



## NUMERACY: FORCES OF FLIGHT TEACHER NOTES

This resource primarily supports the science and numeracy curriculum for students working at KS3. However, by learning more about the iconic aircraft from our collection it would also support the teaching of History.

STEM is critical in the design and engineering of aircraft to be able to carry out their specific roles. The Imperial War Museum at Duxford is home to one of the largest collections of commercial and military aircraft in the world.

Since the first powered flight in 1903 advances in technology have enabled aircraft performance to increase dramatically. From propeller and piston engine aircraft to jet powered aircraft, STEM has been at the heart of this evolution.

These advances in technology have increased power, thrust and speed and enabled planes to fly higher, longer, further and to be more manoeuvrable and versatile in their roles.

This resource explores changes in technology and design using the Second World War Spitfire and the Typhoon jet aircraft which came into service in 2003.

The resource will enable students to calculate and compare some of the performance factors that have improved with the technology of aviation and to understand and appreciate what these mean in the evolution of aircraft design.

This learning resource is to contextualise how STEM impacts well known technology and enables it to develop.

**NB:** There are two versions of this challenge – **version i: tricky** and **version ii: trickier!** In **version ii** students are given extra calculations to work out wing surface area within the challenge, whereas in **version i** the wing surface area is already given.

## Spitfire Mk1A



## Typhoon FGR4



### Technical Specifications:

Aircraft Parameter	Spitfire Mk1A	Typhoon FGR4
Max speed (mph)	354	1320
Max rate of climb (m/s)	4	318
Max range (miles)	430	1800
Service ceiling (metres)	10500	19800
Max take-off mass (kg)	2800	23500
Fuel capacity (kg)	800	5000
Max thrust (kN)	6.5	180

### Glossary:

- **Port** – the pilot's left wing if they are facing forward in the cockpit
- **Starboard** – the pilot's right wing if they are facing forward in the cockpit
- **Weight** is the force of gravity. It acts in a downward direction - usually measured in *Newtons*— toward the centre of the Earth
- **Thrust** is the force that propels an aircraft in the direction of motion. Engines produce thrust
- **Drag** is the force that acts opposite to the direction of motion. Drag is caused by friction and differences in air pressure
- **Lift** is the force that acts at a right angle to the direction of motion through the air. Lift is enabled by an aircraft's wings
- **kN** stands for **kilonewton(s)** – a Newton is a measurement of pressure and force used in engineering. A kilonewton is 1,000 Newtons.
- **Service ceiling** – the maximum height a pilot will fly the aircraft before its performance is affected
- **Mass** is a measure of how much matter is in an object measured in kg

- **Max take-off mass** – the maximum mass at which the aircraft is certified to take-off
- **mph** – miles per hour
- **m/s** – metres per second

*IWM (Imperial War Museums) tells the story of people who have lived, fought and died in conflicts involving Britain and the Commonwealth since the First World War. Our unique collections, made up of the everyday and the exceptional, reveal stories of people, places, ideas and events. Using these, we tell vivid personal stories and create powerful physical experiences across our five museums that reflect the realities of war as both a destructive and creative force.*