AIMING FOR AWESOME

Speed record

Teacher's Guide

Royal Academy of Engineering

THIS IS ENGINEERING

ROYAL AIR FORCE Youth STEM

The aim of this resource is to give students the opportunity to investigate the impact of science, technology, engineering and mathematics (STEM) on the air speed record.

Curriculum links

England

Activity	Key Stage	Subject	National Curriculum
Time to calculate	KS3	*Science*	**Describing motion:** speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time).
Time to calculate	KS2	*Mathematics*	**Number:** fractions (including decimals and percentages).
Speed of sound	KS2	*Science*	**Sound:** identify how sounds are made, associating some of them with something vibrating. **Sound:** recognise that vibrations from sounds travel through a medium to the ear.
Time to investigate	KS2	*Science*	**Working scientifically:** taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
Time to investigate	KS3	*Science*	**Working scientifically:** Experimental skills and investigations. **Working scientifically:** measurement.

Wales

Activity	Key Stage	Subject	National Curriculum
Time to calculate	KS2	*Mathematics*	**Using number skills:** use number facts and relationships. **Using number skills:** fractions, decimals, percentages and ratio.
Time to investigate	KS2	*Science*	**Skills:** Enquiry.
Time to investigate	KS3	*Science*	**Skills:** Enquiry.

Scotland

Activity	Subject	Topic	Experiences and outcomes
Time to calculate	*Numeracy and mathematics*	Number and number processes Fractions, decimal fractions and percentages	MNU 2-03b, MNU 2-07a, MTH 4-07b
Time to investigate	*Numeracy and mathematics*	Time Measurement	MNU 2-10b, MNU 2-11b, MNU 4-11a

Northern Ireland

Activity	Key Stage	Subject	National Curriculum
Time to calculate	KS2	*Mathematics and numeracy*	**Number:** understanding number and number notation
Speed of sound	KS2	*The world around us*	**Strand 2:** Movement and energy: the causes and effect of energy, forces and movement.
Time to investigate	KS3	*Science*	**Developing pupils' knowledge, understanding and skills:** develop skills in scientific methods of enquiry to further scientific knowledge and understanding.

Preparation

- Ensure all materials and equipment needed are available well in advance of the session. See the resource list below for essential materials and components.
- Ask students to bring in at least one plastic bottle each to make a sonic cannon.
- A full risk assessment should be conducted prior to the session.
- Support may need to be given to students when cutting the plastic bottle.
- This session is expected to last 60 minutes.
- Ensure technology is available to project the relevant video materials.

This resource has been linked to the Engineering Habits of Mind (EHoM). For more information about the EHoM please see the information sheet provided or www.raeng.org.uk/ltbae.

Resource list

For this activity, you will need the following per student:

- Balloon
- 3 x plastic bottle
- Tape
- Tea light candle
- Matches or Bunsen burner and splint

The following specific components may not be readily available in schools and other educational establishments. Therefore, it may be necessary to order these items.

Description	Product code	Pack size	Supplier
Balloons	06-9972	100	www.rapidonline.com

Speed record

The first air speed record was set by Wilbur Wright in 1903 at 6.82mph during one of the first powered flights.

Since that first flight, the massive advancement of aircraft technology meant that the airspeed record is continually being broken; in 100 years, the record has gone from 6.82 mph to over 2,000 mph.

During the 1940s, the airspeed record was broken twice by Royal Air Force (RAF) pilots.

On November 7 1945, Group Captain H J Wilson achieved the first officially confirmed speed record for a jet aircraft at 606.25 mph while flying the **Gloster Meteor**, Britain's first jet fighter.

Ten months later, on September 7 1946, Group Captain E M Donaldson set a new world speed record of 615.81 mph, also in a **Meteor IV** aircraft.

The speed of sound

The term sound barrier came into use during the Second World War. Many people thought it would not be possible to go faster than the speed of sound despite many aircraft reaching speeds close to it in the 1940s.

The speed of an aircraft is sometimes described using the Mach number. The Mach number is the ratio between the speed of the object and the speed of sound. Aircraft travelling faster than the speed of sound, or Mach 1, are called supersonic. The speed of sound is 340 miles per second.

The sound barrier was eventually broken by aircraft in 1947. When aircraft travel faster than the speed of sound, you can hear a sonic boom.

TIME TO CALCULATE

The speed of an aircraft tells you how fast or slow it is moving. To find the speed of an aircraft you need to know:

- The distance travelled.
- The time taken to travel that distance.

You can calculate speed using this equation:

$$speed = \frac{distance}{time}$$

Calculate the speed of the following aircraft:

- The **Albemarle aircraft** flew 120 miles in 30 minutes (0.5 hours).
- The **de Havilland Hornet** flew a record 121 miles in just 15 minutes.

Answers provided to STEM activity leader

- $speed = \frac{distance}{time} = \frac{120}{0.5}$ *or* $120 \times 2 = 240mph$
- 15 minutes is 0.25 hours, so:

$$speed = \frac{distance}{time} = \frac{121}{0.25} \text{ or } 121 \times 4 = 484mph$$

STRETCH AND CHALLENGE

How far could the spitfire travel in 45 minutes at its top speed of 330mph?

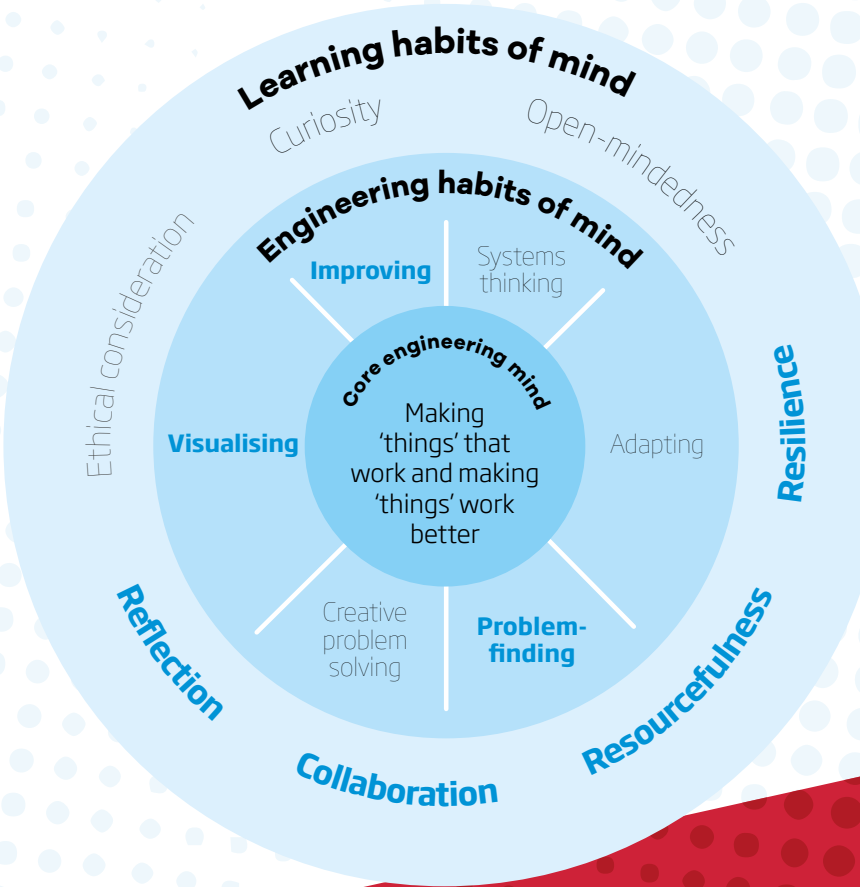
Answers provided to STEM activity leader

Students will need to re arrange the equation.

$distance = speed \times time$

45 minutes is 0.75 hours, so:

$distance = speed \times time = 330 \times 0.75 = 247.5mph$



Speed record

Vortex

A vortex is a region in a liquid or gas that is spinning, or rotating, around an axis.

When an aircraft flies, a vortex is created around the wing.

When a wing generates lift, the air on the top surface has lower pressure compared to the bottom surface. Air flows from below the wing and out around the tip to the top of the wing in a circular fashion.

TIME TO MAKE

To make a cannon, you will need:

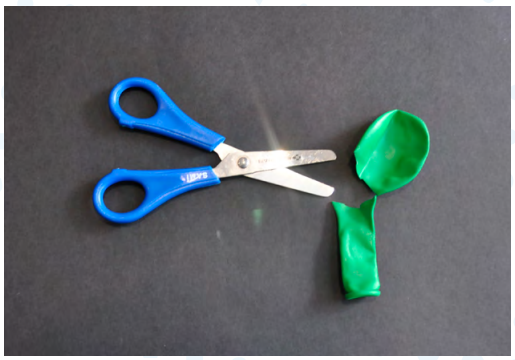
- Plastic bottle
- Balloon
- Scissors
- Tape

Guidance provided to STEM activity leader

- Conduct a full risk assessment prior to starting this activity. This activity will work with any sturdy plastic drinks bottle, though the shape of the bottle will affect the launch speed.

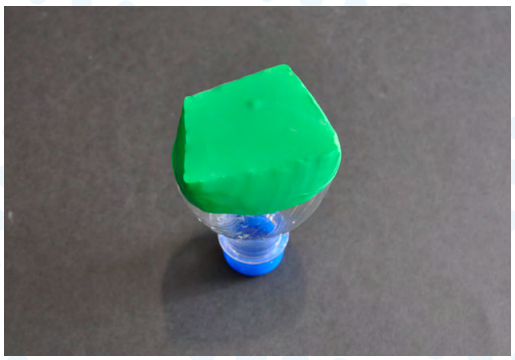
1 First, cut the bottom off the plastic bottle.

2 Then cut the balloon so that you have a piece large enough to cover the bottom of bottle.



3 Use tape to secure the balloon to the bottle.

4 Finally, stretch the balloon and release.



TIME TO INVESTIGATE

Investigate how the distance the vortex travels affects its strength.

To do this, light a candle with a lighter or splint.

Hold the vortex cannon one metre away from the candle and create a vortex.

Move the cannon 10 centimetres closer to the candle and test again.

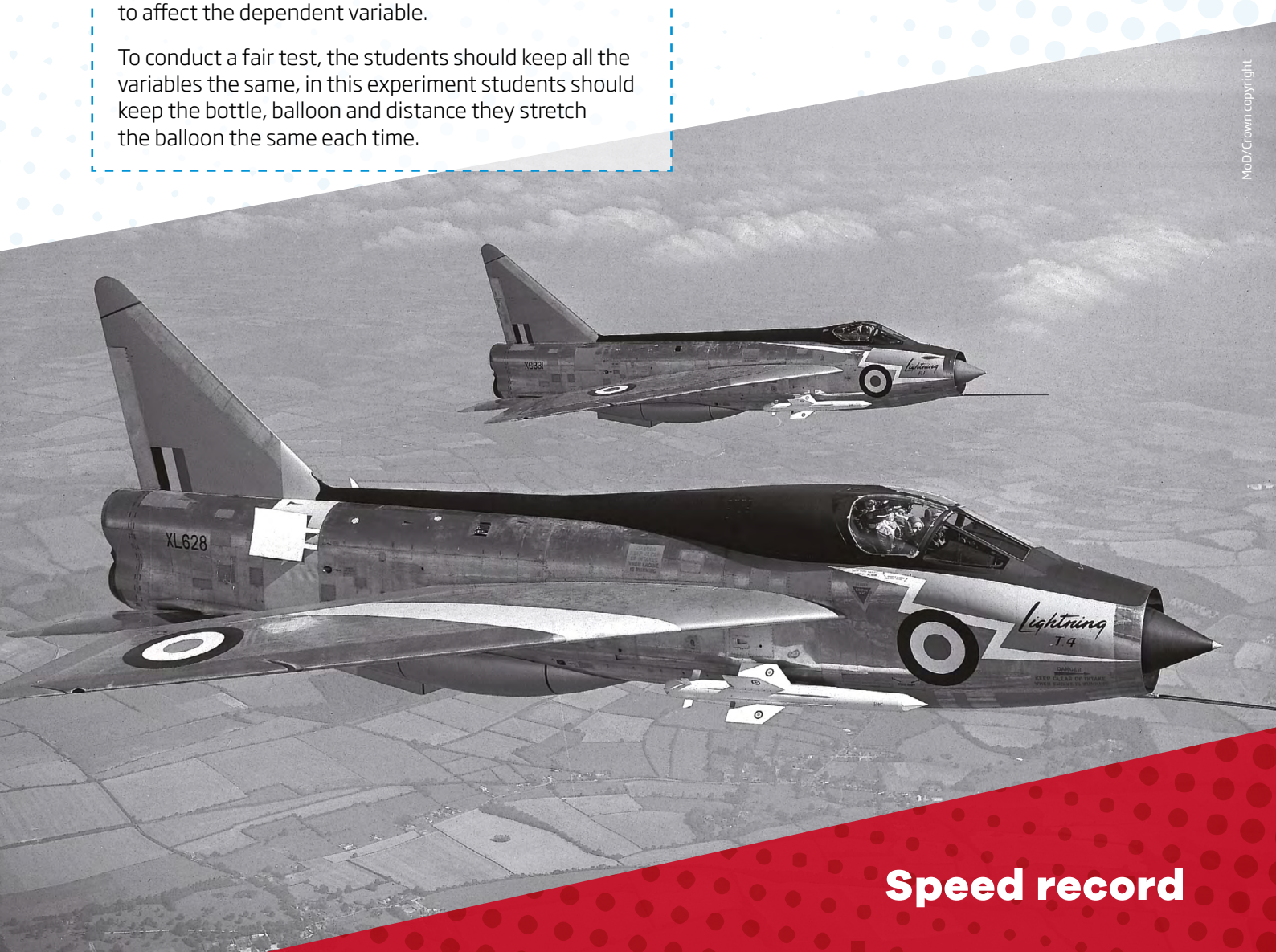
- How close do you have to be to the candle to blow out the candle with a vortex?

To ensure your results are repeatable, you should conduct the investigation at least three times. How can you ensure you have conducted a fair test?

Guidance provided to STEM activity leader

A common misconception is that repeating an experiment makes it a fair test. A fair test is one in which only the independent variable has been allowed to affect the dependent variable.

To conduct a fair test, the students should keep all the variables the same, in this experiment students should keep the bottle, balloon and distance they stretch the balloon the same each time.



Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

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Together we're working to tackle the greatest challenges of our age.

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We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.

ROYAL AIR FORCE Youth STEM

The RAF Youth STEM programme is designed to engage and inspire young people by building their interest in engineering and technical career pathways.

From cyber specialists to aerospace, aviation, electronics, and mechanical disciplines, the RAF is committed to widening participation in STEM, extending opportunities to all, and encouraging greater diversity in this critical area of national skills shortages.

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