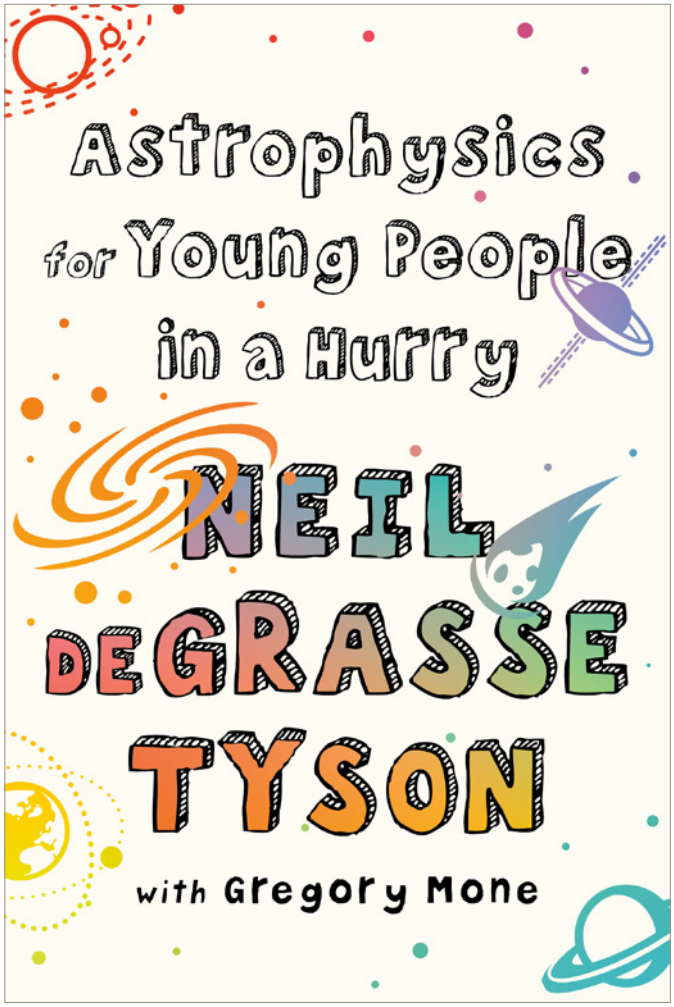
# ASTROPHYSICS FOR YOUNG PEOPLE IN A HURRY

## Pupil activity sheet

CENTRE *for* INDUSTRY EDUCATION COLLABORATION

This is one of a series of six activity sheets to use alongside the books which have been shortlisted for the Royal Society Young People's Book Prize 2020.




"At least once a week, if not once a day, I hope you take a moment to wonder what cosmic truths lie undiscovered before us."

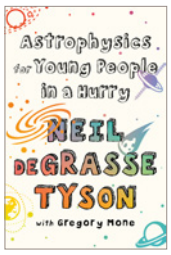
***Astrophysics for Young People in A Hurry***

Learn about the mysteries and discoveries that help scientists, like astrophysicists, think about the universe in the incredible *Astrophysics for Young People in a Hurry* by Neil De Grasse Tyson.

### Seeing is believing

If you look up at the night sky, you may see the moon, stars and even distant planets. Some of these objects may be millions of miles away. It is amazing what can be seen with your eyes!

Our eyes do have limits though. There are tiny, microscopic things close by and things very far away that we are unable to see without help. Useful tools, like magnifying glasses, microscopes and telescopes magnify objects so we can see them.




# Astrophysics for Young People in a Hurry

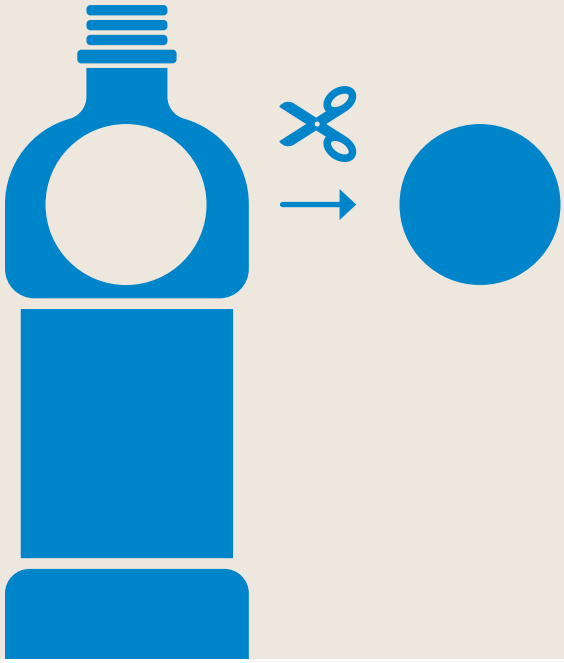
## Pupil activity sheet (continued)

### Make a simple magnifying lens

Magnification means making something appear bigger without actually changing its physical size. Magnifying tools use special lenses which are curved outwards (convex) in shape. These lenses bend light as it passes through and increases the size of the image that is sent to the eye.

To build a simple magnifying glass, follow the steps below.

1. Draw a large disc on the round part at the neck of a clear plastic bottle.
2. Ask an adult to help you to cut this out.
3. Pour a little water onto the disc.
4. Hold it over an image or writing to make this appear bigger, just like using a magnifying glass.



### Recording observations

In 1609, Italian astronomer, Galileo Galilei, designed his own telescope which could magnify objects 20 times. Galileo was the first to point a telescope to the night sky and examine the Milky Way as well as mountains and craters on the Moon. He also discovered the rings of Saturn, sunspots (on the Sun) and four of Jupiter's moons.

Like all great scientists, Galileo recorded his observations. He used ink to draw what he saw of the Moon through his telescope. These are the first telescopic observations of an object in outer space.

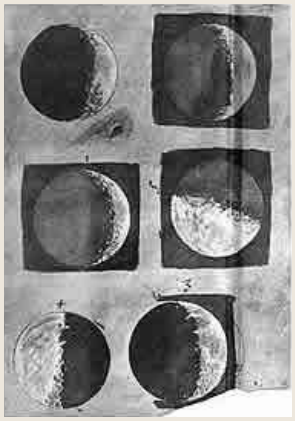
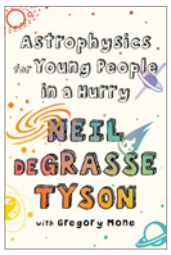


Image credit: NASA.

### Looking to the sky at home

If you have binoculars or a telescope at home, use them to look as far as 250 000 miles away at our nearest neighbour in space, the Moon. Keep detailed drawings of your observations, like Galileo. You could use secondary sources, such as a moon map, to help you to locate and identify different features of the moon.

Can you find where Apollo 11 landed in 1969 and the area where Buzz Aldrin left his boot print?




# Astrophysics for Young People in a Hurry

## Pupil activity sheet (continued)

### Mathematics challenge:

It's astronomical!

Scientists decided that metres and kilometres are too small for measuring distances throughout the solar system so they created a new unit of measurement called the astronomical unit (AU).

1 AU is the average distance between the centre of the Earth and the centre of the Sun (150 000 000 km). This means that we can calculate other planets' AU value by dividing their average distance from the Sun (km) by 150 000 000.

Complete the table (right). Some numbers are provided, but you will need to research the rest before you start your calculations. And you'll need a calculator too.

| Planet | Average distance from the Sun (km) | Average distance from the Sun (AU) |
|---|---|---|
| Mercury | 58 million km | 0.4 AU |
| Venus | | |
| Earth | 150 million km | 1 AU |
| Mars | | |
| Jupiter | | |
| Saturn | 1429 million km | |
| Uranus | | |
| Neptune | | |

### Did you know?

When looking beyond our solar system, the AU is too small. Scientist have created an even LARGER unit of measurement called the light year. This is the distance light can travel in one year. When we study a galaxy five billion light-years away, this means that it took five billion years for the light to get here. In other words, we are seeing that galaxy as it was five billion years ago.

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# Astrophysics for Young People in a Hurry

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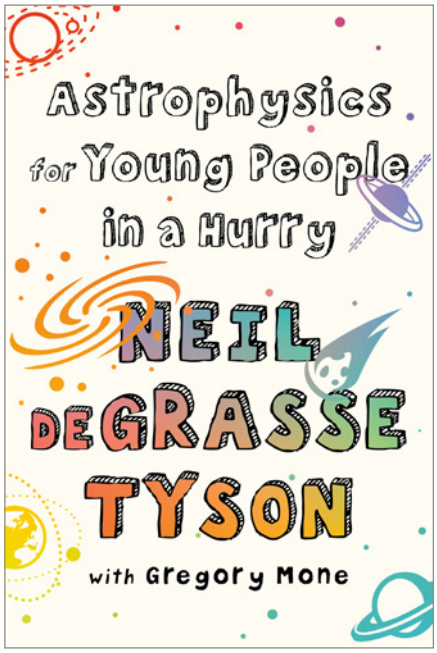
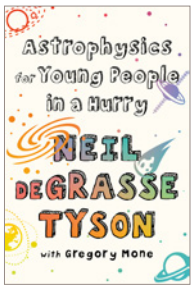
### What is physics? Is physics for me?

In 2007, researchers at the Institute of Physics produced the report *Public Perceptions of Physics* which showed that whilst the majority of adults (78%) agree that physics makes a valuable contribution to society, 46% could not answer the question "what do physicists do?"

As you work through these activities, make sure pupils understand that the rewards of studying physics can be huge and how being a physicist can make a real difference to people's lives and improve our future, for example: space travel, cars, electricity, esports games and animation.




# Astrophysics for Young People in a Hurry

## Teacher activity sheet (continued)

### I'm spinning around

Find out if your pupils are brave enough to investigate the force that helps keep satellites in orbit around a planet in space.

1. Use an undamaged bucket with a strong handle and half-fill this with water.
2. Stand outside in an open area, well clear of people and other obstacles.
3. Hold the bucket by its handle with your arm extended and start spinning it by your side towards the sky and back to the ground in a circular motion. Make sure to spin it fast enough to keep the water inside the bucket.
4. Stop spinning and carefully bring the bucket back to rest on the ground.

Pupils should find that if they swing the bucket fast enough the water will stay in the bucket and this is a great way to explain something called 'circular motion'. The water wants to fly off from the circle, but the bucket gets in the way and keeps it in place. This is the same effect you feel when you ride on roller coasters or go around a tight corner in the car.

#### Note for teachers

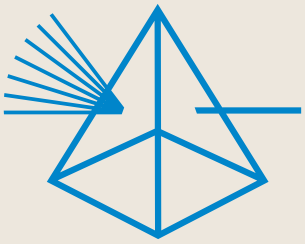
Learning about forces felt when spinning around might lead to confusion over definitions of more complicated scientific vocabulary which you may prefer to avoid in the primary age phase. Essentially, for an object moving in a circle, centrifugal force is the apparent force outward on the object and centripetal force is the inward force on the object. Both work together to keep that object moving at a steady speed in a circular path.

### Who is Roy G. Biv?

As pupils read the book and complete activities on the pupil sheet, they will develop an awareness that every bit of information a telescope delivers to an astrophysicist comes to Earth on a beam of light.

In the 1600s, Sir Isaac Newton, discovered that white light is made up of lots of different colours. He placed a glass instrument called a prism in the path of a sunbeam and separated light into the familiar seven colours of the rainbow we know today. Roy G. Biv is not a person, but rather a memory aid used to recall the order of the colours of a rainbow: red, orange, yellow, green, blue, indigo and violet. You can read more about this on page 122.

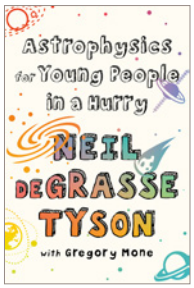
Pupils can investigate this phenomenon by:



1. Placing a piece of plain white paper on the ground under the sunlight.
2. Putting a prism on or above the paper.
3. Moving the prism around until you see rainbow colours on the paper.
4. Holding the prism at different heights and angles to see if it has a different effect.

If you do not have prisms in school, pupils could investigate alternative ways of splitting white light to 'make rainbows' using simple equipment such as a CD or glass of water and a mirror, plain paper and a torch.

**Keeping safe**: Adult supervision is vital in experiments involving sunlight. Do not look directly at the sun or at the reflection of the Sun in a mirror.




# Astrophysics for Young People in a Hurry

## Teacher activity sheet (continued)

### Research like a scientist

Amazing telescopic inventions allow scientists to explore the distant reaches of the universe. Pages 125 – 131 describe just some of these. Encourage pupils to find out about other important inventors and their telescopes throughout history. They could use these people, inventions and places to get them started:

**William Herschel**

**Nancy Grace Roman**

**George Robert Carruthers**

**James Webb**

**Mary Jackson**

**Maggie Aderin-Pocock**

**Jocelyn Bell Burnell**

**Annie Maunder**

**Subrahmanyan Chandrasekhar**

**Hiranya Peiris**

**Lovell telescope**

**Hubble telescope**

**WM Keck Observatory**

### Career links

If your pupils have enjoyed reading about what astrophysicists do and want to know more about careers associated with exploring space, why not suggest the following:

- **Astronomer**: use telescopes and cameras to study the universe, its objects and how it works. Astronomers also use maths and computer models to explain observations and findings to the wider public.
- **Space archaeologist**: study satellite images and research various human-made items found in space. The job also includes solving clues as to how and why these items got there as well as preserving them as important evidence in space history.
- **Astronaut**: undergo extensive training to travel in a spacecraft and carry out exciting science experiments in space. You will need to clean, check and repair equipment and even 'spacewalk' to work outside. It's a tough and dangerous job but the view is terrific!

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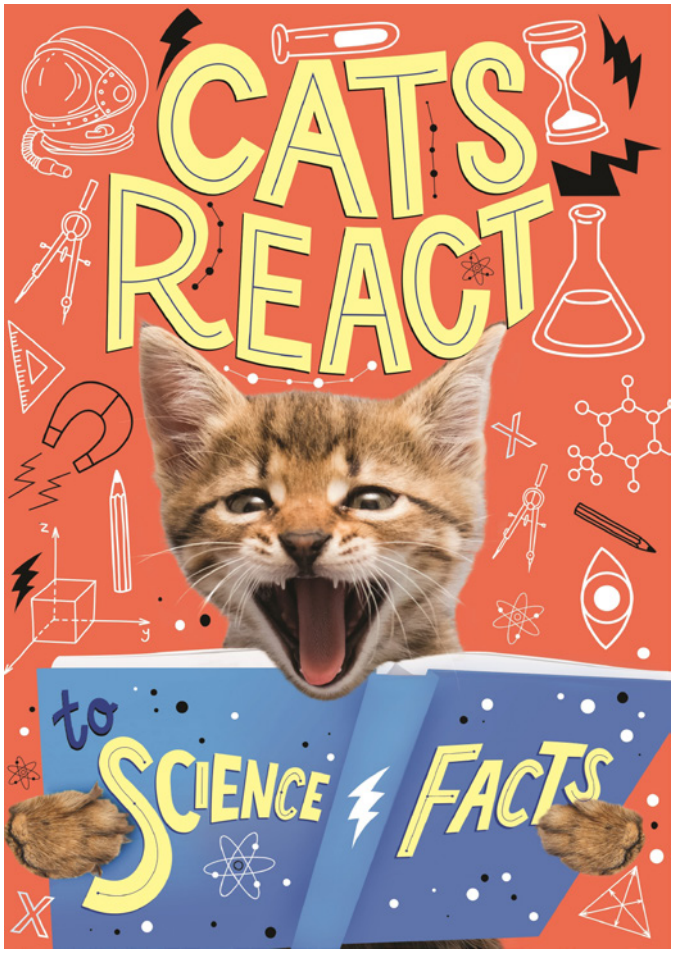
# CATS REACT TO SCIENCE FACTS

## Pupil activity sheet

This is one of a series of six activity sheets to use alongside the books which have been shortlisted for the Royal Society Young People's Book Prize 2020.

CENTRE *for* INDUSTRY EDUCATION COLLABORATION




Get ready to discover mind-blowing science facts alongside some furry feline friends with *Cats React to Science Facts* by Izzi Howell.

### What is a fact?

A fact is a statement that is known or proved to be true but how would you check to see if something is a fact or not?

#### Fact checking

Today, many people go to the internet for information but just because a statement might appear as a fact, it is important to check different sources such as books, other websites and expert opinions.

Some things to think about are:

- Has the same fact been reported by other sources?
- Who is the author and do they write about this topic often?
- How long ago was this published?
- Can this be backed up with evidence (careful observation or measurement)?

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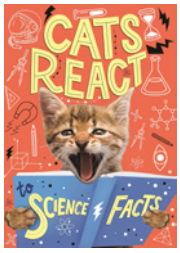
"A bolt of lightning contains enough energy to toast 160,000 pieces of bread!"

***Cats React to Science Facts***




# CATS REACT TO SCIENCE FACTS

## Pupil activity sheet (continued)

### Incredible facts

Here are some incredible facts from the book:

The loudest known sound ever was the eruption of the Krakatoa volcano in Indonesia in 1883. (p31)

A cricket's ears are on its front legs. (p35)

Pancakes are always round because of gravity pulling down on the batter evenly, making a circular shape. (p45)

The peregrine falcon's streamlined shape allows it to move over 300km/h which is as fast as a Formula 1 car. (p49)

Pure water is an electrical insulator but tap water is an electrical conductor. (p79)

Create a poster or presentation to show how you have been able to check these facts to see how accurate they are. Use the checklist on page 1 and think about what investigations you might carry out in order to gather your own evidence.

### Mini experiment: Fantastic freezing

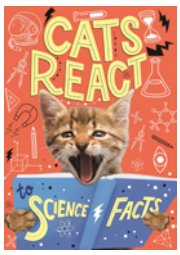
Did you know that hot water can freeze faster than cold water?

This does seem to be surprising as we know that hot water takes longer to cool down than cold water so how could it possibly freeze faster? That is something that has even baffled scientists – in fact, they're still working hard to collect evidence to prove the effect exists in the first place.

What could **you** do to collect evidence that hot water freezes faster than cold water?

- Think about:
- What will you need?
- What will you do?
- What evidence will you collect? What will you measure?
- What safety rules will you follow?
- Does your evidence support the scientific theory or not?

You may find that your experiment needs to be repeated with greater accuracy, it is also possible that unusual results can lead to more questions and further investigations.




# CATS REACT TO SCIENCE FACTS

## Pupil activity sheet (continued)

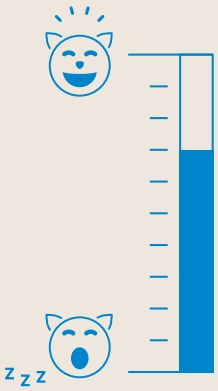
### Mathematics challenge

What type of graph would you choose to show the time taken for a sample of hot water to freeze compared to the same size sample of cold water? Use the space below to draw and label your axes. You could have a go at estimating a set of data and recording it on your graph.

### Fact gathering at home

Think about an area of science that you find interesting. This could be anything that interests you, from rocks, through teeth, to black holes.

Research some amazing science facts about your chosen topic. Remember to check a number of different sources and include facts that have scientific evidence to back them up.




Using the facts you have collected, create a Cats React to Science Facts style page for your chosen topic. Try to include a 'react-o-meter' to rate the scale of your facts and a 'claw-ssary' to explain the meaning of any new or tricky scientific words.

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# CATS REACT TO SCIENCE FACTS

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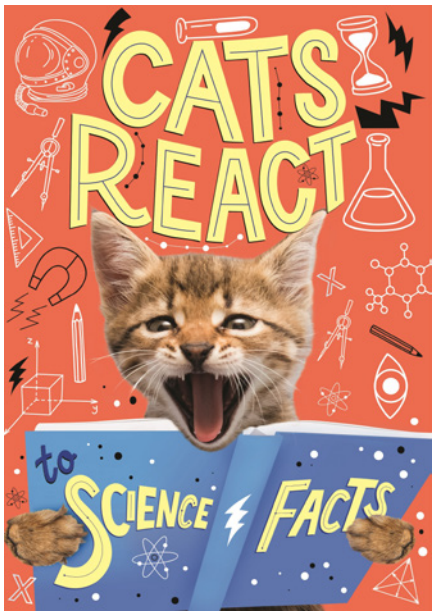



### Light sources

Page 18 contains a number of purrrfect facts about natural and artificial light sources, for example:

- The Sun creates almost all of the natural light on Earth.
- Some man-made light sources, such as lamps, are powered by electricity.

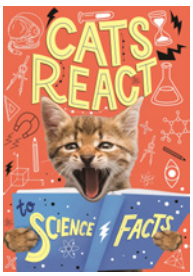
### Mini experiment:

#### To light or not to light, that is the question?

Pupils could test a range of everyday objects and categorise them into light source or not. You could use a mobile phone, aluminium foil, torch, metal spoon or electric tea light candle.

Then, to test their hypothesis, pupils could place the objects, one at a time, into a shoe box with a small hole pierced into one end. Once the lid is placed onto the box, pupils can peek through the hole to observe whether or not they can see light.

They may wish to re-sort their original choices based upon the experimental evidence (observations) collected.




# CATS REACT TO SCIENCE FACTS

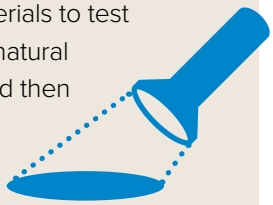
## Teacher activity sheet (continued)

### Find out more

Page 22 describes how different materials can be:

- Transparent – let light through
- Translucent – let some light through
- Opaque – do not let any light through

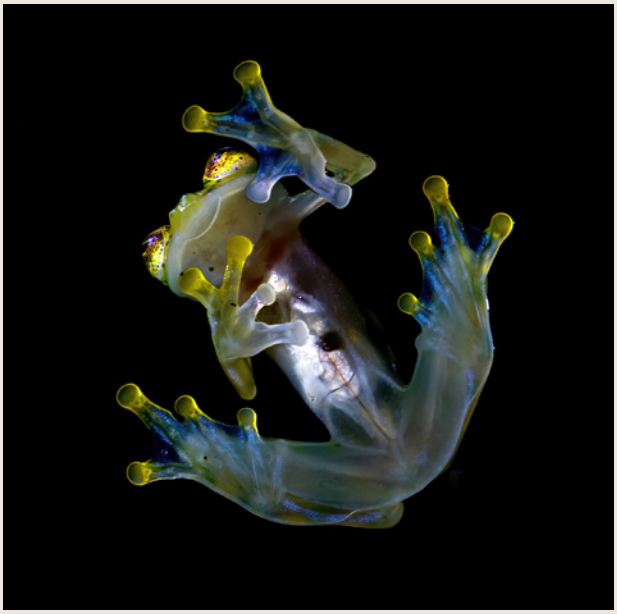
Pupils should collect different materials to test by holding them up to sources of natural light or shining torches through and then recording which are transparent, translucent or opaque.



Ask your pupils: did you collect any surprising results?

Encourage pupils to think about why we need translucent, transparent and opaque materials (for example, for different purposes).

Other than the glass frog that lives in Central and South America, can they find any facts about other living things in nature (plants or animals) that are transparent or translucent?



© Henk Bogaard

### Career links

Help pupils make the link to careers involved in gathering scientific evidence for different purposes. These could include:

- **Research scientists**: design, carry out and analyse information from their own controlled lab-based investigations, experiments and trials. They work for the government, environmental organisations, specialist research organisations or universities.
- **Forensic scientist**: collect and analyse evidence from crime scenes. They could specialise in analysing blood and DNA samples, handwriting and signatures or recovering data evidence from computers and technology.
- **Science writer**: conduct research, write and edit articles on scientific topics for many different kinds of publications, from scientific journals to popular science magazines, such as New Scientist and National Geographic.

### Shady facts

Did you know that shadows are formed when an object blocks light? Page 24 and 25 have lots more facts about shadows.

Pupils could have a go at the shadow size investigation from the Royal Society's Brian Cox school experiments found at: **stem.org.uk/resources/elibrary/resource/315603/what-factors-affect-size-shadow-shadow-theatre**

The accompanying videos show how to set up and run the investigation and also explain how shadows can be relevant to our lives through their use in X-rays and also explain how eclipses occur.

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# GUT GARDEN

## Pupil activity sheet

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"We have explored the outermost reaches of the planet, and yet there is a whole world waiting to be discovered inside our own bodies."

***Gut Garden***

Prepare to be amazed as you learn about the inner workings of your gut and the millions of microbes who share their lives with us.

### Mathematics challenge

In *Gut Garden* we learn that if you rolled it out the small intestine would measure over 6 meters. Can you estimate how far that would be?

Place an object on the floor and then place another object where you think 6 meters away is. Now measure the distance to see if you were right. Now count how many people there are in your family and work out how long all of your small intestines would be if you laid them end to end. How far do you think they would stretch?

### Getting gassy at home


Fermented food is food which has been partially digested by microbes before we eat it. Examples include yogurt, some pickles and sourdough bread. Many people believe that eating fermented food helps to promote health by introducing healthy bacteria into the gut. Why don't you have a go at making sauerkraut; all you need is 1 cabbage and a tablespoon of salt.

1. Shred the cabbage and sprinkle it with salt.
2. Put it in a bowl and pound it with a potato masher until the cabbage is covered in liquid.
3. Stuff the cabbage and the liquid into a jar, making sure that all of the cabbage is submerged.
4. Cover the jar with a tight lid and leave at room temperature for two weeks.

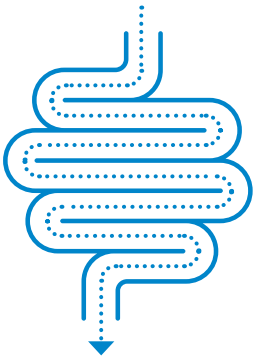
Enjoy your sauerkraut with a hot dog or salad. It will keep for some time in a sealed jar in the fridge.


# GUT GARDEN

## Pupil activity sheet (continued)

### Modelling the digestive system

Imagine that you were a mouthful of food going on a journey through your gut! What are all of the things that happen to 'you' on your way through the digestive system? Do you think that it would be possible to make a model of your journey? Here are some suggestions of things that you could use for some parts of the gut. We've left some boxes blank so that you can think about what could be used to create these.



| Part of gut and what it does | Equipment | What to do? |
|---|---|---|
| **Mouth and teeth**<br>Food is crushed here and mixed with saliva. | Example foods<br>Water<br>Pestle and mortar (alternatively the end of a rolling pin can be used with a plastic bowl) | Crush up the food to represent chewing and then mix in some water to act as saliva. (Good foods to try include Weetabix and biscuits. You may also choose to add a spoonful of chocolate powder). |
| **Throat and oesophagus**<br>When you swallow the food it passes through your throat and down the oesophagus to the stomach. | Funnel and tubing such as thin flexible hosepipe. | Pour the 'chewed up' food into the funnel and then squeeze it down the tube into the next part of the gut. |
| **Stomach**<br>Food is churned around here and mixed with digestive juices which help to break it up further. | Elastic band<br>Large rubber glove<br>Water | Squeeze the glove and mix in some extra water (poured down the funnel) so that the food begins to resemble thick soup. It is now ready for the next part of the gut. |
| **Small intestine** | | |
| **Large intestine**<br>Most of the water is absorbed back out of the food as it travels along this part of the gut. | A pair of tights<br>Elastic band<br>Disposable gloves | As you squeeze the food along the tights, much of the water will leak out through the tights so that by the end of this stage your food should thicken up and begin to resemble poo. |
| **Rectum and anus** | | |

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### Words words words

This book contains a lot of challenging vocabulary which some of your pupils may find off-putting. Encourage your pupils to compile a list of some of the more unusual words and create an image that will help them remember what each word means. Here are some to use as examples to get started.

**Microbe** A tiny life form that you can only see with a microscope. They come in all shapes and sizes and they are EVERYWHERE.

**Symbiosis** A relationship between two life forms that benefits both partners. Eg. Humans provide a place to live and plenty of food for microbes and microbes help to keep humans healthy.

**Oesophagus** The tube between your throat and your stomach.

**Peristalsis** The propelling motion that pushes food through the digestive system, for example when you swallow.

**Dysbiosis** An imbalance of the microbes living in the gut. This can lead to stomach upsets and other illness.

Here are some more words to consider:

**Saliva** **Bacteria** **Pathogen** **Antibiotic** **Fermentation**


**Example artwork:** Symbiosis (left) and Oesophagus (right).


# GUT GARDEN

## Teacher activity sheet (continued)

### Full of gas

As the book explains, bacteria in the gut break down fibre using a process known as fermentation and one of the by-products of fermentation is gas. Another microbe which breaks down carbohydrates using fermentation is a single celled fungus called yeast.

A simple way to demonstrate this is by putting a teaspoon of dry yeast, a spoonful of sugar and 200ml of warm water in a small pop bottle. Stretch the neck of a deflated balloon over the top of the bottle and then give it a shake to mix all of the ingredients up, being careful not to get them into the balloon. Watch what happens over the next 30 minutes. Where do your pupils think that all of this kind of gas goes when it is produced inside the body?

Challenge children to investigate other 'foods' instead of sugar to see if this has the same effect upon the yeast. They could try milk, ketchup, coffee, fruit juice or anything else that they can think of. Don't let them forget to predict what they think will happen before they start their investigation.



### Career links

As the book tells us, there is so much about the inner workings of our gut and microbes that is still waiting to be discovered. Different types of scientists often need to collaborate in order to help us tackle diseases such as Covid-19, for example:

- **Microbiologist**: study microbes and try to understand how they live, grow and behave.
- **Pharmacologist**: work on the development and delivery of medicines to cure and prevent disease.
- **Epidemiologist**: study the patterns of diseases in populations and use this to work out what causes them and how to prevent them.

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# IN THE KEY OF CODE

## Pupil activity sheet

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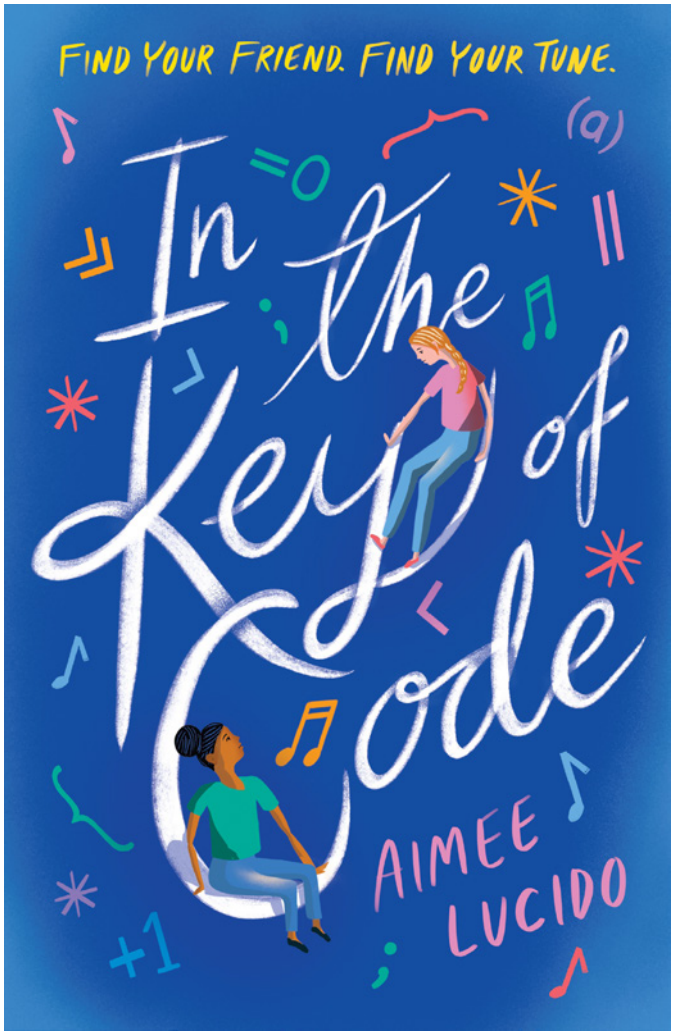
CENTRE *for* INDUSTRY EDUCATION COLLABORATION




"...this system of learning made it seem like these subjects [poetry, coding and music] were separate from one another, when in reality they are deeply intertwined."

***In the Key of Code***

In this story by Aimee Lucido we find out how Emmy becomes fascinated by the language of computer coding and learns how she can use coding in exciting and creative ways.

### Mathematics challenge

Did you know that the only language that computers can understand is binary? All of the symbols and words that are used are represented to the computer in this way. In the story Emmy gets a mysterious message written in binary. In binary the only digits are 1 and 0, so if you wanted to write letters of the alphabet as numbers instead of A=1, B=2, C=3 .... Z=26, they would be written as:

**A** = 00000001

**B** = 00000010

**C** = 00000011

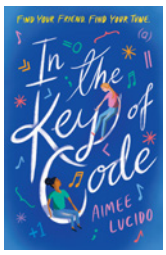
**D** = 00000100

**E** = 00000101

Can you work out what all of the other letters of the alphabet would be written in this way? Emmy received the following message written in binary:

00001101 00000101 00000101 00010100
00100000 00001001 00001110 00100000
00001100 00001111 00000010 00000010
00011001 00100000 00000001 00010100
00100000 00010100 00001000 00010010
00000101 00000101

See if you can decipher it before turning to page 330 in the book to see if you are right!




# IN THE KEY OF CODE

## Pupil activity sheet (continued)

### Coding music

Wouldn't it be exciting to use code to create music? For this activity you will need to download the free music coding software, sonic pi, onto a phone, tablet or computer.

Copy the following code *exactly* into the code window at the top of the screen and press 'run'.

```
live_loop :flibble do
sample :bd_haus, rate: 1
sleep 0.2
end
```

You have used code to tell your machine to make this sound!

Try changing the number for rate from 1 to 5 and pressing run again. What do you notice? What has changed? What do you think will happen if you change the number to 9?

Now change sleep from 0.2 to 0.5 and press run. Now what has changed? What could you do to slow the beat down? How could you speed it up?

There is a lot more to discover about music and coding; why don't you have a play with this exciting software and see what you can do?

### Looking at words

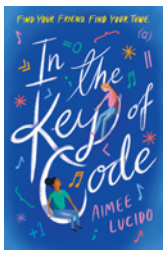
This is a book that needs to be looked at, rather than just listened to, as the way that the words are arranged on the page adds to their meaning. For example, on pages 139 and 181 you can tell who is speaking because the words are arranged in two columns, one for each speaker. On other pages the way that the words are written show their meaning. For example, take a look at the words 'surges' 'jumping' and 'disappears' on page 78.

Could you use your artistic skills to produce some words that look like what they mean? You could try some simple ones such as:

**small** **smaller** **smallest**

But others would take a bit more thought.

How, for example, would you represent the words **dissolve** and **melt**? How would they look different to each other? How would you represent **gravity** or **air resistance**? What about **evolution**? Why don't you see if you can represent some of the words from your current science topic in this way?




# IN THE KEY OF CODE

## Pupil activity sheet (continued)

### Speaking to robots at home

Algorithms are sets of very detailed instructions given to a computer. You have to be very precise when you give instructions to a machine because it will do exactly what you tell it to do and you need to break everything down into tiny steps.

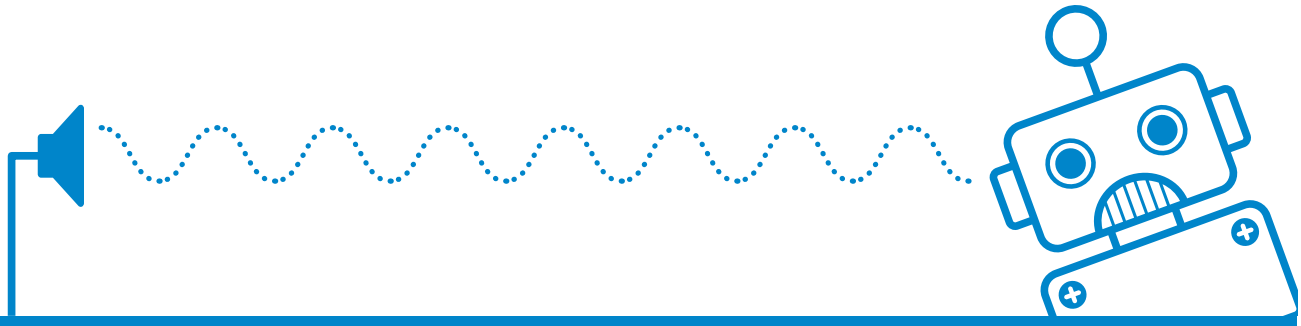
For example, if a robot was making a cup of tea and you told it to pour the water into a cup it would pour all of the water from the kettle in, as you had not told it to just fill the cup.

Try writing out some instructions for a robot to make a sandwich or to sharpen a pencil. Now see what happens if your friend or family member follows the instructions exactly as you have written them.

If anything goes wrong because of a mistake in your instructions to a computer this is called a bug. Rewriting the instructions so that they are more accurate is called ‘debugging’.

Now that you have tried them out do you need to debug your sandwich making/pencil sharpening instructions? What other activities could you write instructions for?





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# IN THE KEY OF CODE

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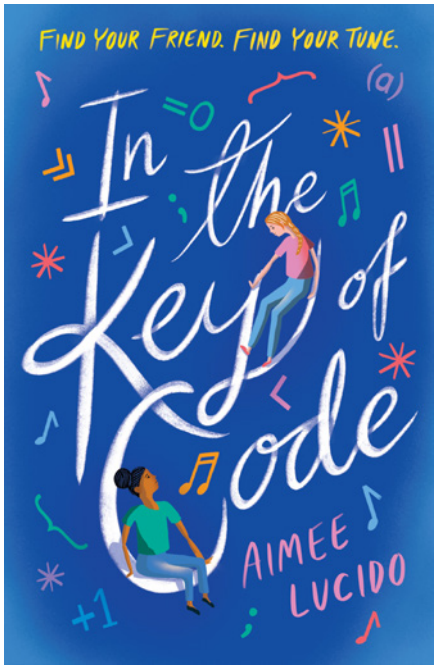


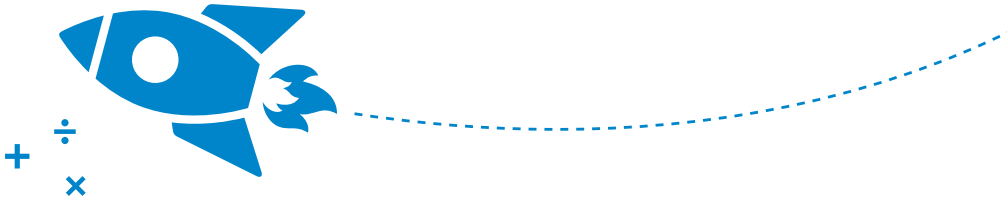

### The first computers were women

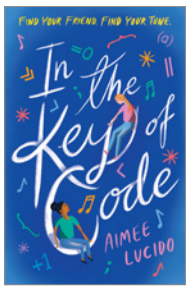
On page 160 Ms Delaney tells the girls that the first computers were not machines, but were women who performed the calculations now done by computers. In fact, when machine computers were first introduced, Alan Shephard, the first American in space, would not make the journey until the maths had been checked by one of those original 'computers', African American Katherine Johnson.

### Katherine Johnson

Katherine Johnson was born in 1918 into a world where toasters, television or Lego bricks had yet to be invented and less than twenty years after the Wright brothers made their first flights in an aeroplane. In her lifetime she not only saw the first men land on the moon, she helped to get them there!

When Katherine died on 24 February 2020, she was honoured by NASA Administrator James Bridenstine who said, "Our NASA family is sad to learn the news that Katherine Johnson passed away this morning at 101 years old. She was an American hero and her pioneering legacy will never be forgotten."






# IN THE KEY OF CODE

## Teacher activity sheet (continued)

### Mixed up subjects

We live in a culture that tends to separate different areas of learning rather than recognising the links between them. Aimee Lucido, author of *In the Key of Code* noted that, in reality, different subject areas are deeply intertwined. She combined her love of poetry, music and coding to write this book; each element contributes equally so that the whole is greater than the sum of its parts. The book is written in verse and needs to be seen on the page to really appreciate the story.

Another example of where different disciplines inform each other is the Sciku project, where practising scientists summarise their research into the form of a haiku poem. Haiku poems are written in the form of three lines with 5, 7 and 5 syllables respectively. The tight constraints force the author to distil their meaning with a careful choice of words which reinforce and illuminate understanding.

You could challenge children in your class to produce a haiku based on an element of their science or computing curriculum. See below for some examples to get them started.

**Shape of my body**
**Creates a matching shadow**
**Light can't turn corners**

**Boolean choices**
**Moving binary mountains**
**One bit at a time**

**The slower rabbit**
**Cannot out run the buzzard**
**Natural selection**

### Machine learning

Most of the technology we use today uses machine learning so that it can adapt and become more useful to the person who uses it. That is how our computer gives us advertisements for products that we have a history of buying or looking at. The sellers hope that by targeting their promotions in this way they are likely to make more sales. Why don't you look at the Royal Society machine learning quiz with your class and see how much you know about which technologies use machine learning?

### Career links

In the book Emmy learns how to program computers by using code. This is a skill which is used in many different careers, often combined with other skills such as statistical analysis or creativity. For example:

- **Data scientist**: analyses large sets of data and uses these to make predictions and provide solutions for a variety of situations.
- **Software engineer**: Aimee Lucido, the author of this book is a software engineer. Software engineers apply the principles of computer science to design and develop computer software. (You can see Aimee talking about her book here; the relevant clip starts at 50 seconds and ends at 4:00 minutes).
- **Video game developer**: combines coding and computer skills with creativity to create and build the games for computers, consoles or mobile phones.

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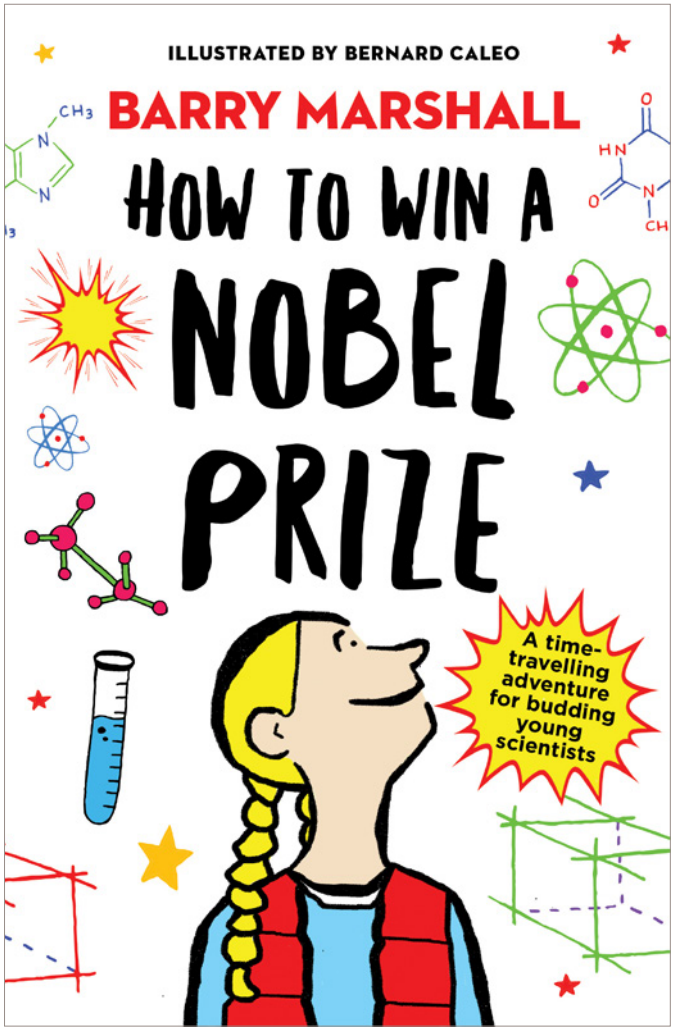
# How To Win A Nobel Prize

## Pupil activity sheet

This is one of a series of six activity sheets to use alongside the books which have been shortlisted for the Royal Society Young People's Book Prize 2020.

CENTRE *for* INDUSTRY EDUCATION COLLABORATION




In this book we meet lots of scientists who have contributed to the good of humanity and been awarded Nobel Prizes. As you read it maybe you will be inspired to think how you could use science to make a positive difference in the world.

### What is a Nobel Prize?

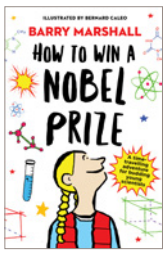
The Nobel Prize is awarded to people who have done amazing work in one of six subject areas: physics, chemistry, medicine, literature, peace and economics. Renowned scientists that have won Nobel Prizes include Venki Ramakrishnan, Dorothy Hodgkin, Marie Curie and the author of this book, Barry Marshall.

The Prize is awarded to people whose work has, in some way, greatly benefited the advancement and progress of humankind. No small feat!

**Images:** (from top to bottom) Nobel Prize winners Venki Ramakrishnan, Dorothy Hodgkin (© Godfrey Argent Studio), Marie Curie and Barry Marshall (© Sharon Smith).

"Don't waste your life chasing awards. Do the work you want to do. Then it won't seem like work at all"

***How to Win a Nobel Prize***




# How To WIN A NOBEL PRIZE

## Pupil activity sheet (continued)

### Future Nobel Prize winner

Imagine that in 60 years, you are receiving a Nobel Prize for your achievements in a field of work that you have spent your career working in. Think about what field this could be, and what you would be most proud to have achieved a Nobel Prize for.

Write a biography for yourself, as if the year is 2080, explaining what you are being awarded the Prize for and how your work has benefited humankind.

**Image:** A Nobel Prize medal.

### Writing secret messages at home

Wouldn't it be fun to write a message that no one could read – unless they knew how to reveal your secret. You can make your own invisible ink using equal quantities of baking powder and water. You can use a cotton bud to write a message to a friend which, once dry, becomes completely invisible. If your friend then paints over the message with purple grape juice concentrate or strong hibiscus tea the message will be revealed (see page 120 of the book for more details).

Another way to make invisible ink is to mix the juice of a lemon with a few drops of water and then write with it using a cotton bud. Once the writing is dry it cannot be read until your friend holds it close to a light bulb to heat it up and reveal the top secret message.

Why don't you investigate whether the recipe in the book or the diluted lemon juice works best by trying them both out? You could also try out some other liquids to see if you can discover any other secret inks!

**Safety alert:** Light bulbs can become very hot. Please have an adult supervise you while you carry out this activity.

### Mathematics challenge

Much like Nobel Prize winning physicist, Subrahmanyan Chandrasekhar, on page 105 you are challenged to use a toilet roll tube to look up at the night sky.

To start, do this in a place where there are many light sources such as streetlights, shops and car headlights. Count how many stars you can see.

Do this three or four times and calculate the average number by dividing the total number of stars that you counted with the number of times that you did this.

Next, you need to go somewhere with much less 'light pollution' such as a large park or somewhere much further from streetlights. To keep safe, make sure that you take a responsible adult with you. Again, look up at the sky through the toilet roll tube three or four times and work out the average number that you see.

Do you notice a difference? On page 107 we learn that this is because the more light there is the fewer stars we can see. During the day we cannot see any at all they are outshone by the sun. As dusk falls we see one or two of the brightest stars, the darker it gets the more stars we can see.

If you are unable to visit a place with less (or more) light pollution than where you live see if you can find another person who lives somewhere else who can do the same activity so that you can compare data with them.

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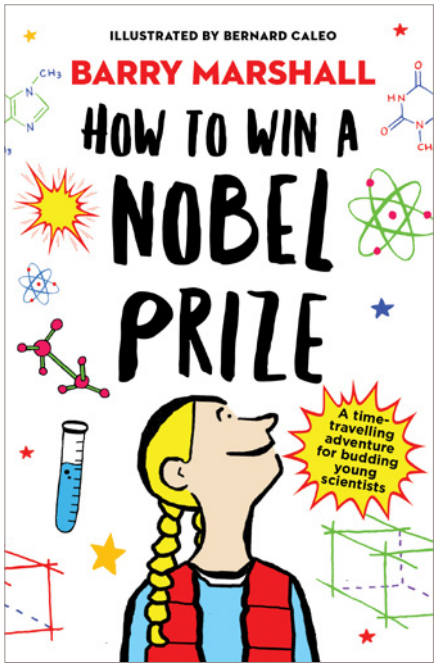
### Note for teachers

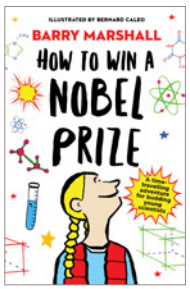
Young people often enjoy science lessons. However, they tend to think that careers in science are only for exceptional people, rather than recognising that there are a wide range of science careers open to all types of people armed with curiosity and a desire to learn about how the world works. As you work through these activities make sure that they understand that, even if they never win a Nobel Prize, they could have a STEM career if they choose to study the necessary subjects. On the other hand, although Nobel Prize winners represent a tiny fraction of scientists there is no reason why, one day, it couldn't be them.




### Radiation and plants

It can be valuable to work alongside your pupils as partners in science where you ask and seek to answer questions together. Young people are often more confident to talk about their thinking when you work collaboratively with them in this way. An experiment is described in the book which asks you to put 6 seeds from a fast growing plant in a microwave for 5 seconds and then compare how they grow with 6 seeds which have not been irradiated (see page 37 – 38 for more information).

Before carrying out this investigation, work together with your class to predict what you think will happen and to explain why you think this. After this experiment you could then consider what would happen if the seeds were irradiated for longer or shorter periods of time. You could also predict, and then test your theories, to consider what would happen if the seeds were put in the fridge or freezer for a few days.




# How To WIN A NOBEL PRIZE

## Teacher activity sheet (continued)

### Time Travel

There is a tantalising suggestion towards the end of the book that in the future Mary is awarded the Nobel Prize for inventing a time travelling device. Ask your pupils to get their thinking caps on; how do they think that time travel could benefit people? Do they think that there are any ways that time travel might be dangerous? Ask your class to imagine that they have been given the chance to arrange just *one* time travelling journey. Where should they go to create the most benefit to mankind? Pupils could explain their ideas to the rest of the class before voting on where their journey should go.


© ColobusYeti

### Career links

The Nobel Prize is awarded to people who have contributed to the benefit and advancement of humanity. The following careers are just some of those that might qualify, can you and your students think of anymore?

- **Crop scientists**: work to improve the quality of the food that we grow, for example by breeding disease resistant plants with higher yields.
- **Virologist**: can work as doctors, or research scientists, or both. They work to find out about viruses, how some of them can cause illness and how they can be controlled.
- **Materials scientist**: research the properties of materials and develop exciting new materials for different uses.

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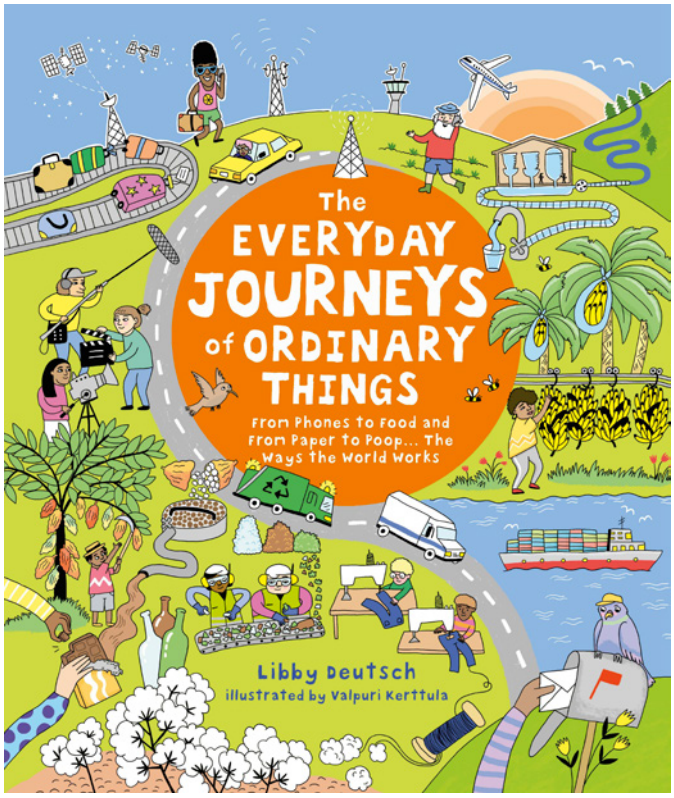
# THE EVERYDAY JOURNEYS OF ORDINARY THINGS

## Pupil activity sheet

CENTRE *for* INDUSTRY EDUCATION COLLABORATION

This is one of a series of six activity sheets to use alongside the books which have been shortlisted for the Royal Society Young People's Book Prize 2020.




"Once you start noticing these extraordinary journeys, you'll never look at the world in the same way again."

***The Everyday Journeys of Ordinary Things***

Prepare to be amazed as you learn about ordinary objects and services that have been on the most extraordinary journeys to reach us with The Everyday Journeys of Ordinary Things by Libby Deutsch.

### From tree to tummy

Think of all the machines, people, plants and processes that it would take to make your favourite bar of chocolate. Collect your ideas as notes or drawings.

Compare your thoughts with a friend, before reading pages 24 and 25 and adding to your ideas in a different colour (don't check the answers ahead of time). Discuss which stages of the journey you added, or any ideas you had that were missing from the book.

© Matveev_Aleksandr


# THE EVERYDAY JOURNEYS OF ORDINARY THINGS

## Pupil activity sheet (continued)

### Mini experiment: Chocs away!

Once it has been made, your favourite chocolate bar is collected by lorries and delivered to local shops. The chocolate needs to be kept cool so that it does not melt. Can you find out how the colour of the lorry could affect the chocolate on a hot sunny day?

There are lots of different ways to investigate this and we've suggested just one way below:

1. Advance preparation: Use ready-mix paints to cover pre-cut squares of aluminium foil in different colours. Choose contrasting light and dark colours, for example, black, white, purple and yellow.
2. When the paint has dried, put one piece of the same type of chocolate onto each colour square and leave them in direct sunlight or under a bright lamp.
3. Start a timer and observe as the chocolate melts on the different colours. You can prod your chocolate squares with a lolly stick to help you to observe the melting process.
4. Record the time taken for the chocolate to melt on each colour of foil.
5. Talk with your classmates and share your ideas about which melts fastest, and which takes the longest time to melt?

© TomasSereda.

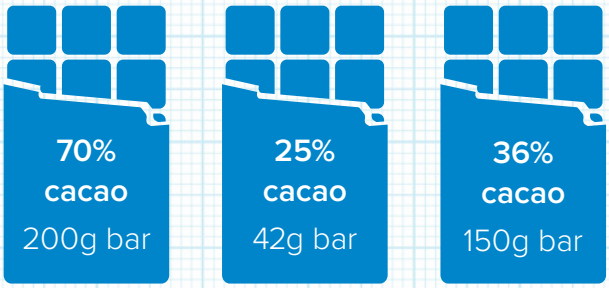
### Mathematics challenge:
From bean to bar

Look carefully for the percentage number on the wrappers of different chocolate bars.

70% means seventy percent of that bar comes straight from cacao beans, including cocoa solids (powder) and cocoa butter (the fat) – you can see this in stage 7 on page 25. The remaining thirty percent consists of all the other ingredients like milk, sugar and vanilla.

In general, chocolate with a higher percentage of cacao will be darker and more bitter than chocolate with a lower percentage.

Look at the weight and percentage number on the chocolate bars below. Can you work out how many grams of each bar will be made directly from cacao beans?




**Based on the results of your experiment, what colour lorry do you think should be used to transport chocolate bars?**

**Why do you think this is? Think about how heat and light react with different colours.**


# THE EVERYDAY JOURNEYS OF ORDINARY THINGS

## Pupil activity sheet (continued)

### Make your own chocolate bar at home

Investigate changing state and reversible changes at home by making your own bar of chocolate or individual chocolate treats at home.

#### Ingredients and equipment

- Chocolate chips
- 2 bowls
- Hot water
- Spoon
- Baking moulds or baking paper

#### Method

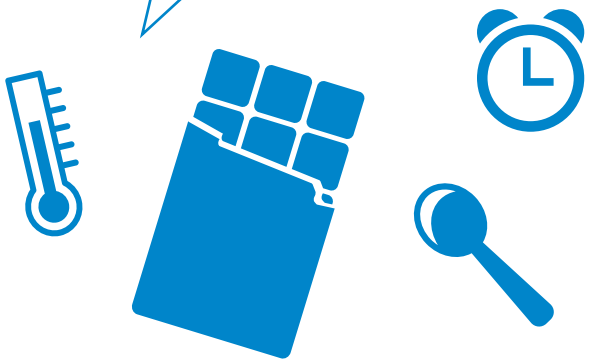
1. Wash your hands and place the solid chocolate chips into a bowl.
2. Pour hot water into a different bowl and place the bowl of chocolate chips on top so that they can melt with the heat from the water.
3. Stir the chocolate chips until they are completely melted and remove from the heat.
4. Drip the melted chocolate carefully into baking moulds or in swirls or circles onto baking paper.
5. Place in a fridge to harden and then gently remove the solid chocolate from the moulds or paper.

**You could compare your results when using plain, white and dark chocolate.**

**Which chocolate takes the longest time to melt and/or solidify?**

**Where is the best place to put the melted chocolate so that it solidifies quickly?**

**What other food can be changed from solid to liquid and back again?**



**Health and Safety**

You must work with an adult when using hot water to melt chocolate. Use a thermometer or temperature probe to make sure that the water is no hotter than 50°C. Take care to avoid splashing water on your skin, even at this temperature.

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# THE EVERYDAY JOURNEYS OF ORDINARY THINGS

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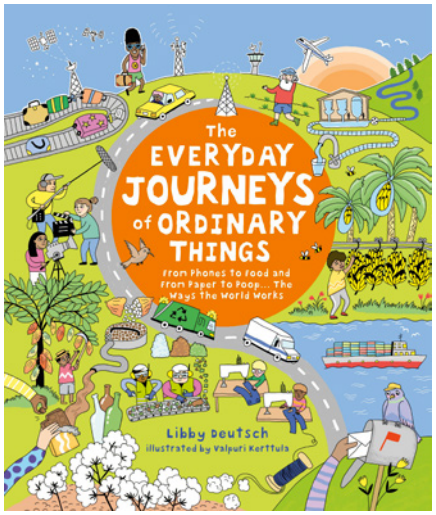



### Activity 1: Sustainable stories

Over recent years, people have begun to think more about the sustainability of the everyday journeys of ordinary things. This means that we need to consider whether they meet our needs now, without having a negative impact on the needs of people living in the future. Some great introductory activities to help you to think more about sustainability can be found at: **ciec.org.uk/sustainability.html** Ask pupils to think about which everyday journeys in the book could be classed as sustainable.

Examples might include the journey of a banana (page 10), the journey of paper (page 16) and the journey of a glass bottle (page 22). Pupils should select their own journey from the book and discuss the positive or negative impacts to our environment.

### Career links

There are so many careers included in this book! Pupils could choose different journeys from different pages and research all the different careers involved. Some examples from 'the journey of electricity' could include:

- **Mechanical engineer:** know how things are made and how machines operate as you design power-producing machines, such as electric generators and steam and gas turbines.
- **Renewable energy scientist:** study and discover ways to get electrical energy from natural sources such as wind, sun, ocean currents and other sources that do not get used up.
- **Electrician:** install and maintain the electrical power for our homes, businesses and factories. You will need to follow strict rules to ensure that buildings have enough power to operate safely for the people that live and work there.


# THE EVERYDAY JOURNEYS OF ORDINARY THINGS

## Teacher activity sheet (continued)

### Activity 2: Crush the can

During the recycling process, glass is crushed into little pieces called cullet. Pupils can learn more about this process on page 23. Explain to pupils that metal waste also needs to be sorted, crushed and baled ready to be transported to the recycling plant.

To investigate the strength of metal cans, and how best these can be crushed, pupils could create three identical open-ended cylinders out of A4 card and then find:

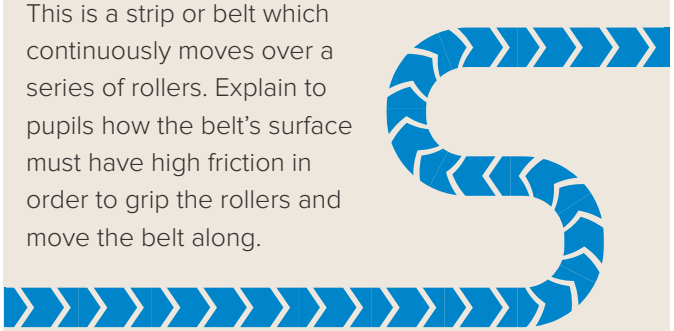
1. The force needed to crush the cylinder from the top by standing it upright with a piece of card on the top and applying a force using a push-meter, or by adding 100g (1N) weights until the cylinder collapses.
2. The force needed to crush the cylinder by applying a force in the same way from the side.
3. The force needed to crush the cylinder by applying a force on the top and the side simultaneously.

Further details of the full 'crush the can' investigation can be found on page 22 of **ciec.org.uk/pdfs/resources/forces-and-recycling.pdf**. Pupils should discuss their findings to suggest which direction of force will crush the cylinder shape most easily. This can be applied to food cans, fizzy drink cans and plastic bottles during the everyday journey of recycling.

If you would like to get your students involved in the Young People's Book Prize as a judging panel, please email **sciencebooks@royalsociety.org** for more information.

### Activity 3: Clever conveyor belts

Discuss how many of the everyday journeys described in the book involve the same clever invention – the conveyor belt. This is a strip or belt which continuously moves over a series of rollers. Explain to pupils how the belt's surface must have high friction in order to grip the rollers and move the belt along.



Pupils could test a selection of different flexible surface materials, for example polythene (bin bag), both sides of carpet, vinyl tiles and such to compare the amounts of surface friction.

They could try different ways of investigating and then compare their results as a team. Here is one idea:

1. Attach a force meter to a box containing a 1kg mass and slowly pull on the force meter.
2. Watch the box and wait for when it first starts to move.
3. Record the correct reading when the box started to move.

**Did you know?**

Many conveyor belts are made out of rubber sheeting. This is because rubber is durable, flexible and has high surface friction. There are also ways to increase the friction of the rollers – can you suggest how this might be done?