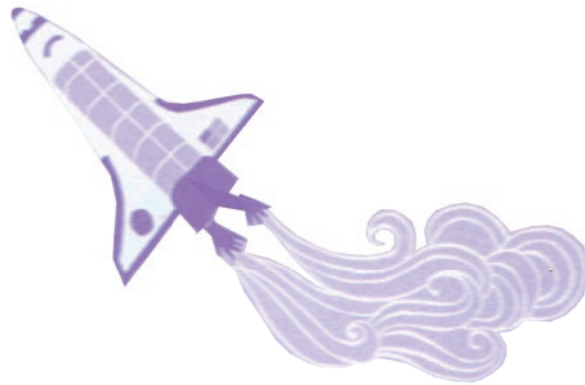


AQUILA'S  
MAGNIFICENT  
MEGA-MAG





At **AQUILA** we believe learning is fun, it never stops, and it can happen anywhere! We hope your young ones enjoy this free educational resource; it's packed full of fun and engaging topics to keep them busy, entertained and thinking clever thoughts!

#### **About us...**

AQUILA is more than just an 'educational magazine'. It's more like a club for bright and inquisitive kids who love to take on new challenges. Through **AQUILA**, readers can discover a community of children who are just like them – creative, curious and full of fun.

**To find out more visit: [aquila.co.uk](http://aquila.co.uk)**



# SCIENCE

This section takes you back to 17th-century pioneering experiments, super-sneaky wartime inventions, and shows you how to build a structurally-sound pillow fort using principles from science and maths.

**Seeing the Invisible** – Antonie van Leeuwenhoek's experiments with lice and sweat

**Foldscope** – Unfold the \$1 origami microscope

**What is Light?** – An illuminating investigation

**The Ultimate Pillow Fort** – Building a seriously sturdy den

**Meet Charles Fraser-Smith** – Top secret inventor extraordinaire

**King of Whiffs Liam Findlay** – What's in a smell?





# SEEING THE INVISIBLE

## ANTONIE VAN LEEUWENHOEK

**W**ho was Antonie van Leeuwenhoek?

Leeuwenhoek was born on 24 October 1632 in the town of Delft, Netherlands. That's where he lived and where he eventually died at the grand old age of 90. He was from a family of tradesmen and had no education beyond childhood schooling. However, his curiosity, diligence and obsessive need for study led him to become a pivotal scientific figure.



### WHAT DID HE DO?

- Commonly known as 'The Father of Microbiology' Antonie van Leeuwenhoek discovered bacteria, blood cells and sperm cells, along with many other microscopic discoveries.
- He made his own microscopes, which could reach 500X instead of the usual 30X for microscopes of the day. He was very secretive about his methods and this meant that no one else could see as close up as he could. This made it hard for people to believe that his observations were real.
- Leeuwenhoek made over 500 microscopes (fewer than 10 have survived). His microscopes are not like the ones we know today, instead they are a flat brass plate with a small magnifying hole and a sharp point to pin the subject on to. They were also very tricky to use.
- In 1680 he was elected as part of the Royal Society.
- His work has opened up the way for future generations of scientists to learn more about natural history and medicine, and to use this to improve the world around us.





# GETTING SMELLY FOR SCIENCE

Although self-experimentation was not unique for this era, Leeuwenhoek is especially remembered for his peculiar and sometimes smelly home-based experiments.

## GRUBBY LICE LEGS

To observe and describe a louse feeding, Leeuwenhoek let a louse sit on his hand and draw blood from him so he could observe how it fed.

*Super, super gross. Ed.*

If you think that is disturbing then you may not want to read on... Leeuwenhoek conducted another lice experiment in which he put adult lice on his leg and covered them with his stocking then left that stocking on and didn't have a wash for six days. After six days he removed his sock and observed over 80 louse eggs stuck to his leg hair. But it doesn't stop here, brace yourself for feeling itchy...

Leeuwenhoek then put the sock back on and left it on for another four days with no washing (I make that a total of ten days without a wash...). The result was that he had at least 25 young lice living on his leg. At the end of the experiment he felt so disgusted by it all that he threw his lice-filled sock out of the window and then cleaned his leg by rubbing it with ice two times. (Bath? soap? Maybe he should be called Peew-enhoek? Ed.) Based on his findings he calculated that in just eight weeks, two lice could become ten thousand young lice on a 'Person, who does not have a change of linen or garments.'

## TEETH SCRAPING

In 1683, Leeuwenhoek made observations about **plaque** on teeth. He didn't clean his teeth for three days and then collected his own plaque for observations. He also continued his observations by collecting plaque from two women and two men who had never cleaned their teeth before. (Super gross. Ed.) He looked at all of the specimens under his microscope and wrote about each one.

He described the plaque of one of the men by saying: 'an unbelievably great company of living animalcules, a-swimming more nimbly than any I had ever seen up to this time'



The sketches in his notebook of 'animalcules' in the mouth are described today as **microorganisms**. The ones he saw specifically include oral bacteria. This finding was the gateway to the amazingly complex world that exists within the human mouth.

## SWEAT COLLECTOR

Leeuwenhoek also designed an experiment to find out how much water is regularly lost through the skin in a day. To do this he weighed a dry beaker then put his own hand inside it and used a handkerchief to seal the top of the glass. He watched moisture condense on the inside of the glass. Finally he was able to weigh the sweat he had collected from himself and, based on the surface area of his hand, he calculated how much vapour was excreted. From this he estimated that the whole body must produce 28 fluid ounces (828 ml) every 24 hours.

### A few of Leeuwenhoek's other peculiar experiments:

- When he was ill he examined his own tongue and saw it had a furry texture. He scraped the white substance off his tongue and looked at it under the microscope for observation.
- He examined pepper water, river water, snow water, rain water, dirty water from a well near his house and sea water collected for him by a stranger. Often leaving it out a number of days and examining it regularly.
- He also observed cheese fungi, animal sperm, animal bile liquid, urine and exploding gun powder. (Super super super gross. Ed.)





HARVEY

# FOLDSCOPE

WELCOME TO THE FRUGAL SCIENCE REVOLUTION

What if every kid on this planet carried a microscope around in their pocket, just like you might a pencil? How would that change the world for the better? This is the question bioengineer Manu Prakash and his team of researchers at Stanford University are investigating.



*Hold up a second, what is a bioengineer? Ed.*

I thought you might ask. Bioengineering means applying the rules of engineering to **biological systems**. A biological system could be a human body, a field of wheat, a rainforest or an individual plant. Manu describes himself as someone who likes to think like a biologist, and then solve problems like an engineer. He loves tackling puzzles, basically, a lot like the average AQUILAnaut. Some of Manu's other work has involved developing a simple computing system that is made using water droplets. Yes, you read that right, water droplets!

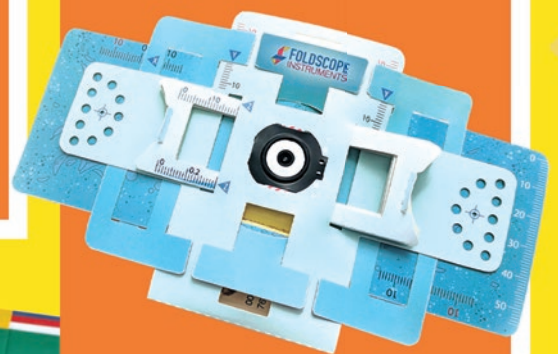
## THE PROBLEM

Manu grew up in India, a country with a high proportion of people living below the poverty line, so he's interested in making things work using the fewest resources possible.

Traditional microscopes are expensive, heavy and difficult to lug around. As a result, in places where there isn't much money to invest in laboratories, microscopes are often either non-existent, too bulky for proper fieldwork, or broken. Without them, scientists young and old struggle to get the clear results needed to progress their research.

## THE SOLUTION

Manu's answer was the Foldscope; a \$1 origami microscope which is made mostly of paper and can travel to any part of the planet.

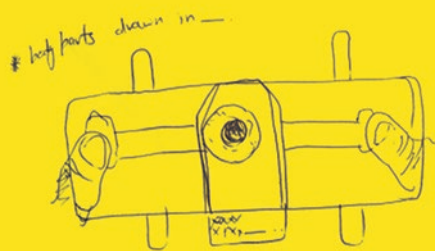


The Foldscope was invented by Manu and Jim Cybulski, while Jim was a PhD student working at Manu's laboratory at Stanford University, in California USA. On field visits across the world they had both experienced the lack of good-quality scientific equipment and seen how it hampered scientific investigation.





## AN INVENTION TO BENEFIT HUMANITY



A design was sketched and an exciting idea jumped into life; **what if paper could be used to build this piece of equipment?** After all, it's versatile, light, cheap and you can fold it into specific configurations with great precision. Jim and Manu decided to try and get the new tool into as many hands as possible.

Since its inception, the team at Foldscope have succeeded in getting their origami microscope into the pockets of 500,000 people across at least 135 countries. By the end of 2019, they intend to have distributed one million Foldscopes across the globe.

### MICROCOSMOS

But this isn't just the story of a very clever \$1 paper toy. This is the story of an entire global community coming together online to share observations, answer questions, solve problems and have fun with science.

*OK, that's great and everything, but what has it actually done? Ed*

Access to cheap and portable microscopes has led to lots of breakthroughs across the planet. Let's look at some case studies to see how the Foldscope is working in real life:

**Dr K. Indumathy** is a project investigator working in the Vellore district of India, near the city of Chennai. Dr Indumathy and her team are committed to collecting, identifying and classifying the various pests and diseases that can affect crops in the region. They show farmers and local students how to assemble Foldscopes and use them in the field (literally) to examine disease **pathogens** and pests so they can treat them effectively.

<https://tinyurl.com/y5ywrjzj>

Marine scientist **Dr Jorge Mardones** and his team from Prakash Labs have been in Chile looking at the effect of **salinity** (saltiness) on toxic algae in Chilean waters. Their research will have a big impact on fish farming in the area.

<https://tinyurl.com/y2f57m24>

**Dr S. Meignanalakshmi** uses the Foldscope to study the stomach juices of cows and diagnose **acidosis** and **parasitic infections**. Farmers can use the technology to help ensure the wellbeing of their cattle.

<https://tinyurl.com/y5hk6r2c>

### FRUGAL SCIENCE

Prakash and his team believe that access to science and science education is a **human right**, and they're doing everything in their power to make it so. It's all part of a **frugal science** revolution; the idea that, if humanity is ever going to reach its potential as a species, the 1 billion people who currently haven't got access to proper healthcare or infrastructure must be able to make discoveries alongside those who do.



#### Five fantastic things to look at through a Foldscope:

- 1 Cheek cells
- 2 Pollen grains
- 3 Tomato skin
- 4 Fungi
- 5 Belly button fluff

### TAKING THINGS FURTHER

Why not have a go at reinventing a useful device for modern living using the frugal science model? Take a high-tech object – it might be a food processor, a tumble dryer or a heart rate monitor. What are the essential components of that device? Can it be made simpler, cheaper and with fewer parts? How about making it from recycled materials? If you had to make the same device with a budget of £1, how would you go about it?

### LET'S DEBATE

Do you agree that access to science is a human right? Why not write to us and let us know.

## \* COMPETITION TIME! \*

**H**ow would you like the chance to win your very own Deluxe Foldscope PLUS an extra 20 Foldscopes for your school or community group?

**All you have to do is write to us explaining what you and your group would love to explore with your Foldscopes, and we'll pick our favourite.**



#### Send your entries to:

AQUILA Foldscope Competition  
Studio 2, 67a Willowfield Road  
Eastbourne, East Sussex  
BN22 8AP

Email entries also accepted at  
[readers@aquila.co.uk](mailto:readers@aquila.co.uk)

Closing Date: **Monday 7th October 2019**

\*Competition is open to AQUILA subscribers only.

\*\*Class entries are accepted if the school subscribes.

**2 TO BE WON!**

To learn more about foldscope instruments and join the frugal science revolution go to [www.foldscope.com](http://www.foldscope.com)

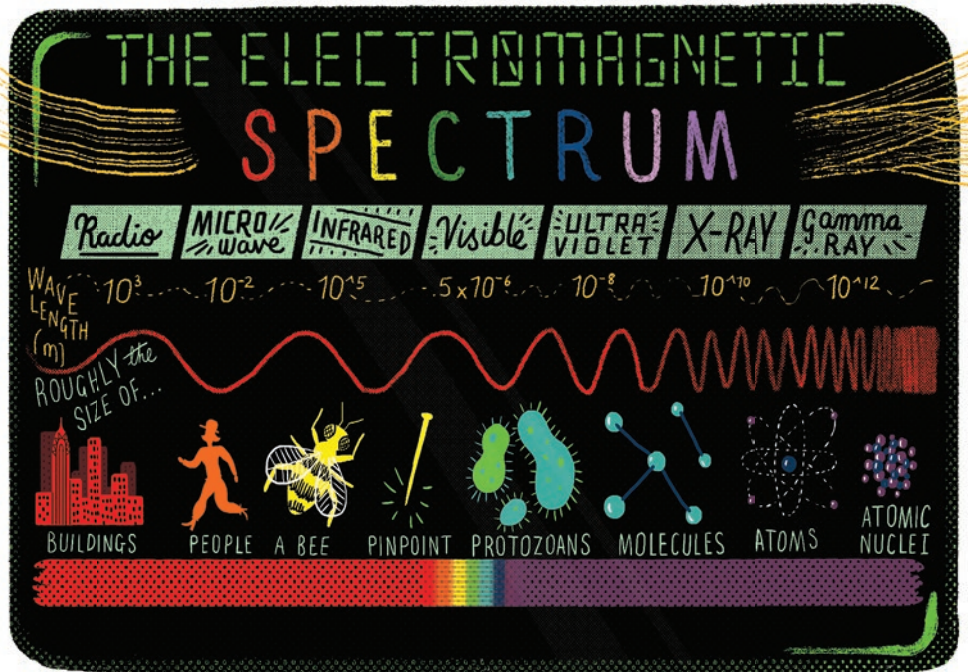




# WHAT IS LIGHT?

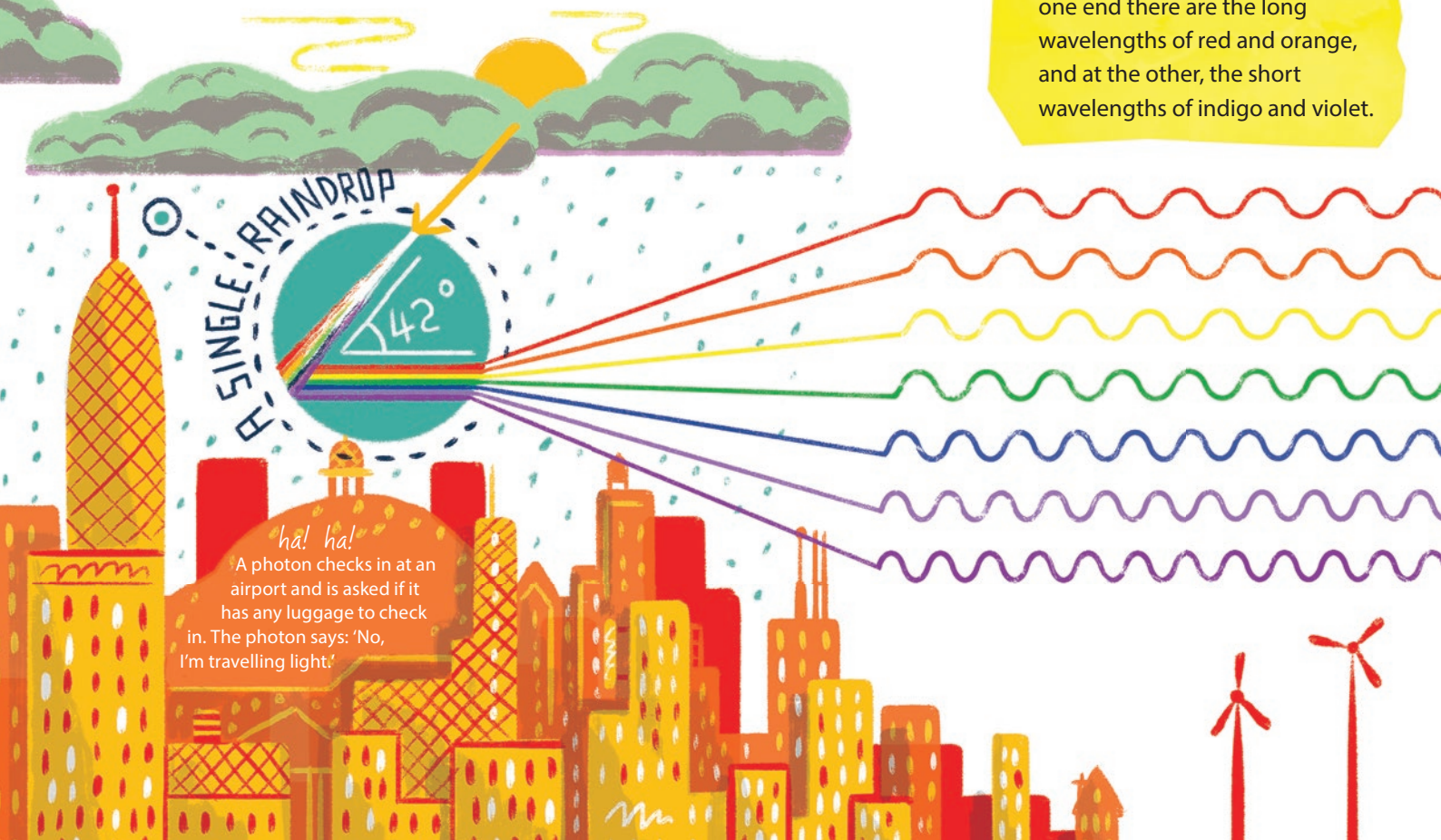
## IT'S NOT SIMPLE!

Light acts both as a **wave** and a **particle**. We call this **wave-particle duality**. A light particle is called a **photon**, it has energy and travels at the speed of light (*obviously*). Light can also be described as travelling in **waves**, rather like the waves of the sea. These waves are part of the **electromagnetic spectrum**, we describe them as the **visible** range because we can detect these light waves with our eyes.



Sunlight that reaches Earth is called **white light** because it seems to be colourless. However, if it passes through the right size of raindrop, the white light is broken apart to reveal the colours of the **visible spectrum**: red, orange, yellow, green, blue, indigo and violet. We see a **rainbow**!

The rainbow is separated out in order of **wavelengths**, this is the distance between two peaks. At one end there are the long wavelengths of red and orange, and at the other, the short wavelengths of indigo and violet.





## CALCULATING THE SPEED OF LIGHT

In the 17th century, the Italian astronomer Galileo tried to work out how fast light travels. He asked two people with lanterns to stand on top of neighbouring hills. The first person flashed their lantern and when the second person saw this, they uncovered their lantern too. Using the time between the two flashes, and knowing the distance between the hills, Galileo hoped to calculate the speed of light. Unfortunately, the two hills were less than a mile apart, making the time gap too short to measure.



In the 1670s, the Danish astronomer Rømer used eclipses of Jupiter's moon, Io, to calculate how long it took light to travel from the Sun to the Earth. With this much greater distance, he estimated it took somewhere between 10 and 11 seconds. We now know it takes just over 8 seconds, making Rømer's 350-year-old estimate impressively accurate. At such a speed, light can travel all the way around the Earth's equator 7.5 times in a single second. Phew!



## WHAT IS A LIGHT YEAR?

Strangely it is not an amount of time, but a measure of distance. It is the distance that light can travel in a year, in certain conditions. It is equal to about 9.5 trillion kilometres (9 500 000 000 000 km) or 5.9 trillion miles (5 900 000 000 000 mi). Non-specialists use it to describe astronomical distances because it makes some sort of sense. Astronomers generally describe distances in **parsecs** (one parsec is equal to about 3.26 light years).

## USING LIGHT FOR 'TIME TRAVEL'

Since light takes time to travel, looking at things in the distance is a bit like time travel. When you look at the Moon, you see an image which was true just over one second ago because it has taken that time for the light to travel from the Moon to the Earth. If you use a special filter to look at the Sun, you see a snapshot of how it was 8 seconds ago (**never look directly at the Sun, it can damage your eyes**). Use a telescope to look further away, and you are looking *even* further back in time.

Let's imagine that we are standing on a planet that is 67 million light years from Earth. Let us also imagine that we have *an enormous and very powerful telescope* that is perfectly focused on Earth. The telescope would show us light which left the Earth 67 million years ago ... that's when *Tyrannosaurus* and *Triceratops* roamed the land. We would see dinosaurs! It is theoretically possible, but first we'd have to get 67 million light years from Earth, then build a gigantic telescope... (*better get started, ed*).

## NEW DISCOVERIES

We are learning more about light all the time! In the summer of 2018, the Canadian Hydrogen Intensity Mapping Experiment (CHIME) discovered some interesting bursts of photons coming from distant galaxies. The team of scientists were very excited by their discovery, and by the time you read this they might have announced why!





CALCULATA

# THE ULTIMATE PILLOW FORT

HOW CAN YOU MAKE YOUR PILLOW FORT AS COOL AS POSSIBLE? BY USING MATHS AND SCIENCE OF COURSE! JUST LIKE ENGINEERS AND ARCHITECTS DO!

## FORCES

The main goal of almost every building – your pillow fort included – is just to sit there, without moving, or breaking, or collapsing. This area of science is called **statics** – the study of static (still) objects. For an object to be static, all the **forces** acting on the object must cancel one another out.

## TENSION

**Tension** happens when an object (like a sheet, or a piece of string) is stretched **taut**, so that it's not sagging at all. It exerts a force on the objects that are supporting it, and that **force** pulls the supports *inwards*.

To fix this, you could:

- Attach taut objects to sturdy supports
- Keep ceilings a little saggy, rather than pulling them tight.

## GRAVITY

**Gravity** is the force pulling everything down to Earth. Heavy objects with more **mass** exert a stronger gravitational force than light objects with less mass. If a support structure isn't strong enough to hold the weight above it, the whole fort can collapse.

To fix this, you could:

- Place lighter objects higher up in the fort
- Ensure heavy objects are supported by strong supports (such as tables), or by many supports (spreading out the weight)
- Avoid putting objects in places where there isn't much support.

**Tip:** Try layering multiple sheets to get a dark, cosy room without the weight of blankets or towels!





## THE KNEES-AND-ELBOWS\* FORCE

(\*not an official name)

Your pillow fort is going to get a few knocks and bumps – a knee here, an elbow there – and you don't want it to collapse with general wear-and-tear!

To fix this, you could:

- Ensure objects are secured well, by using rubber bands, hair ties and pegs to hold them in place
- Use books, or other heavy items, to prop up anything wobbly like cardboard walls
- If something feels unsteady, don't use it as a major support for anything else, instead use another support object nearby.

Engineers and architects need to make sure a building is done right the first time, so they make lots of calculations to figure out the exact strength and direction of all the forces in their buildings. When building pillow forts, most of the **statics** can be done intuitively, and through trial and error.

### SAFETY:

With all the fun of pillow fort building, it's easy to get carried away. These tips will help keep you safe:

- Don't climb on anything that's not sturdy enough to climb on normally
- Keep hard, heavy objects near the ground, so they can't fall on anyone's head
- One of the cool things about making pillow forts is that you're using objects in ways they weren't designed to be used. The downside is that perfectly safe objects can become dangerous if used differently. You can put a lot of weight on the seat of a chair, and yet only a little force pulling on the back of the chair can tip it over. If in doubt, rotate the chair so the forces are pulling *forwards*
- ★ Be very careful when using electrical equipment inside your fort. Lamps and stereos, which are normally perfectly safe, can become dangerous when surrounded by blankets and sheets. Never leave these items switched on inside your fort.

We would love to see your fantastic fort photos. Head to the readers' page at [aquila.co.uk/readers-page](http://aquila.co.uk/readers-page) and follow the link to **send in your letters**, or send them in the post to our usual address!

POLLY

## PUTTING IT INTO PRACTICE: GET BUILDING!

### Mind map

Take some time to think about what sort of pillow fort you want to build. Do you want it to be light and airy, so you can read inside without torches? Dark and cosy so you can tell ghost stories till you fall asleep? As big as possible, regardless of everything else? As you go through the rest of the steps, you'll need to make decisions (and maybe a few compromises).

If you know what you want out of your pillow fort, and judge decisions against those **criteria**, you're much more likely to end up with a fort that you love!

### Make a plan and gather materials

Decide where you want to build your fort, and which major elements of your home you want to incorporate, such as sofas and tables.

Gather your pillows, blankets, sofa cushions, smaller furniture and miscellaneous objects. Gather your pegs, rubber bands, mops and brooms. Assess your materials by their pros and cons: are they strong, weak, rigid, flimsy? Different materials will be useful in different ways.

- Now start planning! Where will your entrance be? What different rooms will you have? Check back with your mind map and balance what you want against what's available!

### Get building!

Start from the **foundations** up. Move in the biggest pieces of furniture, then start building the skeleton walls. Place any cushions or beanbags into the walls. Add extra support beams such as mops and brooms or light washing baskets. Finally, add cardboard, blankets and sheets for remaining walls, doors and ceilings.

### Things will almost certainly collapse at some point!

Consider the situation and decide which force you think caused the collapse? Weight, tension... or a human bump? Then use the relevant engineering tips from the previous page to strengthen your fort.

### Finishing up:

Add your final details – perhaps toilet roll periscopes or homemade flags – and bring in some entertainment, like books, art supplies or music.\* Settle in and have fun!





# MEET CHARLES FRASER-SMITH:

QUINTESSENTIALLY QUIRKY AND QUITE INCREDIBLE



Have you ever looked at your hairbrush and thought: 'I could definitely turn that into a hiding place for a map and saw'? Notsomuch? Well, enter the world of Charles Fraser-Smith, a mild-mannered clothing supply clerk who, during World War II, invented gadgets and gizmos that would make James Bond jealous. Described at school by his teachers as 'scholastically useless' (nice, ed) Fraser-Smith was an exceptional maker, who went on to change the face of the British war effort with his incredible inventions.

In his fake day job at the clothing-supply office, Fraser-Smith was secretly working for the **Special Operations Executive** (and MI6 and MI9), a secretive bunch who worked undercover to sabotage the enemy at every turn. Fraser-Smith was put to work transforming everyday objects into weapons, places to store documents and tools to help prisoners of war escape from camps in Germany. Here are just some of his amazing inventions.

## THE HIDDEN MAP

You might not want to blow your nose on this handkerchief. A map drawn onto a cloth handkerchief with invisible ink, but how can you see it? Well, you could always wee on it. In fact, that's exactly what you had to do to make the map appear.



## CAREFUL HOW YOU TIE YOUR SHOELACES

Because, you know, there's an entire Gigli saw hidden in there that can cut through metal. No double bows please.





## ITCHING POWDER

Added to the life vests of U-Boat crews through the French company that made them. Utter genius. \*itch, itch, scratch\*

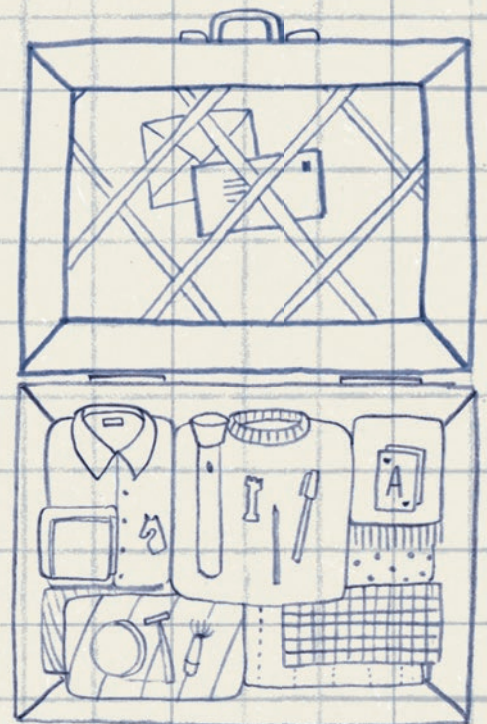


## WHICH WAY?

Lost? Well you could always consult that used match of yours. You know, the one containing a magnetised needle to find north? Just let it float in a puddle and follow its lead.

## PAPER CHASE

Paper laced with a magnesium compound that bursts into flames and disappears completely? Check. Paper that can be eaten to destroy all evidence? Check. Indestructible paper that can be written on while damp? Check, and it's a wrap.



## HIDEY HOLES

We couldn't even begin to list all of Fraser-Smith's ideas, but here are a few of his best hiding stuff inventions: chess pieces and playing card packs with secret compartments, shaving brushes with the thread the wrong way round so you had to open it clockwise rather than anti-clockwise, torches with one fake battery as a secret compartment, pens containing a compass and so on and so on. What a brilliant mind!

## FEELING A BIT PECKISH?

We wouldn't normally recommend this, but tuck into this tube of toothpaste. It's not about minty fresh breath but instead about the high-calorie food that's in there. Perfect for prisoners of war to carry with them during an escape attempt.



# LIAM FINDLAY:

## KING OF WHIFFS

Thanks to the likes of Hermann von Helmholtz we know we can't believe our eyes, but what about our nostrils? Surely they're on the level? I mean, no one would ever go out of their way to make something smell of something it doesn't naturally smell of, would they?

Actually, they would. Liam Findlay is an attractions consultant at AromaPrime, a company that has been making places smell weird since the 1980s.

**Polly:** What exactly does your job entail?

**Liam:** I work with attractions – theme parks, museums, castles, aquariums and other places you might visit on a day out. I show them how to use smells in the most exciting and effective ways. Some of our past customers include Alton Towers, Sea Life aquariums, the Natural History Museum, The Dungeons, English Heritage, Jorvik Viking Centre and Madame Tussauds.

air. Smell has an incredible way of sticking in your memory. I remembered those aromas as I grew up, even after the Timewalk closed. I became a designer for themed attractions and so I got in touch and asked if I could help out in any way. That's how it started.

**Polly:** What do you think scent can add to a museum experience?

**Liam:** More than anything, smell is a master storyteller. Damp odours in a dark space can make you feel claustrophobic as you start to imagine narrow tunnels. Metallic smells can immerse you in an alien world as you board a spaceship ride at a theme park. Strong whiffs of medicine and body parts can bring history to life as you learn about an old hospital! Because of how it directly interacts with your brain, smell is powerful fuel for your imagination!

### FUN FACT TRUMPET:

Did you know that, even though a sound can wake you up, you can not smell in your sleep! *(Speak for yourself, I totally smell when I'm asleep. Sometimes I positively reek! Ed)*

**Polly:** How did you become a... that?

**Liam:** The company I work for has been making themed smells since the eighties. One of their first projects was designing odours for a historical attraction in my hometown of Weymouth. It was called Weymouth Timewalk. Visitors could walk through the town's past, smelling rat-infested ships, the black death *(brilliant, ed)*, and the glorious seaside





**Polly:** How do you even start designing a smell? Especially for a time or a place you could never actually visit?

**Liam:** We have an amazing laboratory full of bottles with labels like Granny's Kitchen, Dinosaur and even Bear Poo! We have a long list of scent recipes but sometimes an attraction will ask for a smell we've never made before.

It isn't always possible to sniff the real thing if you want a reference for a new fragrance oil. For example Camelot Theme Park asked us to make a dragon's breath smell. Our scent designers had to do some research into how dragons were described in medieval times. They researched reptile smells (so... lizard sniffing? Ed) and they already knew how to make smokey scents. This mix led to the perfect recipe. When it comes to creating a new smell, it's often a case of researching, smelling real subjects and then experimenting with ingredients.

**Polly:** Who decides whether an aroma like that is right or not?

**Liam:** Most of the time visitors to an attraction are the best judges of our scents, but everyone experiences smell differently. Years ago we made a rotting flesh smell for a scare attraction. Some people thought it smelled like delicious meat! It was hilarious. We soon made the smell even more ghastly.

**Polly:** What is the weirdest smell you ever produced (in a lab, not, you know... organically)?

**Liam:** No scent is too weird for us, in fact pretty much all of our smells are out of the ordinary. We have produced a penguin sick smell for zoos, and that never fails to amuse people. The actor, Richard E. Grant once sampled it on TV.

**Polly:** Has it ever gone really wrong?

**Liam:** Flatulence is one of our bestsellers. In 2003, a Roman museum wanted to use it for their replica Roman toilet. Silly smells are always fun and get you engaged with the past, but on this occasion, the museum set the strength of their smell machine too high. The pong ended up being far too strong and four schoolchildren were sick when they sniffed it! This was a very long time ago. Customers are always advised on the best ways to use stinky odours, but it is a very amusing story. It even made the news!

**Polly:** What's your favourite smell?

**Liam:** Lemongrass is lovely! I am a writer in my spare time, and I've been writing a novel that involves outlandish aromas – one of the main characters smells of lemongrass. The villains are more odious.

**Polly:** If you could only ever smell one thing for the rest of your life, what would it be?

**Liam:** If I could only smell one aroma for the rest of my life, it might be the smell of the Timewalk – the attraction from my childhood. It's comfortably musty, and it has a personal appeal to me because of my fond memories. There's a perfume called Aramis that's quite similar, although not everybody finds it appealing! I suppose I'm more used to strange pongs than most people.

**Polly:** Why do we remember smells?

**Liam:** The **smell receptors** in our nose are directly linked to the part of our brain that processes memories and emotions. This means that scent has the amazing ability to influence your feelings. So, if you're walking through a recreation of the trenches, a horrible odour can really help you imagine how awful it must have been for soldiers who had to fight there. Alternatively, if you're an older person, you might visit the replica of an old-fashioned house, and the smell of the food, the soap and the coal fire can cause all sorts of childhood memories to rush back. The way themed smells bring back memories is actually useful in care homes too. Our products can help people with dementia to remember their past.

## \* COMPETITION TIME! \*

**H**ave you ever wondered what a T-rex's toenail smelled like? How about Sherlock's socks, or the Duke of Wellington's...erm... Wellingtons\*? Well, now is your chance to find out!

Our mates at AromaPrime are offering one very lucky AQUILAnaut the chance to smell anything they like. All you have to do is tell us what historical smell you'd most like to experience. We'll pick the most interesting one and the lucky winner will receive their custom-made fragrance and a special device to propagate their pong.

\*Use your imagination. Your own entry does not need to be foot or sock related!

THE SWEET SMELL OF  
SUCCESS (OR NOT)

JUST ONE  
TO BE  
WON!



Send your answer on the back of an envelope with your name and address on the inside to:

AQUILA History Stinks Competition  
Studio 2, 67a Willowfield Road  
Eastbourne  
East Sussex  
BN22 8AP

Email entries also accepted at:  
[readers@aquila.co.uk](mailto:readers@aquila.co.uk)

Closing Date: Monday 4 November







# HISTORY

In this section we visit the Vikings and discover that pelicans were, historically, thought to be mythical!

**Not on Your Nelly** – Animal anomalies

**Runestone Cowboys** – Come aboard a Viking longship

**Sign of the Times** – Search for hidden clues in Renaissance masterpieces

**Tragedy!** – Put on your own show, Ancient Greece style





# NOT ON YOUR NELLY



## ANIMALS THAT HAD TO BE SEEN TO BE BELIEVED

**What animals have you seen today?**

Maybe you spotted a fox rummaging for rubbish in your backyard, or a robin flapping about in the birdbath? Perhaps you watched a wildlife documentary and saw a lion dozing on the savannah? How about that video you watched on YouTube: **10 DEADLY GUINEA PIGS: PETTING ZOO PANIC?** Just imagine for a second how few animals you'd know about if we hadn't invented the camera and couldn't travel easily to other places.

### LIAR, LIAR, PANTS ON FIRE!

Explorers used to return from their travels with stories of the strange 'new' creatures they had seen. Many people laughed at them. They thought the explorers were making it all up. Here are just some of the animals people in Europe once refused to believe were real.

### PELICANS

**Carl Linnaeus** was a well-respected Swedish biologist in the 1700s (yes, yes, we've all heard of him; classic *Homo sapiens*, ed). Yes, but even he made mistakes. When he wrote about mythical, un-real animals, he included pelicans. After all, who would seriously believe in a huge bird with a bag under its beak? He thought the Americans just had over-enthusiastic imaginations!

### WIND YOUR NECK IN!

The Plesiosaurus lived in the sea 135 to 120 million years ago. **Mary Anning**, the famous fossil hunter, found the first near-complete fossilised skeleton in

1823. **Georges Cuvier** had just suggested that ancient species of animals might have died out and become extinct but he denied Mary's find because it had too many bones in its neck. He called a special meeting of the Geological Society of London to disprove her, but women – including Mary – were not allowed in. (Talk about dinosaurs! Geddit? Eh? Never mind.) A respected (male) geologist, **William Conybeare** believed Mary and, after much argument, Georges (eventually) admitted how wrong he had been.

### PLATYPUS

In 1797/1798, 28 years after **Captain Cook** landed in Australia, a skin of the amazing duck-billed platypus arrived in London. It wasn't unusual for people to create false animals then; 'mermaids' had been made by sewing the (dead) body of a monkey to the tail of a fish (that's all charming and lovely, Ed). So, when faced with a creature that looked like a mole, with webbed feet, a duck's bill and a beaver's tail, the Natural History Museum's biologist, **Dr. George Shaw**, naturally thought







## GIANT SQUID

For hundreds of years, sailors have told tales of a sea monster – the *Kraken* – whose huge tentacles rose out of the sea and dragged ships down into the deep. But they remained just stories; no one had ever seen one (or lived to tell the tale, anyway). The first real evidence for the existence of giant squid arrived in 1857, when one was washed up on a beach in Denmark.

In 1873, a 12-year-old Canadian boy hacked a 6-metre tentacle off a creature that came up to their rowboat (*uncalled for. Again. What is our problem? Ed*). A giant squid washed up on the shore the next year and was finally photographed.

Giant squid rarely come to the surface of the sea. It's really difficult to find creatures in the deepest parts of the ocean, even if they are 13 metres long, so it wasn't until 2004 that some Japanese scientists managed to photograph a *live* giant squid, and not until 2012 that one was filmed alive actually in the sea!

Of course, while foreign scientists were scoffing at the existence of such 'impossible' animals, the people who lived alongside these creatures always knew they existed. It just took a while for others to *believe* them!

that this was just another hoax. He tried to find the stitches that **MUST** have been used to fit the bill onto the animal.

## GORILLAS

**Hanno**, a Phoenician who lived in the Mediterranean in about 500 BCE, wrote about his voyage around Africa. He found an island full of hairy creatures who were very powerful and, when seized, became so violent that Hanno had to kill them. He took their shaggy skins back to Carthage, where they stayed until the Romans destroyed the town. Incredibly, gorillas remained nothing but a story until 1847, when an American found skulls of 'a very unusual chimpanzee' in Liberia. It was not until the 1880s that live gorillas were brought to Europe.

## OKAPIS

'We've been told of a stripy donkey in Africa', European explorers said in the 1880s. 'It has a long neck like a giraffe and a tongue it can lick its own eyes with'. Well, the scientists back in Europe didn't believe it at all; they even called

it the 'African unicorn', because surely it was just a mythical creature. They had to change their minds though, when a baby okapi was captured and its body brought back in 1909.

*(Why are all these animals winding up dead? This is a horrible list!)*

Good question. Early explorers weren't as concerned with conservation as most people are now.

## KOMODO DRAGONS

In 1910, Dutch settlers in Indonesia simply refused to believe the locals' tales of 20-foot-long monstrous lizards living on Komodo Island, so a Dutch army officer went to see them for himself. He was astonished to find the island was full of these prehistoric-looking lizards. Admittedly, they were a little smaller than the tales had specified (but their saliva was still as poisonous!). More expeditions followed, and a photo and a preserved skin were displayed in 1912, to prove they really did exist.





# RUNESTONE

Nobody else on Earth had boats as efficient (or as cool) as the Vikings.

## SLIM JIM

Ships meant for raiding and exploring were long, tight, shallow and slender. The square sail meant they could cross vast oceans. The light, shallow structure meant they could move far inland up bendy rivers.

## MAST

## MAIN SAIL

Made from wool.

## SHROUD

## OPEN-PLAN LIVING

The Vikings slept and ate on deck.

There were no toilets, they simply stuck their bottoms over the briny sea!

## STERNPOST

## AXE-PLEASE!

Vikings only used axes, never saws, to cut and shape wood. It meant the blade followed the grain of the wood, retaining strength.

## FORESTAY BACKSTAY

## STEERBOARD

This is where we get the word 'starboard' from.

## IN THE CLINKER

Long ships were built of oak, using the 'clinker' style; shaped overlapping planks held in place by wooden pegs and iron rivets. Gaps in the planks were plugged with wool or animal hair soaked in resin or tallow (animal fat) to ensure the vessel was completely waterproof.

## OARPORT

## KEELSON

## STRAKES





# COWBOYS

HALYARD

YARD

## STATS

20-25 metres long  
5-6 metres wide  
The mast is 10 metres tall  
Maximum speed: 15 Knots

## HERE BE DRAGONS!

Carved heads of serpents or dragons were often placed on the stern or at the prow to instil fear into the enemy. The Vikings gave their ships names, like Snake of the Sea, or Raven of the Winds.

TACK

STEMPOST

SHEET

KEEL

Cut from a single piece of oak, from a tree at least 25m long.

## SARDINES

Longships might take up to 60 sailors, who used oars when the woollen sail was not in operation. Sailors sat on benches or sea chests. Inside they kept their personal possessions - extra clothing and weapons. What would you take on a Viking expedition?

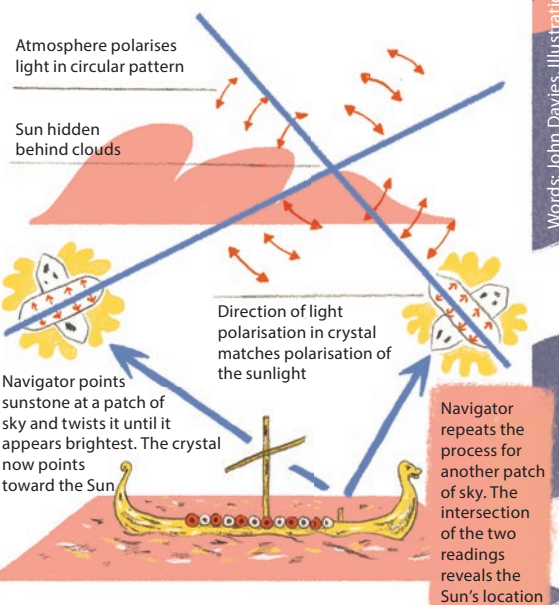
## WHAT IS A SUNSTONE?



Wherever possible Vikings used the position of the Sun and stars to navigate, taking advantage of the longer periods of daylight available in northern waters. Some evidence has been found that adapted sundials known as 'bearing dials' or 'sea compasses' with markings scratched on them were put to good use, while other mariners also carried a **sunstone**.

A sunstone is a type of transparent calcite crystal, also known as Iceland spar. This stone has the ability to **polarise** light, filtering it along different axis.

On overcast days Vikings used sunstones to locate the Sun so they could plot their position.





# SIGN OF THE TIMES

## THE MONA LISA

**D**oes Leonardo da Vinci's work include secret hidden meanings? The short answer is 'probably', because in Leo's day lots of artworks contained hidden meanings. Remember, many people could not read and write. Symbols hidden in the art around them told people how to think and how to behave, it's just that some messages were more **covert** than others.

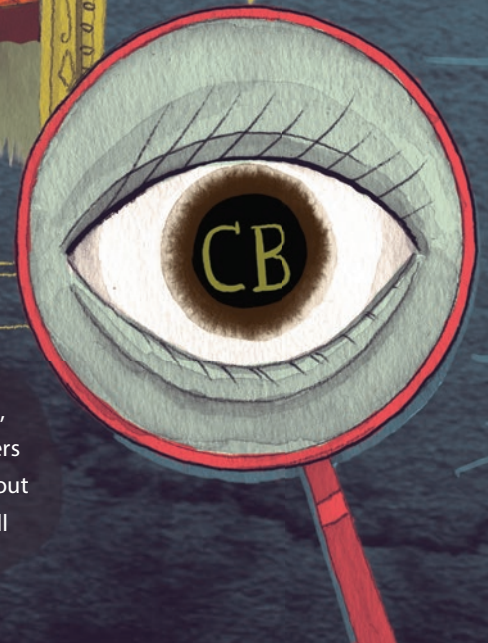
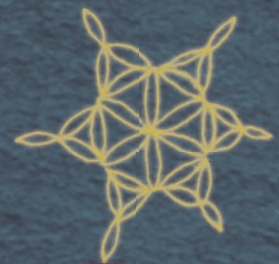
We don't want to toot our own trumpets (*yeah, right! Ed*) but it turns out that if Renaissance painter and inventor Leonardo da Vinci was alive and well today, he'd probably be an AQUILAnaut. The cheeky scamp loved nothing better than hiding symbols and meanings in his paintings, creating puzzles and intrigue and writing from right to left, the trickster.

We're going to take a look at two of his most famous works and the hidden meanings he may have created with the simplest flick of his paintbrush.

**Why the long face?** Probably because she'd been sitting on a wooden stool for hours getting a numb bum, while Leo captured her so-called 'enigmatic smile'. Bottoms aside, there are some fascinating things going on in this picture that you won't see at first glance.



More symbols can apparently be found on a bridge in the background of the painting. It carries the numbers 72 or it might be L2. Theories abound as to what the letters and numbers mean. Some speculate they are related to Christian and Jewish numerology, while others say they are just references to dates and nothing more. The thing about Leonardo though, is that he loved to hide and entertain, so you can never be too sure exactly why he hid those symbols or what he was trying to say with them.

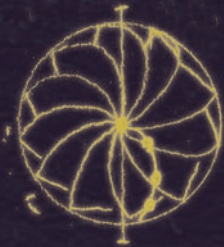


Some say that if you get up close and personal to Mona with a magnifying glass, you'll see that in her right eye are the letters LV, so far so self-explanatory, but what about the letters in her left eye that seem to spell out CE or possibly CB?

abundant  
even now



# THE LAST SUPPER



This rather epic piece took LDV three years to complete. It is still on the wall it was painted on, in a convent called the Santa Maria delle Grazie in Milan, Italy.

Conspiracy theories, symbolism and scandal surrounds this intriguing depiction of the last meal Christ shared with his disciples before his crucifixion. If you're familiar with this story and with Jewish traditions in general, you'll know that religious meals are, in themselves, hugely symbolic affairs. Add an extra layer of that old da Vinci magic and you've got an image that's still causing arguments more than 500 years later.

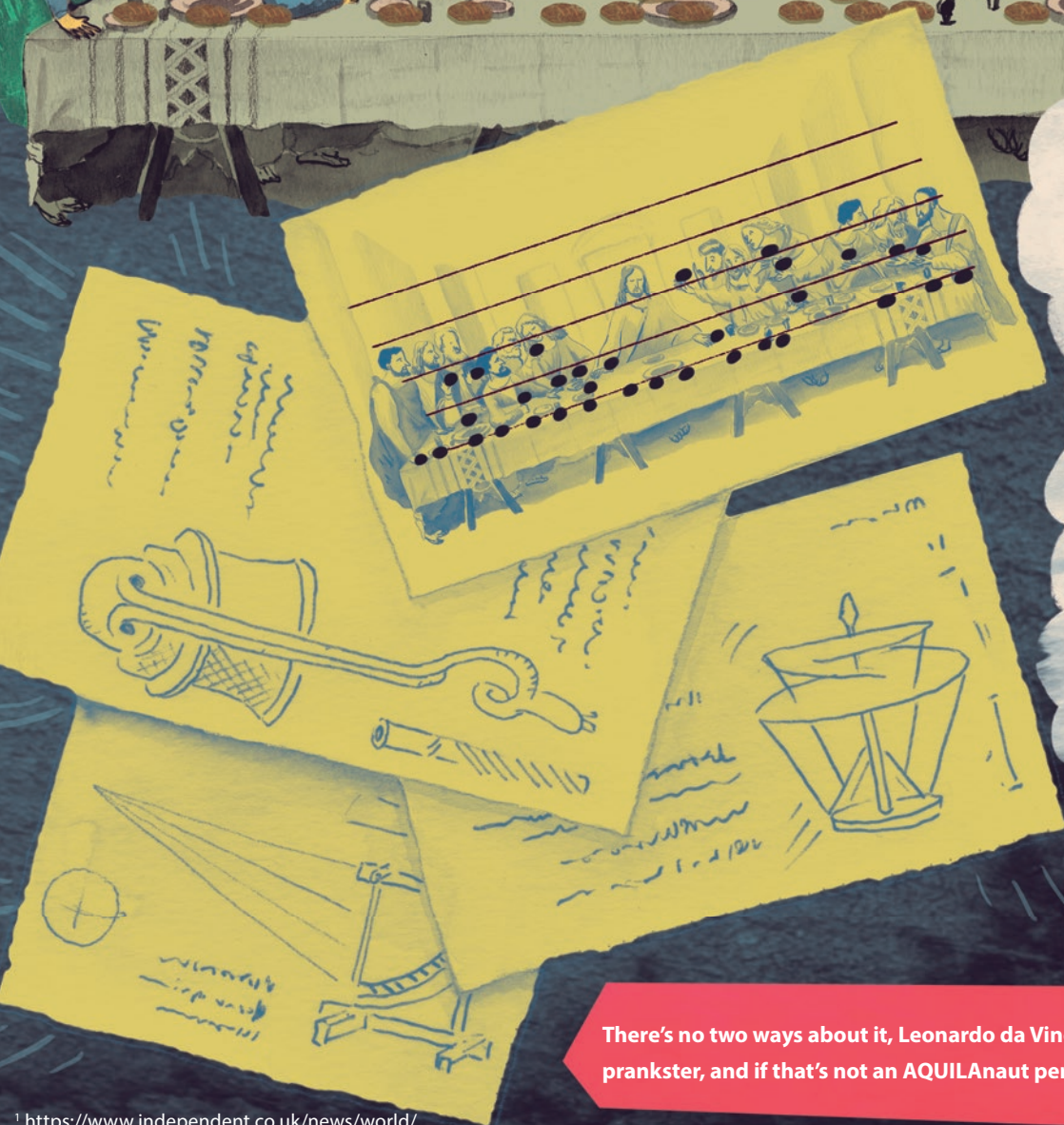


First of all, you have the mystery of the disciples themselves. All based on real life characters. Da Vinci was said to have searched the jails of Italy for the right looking villain to depict arch-traitor Judas. But who is the apostle to the left of Jesus? It's thought to be John, but it looks suspiciously like a woman. This has led to plenty of speculation over the true identity of this character.



But the real genius of this picture is said to be the way the bread rolls are placed on the table, coupled with the position of the disciples' hands. Mark where they appear on the painting, overlay with a blank musical score and you have an instant requiem<sup>1</sup>... if you follow the notes from right to left of course!

A-mazing. Or maybe not. After all, it was all coming from a man who would also scribble down designs for an early helicopter, anemometer and scuba gear, long before anyone had even learnt to pronounce anemone... amenot... anemometer properly.



**There's no two ways about it, Leonardo da Vinci was an all-round genius and prankster, and if that's not an AQUILAnaut personified, we don't know what is.**

<sup>1</sup> <https://www.independent.co.uk/news/world/europe/musician-finds-hidden-hymn-in-da-vinci-work-399740.html>





# TRAGEDY!

So, you want to live in infamy for the next 3,000 years, just like the great **Sophocles** or **Aeschylus**? The ancient Greeks loved watching plays and would compete in the Festival of Dionysus to entertain and move audiences, whilst critiquing kings and tyrants. Thousands of people gathered in Greek **amphitheatres**, which were semi-circular so that the people in the back row could hear the voices on stage (no electricity... so no microphones!). Famous playwrights like **Euripides** and **Sophocles** performed ancient Greek myths and stories of heroes fighting injustice or defeating an evil prophecy... you've heard of Odysseus, right? They were the rock stars of 450 BCE.

If you fancy creating your own epic story with tragic outcomes, comedic relief and shocking twists, follow our step-by-step guide to writing your own Greek tragedy. You'll be chilling in Elysium with millions of fans in no time.

## STEP 1: PICK A SOCIAL ISSUE YOU WANT TO EXPLORE IN YOUR PLAY

Greek plays had a strong moral message. They tried to teach the audience something. Whether it's the price of milk or the terrifying risks of climate change – pick an issue you're passionate about. Nothing says award-winning playwright better than a play written from the heart.

## STEP 2: CREATE SOME CHARACTERS

Every great story has a hero, a villain and somebody who needs rescuing. Why not challenge your audience's expectations and cast a female as your warrior? Or cast a brave hero who has a strong sense of justice and is deeply forgiving of his enemies.



## STEP 3: PLAN YOUR STORY

Is there going to be a war? Will the hero have an unrequited love, or is one of your characters going to chop up their enemy and bake them into a pie? Yes, the Greeks LOVED a bit of gore! There are lots of ways to plan your **story arcs** – try using a storyboard template (you can find these online) or mind-mapping the action. You could even write a list of plot points; whatever the method, find one that suits your inner writer and go crazy! General rule – no more than three lead characters should be on stage at any one time – except for the chorus.

## STEP 4: DEVELOP YOUR CHORUS

The chorus is central to moving the story forward. They are the citizens: people living in the city where the story takes place. They speak in unison, narrating the story, commenting on the action and giving their opinion about their leaders to represent ordinary people. The audiences loved the chorus because they could sympathise with it. (Note – remember their costumes should look similar, to make them look like working people in society.)



## STEP 5: WRITE YOUR SCRIPT

Possibly the hardest of all our steps... What kind of words do the characters use? How does their speech reflect their beliefs or personality? Remember, Sophocles, Shakespeare and all the legends in between had to redraft their scripts until they were happy. Be persistent. Keep writing. Keep redrafting.



## STEP 6: DESIGN YOUR PLAY VISUALLY

Choosing costumes, set and props is equally as important as the lines of dialogue and stage directions you've poured your heart into writing. Does the king wear a purple cloak? (Perhaps it'll have to be green as that's the colour of your parent's tablecloth, maybe NOT flowery like your nan's curtains...) The chorus wear masks. Have you made them? Can you design them? See our helpful photo guide to making your own Greek mask opposite.



## STEP 7: DIRECT!

So, you've written your masterpiece, collected your costumes and imagined your set. Now is the time to get your actors together and bring it all to life. Staging is important – big, dramatic gestures and strong, booming voices will make your play iconically Greek – over exaggerate your body language and movements to make the performance highly dramatic.



## STEP 8: RELAX!

You've done the hard bit and spent lots of time developing your tragedy. Now watch your actors turn your masterpiece into a phenomenon. Sit back, relax and enjoy the show! We can't guarantee you'll earn millions in cash, but we can guarantee that you'll earn the respect of your friends, family and loved ones, whilst maybe teaching your audience a thing or two.

It might seem like a lot of hard work, but we promise you'll feel an enormous sense of achievement in entertaining the crowds of adoring fans and it'll be AMAZING fun to work with your actors and play with costumes and props! The original Greek plays are still being performed today. So go on... WHAT ARE YOU WAITING FOR?

# MAKE A CHORUS MASK

In a Greek play, members of the chorus often wear masks.

### YOU WILL NEED:

- A plastic mask (you can use this again and again)
- Scissors
- Petroleum jelly
- Gloves (important safety gear for any project that involves plaster of Paris)
- ModRoc
- Acrylic paint
- Sharp implement (a needle will do)
- Modelling clay
- Elastic

**1** Cut your mask below the nose and cover in petroleum jelly (this will stop the plaster sticking to the plastic).



**2** Wearing gloves for protection, dip strips of ModRoc in water, squeeze out and cover the front of the mask. Build layers to make facial features.



**3** Leave to dry for 48 hours.

**4** Paint mask and, when dry, peel away the plastic mask from the plaster duplicate. Using your needle and modelling clay, make a hole in each side and attach elastic.



## DISCLAIMER

Plaster of Paris can be dangerous if not used correctly. Always follow the instructions on the container and have a helpful adult present.





# LET'S PUT ON A SHOW!



So, you've written your script, made your masks and chosen your actors, how can you make your opening night as impressive as possible? With a little bit of design inspiration, of course, courtesy of our favourite member of the art elite, Polly Chrome – or as she likes to be called now – Polly-cules.

## STEP 1: DECIDE WHERE THE STAGE BEGINS AND THE AUDIENCE ENDS

There are lots of ways to stage a play. Do you want your audience to sit in a single block of seats facing the stage? That's called a **proscenium arch**. Maybe the stage could be like a catwalk, long and thin with audience members on either side. Or perhaps you could opt for a **promenade performance**, where audience members are dotted about and performers move around them? Your decision will be influenced by the space you are performing in, but also by the piece you want to perform. It's up to you.



## STEP 2: THINK ABOUT YOUR THEMES

What ideas are explored in your play? What colours, textures and images spring to mind when you think about it? Write all the answers down in a **mind map**, even if they sound a little strange. For example, if your play is about a conflict between a nature reserve and the city, your colours might be light spring green and dark smokey grey. Your textures might be gently ruffled like a meadow in the breeze (*such a romantic, ed*) vs. smooth, hard and jagged like glass. Collect colours and images and present them in a **mood board** – that's how we start every issue of AQUILA, by the way; with a collection of colours, textures and images. It's a great starting point for any creative project.



## STEP 3: ALL CHANGE

Situations change during the course of the play (that's kind of the point of any story) – think about simple ways to represent those changes on stage. Think about how objects can be used in more than one way. Can a row of chairs become a bridge? Could a hat become a bowl? Could a ladder become a mountain? Could a mop become a lion? These are all really interesting ways to add to your storytelling toolbox.

## STEP 4: SKETCH

Examining your mood board, sketch your design. You may not use the first sketch, or the second, or even the third. It doesn't have to be perfect. It just has to communicate your idea to the rest of your theatre troop.



## STEP 5: MAKE A MODEL

Professional set designers always make a **scale** model of their design to show exactly how it's all going to come together. This step might not be realistic if you're just playing about in your backyard, but if you're working on a school production or intending on building anything at all, it's definitely a good idea. If anything is wrong, it will probably show up at this stage.







## STEP 6: BUILD YOUR DESIGN

Alternatively, you could use this handy how-to-guide to build a super chic all-purpose theatre set. You can use these in whichever way you like, to play improvisation games, or even in your writing process (*it sounds very professional if you refer to your 'writing process' whenever possible, trust me I do it all the time, ed*).

**1** Cover your surfaces with newspaper or plastic sheeting, this activity can get messy.

**2** Collect as many cardboard boxes as you can. They need to be in good condition, not dented or broken. Differing sizes and shapes work better than uniform sizes.

**3** Tape up the open ends with black tape.

**4** Paint all the cardboard boxes with blackboard paint. We have chosen this paint because a little goes a long way and it has a nice matt finish. It's water-based and only needs one coat.

**5** Leave to dry.

**6** With white acrylic paint, paint different symbols and pictures onto the boxes.

## YOU WILL NEED:

- More than one person (optional, but it's quite a lot of work for one)
- Cardboard boxes
- Black tape
- Blackboard paint
- White acrylic paint

We've chosen things to represent the Greek gods of Olympus, but most of them can have more than one meaning. The eye can be an eye, but it can also represent CCTV, the evil eye, or the Cyclops. You can stack boxes up to create trees and pillars, bodies of water, or large animals. Actors can take them apart during the scene to rearrange the space, or construct the props they need.



## TAKE IT FURTHER:

Just how far can you take this make? We'd love to see your stage sets in action. Head to the readers' page at [aquila.co.uk/readers-page](http://aquila.co.uk/readers-page) and follow the link to send in your letters, or send them in the post to our usual address.







# MATHS & PUZZLES

We get our readers thinking with word, maths, and logic puzzles to stretch and challenge their problem solving skills!

**Six Disastrous Miscalculations** – Enormous errors

**Science of Light** – Brain-scrambling science conundrums

**Skate Maths** – Awesome angles

**Cats Brainfeeders** – Feline-themed head-scratchers for the cat fans

**The Cake Tower of Hanoi** – When maths meets cake

**Leonardo Brainfeeders** – Puzzles for promising polymaths

**Shedevil Mystery** – Can you crack the case of the missing emerald?



# SIX DISASTROUS MISCALCULATIONS

It's always the little things, isn't it? You've got your team in place, you're ready to go and someone messes it all up at the last minute. Well, it's not the end of the world if we're talking about a school presentation, but when those microscopic miscalculations lead to an actual disaster, that's another thing entirely.

Throughout history we have seen, time and time again, how a slip of the finger, a faulty formula or just plain bad maths can lead to tragic consequences. Here are six of the very worst examples:

## NASA'S GENESIS PROBE:

Anyone got \$260 million dollars to spare? That's how much it cost when the Genesis probe crashed on its way home after a three-year mission to collect **solar wind**. Why, I hear you ask? Because someone (*I'm looking at you Stuart*) put a pair of parts in **BACKWARDS**. To be fair it was probably a complicated build, but backwards, really?

Scientists were able to retrieve some of the precious samples after the probe crashed down in the US state of Utah. Further study revealed that the wonky parts meant the probe failed to release the parachute that should have helped to slow it down.



## CHRISTOPHER COLUMBUS AND HIS AWFUL MATHS:

So Christopher Columbus was many things, an explorer, an excellent sailor and finder of new worlds (*erm, they really weren't 'new' now, were they? Ed*), what he wasn't so hot on, was adding up. The thing with Columbus is that he wanted the maths to fit, so he just went ahead and moved Japan on all of his maps.

## NICE ONE, CHRIS!

When he embarked on his voyage to find Asia, he managed to end up in the Bahamas instead. Not downhearted at landing on completely the wrong continent, he promptly captured lots of the indigenous people there and sailed them back to Spain. Why was it a disaster? His crew nearly killed him when supplies started running low, but that wasn't it. The real disaster, of course, was saved for the indigenous people. Subjected to nasty diseases brought from Europe, they were brought close to annihilation as a result.

## BRIDGE OVER TROUBLED WATER:

It should be pretty straightforward, right? Build a bridge, make it strong and job done. But the engineers of the Tacoma Narrows Bridge in the US state of Washington managed to get it spectacularly wrong and in November 1940, just four months after it was opened, the whole bridge plunged dramatically into the water below.

What engineers had failed to take into account was a phenomenon called the **aeroelastic flutter**, a small but vital equation that takes into account how much a bridge is likely to move and twist in the wind. With gusts of up to 40 mph (64 kph) battering the side of the bridge, the cables just couldn't handle the vibration caused by the movement, and they snapped.

A disaster for the good people of Tacoma and the Kitsap Peninsula, but worse for a small dog named Tubby, the only victim of the bridge collapse, who was killed as the car he was in slid into the water below. (*Poor Tubby! Ed*)





## FUN FACT TRUMPET

There are times when these epic fails can prove successful in their own special way. The Tower of Pisa started leaning even before it had been completed, and it soon became one of the world's most famous landmarks. However, after several years of restoration work, engineers have now managed to straighten it by 4 cm, after its wonk got so severe that it had to be closed to the public. If it was straightened completely, would it lose its appeal? Sometimes imperfect is better than flawless!



## CLOSE SHAVE:

You know you're having a bad day when you're ordered to start shaving train platforms. That's right, shaving platforms. In 2014 it turned out that a simple miscalculation by a French rail company meant that almost 2,000 new trains were going to be too wide for 1,300 of the country's train platforms. An embarrassing faux pas, non?

To make the trains fit, workers were ordered to start shaving back the edges of platforms. The extra work was thought to have cost another £40 million, on top of an already pretty hefty train bill. Zut alors!



## THE NOT-SO-TOUGH WARSHIP:

The tough-guy *Vasa* warship had everything: guns, guns and... more guns. It was so big, so strong, so absolutely undefeatable that it promptly sank, killing 30 sailors minutes after leaving its Swedish home.

This embarrassing tragedy, which took place in 1628, was caused by at least two human errors. Firstly, the boat builders had been working from two completely different measurements. One lot measured wood in Amsterdam feet, which is about 11 of today's inches, while the other side measured using Swedish feet. A Swedish foot was a whole inch longer. Secondly, the captain, who wanted to show off his ship's fabulous armoury, left the gun holes wide open. So when the boat tipped, gallons of water poured in.



## Even we make mistakes...

On page 7 of the November issue (Science of Light) we said that it takes just over **8 seconds** for the light from the Sun to reach Earth. Ha! Eight seconds! That would make the temperature on Earth anything between 600° and several million degrees C, not quite the right conditions for life as we know it! Sunlight actually takes, on average, **8 minutes and 20 seconds** to reach our planet. I'm not sure what got into us, perhaps it was all that talk of megaparsecs. Whatever it was, we are really very sorry and hope that this helps to right our wrong! Well done to all our eagle-eyed AQUILAnauts who spotted this error!





# RAIN FEEDERS

## QUICK LIGHT QUIZ

1

Henrietta Swan Leavitt was an awesome astronomer. Which of these other scientists also specialised in astronomy?

- A Nancy Roman
- B Rachel Carson
- C Grace Hopper

2

What type of philosophy is based on the belief that knowledge comes from experience?

- A Scepticism
- B Empiricism
- C Rationalism

3

What is a main difference between moths and butterflies?

- A Butterflies have long tube-like tongues called proboscis, moths don't
- B They have different shaped antennae
- C Moths have one pair of wings, butterflies have two pairs

4

What is a quantum leap?

- A The name for astronaut Neil Armstrong's first footstep on the Moon
- B Doctor Sam Beckett's theory that he could time travel within his own lifetime
- C The process of an electron 'jumping' from one energy level to another within an atom

5

Which of the following has the longest wavelength?

- A Microwaves
- B Radio waves
- C Gamma rays

6

What is the only mammal that can see ultraviolet light?

- A Humans
- B Reindeer
- C Aardvarks

7

What does redshift in a galaxy show?

- A That the galaxy is moving quickly away from us
- B That the galaxy is moving closer to us
- C That the galaxy is very hot

8

True or False?

A rainbow is always an arc?

9

What part of the human eye is responsible for seeing colour?

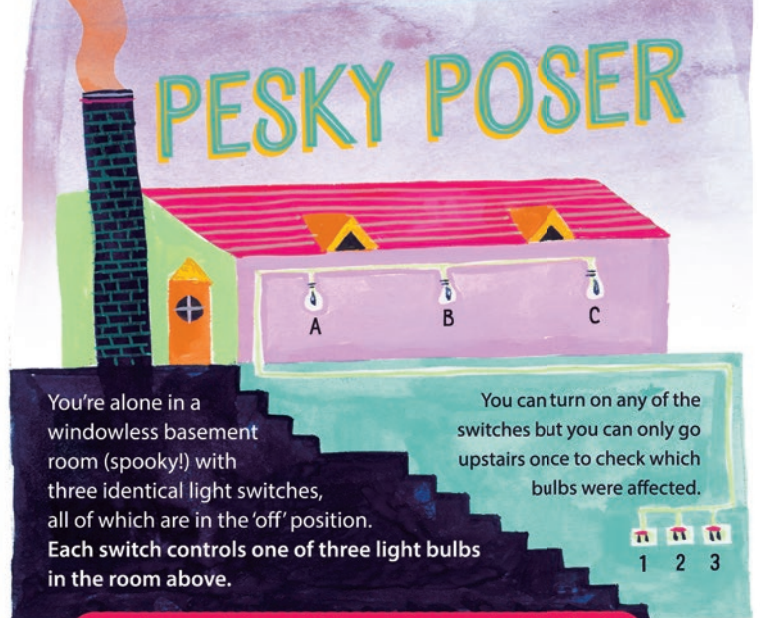
- A Cones
- B Pupils
- C Retinas

10

By using Leavitt's Law (among other things), what did Edwin Hubble discover?

- A That the Milky Way is the centre of the Universe
- B That the Earth spins on its axis
- C That the Milky Way is not the only galaxy

# PESKY POSER



You're alone in a windowless basement room (spooky!) with three identical light switches, all of which are in the 'off' position. Each switch controls one of three light bulbs in the room above.

You can turn on any of the switches but you can only go upstairs once to check which bulbs were affected.

How do you find out which switch controls which bulb?

# HERE'S LOOKIN' AT YOU!

There's a spy hiding in this word search. Colour in all the light-related words to reveal their whereabouts.

T T F W I N F R A R E D B S T  
C R O A F I X L I G H T R M C  
A O C V L A S E R E O N A S E  
R U U E A I J B Y H I O I I L  
F G S E K J Q P Q G Z F N R F  
E H L L I D K X F A M P M P E  
R V C R A Z R C O M M I D U R  
W R O D S T G L E N L E N S V  
R H D I P S W M Y R E E S T S  
A S V E Y E J B Z Y A D N R P  
I H O D P S C X D Q O A C E E  
N A P B D B X R N E L E O T C  
B D T E A U R A E R E R N I T  
O O I A R L A T O I A I E N R  
W W C M K B Y S N F P W S A A

AMP  
ARC  
BEAM  
BRAIN  
BULB  
CONES  
DARK  
DAY  
DIM  
DIP

EON  
EYE  
FIRE  
FIX  
FOCUS  
INFRARED  
LASER  
LEAP  
LENS

LID  
LIGHT  
NEON  
ON  
OPTIC  
PRISMS  
RAINBOW  
REFLECT  
REFRACT

RETINA  
RODS  
SEE  
SHADOW  
SPECTRA  
STAR  
TROUGH  
WAVE  
WIRE  
XRAY

# WELL-LIT WORD MORPHS

Change **STAR** to **HEAT** in 3 or fewer moves by changing one letter at a time. Each word must be a proper word so **STAR** to **SPAR** is okay but not **STAR** to **STAZ**. Then try **MOTH** to **FIRE**.

STAR  
---  
---  
HEAT

MOTH  
---  
---  
FIRE

CONE  
---  
---  
EYES



# UNSCRAMBLE THE ANAGRAMS TO REVEAL FOUR FANTASTIC PHYSICISTS

TIPPLED SIR ANCHOR

STAR IS A NEW COIN

A ray of light can be divided into its  
constituent colours by a prism

Discovered that the frequency of a wave  
depends on the relative speed of the source  
and the person observing it

TELEVISION VS MR HELP

Provided empirical evidence for the  
expanding Universe

LEAVE IT THEN I  
WANT STAR

The relationship between luminosity  
(brightness) and period in pulsating stars

## LASER MOUNTAIN

WINNER!

Which of these  
intrepid explorers will  
be the first to conquer  
Laser Mountain and  
claim the best bunk  
in the space age  
Dymaxion house?

Bucky

Bluebell

Berwick

## STAR TURN

We've been drawing stars, and Calculata has made up a  
code to tell us how many points there should be in each  
star, and how many points we go along each time. Can  
you use the code to complete our drawings?

1 (5,2)

2 (7,3)

3 (9,2)

5 (8,3)

4 (6,1)

Can you draw a  
(9,4) star from  
scratch?





KIT

# SKATE MATHS

Skateparks. A place to hang out with your friends at the weekends, right? Not the first venue that springs to mind when you think of maths and science, is it? (Nope, definitely not, Kit. The skatepark is where I go to get away from Harvey and Calculata when they send me into overload, but carry on. Ed)

Did you know that your local skatepark is actually a great place to put mathematical theory – think calculus – into action?

Accurately calculating your **motion** and **velocity** as well as understanding **angles**, **circles** and how to use your body's **centre of gravity**, can make the difference between pulling off a trick perfectly, or falling on your...erm... *mass*.

## A NEED FOR SPEED (AND MOMENTUM)

What's the best way to pull off a trick? Too fast and you'll fly off the end of your board and smack into a wall. Too slow and you'll never build up enough energy to pull off a stunt or leap across a void.

How can you even tell how fast someone is travelling?

There is a mathematical formula for calculating speed.

$$\text{SPEED} = \frac{\text{Distance}}{\text{TIME}}$$



## SPEED EXPERIMENT

Set up a long tape and stand by with a stopwatch in your hand. Time how long it takes your friend to run or ride from the start of the tape to the end of the tape. Write down the length of the tape e.g. 30 metres and the time e.g. 9 seconds. To work out how fast they travelled, divide the distance by the time.

$$30 \text{ metres} \div 9 \text{ seconds} = 3.33 \text{ m/s.}$$

That's how fast they were travelling in metres per second, to convert it to miles per hour – times the answer by 2.24 ( $3.33 \times 2.24 = 7.5 \text{ mph}$ ).

Your turn – what will you discover about the speed of your skateboarding friends? Can they time you? What else can you observe?

**Momentum** is the measure of **mass in motion**. Change in mass or **velocity** (speed) can change momentum. The formula is  $p = mv$  (**p = momentum**). **Momentum = mass x velocity**.

Imagine you're travelling on a skateboard at 20 m/s and you weigh 50 kg. You could calculate momentum as:  $50 \text{ kg} \times 20 \text{ m/s} = 1000 \text{ kg m/s}$ . The momentum the rider builds up is transferred into the trick they pull. A successful use of momentum would be catching air on a ramp. A momentum fail would be crashing into the ramp, losing momentum and velocity and bruising your bottom.

A skateboarder weighs 40 kg and travels at 20 m per second.

What is their momentum?

800 kg m/s

## RAD REVOLUTIONS

When 12-year-old Tom Schaar landed the world's first 1080 trick (that's three full rotations in the air before landing) in 2012, scientists and mathematicians were baffled. How had Tom been able to do it? Was his incredible success down to his size and weight? Do children have an advantage over adults on performing such feats?



Rhett Allain, an associate professor of physics, pondered these questions and figured out that **bigger doesn't always mean the same**. By this, he meant that you can't just use **scale** when comparing small with large – there are many **variables** that need to be taken into consideration and adjusted. Maybe if the first person to pull a 1440 is a 6-year-old, then we will be closer to knowing whether size does matter!

## FUN FACT TRUMPET



There are 360 degrees in a circle. There are 180 degrees in a semicircle.

PROTRACTOR  
ADVISED  
EXTREME ANGLES



# GOT A BOARD? BUST THOSE TRICKS

Before attempting any tricks just get as comfortable as possible riding your board everywhere!

fig1.



Here are some classic skateboarding tricks. Skaters need to think about the forces in play and, like all good mathematicians and scientists, they have to keep practising until the move becomes as natural as walking – remember, you couldn't do that either when you first tried!

• **Ollie** – make the board fly – stand with your front foot over the **front bolts** and your back foot at the centre of the **tail**. Crouch. Take the weight off your front foot and slam your back foot down hard on the tail. Hop off your back foot, slide your front foot forward and ride the board as it flies up in the air. A good skateboard jump will carry you up with twice the force of your own weight. Aim high.



Once you have nailed the ollie and the frontside 180, why not attempt the **frontside 360** or a **kickflip**?

• **Frontside 180** – When you've mastered the ollie (that alone can take a lot of patience), you can turn it into a frontside 180. 180 what? 180 degrees – half a circle – a semicircle. While you crouch, swing your arm behind you, twisting your upper body. As you hop your back foot up, slide your front foot to the nose and swing your arm around, guide the board 180 degrees from your start position, so you end up facing the opposite direction. **Getting better** – jump higher and swing your shoulders around further.







## QUICK CATS QUIZ

1

What is the *tapetum lucidum*?

- A A spell that requires you to tap your tummy
- B The reflective layer inside certain animals' eyes
- C The eye's blindspot

2

What type of metal is mercury?

- A Death metal
- B Heavy metal
- C Grindcore metal

3

Which of the following books features a fictional character called The Hatter?

- A *Alice's Adventures in Wonderland*
- B *The Hobbit*
- C *Sawbones*

4

Which chemical, found in the human brain, plays an important role in functions such as behaviour and emotion?

- A Dopamine
- B Glutamate
- C Noradrenaline

5

Which pathway in the brain receives the above chemical and connects the thought-processing area with the forebrain?

- A Mesocortical pathway
- B Mesolimbic pathway
- C Nigrostriatal pathway

6

What would people in Ancient Egypt not do when their pet cat died?

- A Have it mummified
- B Shave off their eyebrows
- C Have a pencil drawing of said pet commissioned for their mantelpiece

7

What is a group of cats called?

- A A chowder
- B A clowder
- C A pride

8

True or False?

The musical *Cats* is based on a collection of poems by T. S. Eliot.

9

Which of the following is a first line from a Dr. Seuss book?

- A 'The witch had a cat and a very tall hat, and long ginger hair which she wore in a plait.'
- B 'On the Ning Nang Nong where the cows go Bong!'
- C 'At the far end of town where the grickle grass grows and the wind smells slow and sour when it blows.'

10

True or False?

Chief Mouser to the Cabinet Office is an official title sometimes given to cats that have lived at 10 Downing Street, the home of the UK prime minister.

## CATS-PHRASE

Each picture describes a word or phrase that contains the word 'cat'.

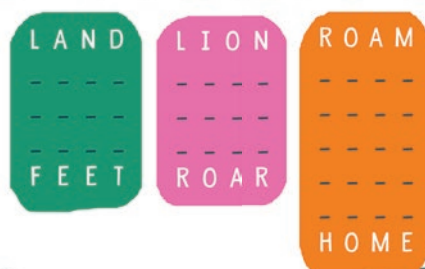
Can you tell us what they are?



\_\_\_ \_ \_ \_ C A T

## WORD MORPHS

Change **LAND** to **FEET** in 4 or fewer moves by changing one letter at a time. Each word must be a proper word so **LAND** to **LANE** is okay but not **LAND** to **LANZ**. Then try **LION** to **ROAR**.



## CAT NAPS

YOU'LL NEED A PROTRACTOR FOR THIS ONE.

Jenkins the male lion sleeps for a mahoosive 20 hours a day.

What percentage of the day does Jenkins spend asleep?

With a protractor, fill in this pie chart to show this statistic as an infographic.

A



Now you've done that, can you tell us which pie chart belongs to which animal?

B



Celia, the female lion sleeps for 18 hours a day

Philip the jaguar: 10 hrs

Precious the tiger: 16 hrs

Ian the domestic cat: 12 hrs

Fynton the human child: 8 hrs

C



E



D



If they all went to bed at the same time, in which order would they wake up? Which animal would eat Fynton before the others had opened their eyes?





2

\_\_ C A T \_\_



3

\_\_ C A T \_\_



4

\_\_ \_ \_ \_ C A T



5

\_\_ \_ \_ \_ C A T

## ROARING RIDDLE

You can work for me, but I don't cost anything.  
You can take me, and you can have me, but you cannot buy me.  
You can march for me, I will come along with you.  
I can have lots of legs, or none at all.  
I can belong to you, but only if you're ready to roar.



## KITTENAGRAMS

Six famous litter-ary cats have been playing in this basket of yarn and they've gotten all tangled up.

Can you find them?



## THE CATS IN THE HATS

Feline clever? Can you use these clues to figure out which cat is in which hat?

DELILAH I .CLAWDIPUSS

LUKE SKYWHISKER BELLAMY

- 1 Bellamy does not have a purple collar
- 2 Luke Skywhisker is not a tabby cat
- 3 The cat in the trilby is not Delilah
- 4 Delilah is allergic to pollen
- 5 I .Clawdipuss is not in the Fez
- 6 Delilah has a green collar
- 7 Bellamy is not a black cat







CALCULATA

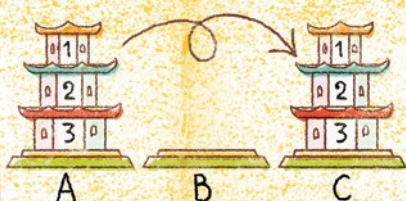
# THE (CAAAAAAKE!) TOWER OF HANOI

When does mathematics look like a big fancy wedding cake? Why, when you're playing the 19th-century French game *The Tower of Hanoi*, of course! Have you ever played it before? I'll give you a rundown...

## YOU WILL NEED:

- Three differently-sized objects that can be stacked from largest to smallest (it doesn't have to be cake, but what else could we use in this issue, ed?)
- Three distinct stacking areas.

## THE RULES



Let's call the stacking areas A, B and C, and the objects Layer 1, Layer 2, and Layer 3. **Layer 1 is the smallest.**

Start with all three objects in **Area A**, stacked like a cake from largest to smallest.

The goal is to move all the objects across to Area C, and make an identical cake.

**But there are two rules:**

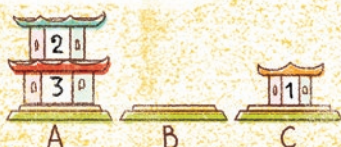
- You can only move **one** object at a time.
- You cannot EVER stack a larger object on top of a smaller one.

Now quick, close the magazine (*I know, it's a wrench*) and have a go at it! Once you get the hang of the rules, see if you can do it in the fewest number of moves possible. No really, I'm waiting for you to close the magazine now.

## SHORTEST SOLUTION

Okay, you're back! Did you manage to solve it? Do you think you found the **shortest solution**? Check and see below.

**1** Move Layer 1 to Area C



**2** Move Layer 2 to Area B



**3** Move Layer 1 on top of Layer 2



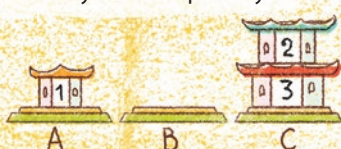
**4** Move Layer 3 to Area C



**5** Move Layer 1 to Area A



**6** Move Layer 2 on top of Layer 3



**7** Move Layer 1 on top of Layer 2

**Only seven moves!**





## MORE LAYERS?

Now we've dealt with three layers, do you think you can figure out the minimum number of moves for four layers? Would it take many more steps, or just a few?

**The trick to solving the game for four layers is that the solution relies on knowing the quickest way to solve for three layers.**

In order to get Layer 4 (the largest layer) free to move into Area C, all the other layers must be sitting (in order!) in Area B. That means, you'll need to:

- move Layers 1, 2, and 3 to Area B in **seven moves**, using the solution for three layers (but swapping Area B and Area C at each step)
- move Layer 4 to Area C, and then:
- move Layers 1, 2, and 3 from Area B to Area C, using the solution for moving three layers again.



Even without physically doing the 4-layer tower, we can work out the number of moves as follows:

**three layer solution + 1 move + three layer solution**

OR

**7 + 1 + 7 = 15 moves!**

*Now that's pretty cool!*

Even better, we can also solve five layers in the same way. Moving five layers means moving the smallest four layers to Area B, then moving the largest one to Area C, and finally stacking the smallest four on top. The solution for five layers is:

**four layer solution + 1 move + four layer solution**

OR

**15 + 1 + 15 = 31 moves!**

*Ooh, I am starting to see a pattern here!*

Yep. That is exactly what you're seeing. The (Caaaaake!) Tower of Hanoi is an example of a **recursive puzzle**. Once you know how to solve the puzzle for a certain number of layers, you can also solve it when the next layer is added, and the next one and the next one and... you get the idea!

You can calculate the minimum number of moves required for a certain number of layers like this:

$x_n$  = number of moves it takes for  $n$  layers

$x_{n-1}$  = number of moves it takes for  $n-1$  layers

$$x_n = x_{n-1} + 1 + x_{n-1} = 2x_{n-1} + 1$$

This is called a **recursive equation**, because you need to know the number of moves for  $n-1$  layers in order to calculate the number of moves for  $n$  layers.

Here 'n' stands for 'number of layers'. So if you want to work out how many moves for 7 layers, then  $n=7$ .

With a bit of maths shuffling and shifting that I won't get into, we can also work out a **closed form equation** (i.e. not recursive!) for the number of moves required:

$x_n$  = number of moves it takes for  $n$  layers

$$x_n = 2^n - 1$$

The minimum number of moves to solve this puzzle gets really big, really fast! The shortest solution for 10 layers is over a 1,000 moves, and 20 layers takes more than one million moves!

*Can we just stick to four layers for now, eh Calculata? Ed*

**Tip:**  $2^n$  (say it as 'two to the power of n') just means 2 multiplied by 2  $n$  times. Like  $2^3 = 2 \times 2 \times 2$ , and  $2^4 = 2 \times 2 \times 2 \times 2$ , and  $2^5 = 2 \times 2 \times 2 \times 2 \times 2$  and so on.



## WHY IS THE PUZZLE CALLED THE (CAAAAAAKE!) TOWER OF HANOI?

The puzzle was invented by French mathematician named Édouard Lucas. It's based on a legend he had heard (or possibly made up) about an Indian temple (nowhere near Hanoi, that's in Vietnam) where a mathematical puzzle, also known as The Tower of Brahma was used to discipline young priests. The legend says that, since the beginning of time, 64 gold discs ranging in size have surrounded three diamond needles in a large room inside the temple. The priests have been working for centuries to move the discs, each one on top of a



larger one, from the left needle to the right needle. Upon completion of the puzzle, the legend claims the world will end.

If one disc is moved per second, how long will this take the priests to complete?

If the priests work at a speed of one move per second it will take  $5.85 \times 10^{11}$  years (that's 58.5 billion years!). The current age of the Universe is reputed to be, according to various sources, around 13.77 billion years. Therefore, it could take the monks over four times the current age of the Universe to complete their task. *I hope none of them need a pee.*





# RAIN FEEDERS

## QUICK LEO QUIZ

1

Which river runs through Florence?

- A Arno
- B Po
- C Tiber

2

What were guilds in Renaissance Italy?

- A Fitted jackets worn by the young fashionistas of the time
- B Hot stones used for cooking pizzas
- C Organisations to help businesspeople and craftspeople make money from the sale of their goods and services

3

What event in 1789 resulted in the Louvre's change of use?

- A The death of Louis XIV
- B The Franco-Prussian War
- C The French Revolution

4

What is the name of paint made from mixing powdered pigment with egg white?

- A Gouache
- B Tempera
- C Tempura

5

True or False?

Killer whales (orcas) are in the dolphin family.

6

Which of these unfinished works of art is accepted to be by Leonardo da Vinci?

- A David-Apollo
- B Manchester Madonna
- C Saint Jerome in the Wilderness

7

True or False?

There was a time when ultramarine pigment cost the same as gold.

8

Which of the following sentences most accurately describes a fractal pattern?

- A A never-ending pattern that is constantly changing in shape
- B A self-similar, repeating pattern that is never-ending and infinitely complex
- C A self-similar spiral made by connected quarter circles drawn inside an array of squares

9

Violent or unsteady movements in air and water are known as what?

- A Turbulence
- B Indifference
- C Lethargy

10

Which of the following inventions is one of Leonardo's?

- A Litter-picking tortoise
- B Motorised back scratcher
- C Robotic knight

# RENAISSANCE WORD SEARCH

Find the words below and colour them in using the corresponding colour to reveal a significant sequence.

ABLE  
AGE  
ART  
AVE  
CAR  
DYES  
EGG  
ERASMUS  
EXALT  
FRESCO  
GREAT  
GUILD  
HE  
ID

L	E	R	A	S	M	U	S	I	D	O	I	L
E	E	N	E	X	A	L	T	P	O	E	G	G
A	P	O	D	N	O	T	F	H	E	A	R	T
H	A	R	N	E	M	O	R	G	U	I	L	D
P	I	T	A	A	B	L	E	R	M	M	I	Y
A	N	A	I	V	R	G	S	E	B	O	S	E
R	T	P	V	E	A	D	C	A	E	N	A	S
S	C	I	E	N	C	E	O	T	R	A	D	E

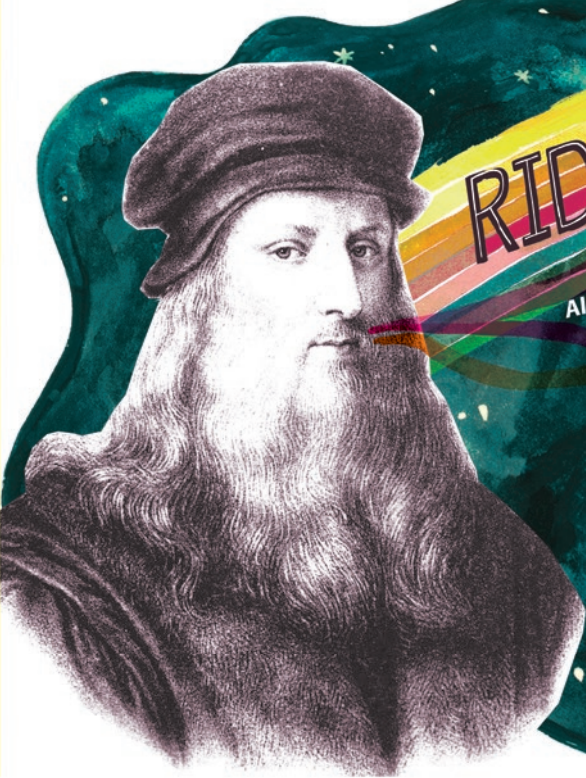
LEONARDO  
LISA  
MONA  
NAÏVE  
OIL  
PAINT  
PATRON  
PO  
RAPHAEL  
ROME  
SCIENCE  
TONDO  
TRADE  
UMBER

## PRUDENZIA'S PIZZA PUZZLE

Our friend Chef Prudenzia is at the long-awaited opening of her fabulous new pizza restaurant. It's a full house *ovviamente* (that means 'of course' in Italian, ed), but there's a perilous problem. Prudenzia has one table of seven people, one table of nine and another table of 11. All the tables have ordered one of her *enorme* super-massive pizzas to share equally between the people seated on it, BUT Prudenzia has no idea how to slice them. **Can you help?**







# RIDDLE ME THIS

All three of these riddles describe a concept or invention Leo experimented with.  
Can you figure out the answers?

**1** I can fly, but I don't have wings.  
I can lift, but I don't have arms.  
I have blades, but I don't belong in a kitchen.  
What am I?

**2** Made of leather, I have a bell that doesn't ring, and a cork that doesn't pop.  
I was designed to be used in warfare, but I wouldn't hurt a fly.  
What am I?

**3** I have a turret, but I'm not a castle.  
I have a hull, but I'm not a boat.  
I have a periscope, but I'm not a submarine.  
Fish can live in me, but I doubt they'd want to.  
What am I?

# THE LAST CUPPA

An impossibly rich old woman has stipulated that her two heirs should stage a hedgehog race. The owner of the **losing** hedgehog will inherit her priceless masterpiece, an incomparably valuable painting entitled *The Last Cuppa*.

A race takes place, but at the last minute both heirs stop their hedgehogs from crossing the finish line, so the woman's lawyer makes a slight change. The two heirs race again, but this time the heir that finishes first inherits the painting. How can this be the case, while staying true to the rich old woman's will?

Words: Freya Hardy, Benita Estevez. Illustration: Sophie Bryant-Funnell

# YOU'VE BEEN FRAMED

You're working as the assistant to Giuliana da Majano – number one picture framer to the rich and famous in Renaissance Italy (*that's the beauty of being an AQUILAnaut... you can time travel*). One of your customers is rather ahead of her time and wants to completely fill a wall with framed reproductions of her artwork, *The Moaning Luca*.

However, she hasn't told you how many frames you need to make.

Can you work out how many she needs based on the size of the wall and the size of the frame?

**WALL DIMENSIONS:** 2M x 2.8M (landscape)  
**FRAME DIMENSIONS:** 50cm x 40cm (portrait)



# WORD MORPHS

Change **CODE** to **LOOK** in four or fewer moves by changing one letter at a time. Each word must be a proper word so **CODE** to **CONE** is okay but not **CODE** to **CODG**. Then try **WOOL** to **DYES**.

CODE  
---  
---  
---  
LOOK

CITY  
---  
---  
---  
RULE

WOOL  
---  
---  
---  
DYES





# the Shedevil Mystery

## THE SCENARIO

You are spending the weekend with Uncle Macleod at a remote castle on the shores of Loch Ness. It's raining, so you and the five other guests have been indoors eating ginger biscuits and playing board games (*lush, ed*). As well as being an upmarket hotel, the castle also happens to be home to a famous emerald called The Shedevil.

Just before teatime on Saturday, at 5.10 pm, you and Uncle Macleod are setting the dining table when a power cut plunges the whole house into darkness. When power is resumed at 5.25 pm, Macleod goes into the library to find that the glass case has been smashed and The Shedevil STOLEN! DUH, DUH, DUHHHH!

You know you didn't do it... and you know Macleod didn't. SO, WHO DUH DUH DUNNIT?

## GETTING STARTED

- 1 Begin by creating a timeline of events based on the statements below. What happened when? Does anything seem strange?
- 2 Which claims can be verified and which cannot?
- 3 Do any of the statements contradict others?
- 4 Could you prove that anyone is lying? How?
- 5 What follow-up questions would you ask?
- 6 Have any of the guests acted suspiciously?



## FACTS OF THE CASE

- No one has arrived at or left the castle since Friday afternoon.
- All doors in and out of the property were locked from the inside.
- There are no signs of forced entry anywhere on the property.
- It was windy and rainy outside and the ground underfoot was muddy.
- It was dark outside.

Can you find the clues on these pages and examine the following statements to work out which guest/s stole the emerald?

Uncle Macleod



## UNCLE MACLEOD

I checked the location of the emerald at 4.45 pm when I closed the curtains in the library. On my way out of the room I passed Nigella Trout and Letitia Tibbins in the reception hall as they headed into the conference room. They seemed to be arguing about something. Letitia was giving orders and I got the impression Nigella was unhappy. When the power went out my companion and I were in the dining room, laying the table. We went to the kitchen to get some candles. It took a long time to find a candle, light one, then go round to the fuse box, fix that and return to the front hall. I remember being quite annoyed with myself but I have been so very distracted with all the plumbing problems we've had recently.

There has been no hot water. It's all very troubling. I met no one on my way to or from the kitchen, although it was pitch black. By the time I arrived in the front hall Nigella and Letitia were already there. Nigella looked a little strange. She was trembling, but I imagine she was scared by the power cut. I suppose everyone else remained in their locations for the duration of the outage. Mr Tibbins, Lady Buckles and Lord Buckles arrived no more than three minutes after I did. Lord and Lady Buckles looked happy and relaxed. CT was wearing a bathrobe. I thought this was a bit strange, and when he reached out to take a candle his skin felt cold and looked pale. I didn't notice that the emerald was missing until 5.40 pm, when I did a quick check to see that none of the bulbs had blown.

clue #1 DRY armchair  
BACK SITTING ROOM

CLUE #2 BLANKETS  
back sitting room



## LORD BUCKLES

When the lights went off I was playing a rousing game of snooker with my good lady wife, the Lady Buckles. We were laughing and making quite a noise, having to talk over the TV in the back sitting room where CT was watching some kind of quiz show. My wife doesn't like the dark, never has, so she insisted on me holding her hand throughout. Quite sweet really. As soon as the lights came on, CT immediately entered the snooker room to enquire if we were OK. He seemed a little rattled and had a long bathrobe on. Then we walked from the snooker room to the front hall to meet the others.



## LADY BUCKLES

I was beating my husband at snooker when the lights went off. Concerned he might use the opportunity to move the balls around the table, and maybe pot a few while he was at it, I insisted on holding his hand. We told each other jokes to pass the time and when the lights came back on CT came in to check we were OK. What a lovely man he is! So charming. Then we all walked up to the front hall to join Macleod, his guest, Nigella and Letitia, who were already gathered there. I noticed some mud on the hem of Letitia's dress. I commented on it, at which point Letitia became quite annoyed with me. I suppose I can be a little nosy.

## Christopher Tibbins



## CHRISTOPHER TIBBINS (CT)

At about 4 pm I went to have a bath, washed my hair, changed into my robe and came into the back sitting room at 4.47 pm to watch the TV for a bit. There was a hospital drama on, my favourite show. I was feeling very relaxed and must have dozed off in the chair. That would have been around 4.50 pm. I awoke again at 5.25 pm when the lights came back on. I got up and went into the next room to see if Lord and Lady Buckles were both OK, then we all went to the front hall to meet the others.



## LETITIA TIBBINS

(sister of Christopher)

Nigella and I went into the conference room at about 4.55 pm to have a private chat. She was annoyed about something or other. We played rock paper scissors to pass the time while the lights were off but then we got bored and decided to go and meet everyone else in the front hall. We must have been waiting there for about five minutes before everyone else showed up.

## Nigella Trout



## NIGELLA TROUT (friend of Letitia)

Letitia and I went into the conference room to admire the lovely drapes in there. I wanted to show them to her as I knew she would appreciate the pattern. We were standing at the window when the lights went out. I remembered that Macleod had said that if anything happened we were to gather in the front hall, so Letitia and I went straight there to wait for the others. We must have been standing there for about 15 minutes. I can't remember what we spoke about. We were just admiring the drapes. They are very lovely. And then we went straight to meet Macleod and his guest.

Who stole the Shedevil? Why not write to us with your deductions and we'll print the best theories in the magazine or on the website.







# ART & MUSIC

In this section you will find fun things to make, articles on artists past and present, as well as thoughtful pieces about music and sound.

**Whole Lotta Lava** – Make your own supervolcano

**Make an Articulated Hand** – This one will grab you!

**Watermark Science** – No forgeries involved

**Tardi-Great!** – Sew your own tardigrade sock monster

**Make a Girard-Inspired Cat-ue** – Purrr-fect for crafty cats!

**Listen to Your Heart** – Sound and the human body

**Haul-Away** – AQUILA explores sea shanties

**Magical, Brilliant Music** – Can all musicians read music?



# WHOLE LOTTA LAVA!



If you adore papier-mâché as much as I do (*so few people do, ed*), you'll love making this massive chunk of volcanic rock. Use it to adorn the set of your art-house film, as an interesting table centrepiece, or (*here's my favourite*) sneak into your school playground early in the morning, place it on the playing field and see if you can convince your headteacher that a seismic event is imminent and you should all be sent home immediately. Only please don't do that last thing, I don't need any more suspensions on my conscience (*Olivia from Ascott-under-Wychwood, I am looking at you*). Anyway, the less said about that the better. There is a lot to do, so let's get on with it.

## YOU WILL NEED:

- Cardboard boxes
- Masking tape
- Lots of newspaper
- Plastic sheeting (optional)
- PVA glue
- Glass bowl or plastic container for papier-mâché gloop
- Paintbrush
- Acrylic paints: black, fluorescent red, yellow and white

**1** Arrange your boxes in an interesting configuration. Use masking tape to stick them together.



**2** Roll up balls of newspaper and stick them onto the surface of the boxes with masking tape, to create an interesting and organic (natural) shape.

This will form a layer of rock to show where the lava has cooled and hardened quickly in the open air. If you're feeling very clever you can twist the paper to show the direction of the lava flow.

**3** Don't cover the entire shape with newspaper balls, leave some bits bare. These will become the parts where molten lava is visible.





**4 Protect the area with newspaper or plastic sheeting.** The papier-mâché process is not quite as messy as an actual active volcano in your living room, but it is messy.

**5** Mix your papier-mâché gloop. Mine is one-part glue to one-part water. Stir thoroughly.



**6** Papier-mâché all over the newspaper balls. You know the drill: tear long thin strips of newspaper, dip them in the gloop, remove the excess gloop with your fingers, place the strip on the surface and smooth it down. When you have finished the first layer leave it to dry and then repeat this step again. Leave the whole thing to dry between layers. You'll need three layers for maximum strength.



**7** When the entire structure is dry, paint the rocks. I did a layer of black paint first, then I took a large, dry brush and gave the rocks a very light dusting of white/ light grey paint to highlight the angles. You can add as much colour as you like, but don't sweep with your brush, instead you want to tickle, stipple and smooch (yes, that is the technical term).



**8 Leave to dry.** I know, waiting is annoying, but the more patient you are, the better your final result will be.

**9** Paint the lava. Paint a blob of white in the middle, where the heat would be most intense. Then work outwards from light yellow, through orange to bright fluorescent red where the lava is beginning to cool and harden.



Blend as you go to get a smooth transition between colours. Isn't it amazing to think that our entire planet once looked like this?

## TAKE IT FURTHER:

Why not have a go at recreating a crystal geode using the same techniques? Be sure to send us photos of your makes. We love to see your handiwork!







# MAKE AN ARTICULATED HAND

We share our hands with around 300 other species of primate (not the spider monkey – they don't have thumbs). Our hands are shorter and our thumbs are more powerful than the others'. For that reason we have the ability to make two grips that other primates can't. The **power grip** is when we grasp something like a pen and use the thumb to strengthen and direct it. The **precision grip** is formed by the thumb and the finger pads, this also lets us accurately hold something like a ball between the thumb, index and middle finger. Let's see if we can make a cardboard hand that can perform just as well. Our friends at **Let's Make Art** are here to show us how.

## YOU WILL NEED

- Strong, thick piece of cardboard big enough to draw around your hand and forearm plus an extra strip
- Pen
- Ruler
- Scalpel or craft knife
- Scissors
- Silver or gold card or acrylic paint
- Glue gun with glue stick (or some extra-strong craft glue)
- Straws (we used bioplastic straws made from polylactic acid). Other alternatives include small sections of bamboo cane or small metal nuts from a hardware shop.
- String

**1** Find a piece of cardboard big enough to draw around your hand and forearm, plus an extra strip.

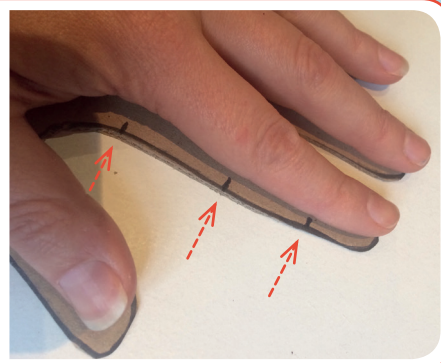
**2** Draw around your hand and forearm. If you want to make a right-handed articulated hand draw around your right hand and if you want to make a left-handed articulated hand draw around your left.



**3** Use scissors and a craft knife to carefully cut out the shape you've drawn (ask an adult for help here if necessary).



**4** Place your hand over the cardboard hand and mark where the joints on your fingers are. There are three on each finger and two on your thumb.



**5** Use a ruler to make your marks into lines across the fingers and thumb.



**6** Use a ruler to press down on each line to make it easier to fold each joint.

**7** Gently bend each joint and you'll begin to see your hand come to life.

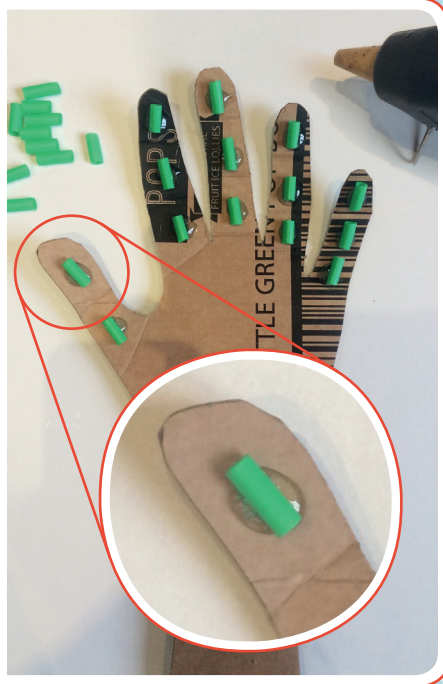


**8** Turn your cardboard hand over and mark a vertical dash between each fold (three on each finger and two on the thumb).

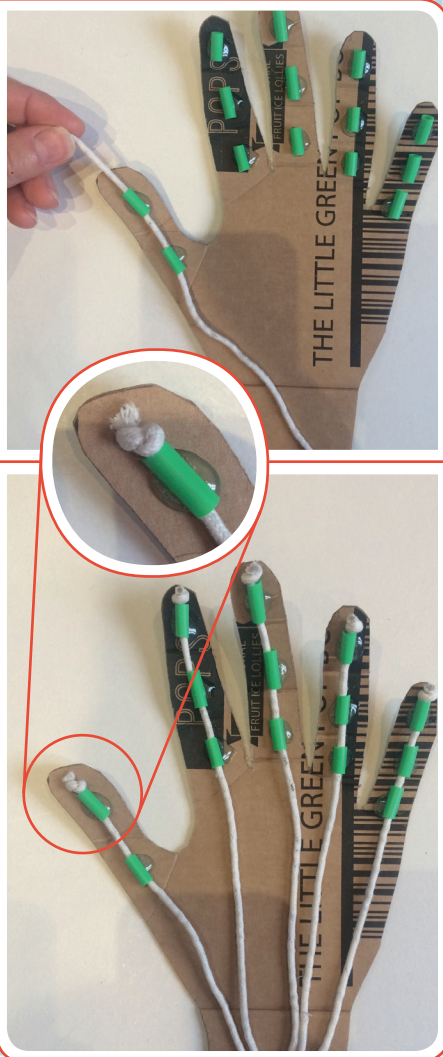




**9** Use a glue gun to attach small lengths of straw (approx 1cm long each) to the dashed lines you've made between each fold.



**10** Thread a piece of string through the straws on each finger. Make a knot at the top and leave each length long enough to reach the end of your cardboard hand.



**11** Fold the extra strip of cardboard to make a rectangular shape to use as a strap for your articulated hand.



**12** Using the glue gun, attach the strap below the wrist of your cardboard hand.

**13** Add some metallic card or paint if you want to give your hand a robotic look and add some finger nails.

**14** Tie a loop at the end of each piece of string.



**15** Slide your hand in through the strap and secure each finger in its corresponding loop. Pull on the loops with your fingers to see your articulated hand grip and extend.



**16** You're ready to go! Try picking up an object with your new hand! Can you throw with it?







# WHAT A MARK!

## WATERMARK SCIENCE

1

Hey! You!

Yes, you!

Come over here and hop in my time machine! Strap yourself in, we are going on a journey through the mists of time...back to a time when UK banknotes were only made from paper....August 2016!

Actually, we still have paper banknotes. The £20 note is fairly common and although the £50 note is a bit more scarce, it is also still made from paper. The Bank Of England plans to replace both with **polymer** notes, starting with the £20 note in early 2020.

So we don't *really* need a time machine to see a paper banknote (which is handy, because I don't *actually* have one). We just need to raid your piggy bank, or find someone kind enough to loan you one.

Hold your paper banknote up to the light. Can you see a picture of Queen Elizabeth II trapped in the paper? It's not a ghost (*a haunted banknote though – that would be cool!*) – it's a **watermark**.

Watermarks were introduced to banknotes to improve security. A watermark like this is incredibly difficult to forge – it's also very hard to show on a printed page! Other countries use them too.

### FUN FACT TRUMPET

**Polymer** notes were first developed in Australia by their national science agency CSIRO after concerns about the number of counterfeiting enterprises that existed in the country in the late 1960s. This boom in fakes coincided with the release of colour photocopies!



### HOW DO YOU MAKE A WATERMARK?

Paper was traditionally made by hand. It was formed in a sieve-like tray from a watery paper pulp; hence the name watermark. A really simple watermark can be made by arranging the wires in the tray to make a pattern. More complex images can be made by adding more wire to make writing or a simple image like a crest or line portrait. When the paper is formed in the tray, it will be thinner where the wire is, so the light shows through in this area.



Hand-making watermarked paper was a very slow process, but in 1826, the

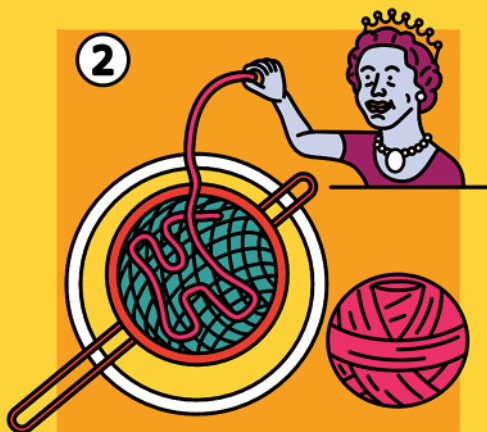
**dandy-roll** was invented. This was a bit like a metal rolling pin with a pattern of wires on the surface. It was rolled over wet paper to leave a mark. Where the wires were thicker, the paper fibres were compacted, creating areas of thinner paper. These thin areas let the light pass more easily and produced the watermark.

More complex images were made by carving a picture in wax. This was then cast in metal, which could be pressed onto wet paper to create an image. Using this technique, shaded drawings could be made.

Making a detailed watermark portrait of Queen Elizabeth II, like you see in a modern UK paper banknote, takes a precise, complex and **SECRET** process. If you'd like to make a watermark, we are going to need to start with the basics....



# MAKE A WATERMARK!



## YOU WILL NEED:

- 10 sheets of (*clean*) toilet roll or some newspaper\*
- Empty 2 litre bottle\*\*
- Cold water
- String
- Scissors
- Sieve
- Bowl
- Tea towel
- Tray

\*if you use newspaper, you'll need to use a blender to break it up

\*\* or a large mixing bowl and balloon whisk, replace the shaking step with whisking



**1** Put the toilet roll in the bottle and  $\frac{3}{4}$  fill it with cold water. Put the lid on. Allow it to stand for 10 minutes.

**2** Place a sieve over a large bowl and create your watermark shape using string. I've made H for Harvey. Make your first design a simple one – it can get more complex with practice!

**3** Shake the bottle vigorously to break up the toilet roll.

**4** While the paper pulp is well suspended, very carefully pour it over your design. The water should drain into the bowl. Try to make an even covering of paper pulp over the bottom of the sieve.

**5** Use the back of your hand to press out as much water as you can.

**6** Lay a tea towel onto a tray. Quickly turn your sieve upside down over the tea towel and give it a sharp tap. The paper should fall out of the sieve.

**7** Carefully remove the string.

**8** Fold the tea towel over the wet paper and press hard to squeeze out as much water as possible. Open the towel up again and carefully peel off the paper. Remove the towel and place your paper on the tray to dry.

**9** When it is dry – hold your paper up to the light – can you see a watermark?



**TAKING IT FURTHER:** Why not try moulding your tissue into a banknote shape and adding the watermark to the bottom left. Once the paper has dried you could try painting it and designing your own money!

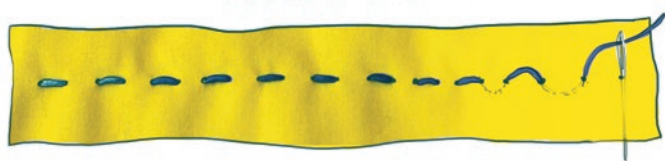


# TARDI-GREAT!

All the talk of microscopic bugs and germs in this issue has made me feel rather itchy (you're itching too now, aren't you?), but the tardigrade is one teeny tiny creature that somehow still manages to have the cute factor. Would you want to cuddle up to one though? The answer is YES!, if it's made out of a sock. *(Erm, the answer would still be no, have you smelt my socks? Ed.)*



RUNNING STITCH



WHIP STITCH



## YOU WILL NEED:

- 1 adult-sized sock (preferably a clean one!)
- Scissors
- Toy stuffing
- Needle and thread (similar colour to your sock and black)
- 2 buttons
- Small piece of pink or red felt
- Larger piece of grey felt (or colour of your choice)
- Fabric glue (PVA will work but may not last as long)
- A helpful adult



**1** Cut the sock into two halves following the cut lines in picture 1. Put the heel part and the cuff to one side.

**2** Use the toy stuffing to stuff the toe part of the sock. Take time to ensure you create a nice rounded shape. Stop when you've almost filled all of the sock.

**3 & 4** With the needle and thread (double up the thread to make it stronger), make large straight stitches (running stitch) all the way around the sock about 1 cm back from the raw edge. When you've gone all the way around, pull the thread gently to close the hole, tucking in the raw edges as you go. Keeping the thread taut with one hand (you may need some help with this), make more stitches until it becomes secure.

**4B** Take the other half of the sock and turn it inside out. Then, cut it into eight equal pieces. You should end up with eight small folded pieces of sock. Sew each piece through both layers of sock, as shown, to create the legs.

**5** Turn each leg the right way out, then stuff lightly. Sew four of the legs along one side of the body using a **whip stitch** (see diagram). You may want to add more stuffing just before you finish sewing it on. Repeat by sewing the other four legs onto the other side of the body.

**6** To make the segments of the body, take a long length of thread and double it up. Next, wrap the thread around the body, between the legs, then pull tight and knot. You will need somebody to help you keep the thread taut as you knot. Do this four times, between each set of legs and then around the back of the head. Trim the thread, or, alternatively, thread the ends onto a needle and hide the ends inside the body.

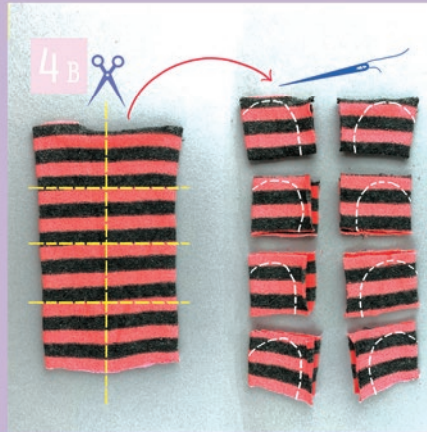
**7** Sew the two buttons onto the face for the eyes with the black thread. Cut a small semi-circle from the pink felt and glue onto the face for the mouth.

**7B** Cut claw shapes out of the grey felt. Run a line of glue along the top edge and stick one at the bottom of each leg.

**8** Tar-da! Your very own cute critter.

**Why not give your finished Tardigreat a name and send us a picture at the usual address? We love to see your makes!**









Alexander Girard (Sandro to his friends) was an architect and textile designer most famous for his contribution to American textile design. Girard and his wife Susan were both keen collectors of **folk art** and their 106,000-piece collection (*yes, one hundred and six thousand!*) consisted of items from over 100 countries, spanning six continents. Sandro's love of folk art also inspired one of his most famous pieces of work. *The Wooden Dolls* was a large family of human and animal characters made out of wood. They were designed to decorate his home in Santa Fe, New Mexico.

Together with our friends at **Let's Make Art** we had a go at making a Girard-inspired cat (*didn't see that coming, ed.*)



*The Wooden Dolls.*



## YOU WILL NEED:

- A4 plain paper
- Cardboard
- Masking tape
- Flour
- Water
- Newspaper
- Acrylic paint
- Chalk pen

## EQUIPMENT:

- Pencil
- Bowl
- Scissors
- Ruler
- Paintbrush

**1** Fold the A4 paper in half lengthwise. Draw half a cat outline on one side, making sure the middle fold is central.

**2** Cut out to create a symmetrical cat shape. Use this as a template and trace two cat shapes onto cardboard. Cut them out carefully.

**3** Using the excess card cut a long strip approx 5 cm wide and long enough to go all the way around your cat shape. This will be used in between the two cat shapes to make your model 3D.

**4** Tape into position using masking tape.

**5** Make your papier-mâché paste by mixing together 1 cup of flour and 1 cup of water (as long as the quantities are the same the cup can be any size).

**6** Tear or cut the newspaper into small pieces and, using the flour paste, cover your model until no cardboard or tape can be seen. Leave it to dry overnight.

**7** Using the acrylic paint colour of your choice, paint your model all over. Leave to dry. Using the chalk pen, draw your design on one or both sides.

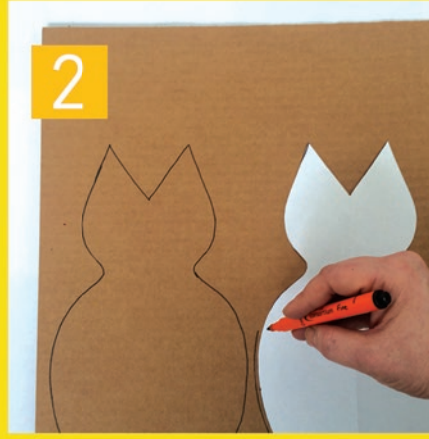
**8** Et voilà, you have your very own 1950s Girard-esque cat sculpture.

## TAKING IT FURTHER

Why not try making additional dolls to add to your 'family' – you could try different ways of decorating them too. Use more than one colour of acrylic paint, or try the **decoupage** technique. Your options are endless!

Don't forget to send us photos of you with your makes – they may even get published in the magazine!









HARVEY

# LISTEN TO YOUR HEART

Sound can have amazing effects on the human body. Think about it – how do you feel when you hear nails being dragged down a chalkboard? How do you react to the sound of someone throwing up? Would you jump at a sudden scream in a horror movie? These types of sounds can all create different sensations and emotions in your body, but scientists believe we can go a step further: listening to the sounds that are generated on the inside of our own bodies, as well as those on the outside.

## LISTEN CAREFULLY, BUT MAYBE NOT TOO CAREFULLY...

Let's examine the effects of external sounds on our bodies. Some researchers think that certain sounds can even make us poo ourselves. Yes, the phenomenon is commonly referred to as 'the mythical brown note' – this is the theory that very low frequency sounds can cause humans to lose control of their bowels and well, leave a little 'brown note', as it were. *(Gross, but ok. I'm interested. Tell me more.)*

Such low frequencies are called **infrasound**. At less than 20 Hz (Hertz) or cycles per second, these types of sounds are too low for the human ear to pick up, but some scientists believe that infrasound vibrations can be picked up in other parts of the human body and can cause both physical and emotional changes, resulting in us needing the toilet, or feeling happiness, sadness or anxiety.

*If external sounds can make weird things happen to our bodies and our emotions, how can listening to internal sounds benefit us?*

## FUN FACT TRUMPET

Did you know that elephants can use infrasound (known as **elephant rumbles**) to communicate with one another over long distances? **Low frequency sounds travel further than high frequency ones.**

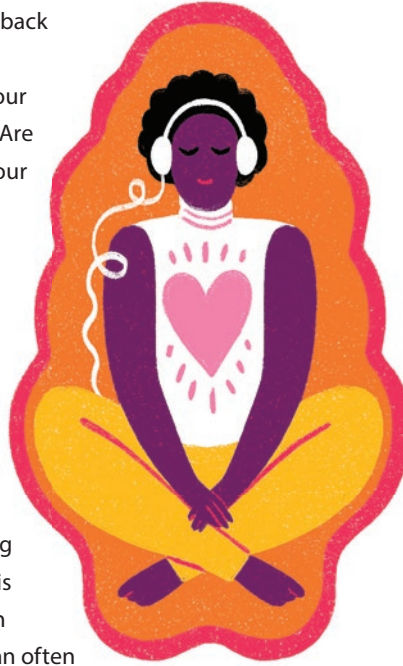




## CLOSE YOUR EYES AND LISTEN TO YOU

Imagine you are in a very quiet place. Sit back and close your eyes. What sounds or sensations do you feel on the inside of your body? Is your heart beating fast or slow? Are you breathing deeply or shallowly? Do your muscles feel tense or relaxed? How does your stomach feel? Are there any sounds coming from it? This ability to 'listen to our bodies' is called **interoception**.

New research carried out by scientists at Brighton and Sussex Medical School is examining how the detection of internal bodily sensations, such as your heartbeat, can shape our decision making and emotional processing. The research is particularly useful in helping people with autism spectrum disorders (ASD), who can often



struggle with their emotions. As many as 50 per cent of people on the autism spectrum suffer from anxiety. Dr. Garfinkel is one of the scientists behind this research. She explains that we can all learn to tune into how often our heart beats. By doing so, we can become more in tune with our own emotions. Patients are also hailing the success of the treatment, saying that it helps them to relax and feel more in control of their bodies and emotions. Ultimately, patients feel happier.

Heartbeat counting is not the only approach used. There are many others including controlled breathing, slow and soft strokes on the skin and controlling the body's temperature by thinking of 'feelings' of coolness or warmth.

### TUNING IN

When you think about it, none of this should come as a surprise. There are lots of similar examples in the animal kingdom. We often think of animals having a sixth sense about events in the natural world but scientific theory points us back to low frequency vibrations. Some animals have been thought to feel or hear infrasonic waves passing through the Earth in the event of natural disasters, which they then use as an early warning system. A brilliant example was the 2004 Indian Ocean earthquake and tsunami, when birds, elephants and other animals were reported to have fled the area for higher ground hours before the actual tsunami hit the low-lying shores of the Indian Ocean.

### THE GOATS HEARD!

Historical records show that our ancestors benefited from the capability of animals and responded accordingly to save lives and property. In fact, there are numerous stories of animals predicting disasters – scientists working in Italy have conducted one of the first ever scientific studies relating to infrasound and animals. The team of researchers attached transmitters to goats living around Mount Etna, on the Italian island of Sicily. They then recorded the animals' movements over several years and compared the animals' movement profiles with volcanic activity. Incredibly, the herd of goats' big moment arrived on 4 January 2012: at 10:20 p.m. At that precise moment Mount Etna began to spew large amounts of lava and ash into the air. The eruption took place six hours after the researchers had recorded unusual activity among the goat herd. Over the course of the study, which lasted two years, scientists could predict a total of seven major eruptions based on the goats' movements. In another Italian city called L'Aquila (*woah!*) in 2009, a major earthquake occurred in April of that year, scientists noticed that five days beforehand, toads had stopped spawning and abandoned their colony completely.

This evidence suggests we may have much to learn from our animal friends about tapping into our senses and listening beyond the obvious sounds we hear in the world around us. It is well known that whales, giraffes, as well as elephants, all migrate and communicate via 'the unhearable' infrasound. So, if you feel anxious, stressed or fearful maybe you just need to listen to your body – whether that's by counting your heartbeats, controlling your breathing or simply employing the good old-fashioned counting of sheep. Research suggests it will make you feel better. **Why not give it a try?**



# Shanty Swag



AQUILA HQ is a flying-fish flap from the English Channel, so that obviously means there is nothing we love more than a good ol' sea shanty, but what are they? Why were they invented? And why are they so *rude*? We decided to say 'Ahoy' to Jowan Collier, a shanty expert from the British Library's Sound Archives, to find out more.

## AQUILA: What exactly are sea shanties and what are they used for?

**Jowan:** Sea shanties are **work songs**. They were popular aboard British **vessels** from around the middle of the 19th century to the beginning of the 20th century. Sea shanties usually have a lead singer known as a **shantyman**, who is in charge of singing the **verses**. The rest of the ship's crew chimes in on the **chorus**. The shantyman would have been chosen due to his strong singing voice.

The songs were used to help co-ordinate much of the manual labour that needed to be done around the ship. For hard jobs, like hoisting the sail, the chorus comes at the end of every line. This makes sure the sailors all pull the rope at once. Each line between gives them time to catch their breath. Because they were meant to accompany work, sea shanties are traditionally sung **a cappella** (without any instruments). Some modern shanty groups now add their own instrumental arrangements.

## AQUILA: What else can sea shanties tell us about the lives of the sailors that sung them?

**Jowan:** These songs were most widely

sung during the Victorian era, a period known for being more than a little strait-laced and prudish (*some historians think even the word 'trousers' was frowned upon!*). At this time the British upper classes weren't keen on wild outbursts of emotion. There *were* developments during this time to challenge this strict hierarchy, but largely Victorian society stuck to a rigid class system. In contrast, sea shanties were bawdy, rude, salacious outbursts of emotion, tales full of miserable working conditions, drunken sailors and wives left alone on shore. They were tough songs for tough times.

Shanties were passed from sailor to sailor through the **oral tradition**. Very few were written down by sailors themselves. Instead, early folk-song collectors like Percy Grainger and Cecil Sharp recorded many of the shanties on their behalf a little later on. This could suggest that a number of the sailors were illiterate, or that writing the words down could get them into trouble with the people they were probably working for.

## AQUILA: Why did these work songs stop being sung on board?

**Jowan:** Gradually older wind-powered ships started being replaced by newer models fitted with new technologies, such as steam. With less heavy work to do, the need for sea shanties died out. The tradition kept on going until the 1920s. Eventually, in the 1950s, the last shantyman, a chap called Stan Hugill, wrote down all the songs he could remember and taught them to younger, if more land-based, folks.

## AQUILA: Did pirates sing sea shanties and if so, were they the same?

**Jowan:** Nobody knows if pirates sang sea shanties, but I like to think they did. We have a record that sailors sang at sea from at least the 15th century onwards. For all the meticulous detail that went into recording the crew and the cargo, no one seems to have written down what was sung on board.

Pirates had their heyday around the 18th century, so they may have sung what we now call **forebitters**, recreational songs that were sung in taverns, after the captain and crew had come ashore. These were usually single, unaccompanied voices (with the same rude content). Officers of the Royal Navy would not have approved!

## AQUILA: Humans seem drawn to using music to help with work – Disney's Snow White whistled while she worked. Tidy up songs are used in schools and I always have a loud radio blasting when (if) I wash up. Why do you think music helps us work?

**Jowan:** Music helps some of us organise our efforts. It gives parameters to our zipping thoughts. Housework, for example, is solitary and repetitive. A tune gives my brain something to latch onto. Singing together gives you a much greater sense of purpose and can bring a team together.

## AQUILA: How do sea songs differ from sea shanties?

**Jowan:** Sea shanties have been ashore for the past one hundred years or so, they have become mixed with whaling songs, sea-related songs and forebitters – the









# MAGICAL BRILLIANT MUSIC

**I**f music be the food of love, play on'. Do you know who said that? William Shakespeare. Of course.

And do you know who couldn't play a musical instrument to save his life? William Shakespeare. So what was he on about then?

It doesn't matter if you're eight or 80, music probably features in your life, whether you're reluctantly dragged along to piano lessons or finding new and innovative ways to drown out your sister's awful violin practice. You probably have your favourite songs, or bands that speak to you about who you are and how you're feeling; even deaf and hearing-impaired people can enjoy music by feeling vibrations (if the conditions are right). Getting on your headphones or popping in your earbuds provides you with an escape from the madness of school and home, and allows you time and space to disappear into a world of sound (and drown out that terrible violin screech).

If (like every adult you know) you secretly perform epic air guitar solos, or picture yourself on stage singing to thousands of adoring fans, chances are you're going to need to learn some sort of instrument. Do you need lessons, or do you think you might be able to teach yourself?

**Can any brain pick up and learn an instrument, or do you have to have hardwired musical ability? Are musicians born, or made? That's what we're here to find out.**

Ask yourself this: who's the better musician:



**Dave Grohl**  
(Nirvana and Foo Fighters)

or



**Lady Gaga**  
(singer and pianist)

It's tough, right? Certainly, much will depend on your personal tastes, but the biggest difference between these two isn't the beard, it's that Grohl is a self-taught axe slayer (or, if you're not familiar with rock lingo – guitarist) and Gaga was taught music from an early age. Grohl can't read a note. Gaga, on the other hand, can sight-read a musical score without missing a beat.





Australian and Canadian scientists have dedicated time to researching whether musicians are born or made. In 2014, a study got as close as scientists can to saying that, while there doesn't seem to be one single gene that determines musical ability, it's quite possible that this aptitude is the outcome of a lot of different genes interacting and working together.

## PLANT A SEED AND WATCH IT GROW

Much like watering a seedling and seeing it grow into a flower, most experts take this to mean that while there might be talent already waiting in your cells, you need to practise and nurture it to really see it develop.

Unfortunately most of us won't be able to find out for sure if we're genetically pre-disposed to musical brilliance. We just have to work with what we've got. Let's imagine for a moment that you've never picked up a guitar before, but you're pretty sure that you're destined to become a rock deity, like Grohl. Whether you have a dormant capability or not, is it possible to teach yourself by ear alone and not dedicate yourself to weeks of slavishly plucking scales and learning to read musical notation?

The answer is yes, but learning by ear is not a shortcut. You'll still need to carry out hours (and hours and hours) of practice. Figuring out a guitar solo by ear is a pretty impressive achievement by anyone's standards. To get the chords down, you'll probably need a little help from a book, or from YouTube, but otherwise, you're good to go. Really though, teaching yourself to play by ear is just as hard work as learning from a teacher. It's just that you're 'winging it' a bit more and you can do it while wearing your pyjamas, something that can't usually be said for bassoon lessons.

## PLASTICITY

Do you think you have a musical brain, and, if so, what does that look like compared to the bog-standard non-musical version?

That weird blob in your skull will change as you learn and develop your musical skills. Another study, this time from Finnish scientists in the field of **neuromusicology**, revealed that listening to music touches almost every aspect of your brain's functions. While your **auditory** elements are busy processing sound, the motor areas of your brain (the bits that control movement) are reacting to the pulse. Then you've got the areas dealing with whatever emotions are coming up.

If listening alone can produce that response, then learning to play it goes even further. To put it simply, musicians' brains are different to those of non-musicians.

However you've learnt to play an instrument, your brain is likely to be bigger and more sensitive than the brains of non-playing folk. What does this mean? Well it *can* mean that you stay more mentally alert as you get older, and that your hearing continues to function pretty well.

If you have **dyslexia** then you might also benefit from learning music. Some studies show that musical training can have a positive impact on reading skills and speech processing.

There are literally zero drawbacks to learning a musical instrument. It can help you improve hand-eye coordination, sharpen your memory and even improve your mood. What's not to love?

Whether you come from a long line of gifted musicians or have never picked up a musical instrument in your life, according to science, Foo Fighters and Lady Gaga, with enough practice you'll be up there with the best of them – giving your screechy sister a run for her money.







# PHILOSOPHY & PSHE

In this section we trace the origins of philosophy, get to grips with ethics and follow human growth from conception.

**The Birth of Philosophy** – Let's meet the wisest of them all

**Are There limits to the Imagination?** – A journey into the human mind

**Let's Debate Safari Parks** – Which side of the zoo fence do you sit?

**How do you Grow?** – From poppy seed to watermelon!

**What is Autism?** – Understanding how special 'different' can be

**Loneliness** – Have we all become antisocial?





# THE BIRTH OF PHILOSOPHY

One of the world's first philosophers was a man called **Thales**. He lived in Miletus, which is on the coast of present-day Turkey. Thales was born around 2,600 years ago. He was a smart guy. He predicted a solar eclipse in 585 BCE (*no easy task, ed*), and he worked out the diameters of the Sun and Moon. According to the stories, he was also a bit of a daydreamer. One day he was wandering about ancient Greece staring at the sky when he fell into a well (*imagine what trouble he would have got into had he owned a smart phone, ed*). Fortunately for the future of civilisation, he managed to climb back out again.

## WATER WORLD

Thales is not only famous for his astronomy and his unlucky accidents involving wells. He is also known as the founder of Greek philosophy. Thales was puzzled by the complexity of the world. It is full of an amazing number of things: pot-plants, ducks, books, boats, apples, mountains... hats! Thales wondered if there was something simpler underpinning this complexity. He asked himself what this might be, and he came to the conclusion that the principle underlying everything is water. In other words, everything is made of water.

This seems to us like a weird idea. We now know that Thales was wrong. But at the time, it wasn't such a crazy thought. After all, water is everywhere. Life depends on it. It can change form from liquid to gas to solid. And Thales lived by the sea, so life in Miletus was probably pretty soggy a lot of the time. As a candidate for something simple underlying the complexity of existence, water must have seemed pretty convincing.

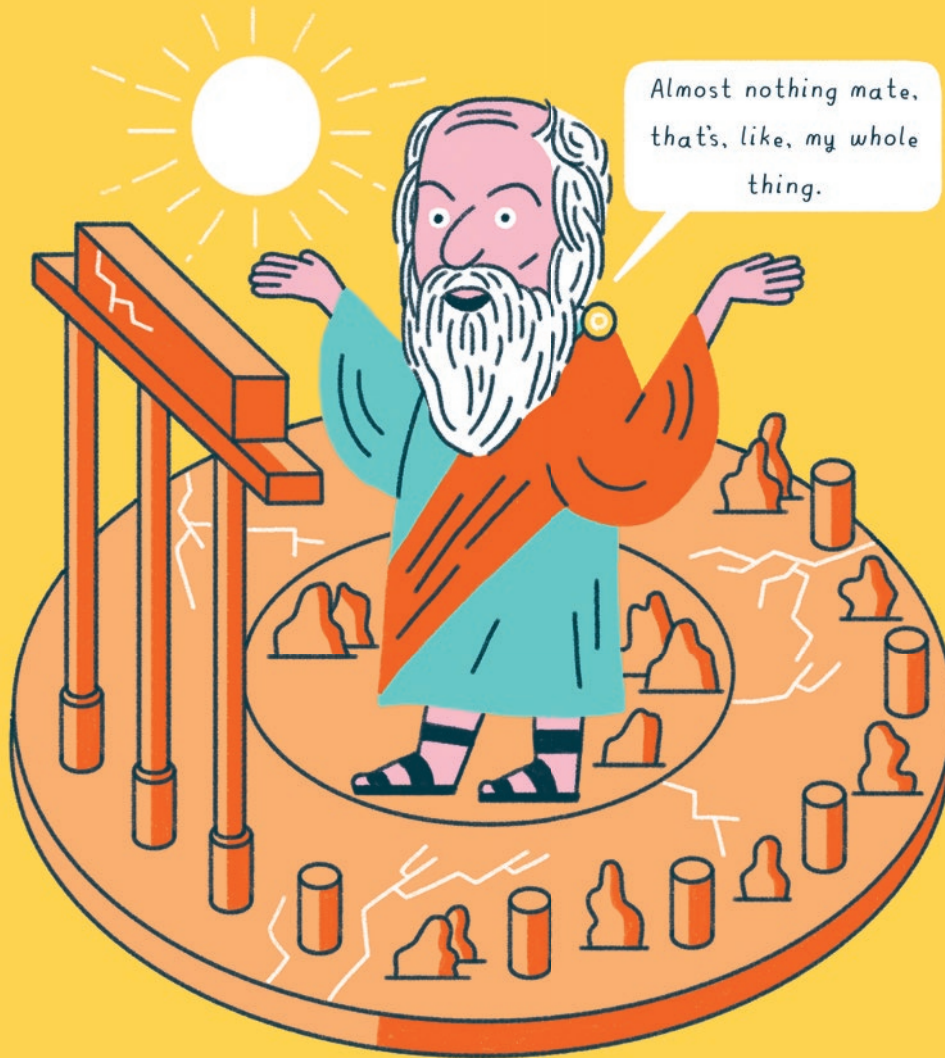
In saying everything was made of water, Thales was trying to find a natural explanation for how the world was instead of relying on supernatural tales about cantankerous gods. He saw that although things might *seem* complex, when we look beneath the surface, they may be much simpler. This is a big insight: the search for simple principles behind complex things is often seen as the **beginning of science**.

## WANNABE THE WISEST

Once people in Greece got started thinking about philosophy, they couldn't stop. Lots of philosophers followed Thales. Of all of them, probably the most important was **Socrates**. He was born in the city of Athens more than a hundred years after Thales died. Socrates worked as a stonemason. He was scruffy, grumpy, and famously ugly (*bet his mum and dad didn't think so, ed*). He was interested in principles too, but in the principles underlying things like goodness and badness, justice and injustice.







Socrates is one of the most important philosophers in all of history. But philosophy wasn't just born in Greece. It was born in lots of places – in Greece, in India, in China. Amazingly, it was born in all these places at almost exactly the same time. It is as if around two-and-a-half thousand years ago, suddenly people everywhere were thinking differently about what it meant to be human, and were asking new and difficult questions about life.

### WHY WAS PHILOSOPHY BORN WHEN IT WAS?

One reason is that around the time of Thales and Socrates, people were starting to live in bigger cities. They were travelling more for trade. They were rubbing shoulders with strangers who had very different ideas and beliefs from their own. This made them question their own beliefs, and think differently about the big questions of life.

The word 'philosophy', or *philosophia* in Greek, means 'the love of wisdom'. Socrates was crazy about wisdom. He wanted to be properly wise – wise XXL. So he decided to find some wise people to talk to. Because it is hard to know who is wise and who is not, Socrates went to consult the Delphic Oracle. The Oracle was a kind of one-stop advice shop. There you could put questions to the god **Apollo**. You'd turn up, ask your question, the priestess would go into a trance and then she would tell you what Apollo thought. Socrates paid a visit and asked the Oracle who was the wisest person in Athens. The answer surprised him. 'There is no one wiser than Socrates,' the Oracle said.

### NOT BIG AND NOT CLEVER

Socrates was puzzled. He certainly didn't *feel* very wise. So Socrates decided to prove the Oracle wrong by talking to all the wise people in

Athens. Unfortunately, when he started asking these wise people difficult questions like 'What is goodness?' the answers he got disappointed him. He realised that these so-called wise people were not so wise after all. In fact, Socrates eventually came to the conclusion that he probably *was* the wisest person in Athens. Nobody knew anything much at all. But most people *thought* they knew stuff. Only Socrates knew what he didn't know. This made him wiser than all the others.

A lot of people in Athens found Socrates quite irritating. They liked feeling wise, and they certainly didn't like feeling stupid. In his willingness to question authority, Socrates had made himself unpopular. In the end, the powerful people in Athens had had enough. They put Socrates on trial and sentenced him to death. Philosophy can be a dangerous business!

### THE ONE IN WHICH PHILOSOPHY IS LIKE CRISPS, (APPARENTLY)

Whatever the reasons for the birth of philosophy, once human beings started philosophising, they just couldn't stop. Just like Thales, scientists of today debate the principles behind the universe. And although many of us still disagree about things like what's right and wrong, hopefully two-and-a-half thousand years of philosophy have given us better ways of disagreeing, of debating, of questioning and of thinking. **Do you think so? Why not write to us at the usual address and let us know.**



# JUST THINK... ARE THERE ANY LIMITS TO IMAGINATION?

Philip has been reading up about the expanding Universe and the Big Bang that started it all off, and he is very excited about the whole idea. Phoebe seems less convinced, however.

'I see. So what was there before the Big Bang happened?' she asks, 'and what was in the space the Universe expanded into?'

'Oh, don't be silly!' says Philip in an annoyingly patronising tone. 'Space and time both came into existence with the Big Bang. So obviously there was no 'before' the Big Bang. And there is no space for the Universe to expand 'into'. It's all perfectly simple, you know.'

Phoebe looks at Philip as if he has gone mad. 'So you mean I'm not allowed to ask questions like that? It all seems pretty dubious to me.'

Philip looks at her pityingly. 'That's OK, Phoebe. You probably don't have the imagination to handle this sort of stuff like I can.'

Fortunately, their mother came in at this point. Otherwise Phoebe might have throttled her twin brother.

## HOW POWERFUL IS HUMAN IMAGINATION?

Can it take things like '**before time came into being**' and '**beyond the Universe**' in its stride? Or is it limited to things we can actually experience?





Philip and Phoebe have stumbled across one of the biggest arguments in the whole of philosophy. At issue are two fundamental questions:

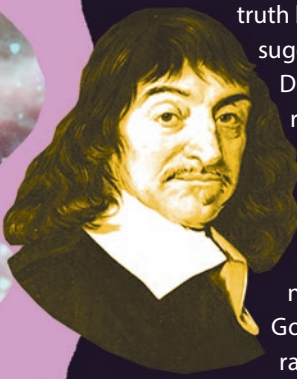
‘WHAT CAN WE KNOW?’  
AND  
‘HOW CAN WE KNOW IT?’

Philosophers are divided into two warring camps on this issue: the **rationalists** and the **empiricists**.

## RATIONALISTS

The rationalists believe in the unlimited power of human **reason** to discover all the secrets of the Universe. We discover truth by sitting and thinking hard about it, they suggest, not by going and looking at things. René Descartes (1596–1650) was a very important rationalist philosopher, and his famous ‘I think, therefore I am’ sums up their position neatly.

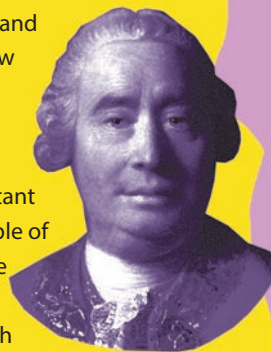
Rationalists also believe in the unlimited power of human **imagination** to create completely novel ideas. Just as some people believe that God created the world out of nothing, rationalists believe that the human imagination can create brand new ideas where nothing was there before.



## EMPIRICISTS

The empiricists deny this. They believe the scope of reason is very limited. The real source of all knowledge, they argue, is **sense experience**: the information that comes to us through our eyes and ears, touch, taste and smell. Reason can merely rearrange this raw material into different patterns; it cannot create anything completely new.

David Hume (1711–1776) was a very important empiricist philosopher. He gave the example of The Golden Mountain. We can visualise the golden mountain only by combining the ideas of ‘golden’ and ‘mountain’ with which we are already familiar from sense experience.



## KANT

The philosopher Immanuel Kant (1724–1804) combined these positions in a novel and compelling way. Reason is enormously powerful, he argued, but only when applied to the information supplied by our senses. If it strays beyond, into places where experience can never occur, it simply freewheels like car tyres spinning on an icy road. He called his 1781 book on this topic the *Critique of Pure Reason*: ‘pure’ reason being reason which wrongly fancies itself imaginative but is in fact just generating nonsense.

## IMAGINATION AND THE UNIVERSE

Kant’s position is relevant to Philip and Phoebe’s discussion. Phoebe wants to know what was there ‘before’ the Big Bang, but Philip replies that there was no ‘before’ because time started just then.

‘Before’ the Big Bang is exactly the sort of zone beyond any *possible* sense experience that Kant talked about. And here, reason and imagination simply do not work. The only words and ideas we can use in this zone are words and ideas

related to our sense experience: ‘time’ and ‘before’ are both like this. So if we try to use them in that other zone they fail to grip and just generate nonsense. In situations like this we must simply give up in silence and ignorance.

So, if Kant is right, yes, Phoebe does lack the imagination to think about these issues. But then so too does Philip – despite what he thinks – along with the rest of us!



## EXTRA TRICKY QUESTIONS FOR BUDDING PHILOSOPHERS

1 Can you make up an imaginary creature whose parts are not derived from your past sense experience? If not, why not?

2 We are unhappy with the idea of events happening for no reason at all, and will always look for a cause or reason for everything. Why?

3 Which is better at finding the truth: doing science experiments, or thinking hard about problems?





# LET'S DEBATE...

Safari parks have been up and running since 1966, and were originally the concept of Jimmy Chipperfield, who was co-director of a circus. But how good are they in reality? Does Jimmy's idea get a thumbs up or a thumbs down from you? Let's see what our tumultuous twins Philip and Phoebe make of it, shall we?



## THUMBS UP

### 1 They're cheaper than a real safari

Can you guess how much a safari holiday actually costs? (Hint – it isn't cheap.) Valued at around £4,000 for a week for a family of four – and that's not including flights or spending money – it is much cheaper to visit one of the safari parks dotted around the UK. They charge between £60 and £100 for admission (*erm, that's still quite a lot of money, ed*). The following parks were established in the 1960s and 1970s and are still running today: Longleat, Woburn, Knowsley, Blair Drummond and the West Midlands Safari Park, so there is a good chance you live fairly near to at least one.

### 2 Better than YouTube

A trip to a safari park can be an excellent day out for all the family. There's nothing like seeing animals in the real world rather than in books or on nature programmes. The vast majority of us are unlikely ever to see these animals in their natural habitat, and in zoos they are mostly behind fences or glass. In safari parks many herbivorous animals, like giraffes, camels and deer, are free to roam around and there is the possibility of getting up close and personal and feeding them from the window of your car. In certain parks you can drive through enclosures where lions and other big cats roam, though obviously it is very important to keep the windows up and stay in the car.

### 3 They do their best for the animals

While it is impossible to completely mimic an animal's natural habitat, great efforts are made to provide the animals with what they need to keep them happy. At Longleat, a former circus elephant called Anne, who has special needs, has a lovely large home with a sandy floor and heating, as well as a paddock outside and a plunge pool. Lemurs have been provided with rope swings and various other equipment to keep them active.

### 4 Endangered species

A good thing about safari parks is that they help to protect endangered species. Conservation and breeding programmes are a way of making sure that certain animals do not face the fate of the Tasmanian tiger *Thylacinus cynocephalus* and become extinct. The West Midlands Safari Park was the first park to successfully breed rare white lion cubs. It houses many animals that are on the International Union for Conservation of Nature's list of endangered and critically endangered species. Woburn Safari Park is recognised for its efforts in breeding the Rothschild giraffe *Giraffa camelopardalis rothschildi* and protecting other species.

### 5 They can teach us about animal behaviour

Through their work, safari parks play a very important role in teaching the public about animal habits and behaviour. In allowing people to feed and pet some of the animals they encourage a more caring attitude, and are able to make the public aware of their involvement in conservation work across the globe.





# SAFARI PARKS

## THUMBS DOWN

### 1 Enclosures can never really be big enough

While safari parks are spacious, usually spread over hundreds of acres of land, enclosures can still seem a little on the small side for certain animals, and the point remains that they are not free. A cheetah, for example, can achieve speeds of 70–75 mph (110–120 kph) as it races across the African savannah, this would prove impossible in captivity.

### 2 Animals can't live on their instincts like they can in the wild

Animals' natural instincts are sometimes suppressed in captivity. In the wild, predators have to hunt so they learn to stalk and capture their prey. In safari parks, food is provided. Raw meat and carcasses are given to the big cats but they don't have to work that hard for it. Likewise, animals in the wild choose who they mate with. Animals in captivity have no choice who gets to make babies and who doesn't.

Sometimes species are too successful in captivity. If populations rise to a level that is bad for the group (too many animals can lead to a rise in violent behaviour) healthy animals may occasionally have to be destroyed.

<https://www.theguardian.com/world/2014/feb/09/longleat-safari-park-lions-destroyed>

### 3 The numbers are off

While safari parks house a large number of animals from all over the world they can't always get the group numbers right for each species. A pride of lions, for example, would usually number fifteen. Elephants congregate in single sex groups of around ten, but this is not always achievable at a park, either because of space constraints or simply because more of these animals are not available. In Woburn, for example, there are three adult female elephants, one male and a female calf and unfortunately Anne at Longleat has to live alone – but she probably wouldn't have survived at all without their help.

### 4 Animals can be unpredictable (and some are just downright rude)

Finally, some animals are a little bit pesky. Baboons and rhesus macaques *Macaca mulatta*, for example, can be a menace to society. At Knowsley and Longleat respectively, they have had to build a bypass for visitors who were worried about their cars being damaged by these animals. They're very intelligent, so the monkeys have great fun with loose fitting car parts! As well as seeing too much of certain animals, there is always the risk of not seeing enough of others if they decide to stay inside during a cold spell.

So, what's the verdict? Do you agree with Philip, that safari parks do an excellent job and should be supported? Or will you side with Phoebe, who thinks safari parks just aren't quite fit for purpose? Why not write us a letter at the usual address and let us know what you think. We'll print the best ones.







# HOW DO YOU GROW?

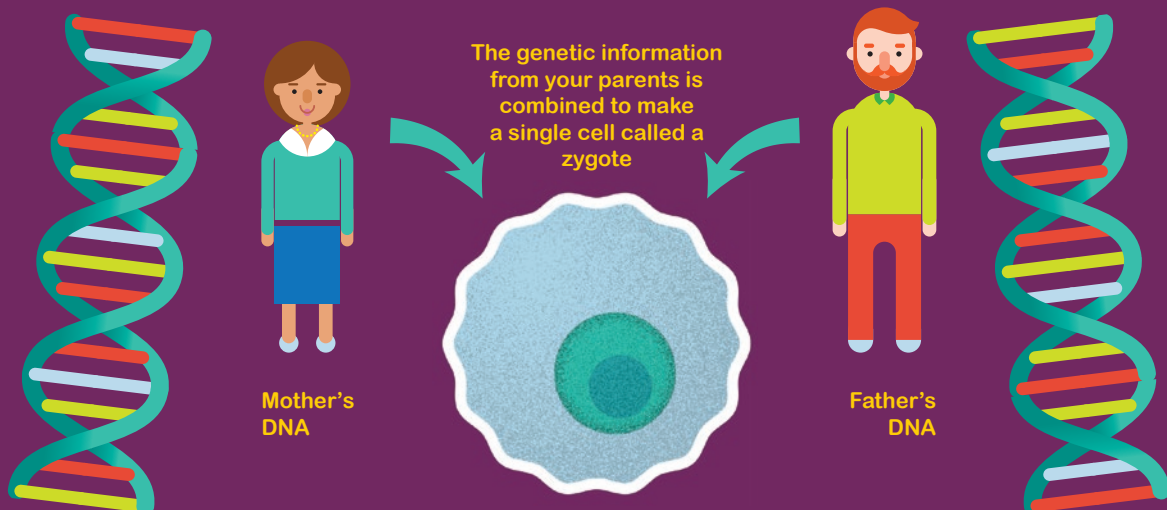
*Human growth is a complicated process that begins at your conception and ends in adulthood.*

This chart shows the periods of growth you go through on your way to becoming an adult.

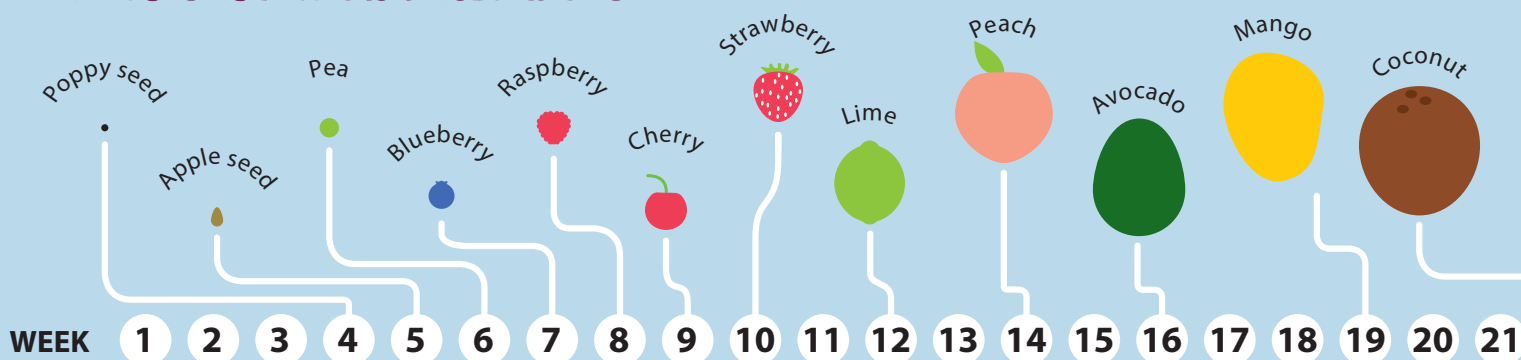
PHASE	AGES	GROWTH TRIGGERS	GROWTH RATE	% OF EVENTUAL HEIGHT
Foetal	Conception to birth	DNA; nutrition; placenta	Fastest	30%
Infantile	Birth to 18 months	Nutrition; good health; happiness	Rapid but slowing down	15%
Childhood	18 months to puberty	Growth hormones; thyroid hormones; good health; happiness	Slow, steady, prolonged	40%
Puberty	Puberty to adulthood	Growth hormones; testosterone; oestrogen	Growth spurts	15%

## GENETICS

At conception, an egg from your mother and a sperm from your father combined to create you. The egg and sperm carried your parents' genetic information (**DNA**) and as the two parts combined, your **genetic make-up** was formed. Your genetics determined how your body would grow. If your parents are short or tall, you're likely to grow up like them.



## EMBRYO GROWTH AS FRUIT & VEG

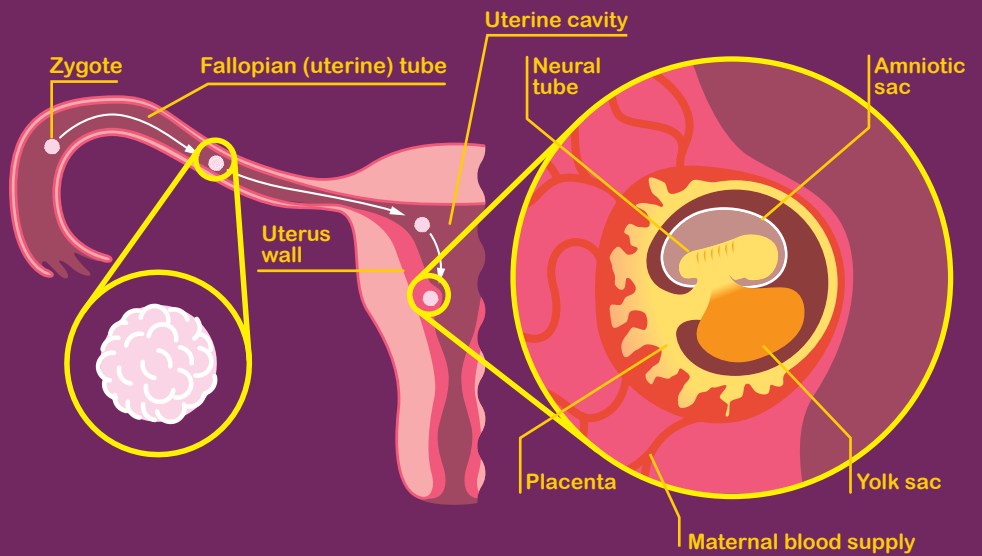




## EMBRYO STAGE

Your parents' combined DNA blended to make a new single cell called a **zygote**, which contained the code for your own unique DNA and the instructions for building your **entire body**. Your original single cell copied your DNA code and split apart into two cells, this took roughly 24 hours. Your cells continued copying and splitting and by the end of the third day, you were a multi-celled ball that looked a little like a tiny mulberry. You passed through the **fallopian tube** and attached to the **uterus wall**, you formed your own **placenta** and **amniotic sac**, and then tiny, multi-celled-ball-you started floating in **amniotic fluid**.

Your 3-week-old embryo was 2–3 mm long and your **neural tube** (later to be your spinal column) was formed. At 4 weeks from conception you were 4–5 mm long and your four-chambered heart started beating! Just 8 weeks after your single cell was formed, most of your major development had occurred and all your major organs and body parts were formed. Your **embryo** was 25–30 mm long (about the size of a raspberry), your face and neck had taken shape and you started to move.



## ECHOES OF EVOLUTION

During the second week of your embryo development, you developed a **yolk sac**, a relic left behind by ancestors who laid eggs. In your fourth week you resembled a fish embryo. During your fifth week you resembled a chick embryo. By your seventh week you were clearly a mammal, with a small tail.

*What? Ed*

Yep, a tail! And by week eight, your embryo had evolved to your human

form. You carry the story of evolution in your DNA.

## FOETAL GROWTH

Your body grew larger and stronger as you evolved in the womb and your brain grew rapidly in the last three months. Your growth was determined by your inherited genes, your placenta and the nutrition passed to you by your mother. You grew from a single cell into a fully-formed baby made up of trillions of cells in just nine months!

WEEK 7

WEEK 16

WEEK 39



Cauliflower

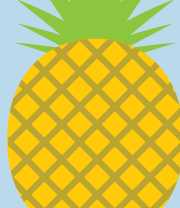
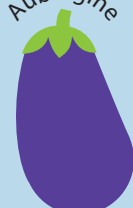
Aubergine

Squash

Pineapple

Pumpkin

Watermelon



22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42



## BIRTH AND ONWARDS

When you'd grown as much as you could in the womb, you signalled to your mum to help you out and you and your mum worked together until you were born. (Do you have a different birth story? Lots of people do.) You were born with 300 bones in your body, a patchwork skull made of bone and cartilage and no visible teeth, even though you were born with all your teeth in your mouth! Twenty baby teeth sat above 32 adult teeth **buds** in your jaw, under your gums still growing and forming until they were ready to erupt.

There you were, a tiny newborn baby, all soft and noisy, fiercely hungry and keen to keep on growing. As well as physical growth, your environment outside the womb triggered growth and development in your **motor skills** (how you use your body), your **senses** (how you experience the world), your **cognitive development** (how you understand the world) and your **social skills** (how you interact with people). You have not stopped growing since your conception, and you will never stop changing.

By the time you were one month old, you'd grown rapidly and your brain was 25 per cent of its adult size. You were learning to lift your head and smile.

At six months old, your lower front teeth might have started erupting, your true eye colour was probably established and your nostrils had doubled in size, you could probably roll over, and sit up, and might have started to crawl.

On your first birthday you might have had six teeth, your brain was 75 per cent of its adult size and you had probably grown around 25 cm since birth, from then on, you continued to grow at an average 7.6 cm per year until age 5. You could probably walk and say a few words.



Age 2, you may have had 16 teeth. By two and a half years old, you probably reached half your adult height and grown a total of 20 baby teeth.

By 3, your brain was 80 per cent of its adult size, you had a thick abdomen and your eyeballs had grown 7 mm since birth (they'll grow another 1 mm by puberty).

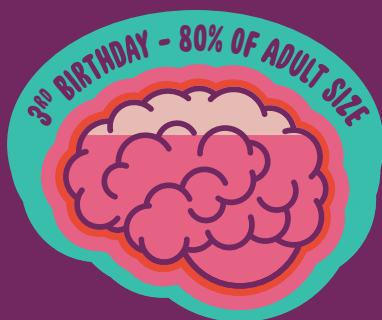
Your 4-year-old belly started flattening out as your abdominal muscles formed and your limbs lengthened, your head was nearly adult-sized and your facial features matured.

At 5, your brain was very close to adult size and volume, and all your brain structures and functions were

established. Your height was double your birth length. Your baby teeth may have begun to fall out and started to be gradually replaced by adult teeth – a process usually finished by age 13. You continued to grow a steady 5 cm per year.

By 7, your brain was 90 per cent of its adult size.

From age 8 through to age 10, you'll probably grow at a steady rate of around 5 cm per year. After that, you'll need to get ready for a major growth spurt! During puberty, your body will start preparing for adulthood and you will experience many changes.





# HOW TALL WILL I GROW?

This formula suggests you can find out your adult height by measuring your parents and doing some maths. Try this:

**Girls:** [(Your father's height minus 13 cm) + your mother's height] divided by two.

**Boys:** [(Your mother's height plus 13 cm) + father's height] divided by two.



## EXAMPLE

Ginny's father is 180 cm and her mother is 170 cm.

$(180 \text{ cm minus } 13 \text{ cm} = 167 \text{ cm}) + 170 \text{ cm} = 337 \text{ cm}.$

$337 \text{ cm divided by two} = 168.5 \text{ cm}.$

Using this formula, Ginny could predict that she would grow to be 168.5 cm tall, that's just 1.5 cm shy of her mother.

## WHAT IF YOU GROW DIFFERENTLY?

We're all different and difference is beautiful. Numbers listed here are averages, which means they are between the lowest and highest recorded numbers. You may discover that your height and other growth patterns are different to these averages. Embrace your uniqueness!



# WHAT IS AUTISM?

We hear from ten children about how autism feels for them, and what they'd like other children to understand.

**'Autistic people can do amazing things,'** says Noah, age 10. But Tristan, 8, describes his autism as: **'Not knowing what to say, and everything feels too noisy, and I get upset easily.'**

So what exactly is autism? Autistic people don't look any different from anybody else, but their brains work a little differently. This means they find some things harder – and some things much easier – than other people. Having autism doesn't stop somebody from being successful or being a good friend. But it can make life difficult, as Reese, age 13, explains: **'I find it really hard to know that I'm a bit different to other people.'**



About one in every 68 people has some type of autism, so you probably know somebody who's autistic – maybe a friend at school or somebody in your family. Or perhaps you are autistic yourself. Not all autistic people are the same: some don't talk much and might need a lot of help at school, while others are sociable, learn well and lead independent lives. They usually have a few things in common, though.

Most of the autistic children we spoke to said making friends was difficult. Nina, 9, said: **'I don't know what to say to other children – I have to think really hard about it. And I**

**can't always tell if somebody is joking.'** Tyler, 15, told us: **'I don't understand people all the time, and I get frustrated that they don't understand me.'** Mo, 14, said: **'I find it really hard to make friends so when I do they become really important to me. When I was younger, I needed my friend to help me understand the other children at school.'** Some children told us they were happier with their own company. Jack, 8, said: **'I'm not a group person. The things I like are alone activities.'**

Children with autism are often sensitive to sounds and smells that other people don't notice. This can make school stressful, as Tristan explains: **'I don't like the noise in the class. It makes me feel angry and makes my tummy feel funny.'** Noah told us: **'I can smell many crazy things that other people can't and I hear the quietest sounds. But I get overwhelmed. If my senses are overloaded, I can't concentrate or understand what people say.'**

Autism can make emotions, as well as senses, more intense, as Reese explains: **'I think non-autistic people don't feel emotion as strongly as we do.'** So autistic people might become angry, anxious, and upset more than other people. These feelings are hard to



control, and hard to escape from. Iris told us: **'I need to be left alone for a while if I'm overwhelmed or anxious.'**

As well as these struggles, many people with autism have some amazing abilities, too. Tyler said the best thing about being autistic is his memory: **'I remember everything!'** Jack told us: **'The best thing is being able to read long books easily,'** while Reese said: **'I think we see detail that other people don't.'** Because of their different ways of looking at the world, autistic people can also be extremely creative. Iris said: **'Being autistic gives me special skills in my art and song writing.'** And Ravi, 11, enjoys losing himself in his imaginary worlds: **'I make up stories about the places in my head, and draw comics about characters I've invented.'**

Some autistic people use their memory and focus to explore a particular interest in great detail. Noah is interested in everything to do with bacteria, while Mo's interests include medical documentaries and murder mysteries. Mo explains why these special interests are really important: **'It gives you something to focus on instead of thinking about things that make you sad. Also you gain knowledge that could help you in**



Sisters Keira, 11  
and Reese, 13



**the future.'** TV presenter Chris Packham recently made a TV programme about his autism, and explained how his intense interest in wildlife led to his successful career.

Some people think lots of historical figures – including Albert Einstein, Charles Darwin and Jane Austen – were autistic. They all thought differently from the people around them and focused passionately on their work.

Keira, 11, appreciates how being autistic makes her stand out – just like these

famous names: **'One good thing about autism is that you are unique – it makes you different in a good way.'** And that's what Ravi most wants his friends to know – that being autistic can be a positive thing; that it can mean new ways of looking at things, new ideas, and new experiences.

**So if you meet somebody with autism, it's worth taking time to get to know them – what they like and don't like, what they can and can't do. The unique ways that autistic people see the world can make them really special friends.**

Illustration: Kaley McKean





# Loneliness



I wonder what you'd say if I were to ask you this question:

What could be as bad for your health as eating a triple cheese and bacon beefburger and a large portion of chips, followed by a deep-fried chocolate bar and a can of pop every day, for a week?

I'm pretty sure your answer wouldn't be 'loneliness', but, surprisingly that is the correct one. Loneliness is so bad for our health that some healthcare professionals are calling it an epidemic<sup>1</sup>.

*So, why are people so lonely?*

Researchers think it's because more people are living on their own. In 2017 it was estimated that 28 per cent of all UK households contain just one person<sup>2</sup>. Many of these are elderly people, but there are many adults – including some young people<sup>3</sup> – who also live alone, maybe because they have moved away for work or to study.

*Why is loneliness so bad for us? I love being alone. Other people are AWFUL!*

Of course there are people who love being alone, but that's not the same thing as loneliness. People who are lonely don't choose to spend so much time alone.

Just like elephants, dolphins and wolves (*don't forget guinea pigs, pets are people too, ed*) humans are a social species. Elephants (and guinea pigs) may go off on their own from time to time but they normally live and work best as a group. We are designed just like them.

Scientists who have done work on loneliness have found that the brains of lonely people actually change<sup>4</sup>. Just think about that for a second. That's not good! They go on to say that being lonely can make people anxious, depressed, negative, stressed, tired and even ill. Scientists believe that our survival depends on our ability to work together as a group, and not on our individual successes.



## AN INCREASINGLY INTERCONNECTED WORLD?

So, why have we become so antisocial? Maybe it's because we tend to travel more than we used to? Perhaps it's because our houses have fences, or even because of modern inventions like televisions and phones? What do you think?

We do seem to have become more private. Our local communities don't seem to be as important for many of us as they have been in the past. Lots of people don't know the names of the people who live next door to them.

This seems strange because on the surface it appears as if our lives are more connected than ever before. Think about it though, being connected by technology is definitely not as good as actually being with someone. Despite social media putting us in contact with lots of 'friends', online connections don't actually give us what we need as humans. We need to actually be around people – to see them, give them a hug or a smile. That's what lonely people crave.

The reality is that right now, someone in your community is sitting alone and wishing they had someone to be with or talk to. A government survey suggested that 200,000 older people had not had a conversation with a friend or family member for more than a month<sup>5</sup>. That's too long.

Although it's not clear exactly how many elderly people will spend this Christmas alone, it is thought that the number will be somewhere between 230,000 and 450,000<sup>6</sup>. That's a lot of lonely people. I don't think anyone should have to spend Christmas alone if they don't want to.

### *What can we do about it?*

Firstly, if you decide you want to help lonely people that's wonderful, but it's important not to do anything on your own. Always keep yourself safe by involving an adult you trust.

Secondly, remember that everyone is different. Some people like being alone, so double check with them before you rush in. Not all old ladies

like bingo, and not every old man likes war stories!

With that in mind, here are a few ideas:

- 1 Talk to your parents/carers and discuss how you might be able to help.
- 2 Your contribution might be very small. That person who is always looking out of their window might be doing that because they are lonely. Maybe you could give them a wave or a smile as you go past, or say hello when you see them out and about? **Always check with an adult before speaking to strangers.**
- 3 Perhaps your school could team up with a local branch of Age Concern, or the Campaign to End Loneliness and start an intergenerational project or activity – how about a skill swap? These can benefit everyone!
- 4 Remember, young people can be lonely too. If you notice that someone is regularly alone at school, why not take a few minutes to get to know them – you never know, it might make their day!

If we could all find a little kindness in our hearts, a little moment in our busy lives to reach out to people who live so close but feel so far away, would we still have lonely people? Maybe, mental wellness can be a complicated problem to solve, but it certainly couldn't hurt.

1. An epidemic is a quick spread of disease within a short time
2. Labour Force Survey, Office for National Statistics
3. Aged 16-24
4. <https://www.iflscience.com/brain/loneliness-for-long-periods-of-time-actually-changes-our-brain-chemistry/>
5. Jo Cox Loneliness Commission/Tracey Crouch – Government Lead on Loneliness
6. Age UK, 2013



WHICH OF THESE

# ENDANGERED CATS

BEST MATCHES YOUR PERSONALITY?

Try our a-meow-zing quiz, and find out.

**1 Name your ideal weekend getaway:**

- A** Hiking in the rugged Scottish countryside
- B** Living it up in Primorsky Krai (that's in Russia)
- C** A busy city-break in Shanghai
- D** A restful weekend on a small island in Japan

**2 Pick a pattern:**

- A** Tartan
- B** Spots



- C** Stripes
- D** Wave



**3 How many of you are left in the wild?**

- A** About 35
- B** About 84
- C** Fewer than 20
- D** Approximately 100

**4 Pick a snack:**

- A** Rabbit, chips and curry sauce (hold the chips)
- B** Siberian roe deer on toast
- C** Slow-roasted muntjac
- D** Ryukyu flying fox, drizzled with soy sauce

**5 Describe your tail:**

- A** Moderately thick and blunt at the tip
- B** Long, bushy and covered in spots
- C** Long and stripey
- D** Darker at one end

**6 Pick a banging dance floor filler:**

- A** 'Take Me Out' by Franz Ferdinand
- B** 'Respect' by Aretha Franklin
- C** 'Tiger Feet' by Mud
- D** Anything J-pop, obviously

**7 Name a key quality you possess:**

- A** I am ferocious and independent
- B** I am adaptable
- C** I have the most beeeeeeautiful fur
- D** I am happy in my own company

**8 What's your style of dress?**

- A** Rough around the edges and angry as a wasp at a sugar-free food festival
- B** Death by polka dots
- C** Furious Wotsit-monster
- D** Like all the greatest fashion icons, I defy categorisation

**9 Your BFF would describe your personal style as:**

- A** Fierce
- B** Classic
- C** Majestic
- D** Quirky







## ANSWERS MOSTLY A:

You are a **Scottish wildcat** (*Felis silvestris silvestris*)

Talk about a walk on the wild side! You're rebellious, striking and untameable, just like the formidable Scottish wildcat. These animals once roamed free all over the UK, that is until about 2,000 years ago, when the Romans arrived. The Romans introduced domestic cats to this country, and over time their shy and elusive cousins retreated to the most sparsely populated areas of land. Today, because of logging and interbreeding, there are thought to be only 35 proper wildcats left in Scotland. Fortunately **Scottish Wildcat Action** is working with local people to halt and reverse the extinction process.

## ANSWERS MOSTLY B:

You are an **Amur leopard** (*Panthera pardus orientalis*)

Blimey! You don't mess about, do you? You're direct, no-nonsense and able to take on anything life throws at you, just like an Amur leopard. These beautiful creatures are found in eastern Russia and north-east China. They can run up to 60 km/h and leap to heights of 3 metres. Their thick fur and pale colour mean they can thrive in both hot and cold temperatures, but numbers are seriously dwindling because of habitat loss, poaching and hunting. The Amur leopard is listed as critically endangered by the International Union for the Conservation of Nature (IUCN).

## ANSWERS MOSTLY C:

You are a **South China tiger** (*Panthera tigris amoyensis*)

Oooh, get you! Elegant. Majestic even, you're just like the South China tiger, an animal both splendid and rare. Indeed, the South China tiger is so rare that most experts think it's extinct in the wild. One hasn't been seen outside of a zoo for more than 25 years. An amazing hunter that is agile on land as well as in water, disappearing habitat is to blame for its extinction. There are plans to reintroduce captive-bred animals back into the wild, which is just as well, because the future of this incredible species depends upon it.

## ANSWERS MOSTLY D:

You are an **Iriomote cat** (*Prionailurus bengalensis iriomotensis*)

Enigmatic, quirky and happiest in your own company, you're just like the Iriomote cat from Japan. This solitary cat only lives in the sub-tropical forest on the island of Iriomote, a fact that makes it extremely vulnerable to **climate change**. These creatures are excellent swimmers and climbers but they spend most of their time on the ground. Active during the night, they sleep in caves or hollow logs during the day. There are only about 100 animals left in the wild. Threatened by human development and interbreeding with domestic cats, this is a **sub-species** on its last legs.









# ANIMALS

This section looks at endangered turtles and explores the role of the humble domestic pet.

**Endangered Cats Personality Test** – Find your spirit feline

**The Backward-Walking Cats of Minamata Bay** – A cautionary tale

**Tourism and Turtles at Loggerheads** – Ancient animals at risk

**Man's (and Woman's) Best Friend** – Domesticated doggos

**Not Just for Christmas** – Heart-warming Victorians

**Sugar Gliders** – Meet the sweetest little acrobats



# THE BACKWARD-WALKING CATS OF MINAMATA BAY



You've probably heard it said that cats have nine lives. It's not true of course, they have one – just like everything else, but cats *are* known for their dexterity and agility, and as such, seem to be able to get out of almost any situation.

Sadly, this is the story of the backward-walking or 'dancing cats' of Minamata Bay – a cautionary tale, not for cats, but for people. You see, the Minamata Bay incident is a lesson in how humans can poison an entire **food chain** without even knowing it.

## HAZARDOUS WASTE

Minamata is a fishing town on the west coast of Kyushu island, in Japan. In 1932 a



large chemical factory opened there and began manufacturing prescription drugs and industrial products, such as plastics. The company used mercury in their production processes. Mercury is a very

dangerous and toxic heavy metal, but rather than dispose of it in a safe manner (*I'm not sure any method is completely safe, ed*), the factory owners simply poured it directly into the bay in Minamata.

*That does not sound good.*

No. No it wasn't.

At first, no one noticed anything different at all, and so for the following 30 years, the company in question, the Chisso Corporation, continued to dump hundreds of tonnes of deadly mercury into the clear, clean waters at Minamata. Meanwhile, the local fishermen and women, who were completely oblivious to the risks, continued to fish for shellfish and clams to feed the local villagers and their animals.

## STRANGER HAPPENINGS

By the 1950s the residents of Minamata were beginning to notice some very strange things afoot in their town. The local cats and dogs, which fed on the fish scraps from the docks, began to act very weirdly indeed. Cats were seen walking backwards. The world's press descended on the community, to see the strange backward-walking or 'dancing cats' of Minamata. But worse was to come.

Cats and dogs started to suffer from strange convulsions and foaming at the mouth. Crows began to crash wildly into the rocks of the bay, others simply dropped out of the sky. Then the human

population began to suffer alarming symptoms too. People began to complain of numbness in their arms and legs. Some lost their speech and hearing, while others simply started to shout out uncontrollably.

## THE INVESTIGATION

Doctors and scientists arrived in Minamata in an attempt to discover what was happening. After a long and painstaking investigation, it was concluded that the uncontrollable shouting, the backward-walking cats and the crows falling from the sky were all clear signs that the people and animals of Minamata, with their daily diet of contaminated seafood, were suffering from severe mercury poisoning. The mercury in their diet had worked its way into their nervous systems.







## AS MAD AS A MILLINER

Though strange, such scenes were not unique in history. Doctors diagnosed the Minamata victims with **mad-hatter's disease**. This illness earned its unusual name after an outbreak of mercury poisonings in 1800s England.

Hat makers or 'hatters' as they were known at that time, were regularly classed as 'mad'. Why? Because they had a tendency to scream, shout out uncontrollably and generally act a little unexpectedly. Initially, people thought it was just a quirk of the profession. Eventually though, as in Minamata, doctors worked out the common link. In the 1800s, hatters also worked with mercury. They used it to soften and treat materials such as felt and fur. Doctors were able to connect the hatters' symptoms, linking the disease to processes used in their trade. As a result of this discovery, a new phrase was coined to describe people who worked in the hat industry. The saying: 'As mad as a hatter' became well known as a result of the outbreak.

*Is the fish in our seas safe to eat?  
Ed.*

It's true that all fish contain small traces of mercury, some species have more than others, but – and this is crucial – fish is tasty and **very good for you** in other ways. Most nutritional experts think that the benefits associated with eating fish far outweigh any potential harm. Fish can be part of a healthy balanced diet, but it's very useful to know where the fish you're eating has come from.

*This is a really sad story. Why do we need to know about it?*

Yes, it is sad. Thankfully, the cats that live and feed in Minamata today are all safe and well, and only walk in the normal forwards direction. Unfortunately there are still people affected by mercury poisoning in Minamata and in other sites across the world. The World Health Organisation considers mercury to be one of the top ten chemicals or groups of chemicals of major health concern. Land-based sources (such as agricultural run-off, discharge of nutrients and pesticides and untreated sewage including plastics) account for approximately 80 per cent of marine pollution, globally. But there are ways people can help to reduce harm for the future.

**The Minamata Convention on Mercury** is a global treaty to protect human health and the environment from the effects of mercury poisoning. Since its adoption in 2013, close to 130 countries have signed up to it. It's hoped that, over the next few decades, the treaty will help to reduce mercury pollution from human practices. In the meantime, people can:

- Educate others about the health risks of mercury poisoning, and the need to protect our planet from dangerous industrial practices.
- Promote the use of clean energy, like solar and other renewable fossil free fuels, wherever possible.
- Reduce our reliance on plastics as much as we can.

Learn more about the convention at:  
[www.mercuryconvention.org](http://www.mercuryconvention.org)





# TOURISM & TURTLES AT LOGGERHEADS

The waters around Greece and its **archipelago** aren't just an ancient history hotspot, they are also home to some awesome sea creatures. The loggerhead sea turtle (*Caretta caretta*) is a case in point. It was cruising around the Aegean Sea long before Socrates was even a hatchling. Sadly though, these shell-dwelling creatures are now listed as **vulnerable**.

## A RELIC FROM THE PAST

Loggerhead turtles are positively ancient. They've been around since the **cretaceous period**. Their shells feel like wet rock. They have soft, bumpy necks, and flippers. Their **carapace** (shell) can measure up to 1 metre in length and an average-sized adult can weigh up to 150 kg – that's about the same as 23 Pepes. They (the turtles, not the Pepes) are generally solitary animals, but they do come together for migration and to breed.

Loggerheads are found all over the world. They play a central role in the food chain, participating in the health of the oceans in ways that may not seem immediately obvious. You see, each turtle is like a travelling reef; plants and animals attach to their shells. The turtles give these hitchhikers a safe place to live and an easy way to travel to other parts of the ocean.

## A PLACE TO GROW

Loggerhead hatchlings love the calm, warm waters of the Mediterranean, especially around the Greek islands, and many ride there on the ocean currents and use the inlets and bays as a place for **maturation** – it's a





(relatively) safe place to grow and learn all there is to know about a life at sea. Islands such as Crete are important destinations for female loggerheads to nest. However, these prime nesting areas are also popular tourist destinations. Sometimes turtles and tourism conflict.

*Why's that? Surely it is great for tourists to see loggerhead turtles in action? Ed*

Yes, **responsible tourism** can be a great way for humans to interact and learn about other living creatures but sometimes, quite without realising it, we can also hinder the natural process that creatures like loggerheads need in order to survive.

*How can my holiday in Crete affect turtles? I may have a picnic and make the odd sandcastle, but that's pretty much it. I'm there to relax. Ed*

### FUN FACT TRUMPET

Sea turtles have projections in their throats called *papillae*. They use these to trap their food so that they can burp out the excess salt water. Ingenious!

## BEACH POLLUTION

Beach pollution can be a major obstacle for nesting females and loggerhead hatchlings. If a beach is polluted the female may decide not to lay her eggs there. Instead she might end up laying them somewhere even less suitable. If she *does* lay them, once the eggs hatch, the tiny hatchlings may struggle to get past obstacles such as sandcastles and crisp packets. They may be unable to make their way quickly to the ocean. Even sun-loungers and beachfront lights can be problematic, causing the hatchlings to become disorientated. And it's not just baby sea turtles that can be affected by rubbish, adult loggerheads have been known to mistake floating plastic bags for a tasty jellyfish meal.

### FUN FACT TRUMPET

Males never return to land after they enter the ocean as hatchlings.

The best thing we can do as tourists is to leave beaches as we find them (or cleaner). Take your rubbish home and flatten any sandcastles before you leave.

*In addition to individuals like you and me acting responsibly when on holiday, what else is being done to protect loggerheads?*

## WORKING TOGETHER

Around the world, organisations such as WWF work globally and with specific countries to protect marine turtles. Greece has its own organisation, called ARCHELON, which forms part of the international strategy on sea turtle conservation. Since 1983 they have been protecting sea turtles and their habitats in and around Greece. Monitoring and researching behaviour, restoring habitats and raising public awareness, as well as rehabilitating sick and injured turtles.

In many coastal destinations, from Greece to Grenada, Costa Rica to California, there are organisations that offer people the chance to volunteer with sea turtle **conservation projects**. This allows people to get involved in monitoring, nest protection and public awareness activities, whilst experiencing some of the world's best beaches. Hopefully with everyone from individual holidaymakers to governments and businesses working together, marine turtles like the loggerhead will increase in number once again.

### FUN FACT TRUMPET

Nesting females appear to be crying while they are out on the beaches, this is actually excretion of excess salt through a salt gland.

## LOGGERHEADS IN CAPTIVITY

The Deep Aquarium in Hull has two loggerhead sea turtles – Sensa and Mabouche – that were rescued from the Mediterranean Sea after losing their lower jaws as a result of being caught on a **longline** (a commercial fishing technique). In addition, Mabouche has some healed damage to her shell where she was hit by a boat propeller, resulting in nerve damage to her back flippers. To help her rebuild her strength, Shoshana Levine and her team at The Deep carry out 'sea turtle aerobics'. Keepers offer up resistance so that Mabouche has to push against them, using her flippers as much as she can! Unfortunately, Sensa and Mabouche can never be released back into the wild. Their injuries mean they would not be able to fend for themselves.





# MAN'S BEST FRIEND

Have you ever watched your family dog snoozing the day away – twitching and even barking in her sleep? Perhaps she is dreaming of the ancient past, when her ancestors had responsible jobs working for their human families?

Today, dogs come in all shapes, colours and sizes but they are all closely related to the wild ancestral wolf *Canis lupus*. Historians and scientists believe that 100,000 years ago wolves were following human tribes, scavenging for leftover food. Humans soon realised that, far from being a pest, the wolf's superior sense of smell and hearing could actually lend the tribe an advantage.

This was the start of a unique partnership that benefitted both species. While wolf-dogs guarded livestock and helped with hunting, humans were granted time to develop practical and technical skills in other areas. Some people think that human history may have progressed quite differently if dogs and humans had never joined forces.







## FIDO FACTS

– Can dogs smile? Some dogs mimic their owners' smiles, pulling back their lips in a toothy 'welcome home' grin. But if an unknown dog bares his teeth or stares hard at you watch out! It is probably afraid and might snap.

– Dogs have super-charged senses, their sense of smell is 10,000 times better than ours. They can 'smell' and detect illnesses, sniff out drugs and find people buried deep under the rubble after earthquakes.

– Like other animals, dogs can hear and feel the vibrations of approaching storms long before we can.

– Ancient Inca tribes even used dogs as cosy hot water bottles on cold nights.

– Heroic dogs have been trained to work for us in wartime, but most special are the ordinary mutts who risk everything to save their human from drowning or from burning buildings.

– Apparently your best friend can sense Earth's magnetic field, say researchers, who report that dogs align themselves with the Earth's magnetic field before pooping, preferring to face either north or south before doing their business!

*(I am going to check this on Pepe's next stroll!)*

Why not take a compass out on your next dog walk? We'd love to know if this is true.

*(Just don't forget to clean up after your pooch! Ed)*

Scientists all over the world are arguing about when and where dogs were first domesticated. Some think it happened in Europe and others that it was in Central Asia or China, sometime between 18,000 and 32,000 years ago. Gradually, and over many generations, humans began to select and breed dogs to enhance their special talents. Some were bred to retrieve waterfowl, others to herd and guard livestock. Powerful mastiffs protected cattle from large predators.

But early humans didn't domesticate dogs only to put them to work. Around 14,000 years ago, in Northern Europe, a little dog was buried in a grave along with two humans. This indicates that the dog was a companion – it was loved and cared for as a valued pet.

Perhaps it's not surprising that the dog became man's best friend, after all, wolf packs have similar social structures to human families. Dogs are the only animals that have developed the ability to read human facial expressions as well as we can. They can pick up on important clues from our tone of voice and they read human body language. Dogs appear to understand many human emotions, but we still know remarkably little about how, why and when these animals first became part of the human experience. Sniffing

out the whole truth is going to take a lot more digging.





# NOT JUST FOR CHRISTMAS:

## THE VICTORIANS AND ANIMAL RESCUE

It's true, of course: 'A dog is for life, not just for Christmas'. Those cuddly balls of fur will need feeding, exercising, training and grooming for years to come. Sadly, some people still forget that. Or perhaps they realise it, but for some reason or another, are unable to go on caring for their pets. These days, owners can take their pets to animal shelters where they have every chance of being rehomed. But that wasn't always the case.

### ROYAL AFFECTION

The most famous animal shelter is also the oldest. Battersea Dogs & Cats Home was founded in Victorian times, when people began to think seriously about how we treat animals. Queen Victoria herself treasured her pets. She had many during her long reign, from her childhood companion Dash, a King Charles spaniel, to her favourite little Pomeranian, Turi, in old age.

### DICKENS' DUTIFUL DOGS

Charles Dickens was already thirty years old when he got his first dog, Timber, but after that he always had dogs, sometimes several together. Once he got frostbite from walking a long way in the snow, and instead of bounding ahead in their usual lively way, his dogs Turk and Linda walked slowly and anxiously beside him as he limped home. He was deeply touched. It is hardly surprising, then, that he did

something to help the many stray dogs that roamed London's streets.

As well as writing novels and Christmas stories, Dickens ran a popular weekly magazine called *All the Year Round*. One of the articles for the week of 2 August 1862 was entitled 'Two Dog Shows', and it compared a fashionable dog show held in Islington, north London, with a not-so-fashionable dogs' home, recently founded in nearby Holloway. At the 'Monster Dog Show' more than a thousand dogs were displayed (including a whole pack of foxhounds, according to *The Times* of Saturday 2 August), and the writer saw many 'beautiful and rare animals', looking comically proud when they won prizes. But at the refuge there were only 'the Lost Dogs of the Metropolis ... poor vagrant homeless curs', picked up from the roadside where they were dying of starvation.

Like other contributions, the piece was anonymous, and, for many years, readers felt sure that Dickens had written it himself. It was great publicity for the dogs' home.

### T'RIFFIC TEALBY

In those days, not everyone thought it worthwhile to help strays. They thought the police should take them away and deal with them (you can imagine how)! But Mary Tealby, the middle-aged woman who had started the Holloway refuge in 1860, felt differently. After seeing a friend tending to an abandoned puppy, she found a nearby stable yard where she could take such dogs, feed them and bring them back to health. Sometimes, they were just lost. Seeing advertisements for the refuge, their owners arrived and were overjoyed to be reunited with their pets. More often, Mary was able to settle her dogs with new and loving owners.

Thanks to continuing publicity, support grew. After all, the RSPCA had been founded as early as 1824, and attitudes to animals were changing. Other important people, like Emily Tennyson, sister of the great poet Alfred Lord Tennyson, came forward to help. Before long, there were just too many dogs for the small stable yard. So in 1871 a larger space was found on the south side of London, at Battersea.







From now on the home would always be associated with this new place. In 1874, John Hollingshead, the journalist now thought to have written the original article in *All the Year Round*, commented in a collection of his own stories and essays, 'This charitable refuge for lost and starving dogs is now a permanent London institution'.

### ROYAL APPROVAL

In 1885, the Battersea home began taking in cats, too. Not long afterwards, in December 1885, Queen Victoria gladly agreed to become its patron. According to *The Times* newspaper of 22 February 1990, in 1896 alone, 42,614 animals were taken in, and by the end of the 20th century as many as 70,000 visitors a year were coming to see the pawed patrons!

The article in *All the Year Round* had praised the home as an 'extraordinary monument' to English people's affection for dogs. It also became a monument to the particular individuals involved in its history, from kind-hearted, hard-working Mary Tealby, to Dickens and Hollingshead — who never stopped campaigning for it, describing it in 1895 as 'an old and favourite asylum of mine'. Following Queen Victoria, our own queen, Elizabeth II, became a patron of the home in 1956.

Battersea Dogs & Cats Home is now very different from the original stable yard, with centres in Berkshire and Kent as well as in Battersea. Thanks to public support, the animals have comfortable quarters, and all the attention they need until they can be taken into new families. Not just for Christmas, of course, but for years of companionship and pleasure — which will more than repay the care they require!

You can explore the homes for yourself at

<https://www.battersea.org.uk/about-us/visit-us>, see some dogs ready for adoption at <https://www.battersea.org.uk/dogs/dog-rehoming-gallery>, and learn about 'kitten season' at <https://www.battersea.org.uk/cats/kitten-season>

### FUN FACT TRUMPET

'Not just for Christmas' is a slogan created exactly 40 years ago, in December 1978, by Clarissa Baldwin, CBE. She was made a 'Commander of the British Empire' for her lifelong devotion to animal welfare.







# SUGAR GLIDERS



**What's sweeter than a jar of honey, weighs less than a cup of flour and thinks leaping through the canopy is a piece of cake? It's the sugar glider!**

Sugar gliders are pocket-sized mammals native to Australia, New Guinea and parts of Indonesia. Like many other mammals from this region they are **marsupials**, giving birth to tiny babies which develop inside a pouch on the outside of the female's body. Kangaroos, wombats, koalas and Tasmanian devils are all marsupials, although, in appearance, sugar gliders look more like flying squirrels that are found in other parts of the world.

## ACROBATS OF THE AIR

In the wild, sugar gliders live in rainforests and bushland, moving expertly through the trees as they search for their favourite foods – tree sap and nectar. Their love for the sweet sticky stuff gave sugar gliders their common name, although they actually have a varied

diet – insects, pollen, fruits and sometimes even small birds and lizards are all on the menu. Their food choice mainly depends on what's seasonally and locally available. The scientific name for sugar gliders, *Petaurus breviceps* (meaning short-headed tightrope walker or acrobat) references their skilful movement in the treetops, with little need to ever visit the ground below.

One of the most remarkable things about these mini marsupials (and another reason for their common name), is their ability to glide over 50 metres – about half the length of a football pitch – using flaps of skin joining their front and back feet on each side of their bodies. This membrane, called a **patagium**, extends from the fifth digit of the front foot to the first digit of the back foot. It works like a parachute

and allows the sugar gliders to leap from danger or towards their next sweet treat. As they spread their limbs, their long tail acts a bit like a boat rudder. They can also move their legs to adjust the patagium, and steer towards their preferred direction. Unlike birds, they can't flap to make themselves go higher, so being able to judge distances is essential!

## FUN FACT TRUMPET

A sugar glider can use its tail to carry twigs and leaves, but it is not strong enough to swing from.





## DOUBLE TROUBLE

During the day, sugar gliders snuggle together in groups in hollow areas of trees, but by night they are up and active. Their huge, wide-set eyes are a useful **adaptation** for **nocturnal** life and help them to spot predators such as owls, cats and large lizards. As well as searching for food, night-time activities include finding leaves to line their nests, social grooming, playing, and marking territory and each other using **scent glands**.

You might be wondering what could possibly be sweeter than a sugar glider? A baby sugar glider perhaps? What about two? It is very common for a female to give birth to two babies, called **joeys**, at the same time. Although you'd be forgiven for thinking they look a bit strange. Sugar glider joeys are actually around the size of a grain of rice (*how many grains of sugar would that be? Ed*) when they make their way into their mother's pouch, using just their sense of smell to guide them. They have no fur and their eyes aren't yet fully developed or able to open, so the pouch is a safe place to spend the next two months as they grow.

# A PERFECT PET?

Their adorable faces (*seriously, have we mentioned how cute they are?*), awesome gliding skills and playful nature make sugar gliders appealing as pets. However, many animal welfare organisations warn against this, and for good reason. In fact, in some countries such as parts of Australia and the USA, it's illegal to own them as pets. A special licence is required for ownership or breeding. Unlike dogs and cats, which have been **domesticated** for thousands of years, wild animals like sugar gliders are not generally suited to life in a standard home. Although they are small, they need a lot of space to express their natural behaviours, like climbing and gliding. They are highly sociable, preferring to live in groups that replicate the colonies they would be part of in the wild. If kept alone, they can become lonely and destructive, not to mention that the noisy nocturnal activity of a group of sugar gliders can be disruptive when you're trying to sleep! Special care also needs to be taken with their diet – they can become ill or **malnourished** if they're not fed the correct balance of food.

Despite threats from the exotic pet trade in some areas, and the destruction of parts of their habitat due to agriculture and sometimes bush fires, sugar gliders are not considered to be endangered in the wild. It's not all good news though. Unfortunately, it's recently been reported that they *are* contributing to the decline of another species. The critically endangered **swift parrot** breeds in Tasmania, an Australian island to the south of the mainland. Tasmania was free from sugar gliders until the early 1800s when it is thought they were introduced by humans. The gliders eat the female parrots on their nests, as well as their chicks and eggs. Situations like this are a real challenge for conservationists – **what do you think the solution could be?**



## FUN FACT TRUMPET

**How are you similar to a sugar glider?** As well as being mammals, sugar gliders have opposable thumbs like humans. This helps them grasp trees as they climb and pick up food and nesting materials!



## LEONARDO BRAINFEDERS SOLUTIONS

How did you do in Brainfeeders this month?  
Find out here:

### QUICK LEO QUIZ

1. A
2. C
3. C
4. B
5. True
6. C
7. True
8. B
9. A
10. C

### RIDDLE ME THIS

1. Helicopter
2. Diving suit
3. Tank

### THE LAST CUPPA

Answer: The heirs swap hedgehogs

### YOU'VE BEEN FRAMED

You need to make 28 frames

### WORD MORPHS

CODE  
CONE  
CONK  
COOK  
LOOK

### WOOL

WOOS  
WOES  
DOES  
DYES

### CITY

CITE  
RITE  
RULE

### PRUDENZIA'S PIZZA PUZZLE

7 people 51.43°



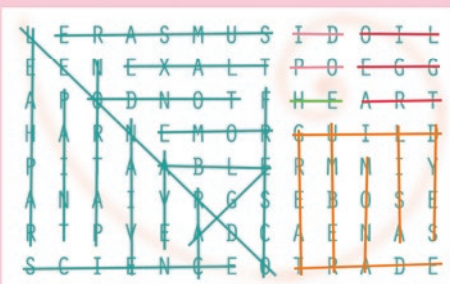
9 people 40°



11 people 32.7°



### WENAISSANCE WORD SEARCH



The significant sequence is the Golden Ratio.

## CATS BRAINFEDERS SOLUTIONS

How did you do in Brainfeeders this month? Find out here:

### QUICK CATS QUIZ

1. B
2. B
3. A
4. A
5. B
6. C
7. B
8. True
9. C
10. True

### CATSPHASE

1. Copy Cat
2. Vacation
3. Scatter
4. Alley Cat
5. Cool Cat

### CAT NAPS

Jenkins sleeps for 83% of the day.



- A. Phillip
- B. Fynton
- C. Celia
- D. Ian
- E. Precious

Fynton would not be eaten, as he would wake first and have a chance to run away!

### WORD MORPHS

LAND  
LEND  
FEND  
FEED  
FEET

LION  
LOON  
LOAN  
ROAN  
ROAR

FOAM  
FORM  
CORM  
CORE  
COME  
HOME

### KITTENAGRAMS

A HERB AGE  
Bagheera

PUTTERBUC  
Buttercup

C. HATCHERIES  
Cheshire cat

CHOKO SNARKS  
Crookshanks

R. FAIREST  
Firestar

HE HANKERS  
Shere Khan

### ROARING RIDDLE

The answer is **pride**.

**THE CATS IN THE HATS**  
Bellamy is wearing a fez.

**Luke Skywhisker** is wearing a trilby.

**I. Clawdipuss** is wearing a spring bonnet.

**Delilah** is wearing a top hat.

## SCIENCE OF LIGHT BRAINFEDERS SOLUTIONS

How did you do in Brainfeeders this month? Find out here:

### QUICK LIGHT QUIZ

1. A
2. B
3. B
4. C
5. B
6. B
7. A
8. FALSE
9. A
10. C

### PESKY POSER

Switch on 1 and 2, leave for 5 minutes then switch 2 off. Go upstairs and inspect the bulbs. The bulb that is lit is controlled by switch 1. The bulb that is off, but hot to touch, is controlled by switch 2. The bulb that is off and cold, is controlled by switch 3.

### LASER MOUNTAIN

Bucky is the first to conquer Laser Mountain.

### FOUR FANTASTIC PHYSICISTS

STAR IS A NEW COIN  
*Sir Isaac Newton*

LEAVE IT THEN I WANT STAR  
*Henrietta Swan Leavitt*

TELEVISION VS MR HELP  
*Vesto Melvin Slipher*

TIPPLED SIR ANCHOR  
*Christian Doppler*

### WELL-LIT WORD MORPHS

STAR  
SEAR  
HEAR  
HEAT

There may be more than one way to solve these.

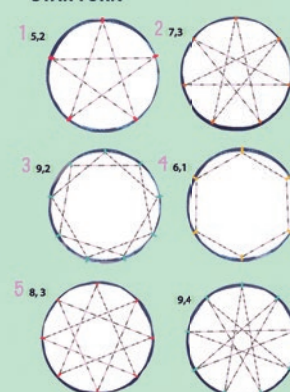
MOTH  
MOTE  
MORE  
FORE  
FIRE

CONE  
CONS  
DONS  
DOES  
DYES  
EYES

### HERE'S LOOKIN' AT YOU

T T F W I N F R A R E D B S T  
C R O A F I X L I G H T R M C  
A O C V L A S E R E O N A S E  
R U V E A I J B Y H I O I I L  
F G S E K J Q P O G Z F N R F  
E H L L I D K X F A M P M P E  
R V C R A Z R C O M M I D U R  
W R O D S T G L E N L E N S V  
R H D I P S W M Y R E E S T S  
A S V E Y E J B Z Y A D N R P  
I H O D P S C X D Q O A C E E  
N A P B D B X R N E L E O T C  
B D T E A U R A E R E R N I T  
O O I A R L A T O I A I E N R  
W W C M K B Y S N F P W S A

### STAR TURN



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