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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 individually.

These activities can be done inside.

These activities are also suitable for teams.

These activities are best done outside.

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

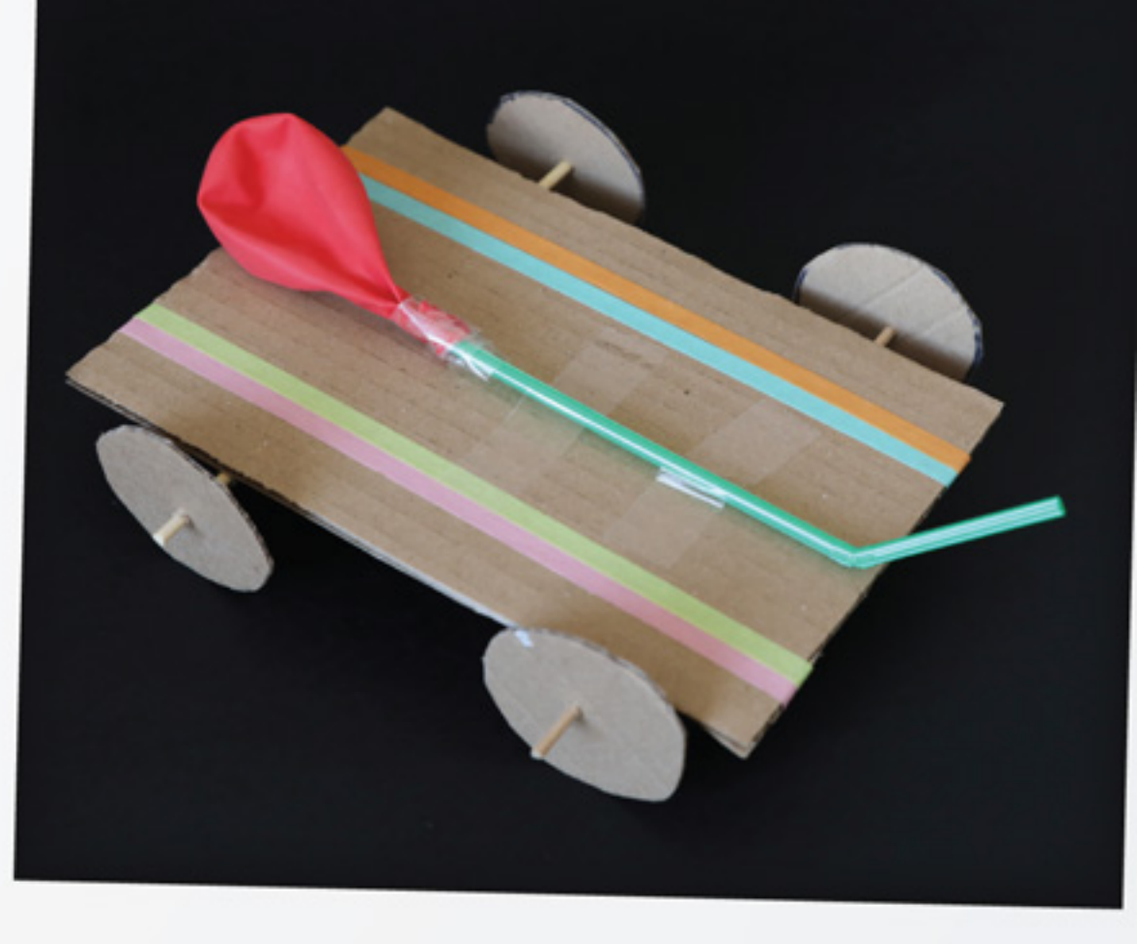
Can be done inside

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

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?

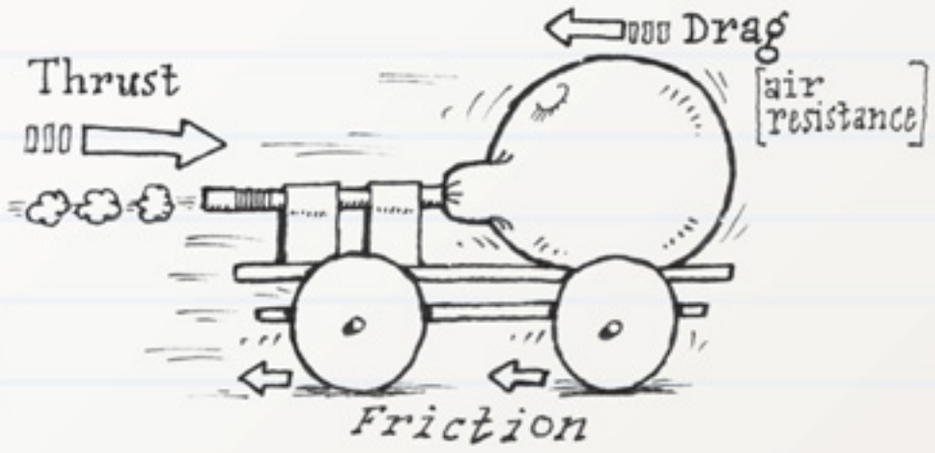
Investigate

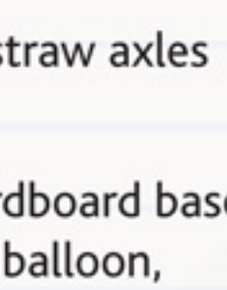
Now adapt your design to see if you can create an air-powered boat. You will need to use a waterproof material for the base of your boat, such as a sponge or a plastic tray.

What are we learning?

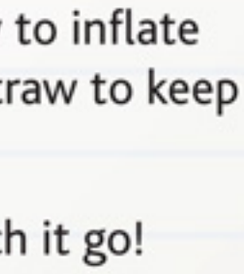
The air escaping from the balloon propels the car in the opposite direction. This is an example of Newton's third law of motion (for every action there is an equal and opposite reaction).

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!





Mechanical engineer



Physicist

Can be done inside

Can be done individually

2. ARCTIC ENGINEERING

Why are igloos built in a dome shape?

You will need

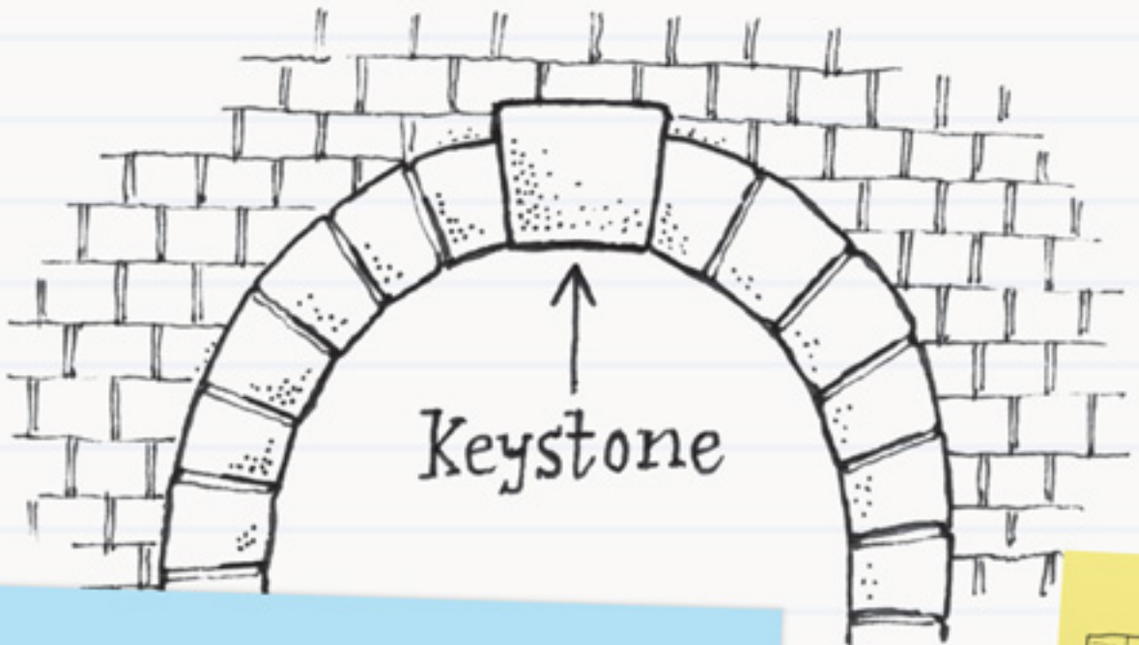
- Marshmallows
- Cocktail sticks
- A large plate or tray

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