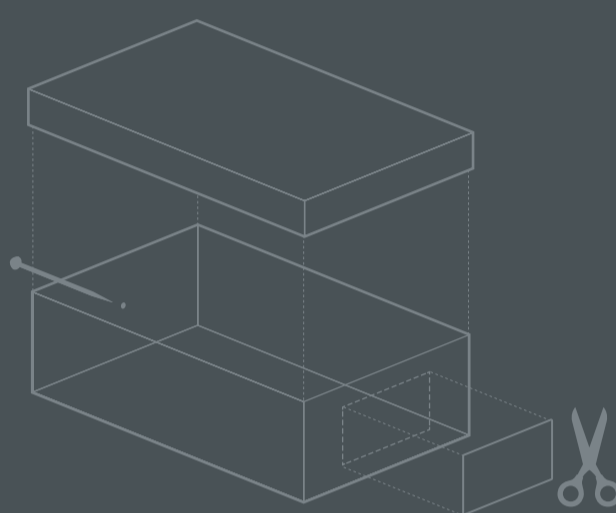
1) Carefully make a very small hole in one end of a taped-up box.

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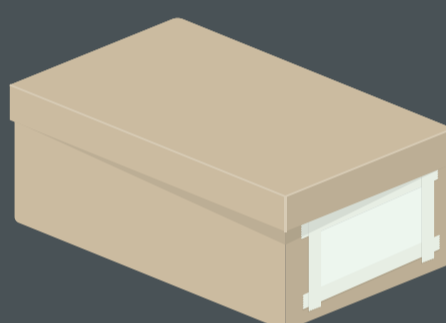
2) Cut away the other end from the box.

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3) Tape a sheet of greaseproof paper over the open side of the box.



PINHOLE

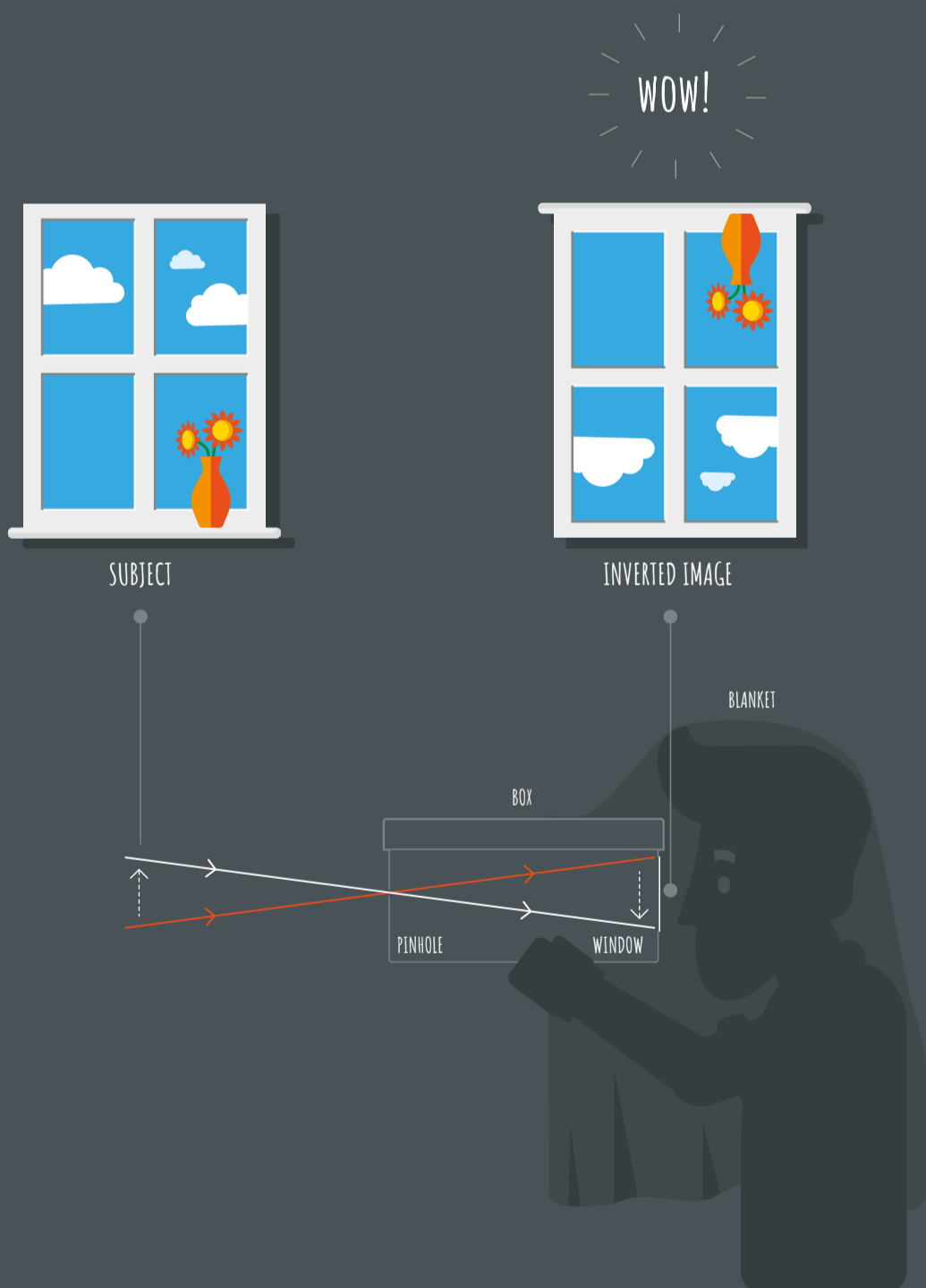


WINDOW

4) Look through the greaseproof paper screen to the pinhole while covering the box and your head with a thick blanket.

-----

5) Point your camera towards a bright light source like a window (assuming it is daytime).



### CAN YOU SEE AN INVERTED IMAGE OF THE WINDOW ON THE SCREEN?

What happens if you make the hole larger?

-----

Is the picture brighter? Is it as sharp/focused?

-----

A camera is similar to this box, but it has a lens to focus the light and light-sensitive film or digital sensors to record the image. The lens enables the image to be brighter by letting more light in while keeping it focused.

BACK TO THE START



NEXT EXPERIMENT THIS WAY

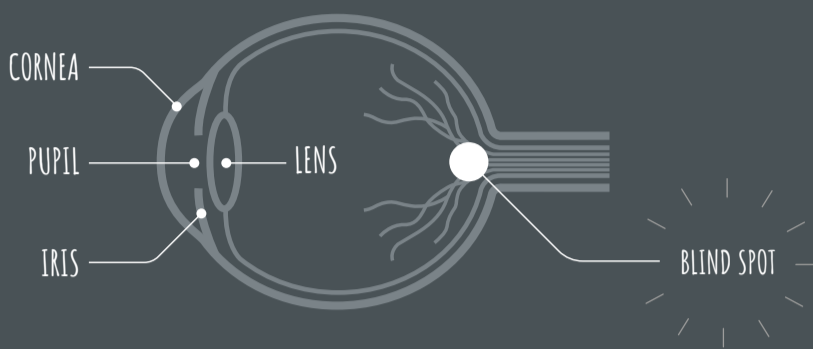
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# 3. FINDING YOUR BLIND SPOT

If you made the pinhole camera (activity 2), you will find the eye easier to understand. The lens in your eye is like the pinhole in your camera, but, in place of the screen, is a layer of over 90 million light-sensitive cells called the retina.

The lens and the clear cornea focus the light rays from the image you are looking at onto the retina. Like in the pinhole camera, the image is upside down, but your brain inverts it.



Topsy-turvy specs! If you give someone glasses that turn everything upside down, after a few days, their brain sees the image the right way up again. When they take the special spectacles off, they see everything topsy-turvy again!

If you were to design an eye, you would make all the nerves that send signals from the light-sensitive cells come out the back of the cell. But we are not designed. The nerves go forward into the eye. Evolution can only modify what it starts with, so once this odd arrangement was set, switching the cells round was too big a leap.

These nerves come together as the optic nerve, a thick cable that 'punches' back through the retina into the brain. Where this happens, there are no light receptor cells. In other words, we have a blind spot.

A blind spot is a disadvantage if you are trying to watch out for predators!



## CAN YOU FIND YOUR BLIND SPOT?



- 1) Starting 40 cm back, look at the image above with the plus sign and the circle. -----
- 2) Look straight at the image, with your nose positioned in between the plus and the circle. -----
- 3) Close your left eye and focus your right eye on the plus sign. Do not look deliberately at the circle. -----
- 4) Now move closer, slowly. Keep looking at the plus sign with your open eye.

## DID THE CIRCLE DISAPPEAR AND REAPPEAR AS YOU MOVED CLOSER?

If it did, you found your blind spot.



KA-CHING – JACKPOT!

BACK TO THE START



NEXT EXPERIMENT THIS WAY

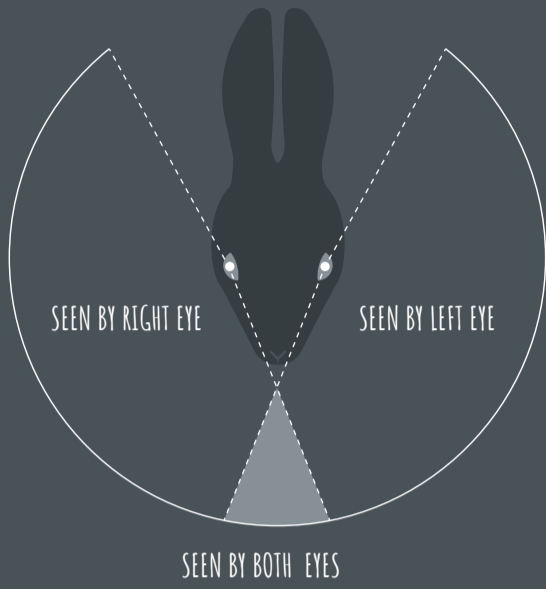
We've teamed up with our friends to help budding explorers find out about our world.



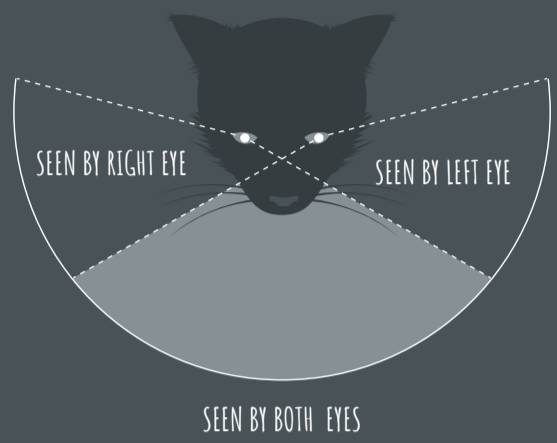
# 4. BINOCULAR VISION

## WHY DO SOME ANIMALS HAVE EYES THAT FACE FORWARD?

Our eyes face forward, as do those of other primates, cats and owls. But the eyes of rabbits, cows and pigeons are on the sides of their heads. Why?



RABBIT



CAT

There are advantages to both arrangements. Having eyes on the sides of your head gives you a wide view for looking out for predators, but judging distances is better with side-by-side eyes.

Why might a wolf and a monkey both benefit from being good at judging distance?

Hold a finger up at arm's length in front of your eyes. Slowly bring your finger nearer to your eyes. As you do so, you will see one finger become two.

Again, hold one finger up at arm's length. Focus on your finger and then focus on the wall behind your finger. Do you now see two fingers?



## CAN YOU MAKE A HOLE IN YOUR HAND? YOU WILL NEED...



SHEET OF PAPER

- 1) Roll a piece of paper into a tube.  
-----
- 2) Hold your left hand upright at arm's length and then hold the tube against your hand.  
-----
- 3) Bring your hand and the tube closer while looking at your hand and, at the same time, looking down the tube.



Have you apparently created a hole in your left hand?



CONGRATULATIONS –  
LET'S PARTY!

BACK TO THE START



NEXT EXPERIMENT THIS WAY

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# 5. OPTICAL ILLUSIONS

It is quite easy to fool our eyes and brain and there are lots of optical illusions. Here are two of them.

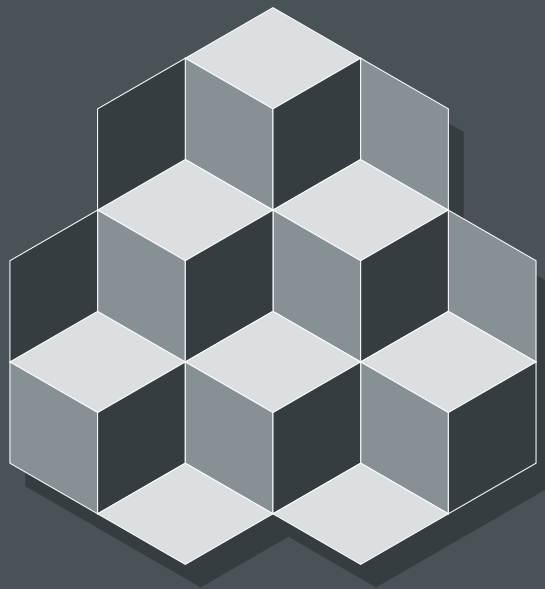
## WHICH LINE IS THE LONGEST?

Guess and then measure them. Were you right?



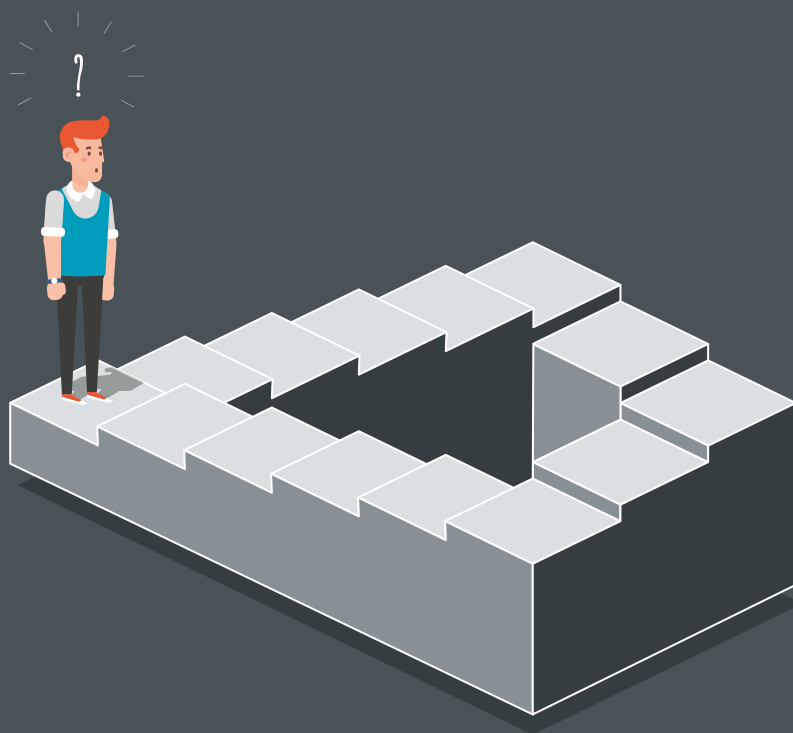
## HOW MANY CUBES CAN YOU SEE?

Are you sure? Count them again. You may even see them change as you look at them.



## THE IMPOSSIBLE STAIRCASE – PENROSE STAIRS

Don't go round in circles. Have a search online for more optical illusions.



BACK TO THE START



NEXT EXPERIMENT THIS WAY







## 6. INVESTIGATING ATMOSPHERIC PRESSURE

### WHAT IS ATMOSPHERIC PRESSURE?

As you wade through water, you can feel the water pushing against your legs. Walking through air is much easier, but it too has density and thus weight. It is constantly pushing against us in all directions.

We live at the bottom of a deep layer of air called the Earth's atmosphere. Although this air is not very dense, its huge depth creates a weight that pushes down to produce pressure. We call this atmospheric pressure.

#### EXPERIMENT ONE

### DOES AIR PRESSURE ACT IN ALL DIRECTIONS?

#### YOU WILL NEED ...

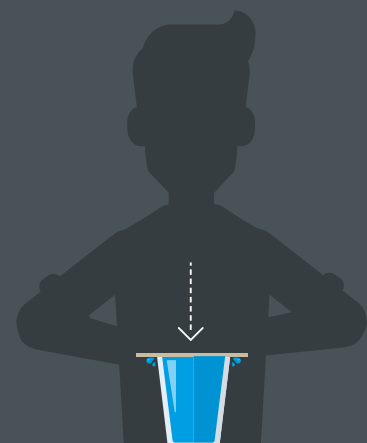


A PIECE OF STIFF CARDBOARD

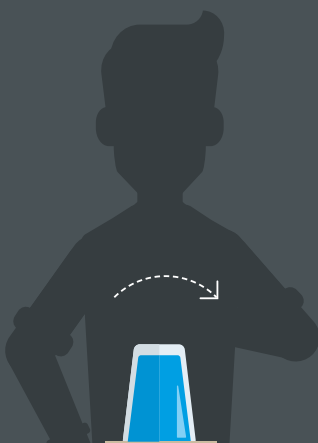


A GLASS OF WATER (FULL TO THE TOP)

- 1) Fill a glass to the very top with water.
- 2) Gently slide a thin, stiff card over the top of the glass while trying not to get any air trapped between the card and the water.
- 3) Turn the glass over while holding the card in place.
- 4) Remove your hand from the card. You may want to do this over a sink or bath in case it goes wrong!



1.



2.



3.

### DID THE AIR PRESSURE HOLD THE CARD IN PLACE?

#### EXPERIMENT TWO

### CAN YOU LIFT A HEAVY WEIGHT JUST USING AIR PRESSURE?

#### YOU WILL NEED ...



A PIECE OF BOARD

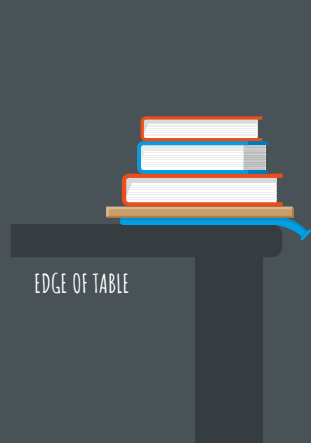


SOMETHING HEAVY (A FEW BOOKS)



AN INFLATABLE BALLOON

- 1) Place a weight on a balloon but leave the neck of the balloon hanging off the edge of the table.
- 2) Blow into the neck of the balloon.



1.



2.

### DID YOU LIFT THE WEIGHT? HOW HARD DID YOU HAVE TO BLOW?

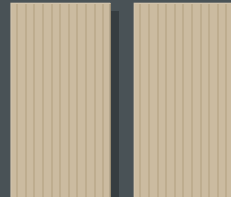
#### EXPERIMENT THREE

### HOW DO AIRCRAFT WINGS WORK?

#### YOU WILL NEED ...

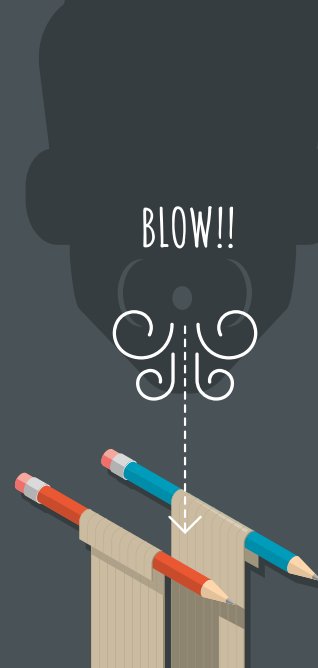


PENCILS ~ 2

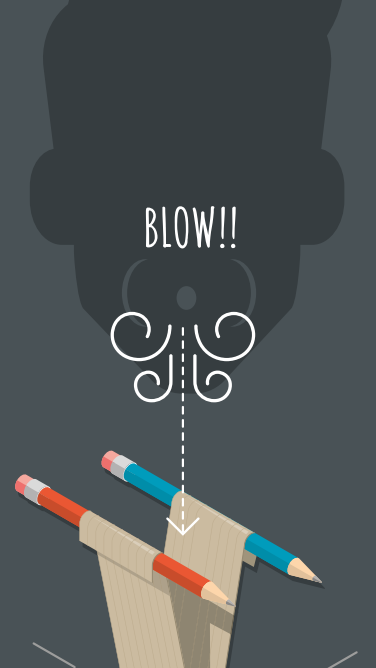


PIECE OF THIN CARD ~ 2

- 1) Loosely hang two long, narrow strips of card from two rods. Roll the end of the pieces of card over the rod rather than creasing them.
- 2) With the strips a few centimetres apart, blow gently between them.



BLOW!!



BLOW!!

WOW!

### DID THE CARDS MOVE? WHICH WAY DID THEY MOVE?

If you use only one card, you may be able to get it to rise to an almost horizontal position by blowing.

An aircraft wing is relatively flat underneath and curved on top. That means, as the aircraft is pushed forward, the air going over the wing has to travel further. This is similar to you blowing on one side of a card strip. The air is stretched to have a lower air pressure above the wing. The difference in pressure above and below the wing causes it to lift.

#### EXPERIMENT FOUR

### CAN YOU USE AIR PRESSURE TO REVEAL HIDDEN TREASURE?

#### YOU WILL NEED ...



A DRINKING GLASS



A SAUCER OF WATER



A LIVE MATCH

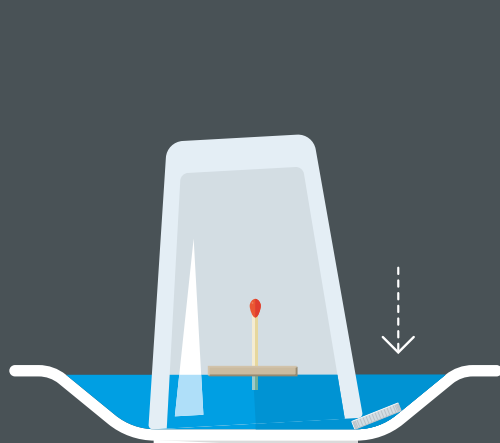


A SMALL PIECE OF CARD



A SMALL COIN

- 1) Fill a saucer with water to two-thirds full.
- 2) Place an upturned glass with a coin under its edge.
- 3) Remove the glass and place a burning match on a card float on the water. Be careful!
- 4) Replace the glass.



1.



2.

### WAS THE WATER SUCKED INTO THE GLASS? DID IT RECEDE IN THE SAUCER TO REVEAL THE COIN?

The burning match consumes some of the oxygen in the air, which reduces the air pressure inside the glass. The relatively higher air pressure outside the glass pushes the water into the glass until the pressure balances.



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# 7. WATER PRESSURE

Have you ever noticed your ears popping when you dive to the bottom of a swimming pool? This is caused by the increase in water pressure as you go deeper. You may have noticed a similar sensation when taking off in an aeroplane. As the plane rises, there is less air above pressing down on you, so the higher-pressure air in your ears tries to get out.

## DOES WATER PRESSURE INCREASE WITH DEPTH? YOU WILL NEED...

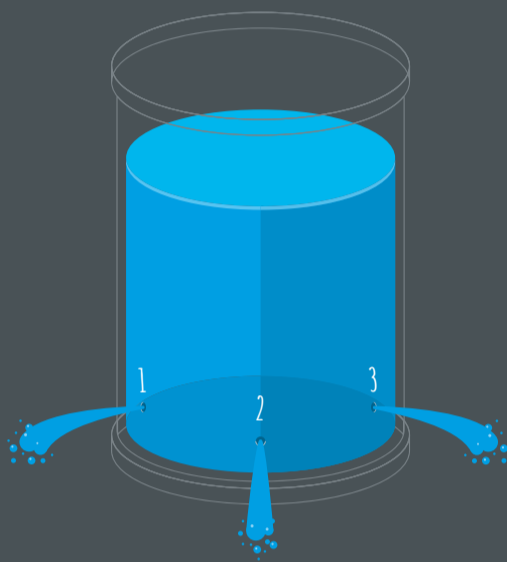
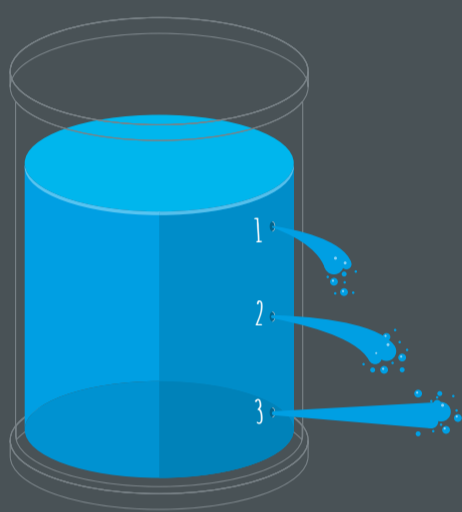


BOWL



TIN CANS x 3

- 1) Make three holes in a vertical line in the side of a tin can.  
You can use a nail, but be careful!
- 
- 2) Block the holes on the outside with pieces of plasticine or something similar.
- 
- 3) Fill the can with water and then unplug all the holes, at the same time if you can.



## WHICH WATER JET GOES THE FURTHEST?

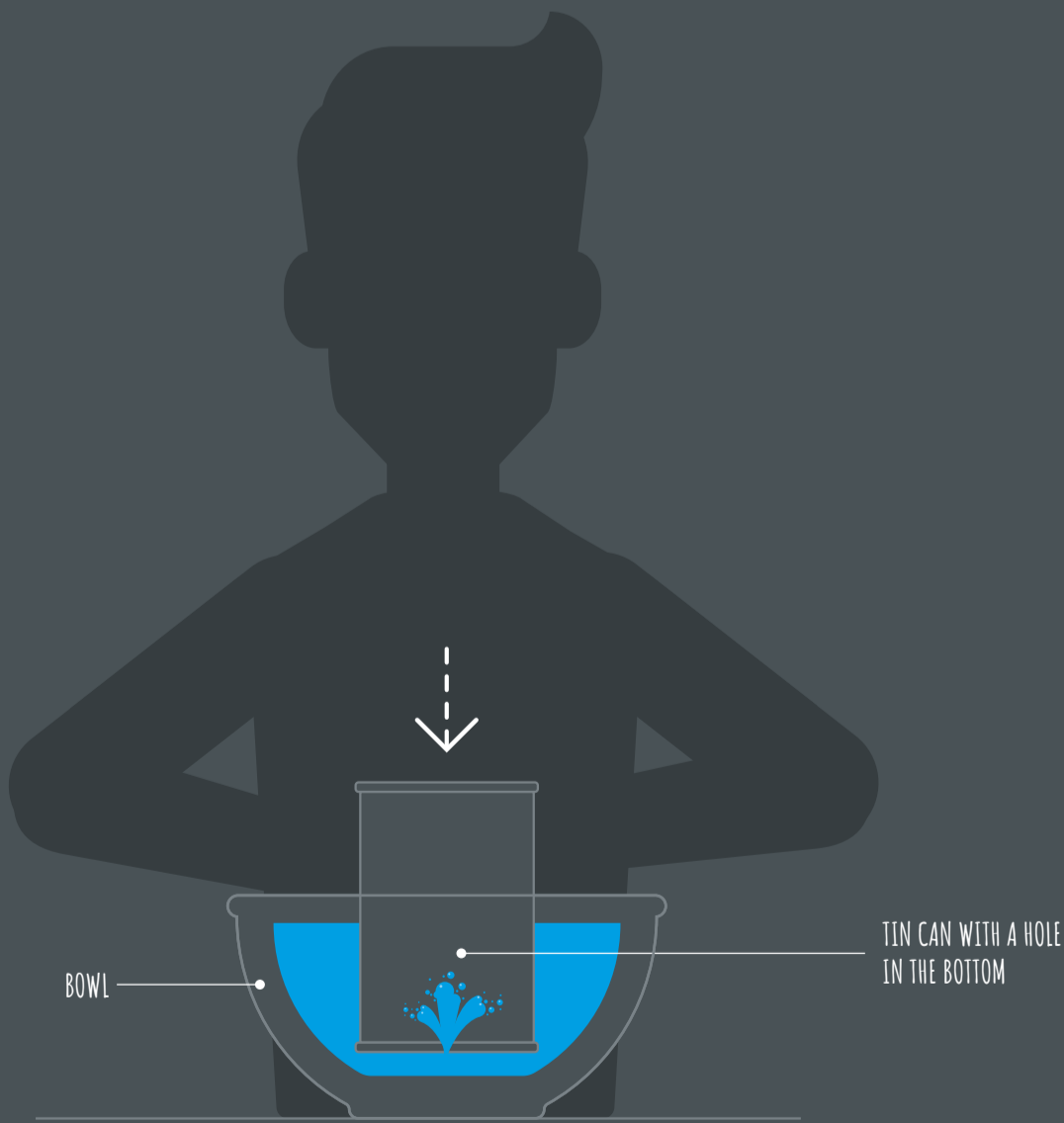
## DOES PRESSURE ACT IN ALL DIRECTIONS?

- 1) Using another tin can, make three holes around the base of the can at the same height.
- 
- 2) Plug the holes.
- 
- 3) Fill the can with water.
- 
- 4) Simultaneously unplug the holes.

## ARE THE WATER JETS ALL THE SAME STRENGTH?

## DOES PRESSURE ACT UPWARDS AS WELL?

- 1) This time, punch one hole in the bottom of a tin can.
- 
- 2) Push the can into a bowl of water while keeping the top above the water.



## DOES THE WATER JET UPWARDS? WHEN DOES WATER STOP FILLING THE CAN?

"Water always finds its own level."





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## 8. ACIDS, ALKALIS AND INDICATORS

### WHAT ARE ACIDS AND ALKALIS?

Acids and alkalis are chemical opposites. One can neutralise the other.

When dissolved in water, an acid produces positive hydrogen ions and an alkali produces negative hydroxide ions. The higher the concentration of hydrogen or hydroxide ions in the solution, the stronger the acid or alkali. This strength is measured on the pH scale, where 1 is the strongest acid, 7 is neutral and 14 is the strongest alkali.



### CAN YOU FIND ACIDS AND ALKALIS IN YOUR KITCHEN?

#### YOU WILL NEED...



SIEVE



BOWL



JARS



KITCHEN PAPER



DRINKING STRAW

- 1) Choose a plant with a strong colour that you can chop up. Red cabbage works well.



RED CABBAGE

- 2) Chop the cabbage into small pieces. Then boil them in a little water for a few minutes. Let the water cool down.

- 3) Dilute household substances in jars using a little water. You will need to shake some of them to help the powder dissolve. Try using



WHITE VINEGAR



BAKING POWDER



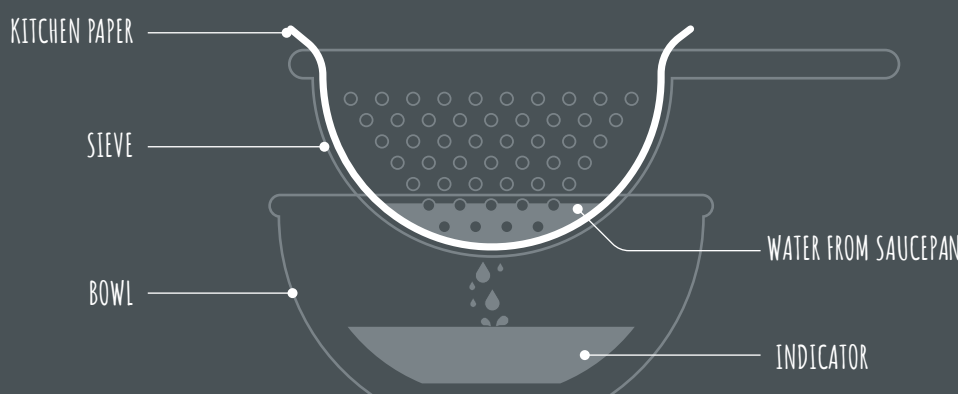
SOAP SOLUTION



LEMON JUICE

- 4) Line a sieve with kitchen paper to make a filter.

- 5) Place the sieve over a bowl and carefully tip in the now cool coloured water. Keep the paper and let it dry.



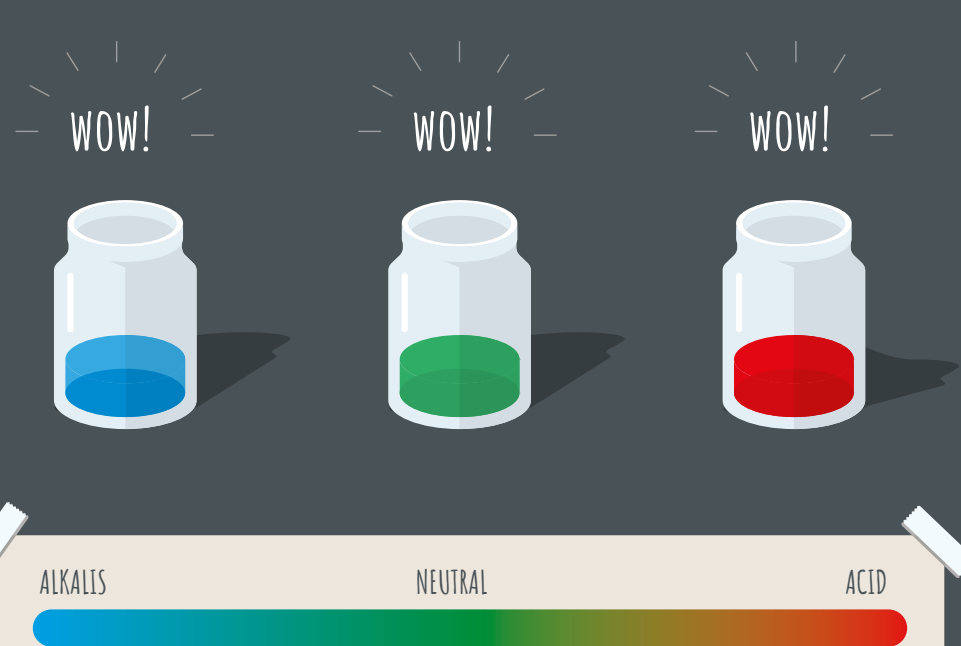
- 6) Add a few drops of the water from the bowl, which should be more or less clear, to each jar. You can use a drinking straw as a pipette.



### WHAT COLOURS DO YOU SEE?

Acids and alkalis are chemical opposites. One can neutralise the other.

Usually, depending on the plant material, acids turn the liquid red and alkalis will turn the liquid blue; green will be about neutral.



### CAN YOU NEUTRALISE A SOLUTION?

Try pouring one of your alkalis into one of your acids along with some of the indicator fluid.

Once your filtering paper is dry, you can use a drinking straw to drip drops of your solutions of household substances onto the paper

### CAN YOU CREATE INDICATOR PAPER?

Did the paper change colour?

If it did, you have created indicator paper like the litmus paper you may use at school.

