AIMING FOR AWESOME

1918 2018

Aircraft design

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 aircraft design.

Curriculum links

England

Activity	Key Stage	Subject	National Curriculum
Model aircraft	KS2	*Science*	**Working scientifically:** planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
Time to think	KS2	*Science*	**Forces:** identify the effects of air resistance, water resistance and friction that act between moving surfaces.
Model aircraft	KS2	*Design and technology*	**Evaluate:** evaluate their ideas and products against their own design criteria and consider the views of others to improve their work; understand how key events and individuals in design and technology have helped shape the world
Time to think	KS3	*Science*	**Forces:** using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces
Time to think	KS3	*Science*	**Forces and motion:** forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only); change depending on direction of force and its size.
Model aircraft	KS3	*Design and technology*	**Evaluate:** test, evaluate and refine their ideas and products against a specification; understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists

Scotland

Activity	Subject	Topic	Experiences and outcomes
Time to think, Model aircraft	*Science*	Forces	SCN 2-07a
Model aircraft	*Technologies*	Craft, design engineering and graphics contexts	TCH 2-14a, TCH 4-14b,

Northern Ireland

Activity	Key Stage	Subject	National Curriculum
Model aircraft	*KS2*	The world around us	**Strand 2:** Movement and energy: the causes and effect of energy, forces and movement.
Time to think	*KS2*	The world around us	**Strand 2:** Movement and energy: the causes and effect of energy, forces and movement.

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. The paper aircraft launcher will need to be built prior to the session.
- Students will be making and launching paper aircraft, it is advised that the activity therefore takes place in the school hall or playground. A full risk assessment should be conducted prior to the session.
- This session is expected to last 60 minutes.

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

- Paper
- Paper aircraft launcher

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
Paper aircraft launcher	EDGP045S	1	www.mindsetsonline.co.uk

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Aircraft Design

The 1920s and 30s were the 'golden age of aviation' when aircraft changed from slow, wood and wired-framed and fabric-covered biplanes to faster sleek, all-metal monoplanes.

R J Mitchell CBE FRAeS was born at 1895. After leaving Hanley High School, a co-educational grammar school in Stoke-on-Trent, at the age of 16, he gained an apprenticeship at Kerr Stuart & Co. of Fenton, a locomotive engineering works. At the end of his apprenticeship R J Mitchell worked in the drawing office at Kerr Stuart and studied engineering and mathematics at night school.

R J Mitchell designed of the Supermarine S.6B which helped the Royal Air Force win the famous Schnieder Trophy Air Race for seaplanes and flying boats.

In 1931 the Air Ministry issued a requirement to the aircraft companies of the UK for a fighter aircraft to replace the aging Gloster Gauntlet. The Gauntlet was a Bi-plane that first flew only two years earlier in January 1929.

During the 1930s, there was an increase in the need for a fast fighter that could defend the country against any expected attack. R J Mitchell understood this need, and designed one of the most iconic aircraft ever, the Supermarine Spitfire.

Activities

TIME TO THINK

What forces are acting on this aircraft when it is in flight?

Answers provided to STEM activity leader

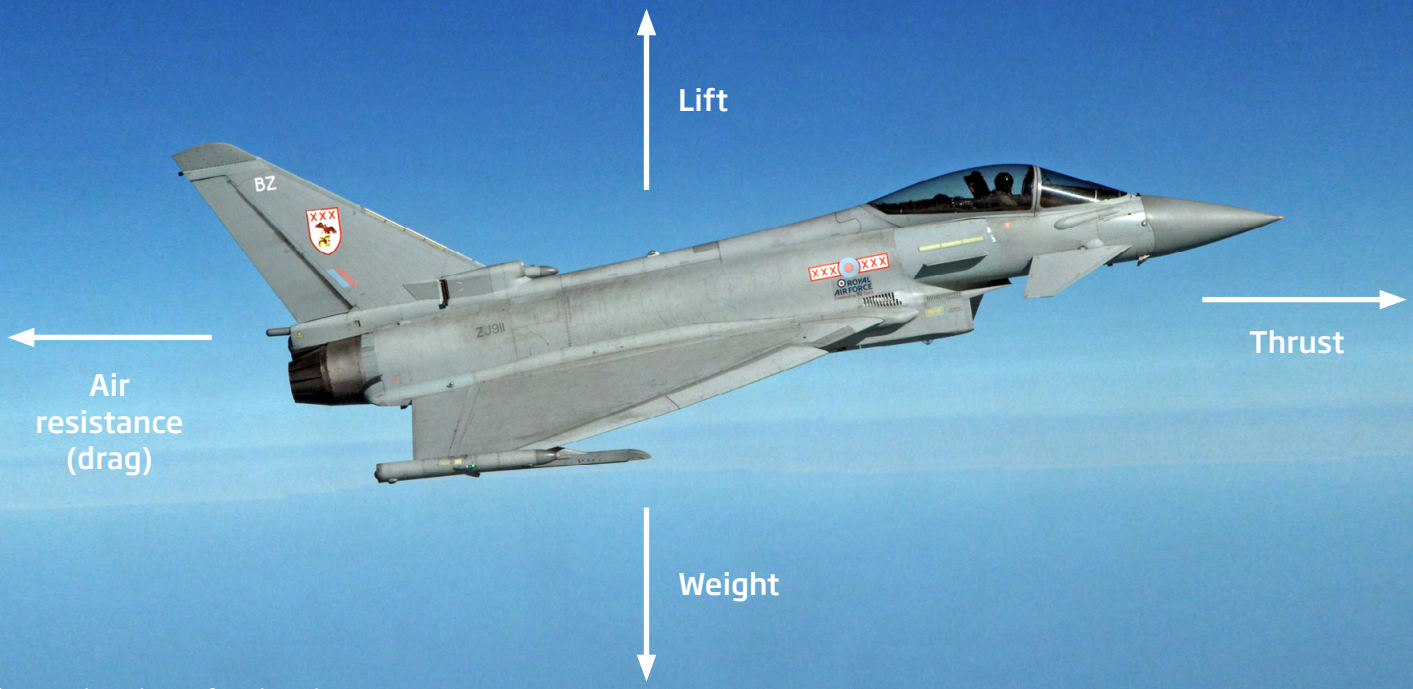
The four forces acting on an aircraft in flight are:

- lift, upward force
- weight, downwards force due to gravity
- thrust, forward force
- air resistance, caused by the fictional force between the air and the plane.

Demonstrate drag force by asking the students to stand up and move their hands. First, ask the students to sweep their arms back and forth with their hands vertically. Second, get them to make the same movement with their hands parallel to the floor. The students should be able to feel the *wind* rushing past their hands.

Draw arrows to show these forces on the picture.

Answers provided to STEM activity leader



STRETCH AND CHALLENGE

Draw arrows to show the direction and magnitude of the forces on aircraft in flight when it is:

1. Moving at constant speed

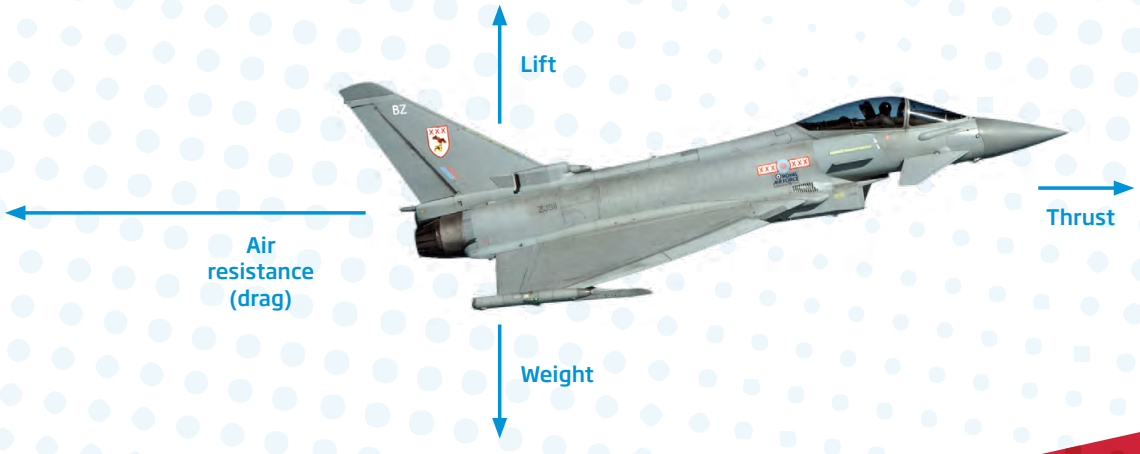
Answers provided to STEM activity leader

2. Accelerating

Answers provided to STEM activity leader

3. Decelerating

Answers provided to STEM activity leader



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Model Aircraft

Part 1

Make a paper aircraft to be launched through the paper aircraft launcher.

What do you notice about the aircraft that went furthest?

Guidance provided to STEM activity leader

- Ask students to make a paper aircraft without any guidance. Launch each one through the launcher leaving them where they land. In most cases, the aircraft will only go a few feet.
- Pick out the design that went the furthest and the one that went the shortest distance. Holding the two side by side, ask the students to identify the biggest differences between the two shapes.

Part 2

Use what you have seen from the first launch to design and make an improved paper aircraft. Launch this second aircraft.

Did your aircraft go further than the first attempt? What are the differences between your first and second design?

Guidance provided to STEM activity leader

- Ask the pupils to use what they have seen from the first launch to design and make an improved paper aircraft. Launch this second aircraft and look at where they land. The majority will land in an area further than the first group.
- Pick up the second model and discuss the improvements made over the first design.


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Part 3

Use the templates to make a paper aircraft and launch the aircraft.

How is this aircraft different to your original designs? Which planes travelled further? Why do you think this is?

Prompts provided to STEM activity leader

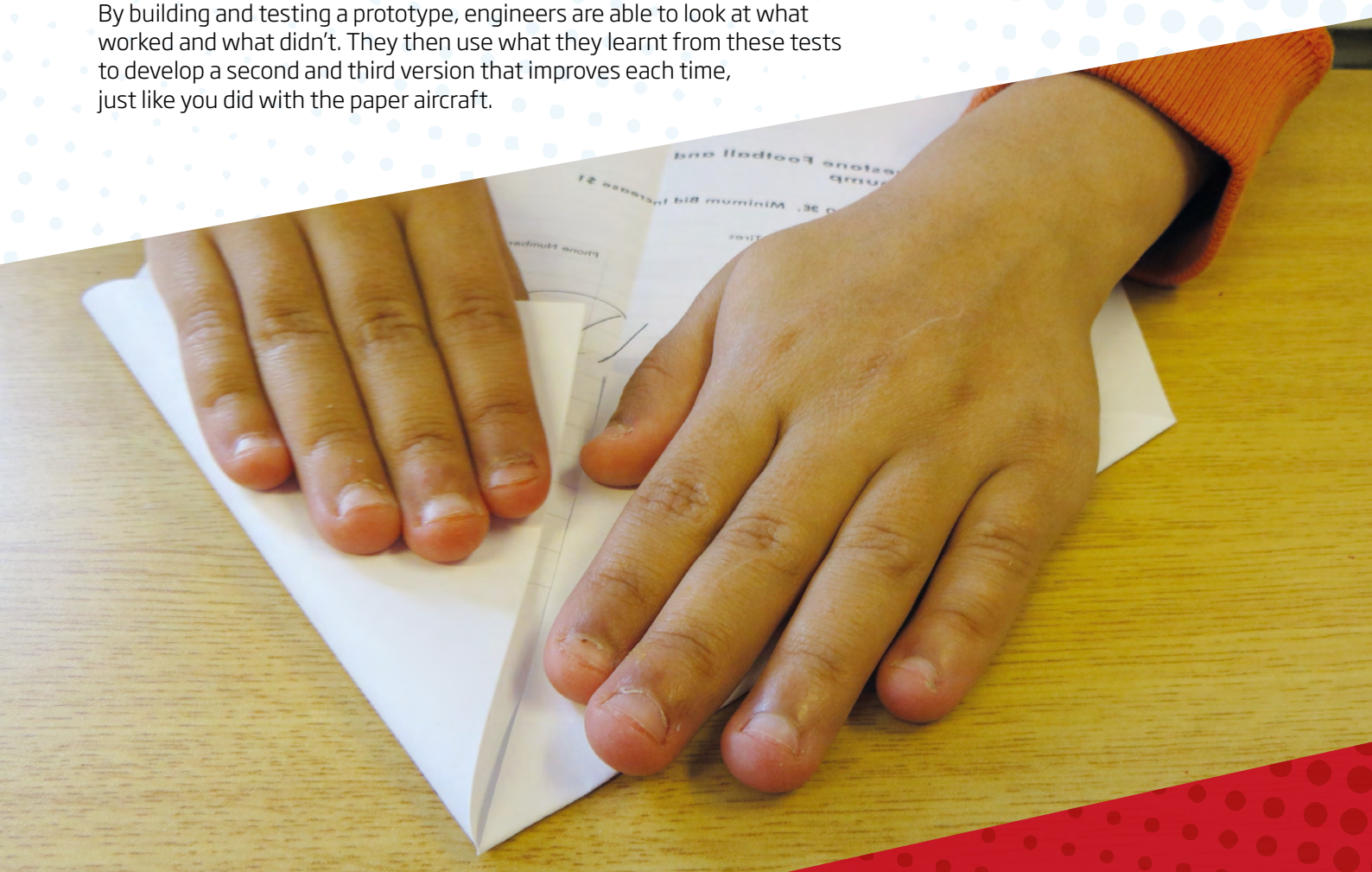
Students should think about:

- the shape of the aircraft
- the shape of the nose of the aircraft
- the shape of the tail of the aircraft
- the wingspan.

Iterative Design

This is the iterative design process that engineers go through to solve problems such as building an aircraft.

By building and testing a prototype, engineers are able to look at what worked and what didn't. They then use what they learnt from these tests to develop a second and third version that improves each time, just like you did with the paper aircraft.



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.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

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

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

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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