



RAF: First to the Future - Classroom Resource

Supporting information for teachers

What is the resource?

This resource provides a taste of some of the issues explored within the RAF Museum's RAF: First to the Future exhibition. The resource focuses on debating activities connected to the RAF and the Armed Forces. This encompasses use of new technology and ethical issues surrounding warfare today and in the future.

How can I use it?

The resource is for use in the classroom and can be used as a stand-alone activity, or it can support a visit to the RAF Museum, London.

The resource is a 'plug and play' so is ready to be shown on classroom screens. It contains everything you need to deliver four practical activities.

Each activity can be used as a stand-alone lesson or elements of the activities can be combined to provide a dynamic lesson. This resource provides a flexible framework to look at some of the moral and ethical issues surrounding the RAF and the Armed Forces in a modern world.

You may also decide to use the activities as starters for your existing curriculum or you may choose to build a unit of work around the issues raised.

What are the activities?

Stand Your Ground!

A series of statements regarding potentially controversial issues related to the RAF and the Armed Forces. Pupils are asked to move to different sides of the room to show if they are 'for' or 'against' a series of statements. Each are explained in advance and students are asked to justify their positions.

Designed to Win – The F35 Lightning II

An exploration of the groundbreaking technology of the RAF's newest fighter aircraft. Students explore the features of the aircraft and decide which are the most or least important on the battlefield of today.

Note: Slide 37 can be printed and a copy provided to each pair / small group of students. Having discussed the technologies, they then rank them from most important to least important. Because each mission could be different, there is no right or wrong ranking. The emphasis is on the students justifying their decisions.

Persuade Me

In this activity students explore the ethical issues around making precision strikes on human targets. Participants weigh up the pros and cons of making a strike that has the potential to carry out a mission, but that could also put civilian lives at risk.

Full Circle

Statements relating to the F35 and the cost of such technologies are debated by students in an exercise involving going back and forth with pros and cons. Sitting in a circle, each student must give an alternating 'for' or 'against' argument or statement. This allows both sides to be considered and will give participants an opportunity to explore different points of view.

What curriculum areas does it support?

Curriculum links can be found within the following subjects: Citizenship, Computing, Design & Technology, English, History, Politics & Government, PSHE and Science.

The content can also be used within assemblies, to facilitate careers-focused discussion or as stimulus for extra-curricular debate clubs.

What skills does it support with my students?

It focuses on discussion and debating skills and is for use across Key Stages 3, 4 and 5.

What next?

If you have enjoyed the activities in this resource you can find out more about the issues raised by visiting our [RAF: First to the Future](#) exhibition or book on to our [Debate Space workshop](#).

Debate Space workshop

Are robots taking over the world? Should drones be allowed in our skies? Should we be worried about AI? Supplement your exhibition visit with a 60-minute facilitated workshop in our purpose-built Interactive Debate Space, £60 per session.

Book online at the following URL:

<https://www.rafmuseum.org.uk/london/schools/school-visit-booking.aspx>

How can I provide feedback?

We would love to know what you think about this resource. Please let us by completing this short survey: <https://www.surveymonkey.co.uk/r/FttFResource>

The F35 and Glossary of key terms

What is the RAF?

RAF stands for Royal Air Force. It is the United Kingdom's aerial armed service and helps defend Britain from the air. It was formed in 1918 and is the oldest independent air force in the world. The RAF employs around 33,000 people.

What is the F-35 Lightning II?

The RAF has always pushed the boundaries of speed, reach and height to gain an advantage over the enemy. Many new designs have evolved over the last century that have enabled aircraft to travel faster, further, higher and lower.

The Lockheed Martin F-35 Lightning II is the world's most advanced aircraft and is part of the RAF's fleet. The F-35 is a 5th Generation multi-role aircraft, capable of ground attack and air-to-air combat. It combines advanced stealth with fighter speed and agility. It has fully fused sensor information and network-enabled operations. It is the first production aircraft capable of both vertical take-off and landing and supersonic flight. It is also the first stealth aircraft to enter RAF service.

Who developed the F-35?

The Lockheed Martin F-35 Lightning II project involves 12 international participants and over 1,500 suppliers. The other participants – including the USA, Italy and the Netherlands - will also acquire F-35 aircraft for military use. Each aircraft costs around £80 million to build and the entire development cost is expected to be well over a trillion pounds. We think that the F-35 will be the UK's main strike aircraft until at least 2040.

Why was the F-35 developed?

Fleets are getting smaller and older and therefore need replacing with modern, more capable aircraft.

What capabilities does the F-35 have?

Multi mission: The F-35 is designed for many missions, with advanced, integrated sensors built into every aircraft. Missions that were previously performed by a number of different specialised aircraft can now be executed solely by a squadron of F-35s.

Stealth: Many features, such as the external shape and the materials used on the surface of the aircraft, make the F-35 virtually undetectable to enemy radar.

Supersonic flight: The F-35 is able to fly at supersonic speeds (mach1.6 – 1930 km/h). Supersonic means faster than the speed of sound (mach1 – 1235km/h).

Vertical take off and landing: The F-35B model has the ability to take off and land vertically.

Continuous all-direction target detection and identification: The F-35's Distributed Aperture System (DAS) is the most sophisticated 360-degree situational awareness system in use. Six cameras mounted around the aircraft send high resolution real time images to the pilot's £400,000 custom-built helmet. This allows the pilot to see the whole environment around them. At night and in total darkness the images are presented as if it is daytime. When the F-35's radar detects something, the software will closely monitor it and make the pilot aware of any potential threats. The software is also able to prioritise potential threats for the pilot.

Off boresight: The F-35 doesn't need to be physically pointing at its target for weapons to be successful. Sensors can track a nearby aircraft and provide the information to the pilot via their helmet, and a seeker missile can be used.

Advanced electronic systems (avionics): These enable F-35 pilots to locate and track the enemy, jam radars and disrupt attacks. Advanced avionics give the pilot real-time access to battle space information with 360-degree coverage and a tactical advantage. Data collected by sensors on the F-35 will immediately be shared with commanders and allies on land, sea and air, providing an instantaneous view of ongoing operations.

Air-to-ground attack: The combination of stealth, radar, and the ability to carry weapons and fuel internally allows F-35 pilots to engage ground targets at longer ranges without being detected and tracked. Use of precision-guided munitions speeds up operations and can help minimise collateral damage. The F-35 will enter the battlespace first, clearing the way for follow-on forces.

Air-to-air combat: Other aircraft can be more easily detected by radar. As the F-35 is almost invisible to radar, pilots are able to detect other aircraft before being 'seen' themselves and can make more informed decisions.

Intelligence, Surveillance and Reconnaissance (ISR): The F-35 has the most powerful integrated sensors of any fighter aircraft in history. Pilots have a 360-degree access to 'real-time' information, which is securely shared with commanders at sea, in the air or on the ground, providing a more comprehensive view of operations. Combining this information with stealth, the F-35 can perform critical ISR missions.

Full Mission Systems Coverage: The F-35 has the largest suite of communications of any aircraft, including radar, GPS, satellite, targeting system, and helmet displays. It has immediate communication with other aircraft or ground units, and commanders.

Joint operations: The F-35 is designed to share everything it can see with other aircraft and commanders. It can support the operations of all involved.

Built-in maintenance: 95% of parts are very easy to replace while in the field (e.g. the ejection seat can be removed without removing the canopy). There is an

automatic logistics information system to alert ground crew to any parts which need ordering.

What are the vulnerabilities of the F-35?

Multi-role: can one aircraft do everything?

Cost: each aircraft costs just over £80 million

One pilot: if something happens to the pilot, the whole aircraft will crash

Fuel cell safety: these are near to critical areas, and near to the pilot

Delay in build: the development and build has run over schedule, which has meant other countries are not far behind building their own 5th generation aircraft

Large supply chain: parts are manufactured in multiple countries, with multiple companies involved

Reliance on software: who owns the rights and who makes the updates?

Reliance on communications / networks cyber information / satellites: what would happen if any of these were cut, or hacked? Could they be fed fake information?

Where can I find out more?

<https://www.rafmuseum.org.uk/galleries/raf-first-to-the-future/>

www.f35.com

(includes 'Fast Facts' document – see section 'About the F-35')

<https://www.raf.mod.uk/aircraft/f-35b-lightning/>

(includes 3D model)