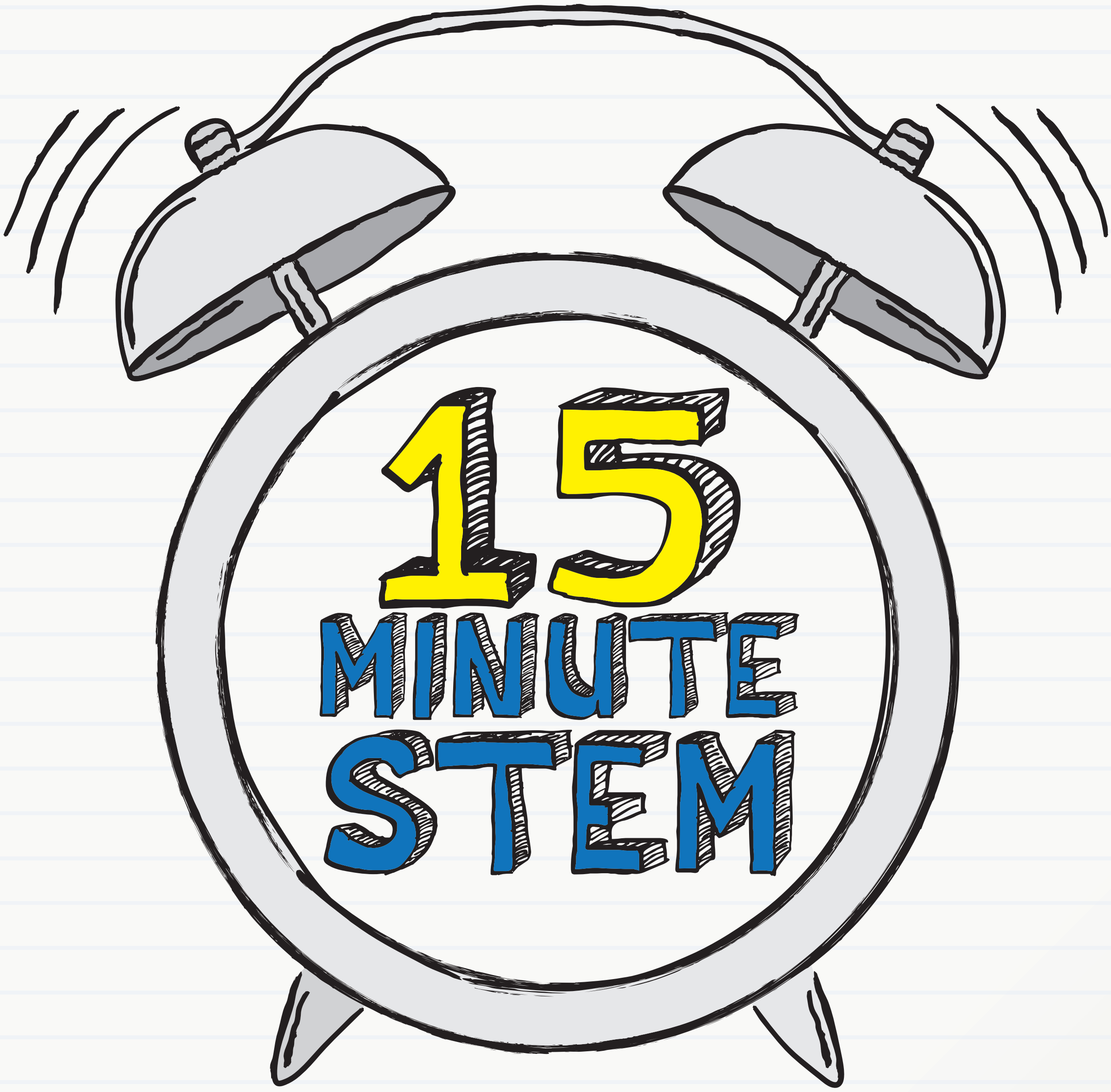
Emily Hunt



Quick, creative Science, Technology, Engineering and Mathematics activities for 5–11-year-olds

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CONTENTS

ACKNOWLEDGEMENTS

My thanks go to the many people who have made possible the creation of *15-Minute STEM*. Thanks to the fantastic team at Crown House Publishing for sharing my enthusiasm for STEM education and for their guidance throughout the process.

Thanks also to Jane Hewitt for bringing the activities to life with her beautiful photographs, and to the school communities – of Darton Primary and Worsbrough Common Primary – who feature in those photos. The book is filled with images of excited, happy children, and this never fails to make me smile as I flick through its pages.

A final thank you goes to my family for always being there to offer a listening ear or a word of encouragement when needed, and to my husband Edmund. Time and time again I have been grateful for his scientific expertise and insight, which has helped me to develop my ideas into the finished product that you see before you today.

INTRODUCTION: THE CASE FOR 15-MINUTE STEM

STEM stands for science, technology, engineering and mathematics. These disciplines have an impact that can be seen in all aspects of our lives. From construction to space exploration, from caring for our environment to the digital revolution; the demand for STEM skills is massive and is only set to grow.

STEM education is a cross-discipline approach to teaching these interrelated subjects, with problem solving at its heart. Great STEM education works through activities with real-world applications, helping children to understand how their learning is relevant and how they could use it in the future. It is an important tool in breaking down stereotypes and encouraging more children to pursue STEM careers. There is a notable under-representation of women and people from ethnic minority backgrounds in STEM careers, so it is important that all children can realise their own capabilities first-hand.

But then again, if you've picked up this book, the chances are you already know all of that. Most teachers and parents recognise STEM to be an important priority area for modern education. However, you may be looking for answers to one or all of the following questions:

How do I fit STEM education into my day?

What kind of STEM activities should I be exploring?

How can I deliver STEM education when I'm not an expert myself?

Is STEM education just for the classroom?

This book is intended to reassure you that you don't need to be an expert to deliver high-quality STEM education. It contains 40 quick, easy-to-resource STEM activities for primary school teachers, and is also ideal for parents to use at home with their children.

How do I fit STEM education into my day?

15-minute STEM activities really do take just 15 minutes

Each activity has been tested to ensure that it can be delivered quickly. This means that with minimal preparation you can slot a 15-minute STEM activity into those spare moments in an otherwise busy day. Of course, it is up to you how much time you spend preparing the children and discussing their findings afterwards.

15-minute STEM is easy to resource

Many of the activities in this book can be resourced from everyday materials found at home or in the classroom, allowing you to deliver them at short notice. Phew! The 'You will need' boxes list the resources you will need to complete each activity once. You will need a set of resources for each child or group undertaking the activity.

It doesn't need to match the curriculum

That's the charm of these 15-minute activities. They can be presented independently of other learning, giving you greater flexibility to slot them in as stand-alone projects. You will find that the children naturally draw upon a range of prior knowledge to complete each activity.

What kind of STEM activities should I be exploring?

STEM activities should make real-world connections

In my experience, children respond best to activities with obvious real-world relevance. Therefore, each activity starts with a question they might ask themselves. It's then up to the children to investigate! I've also linked each activity to STEM careers that engage with conceptually similar tasks, a glossary of which is included at the back of the book. Research shows that the perceptions children have about certain jobs and careers are formed at a young age and that gender stereotyping exists from the age of 7.[1] By introducing children to relevant STEM careers we can challenge these early perceptions and stereotypes and widen their career aspirations.

How can I deliver STEM education when I'm not an expert myself?

Follow the explanation of the learning

Each activity is written as a script that can be delivered directly to children. A helpful 'What are we learning?' box accompanies each activity, which outlines the key learning points. These explanations are targeted towards the primary school age range, equipping you with the key facts you'll need in order to summarise the task.

Less structure, more action

I've kept the activity instructions on the lighter side, and would encourage you to be hands-off with the children. Instead of outlining exactly what the task entails, start with the question, expose the children to the resources and allow them to lead the exploration – supporting them when needed with the step-by-step instructions.

1 See Nick Chambers, Elnaz T. Kashefpakdel, Jordan Rehill and Christian Percy, *Drawing the Future: Exploring the Career Aspirations of Primary School Children from Around the World* (London: Education and Employers, 2018). Available at: https://www.educationandemployers.org/wp-content/uploads/2018/01/DrawingTheFuture.pdf.

Is STEM education just for the classroom?

STEM education is for both teachers and parents

These activities can be done at home, as well as in school. In fact, reinforcing STEM principles across these two settings helps to embed the learning in real-life contexts and fosters an interest in these disciplines from a young age.

15-minute STEM is deliberately adaptable

Each activity can be made suitable for specific age groups within the 5–11 range with a little bit of adaptation. Stick to the basic structure of the activity with younger children, and use the 'Investigate' cues to extend the task with older children. This can also be used to extend the activity beyond 15 minutes, depending on the children's engagement with the task. If a whole class is completing the activity there is plenty of scope to discuss and compare results afterwards. Many of the tasks could also be completed in small groups to encourage collaborative problem solving and teamwork.

Oh, and another thing ...

15-minute STEM develops soft skills

Problem solving, critical thinking, teamwork, communication, confidence, spatial awareness ... the list goes on! These hands-on activities are designed to encourage curiosity and creativity, along with a wide range of other important soft skills, which are crucial to success in STEM and other careers.

Now, let's get started!

HEALTH, SAFETY AND A FEW OTHER BITS

- Some activities come with templates or resources for you to copy (e.g. activity 35, Spinning Helicopters), but you might want to have a go at making your own instead.
- Some of the activities are seasonal. For example, activity 13, Leaf Shape Sorting, works best in the autumn when there are lots of fallen leaves. Save these activities for the right time of year.
- Some of the activities are messy! It's a good idea to try them outside and to make sure that you are wearing suitable clothing. This is indicated at the start of these activities – see the key below.
- Some of the activities need to be returned to throughout the day (e.g. activity 5, Chasing Shadows). Again, this is noted at the start of these activities.
- Some of the activities involve the use of single-use plastics such as drinking straws. Where possible, reuse these plastics for other activities.

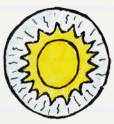
Some important guidelines to share with the children:

- When working with warm water, take it from the hot tap rather than a boiling kettle.
- When doing outdoor activities, remember to stay within sight of an adult.
- Take care with sharp objects, such as scissors.
- Never taste any of the products of the experiments.
- Wash your hands after completing each experiment and be careful not to touch your eyes.
- Be respectful of the natural environment, being careful not to disturb it.
- When working with living creatures, such as minibeasts, make sure they are returned to where they are found.

Throughout the book you'll find different icons next to the activities. Here's what they mean:

You will need to return to these activities later in the day to make observations or collect more results.

These activities can be done inside.



These activities are best done outside.

These activities can be done individually.

These activities are also suitable for teams.

Be extra safety-conscious with these activities; adult help or accompaniment may be necessary.

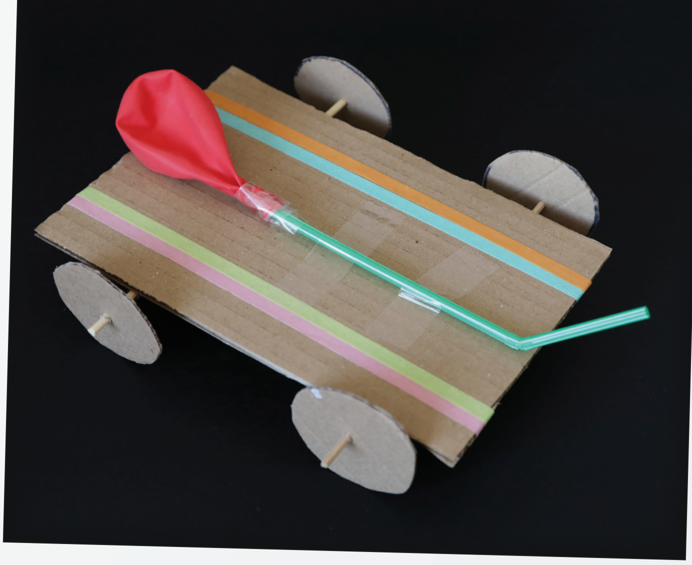
Can be done inside

Can be done individually

Be extra safety-conscious

1. AIR-POWERED CAR

How can we power a vehicle using a balloon?



You will need

- A balloon
- Cardboard
- Straws x3
- Wooden dowels x2
- Wheels x4 (e.g. cardboard circles, plastic bottle lids, old CDs)
- Sticky tape
- Scissors
- A measuring tape

Investigate

Now adapt your design to see if you can create an air-powered boat. You will need to use a waterproof material for the base of your boat, such as a sponge or a plastic tray.

What are we learning?

The air escaping from the balloon propels the car in the opposite direction. This is an example of Newton's third law of motion (for every action there is an equal and opposite reaction).

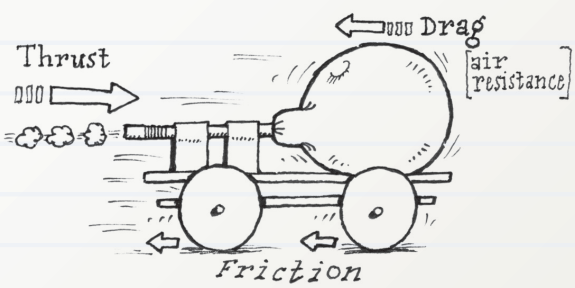
The same physics occurs in the launch of space rockets, which burn fuel and eject gases behind them, propelling them upwards. Check out activity 31, Rocket Racers!

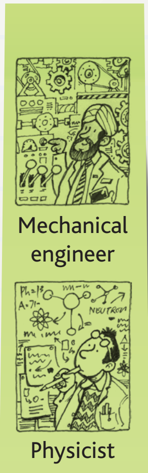
How to do it

Note: You will need an adult to pierce the holes for the dowels to go through if you are using plastic bottle lids for your wheels.

1. Create the base of your car from a piece of cardboard.
2. Tape two straws across the base's underside to create the axles (an axle is a rod that connects two wheels).
3. Thread the wooden dowels through the straw axles and attach wheels onto the ends.
4. Tape the third straw to the top of the cardboard base and insert one end into the opening of a balloon, securing with sticky tape.
5. Blow through the other end of the straw to inflate the balloon. Then pinch the end of the straw to keep the air in until you are ready to test it.
6. Place your car on a flat surface and watch it go! Measure the distance that it travels.

Optional: Experiment with using different materials or sizes for the wheels. What works best? Can you think of reasons why? Can you increase the distance that your car travels?





Can be done inside

Can be done individually

2. ARCTIC ENGINEERING

Why are igloos built in a dome shape?

You will need

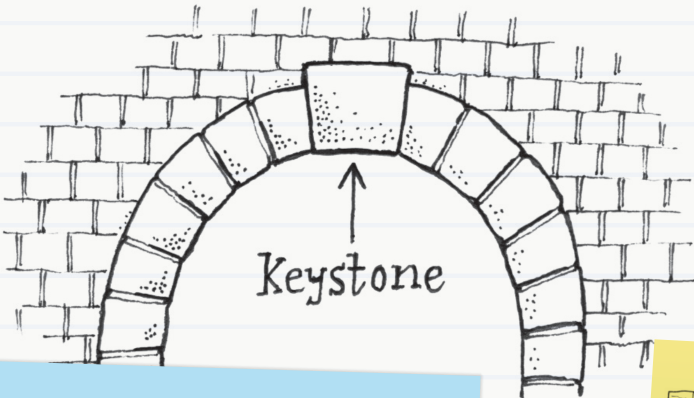
- Marshmallows
- Cocktail sticks
- A large plate or tray

How to do it

1. Begin by creating the circular base of the igloo on your plate or tray. Use the cocktail sticks to secure the marshmallows together closely.
2. As you build up the marshmallow layers, make smaller circles, and curve the sides of the igloo inwards, creating a dome shape. The sides should meet at a single row of marshmallows along the top.
3. Review your design. Is it structurally strong? If you're feeling brave, try building it again without using the cocktail sticks for support.

Investigate

Look for dome and arch shapes in the architecture around you. Can you spot any keystones?



What are we learning?

An igloo is a hut built from blocks of compacted snow. Snow is a good material for an igloo because air pockets trapped inside act as an insulator. This means that it prevents heat from escaping.

Igloos are shaped like a dome. This is a structurally strong shape. The final block of snow at the top is usually larger than the ones used to build the walls and is referred to as the keystone. The downward force of its weight holds all the other blocks in place. We can cheat a bit in this activity by using cocktail sticks for support, but in real structures the weight is sufficient to hold the dome together.

Architect

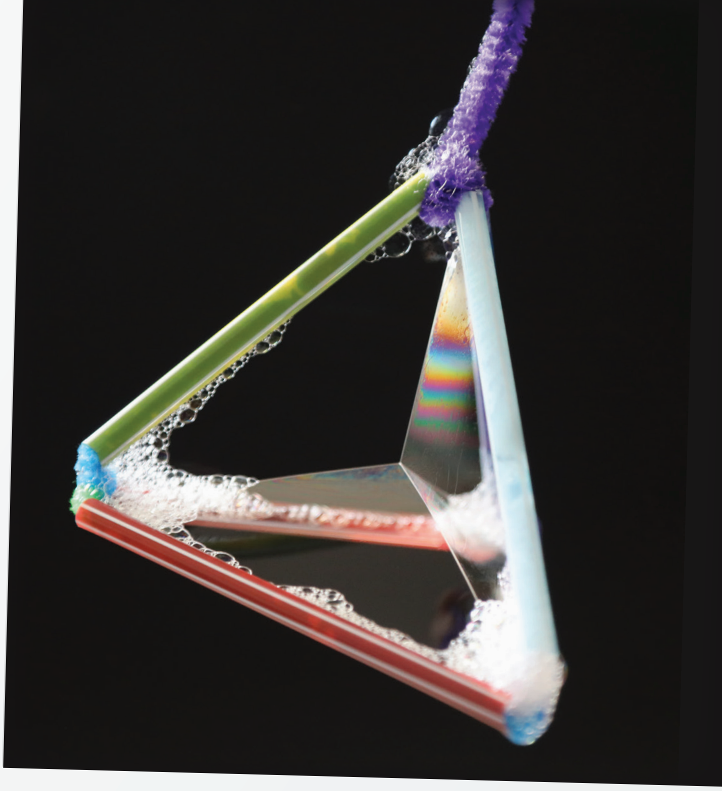
Civil engineer

Best done outside

Can be done individually

3. BUBBLE GEOMETRY

How have engineers been inspired by nature?



You will need

- Straws
- Pipe cleaners
- Washing-up liquid
- Water
- A bowl
- Glycerine (optional)

How to do it

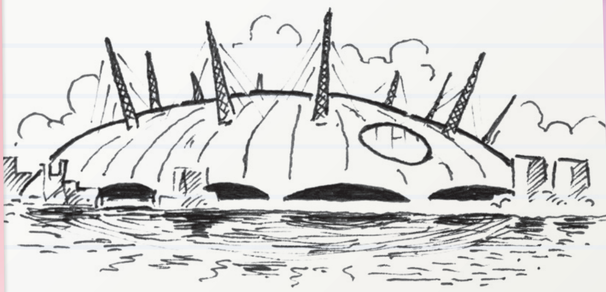
1. Mix water and a little washing-up liquid together in a bowl to create a bubble solution. You could add a teaspoon of glycerine to help strengthen the bubble solution.
2. Decide on the 3D shapes you will make to dip into your bubble solution. For example, a cube or a pyramid.
3. Cut each straw into quarters. Then thread pipe cleaners into the straws, to start building your 3D shape. Bend the pipe cleaners and use them to join together other straw segments.
4. Once you've made your 3D shape, attach a length of pipe cleaner as a handle.
5. Dip your 3D shape into the bubble mixture and then pull it out to inspect your bubble.
6. Have a good look, then blow your bubble away!

Investigate

Research what other structures have been inspired by nature. Alternatively, find out more about Frei Otto, the German engineer and architect who pioneered the concept of a tensile structure by observing soap bubbles.

What are we learning?

These geometrical bubbles are an example of a tensile structure. Tensile structures are formed when a material is spread out and held in tension between two or more anchors. An example is the dome of London's O2 Arena. These structures can cover large areas with minimal amounts of building material and are very light. Our bubbles stretch between the straws in a similar way.



Architect

Civil engineer


Can be done inside


Can be done individually

4. CATAPULT CHALLENGE

How can we create a catapult that launches a projectile a long way?

You will need

- Lolly sticks x8
- Rubber bands (lots)
- A plastic spoon
- Soft items to launch as projectiles (e.g. marshmallows or pompoms)
- A measuring tape

Investigate

Research how catapults have been used in the past by ancient and medieval militaries.

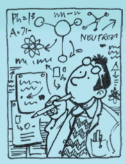
What are we learning?

A catapult is a launching device used to fire a projectile (an object) across a distance. Historically they have been used in warfare. When we prepare to fire our catapult, potential energy is stored in the stretched rubber bands. When we release the arm this is converted into kinetic (movement) energy in the spoon which is transferred into the fired projectile, as well as some heat energy in the rubber band.

How to do it

1. Tightly secure six lolly sticks together with a rubber band at each end.
2. Take two additional lolly sticks. These will form the arm and the base of your catapult. Secure them together at one end using a rubber band. Position the lolly stick stack horizontally on the surface in front of you. Then sandwich the stack between the arm and the base, facing vertically. Attach a rubber band around the join in a criss-cross shape.
3. Finally, attach a plastic spoon along the arm of your catapult using more rubber bands.
4. Holding the arm and base's join securely in place, place your projectile on the spoon and bend the arm down with your finger. Release and measure how far the projectile travels!
5. How could you improve your catapult to make your projectile travel further? What's the best launch angle?

Optional: Now adapt your catapult to see how high you can fire your projectile. You could measure height by firing it at a wall and seeing where it hits.


Physicist


Mechanical engineer

Return to activity later

Best done outside

Suitable for teams

5. Chasing Shadows

How do shadows change throughout the day?

You will need

- Chalk
- A measuring tape
- A watch or clock
- A clipboard
- Paper
- A pencil

Investigate

A sundial is an instrument that tells the time based on the position of the sun in the sky. Find out more about how sundials work. Can you create your own using natural materials?

What are we learning?

Light travels in a straight line. When we place a solid object, such as a person, in its path, it blocks some of the light, creating a shadow.

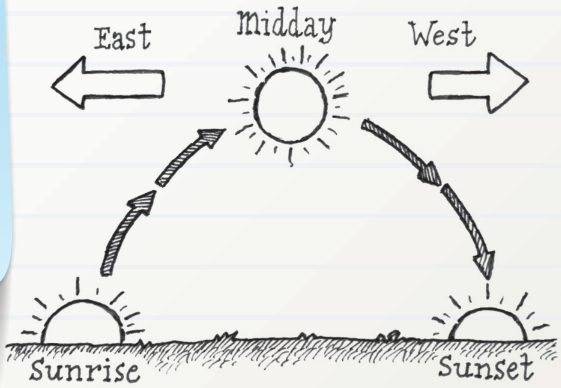
As the earth rotates, the relative position of the sun in the sky changes, which changes the length and position of shadows. In the morning your shadow is longer and faces west. By midday the sun is directly overhead, making your shadow short. In the afternoon your shadow grows longer again and faces east.

How to do it

Note: You will need to do this activity on a sunny day. You will need to return to it throughout the day.

1. Begin this activity first thing in the morning. Head outside, stand on a dry, hard surface (e.g. a playground or driveway) and choose a direction in which to face. Get someone to draw around your shadow using chalk.
2. Measure the length and position of your shadow in relation to you (e.g. in front, to the left, or in degrees). Record the time.
3. Decide how regularly you are going to check your shadow throughout the day (e.g. at hourly intervals).
4. Return to check the position of your shadow periodically, standing in the same place each time, with your feet pointing in the same direction. Record your findings.

Optional: Younger children could skip the measurement and draw around each other's shadows in a different colour each time.



Astronomer

Meteorologist

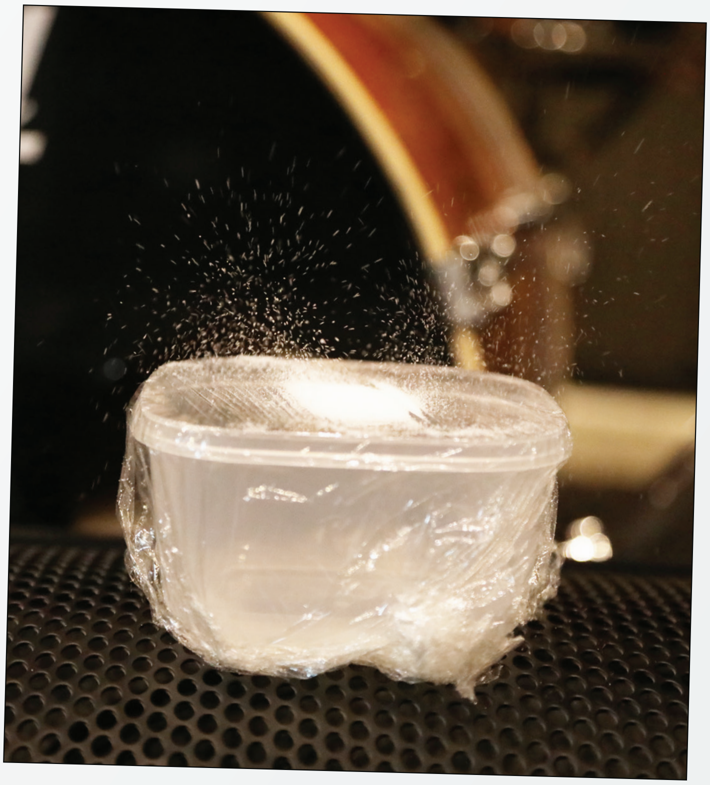

Can be done inside


Can be done individually

Be extra safety-conscious

6. DANCING SALT

How does sound travel?



You will need

- A large bowl
- Cling film
- Salt
- A sound system and speaker
- Food colouring (optional)
- Ingredients with different-sized granules (e.g. rice, granulated sugar and caster sugar)

Investigate

Try placing ingredients with different-sized particles on the cling film (e.g. rice, granulated sugar and caster sugar). Do you notice a difference in the way the different-sized particles vibrate?

How to do it

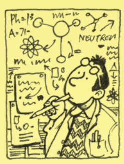
Note: For best results, place a wireless speaker directly inside the bowl before covering with cling film.

1. Place the cling film tightly over the bowl.
2. Gently pour a small amount of salt onto the centre of the cling film. You could dye the salt with food colouring beforehand so you can see it more clearly.
3. Hold or place the speaker against the bowl. Turn on the sound system and play some music. Move your speaker around at different angles until you can see maximum vibrations in the salt. Take care as you do so to not let the salt particles fall onto the speaker.
4. Observe what happens to the salt as you change the volume. What kind of music makes the salt dance best? What patterns does the salt make?

What are we learning?

The speaker creates sound waves, which are temporary compressions of the air. These disturbances travel through space, transferring energy. The sound waves travel out of the speaker and hit the bowl and cling film, causing them to vibrate. This in turn makes the salt vibrate, or 'dance'. The vibrations cause the salt to move in different ways depending on the frequency (number of sound waves per second) and volume (loudness of each sound wave).


Sound engineer


Physicist

From caring for our environment to the digital revolution, the demand for STEM skills is huge and is only set to grow.

Like most teachers and parents, you probably recognise STEM as an important priority area for modern education. However, you may be wondering:

- How do I fit STEM education into my day?
- What kind of STEM activities should I be exploring?
- How can I deliver STEM education when I'm not an expert myself?
- Is STEM education just for the classroom?

Enter 15-Minute STEM!

Containing 40 quick, easy-to-resource activities, *15-Minute STEM* reassures teachers and parents that they don't need to be experts to deliver high-quality STEM education.

15-Minute STEM is crammed full of engaging practical ideas that are quick to do yet also inspire longer-term engagement. Definitely one of the best resources I have read in a long while.

Professor Bill Lucas, co-author of *Educating Ruby* and *Thinking Like an Engineer*

Brilliant! Packed full of fun and exciting science- and engineering-based activities that will engage and inspire children. Fantastic!

Lynda Mann, Head of Education Programmes, Royal Academy of Engineering

A real treasure trove of creative learning opportunities that you can dip into time and time again.

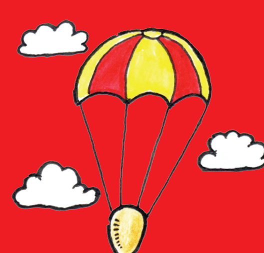
Gilly Tyree-Milner, Forest School/Outdoor/Nurture Lead Practitioner, Worsbrough Common Primary School

A great resource for teachers who are taking their first steps in creating a STEM-rich classroom.

Tanya Shields, Primary STEM Lead, STEM Learning Ltd

Complete with easy-to-use instructions, *15-Minute STEM* offers an impressive collection of imaginative, interactive activities which encourage children to question, deduce and hypothesise as they learn.

Jo Lancett, Head Teacher, Darton Primary School



A fantastic resource to get children of all abilities hands on with STEM, both in school and at home.

Joanne Fitton, environmental scientist and parent governor

Emily Hunt is an experienced primary school teacher whose role as a science subject leader at a school in Bristol ignited in her a passion for promoting STEM education. During a recent year in the USA she developed a popular website and blog – www.howtostem.co.uk – offering STEM activities and advice for educators working with the 5–11 age range. She also worked within the US education system to deliver science outreach, and holds a Master of Education from the University of Cambridge.

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