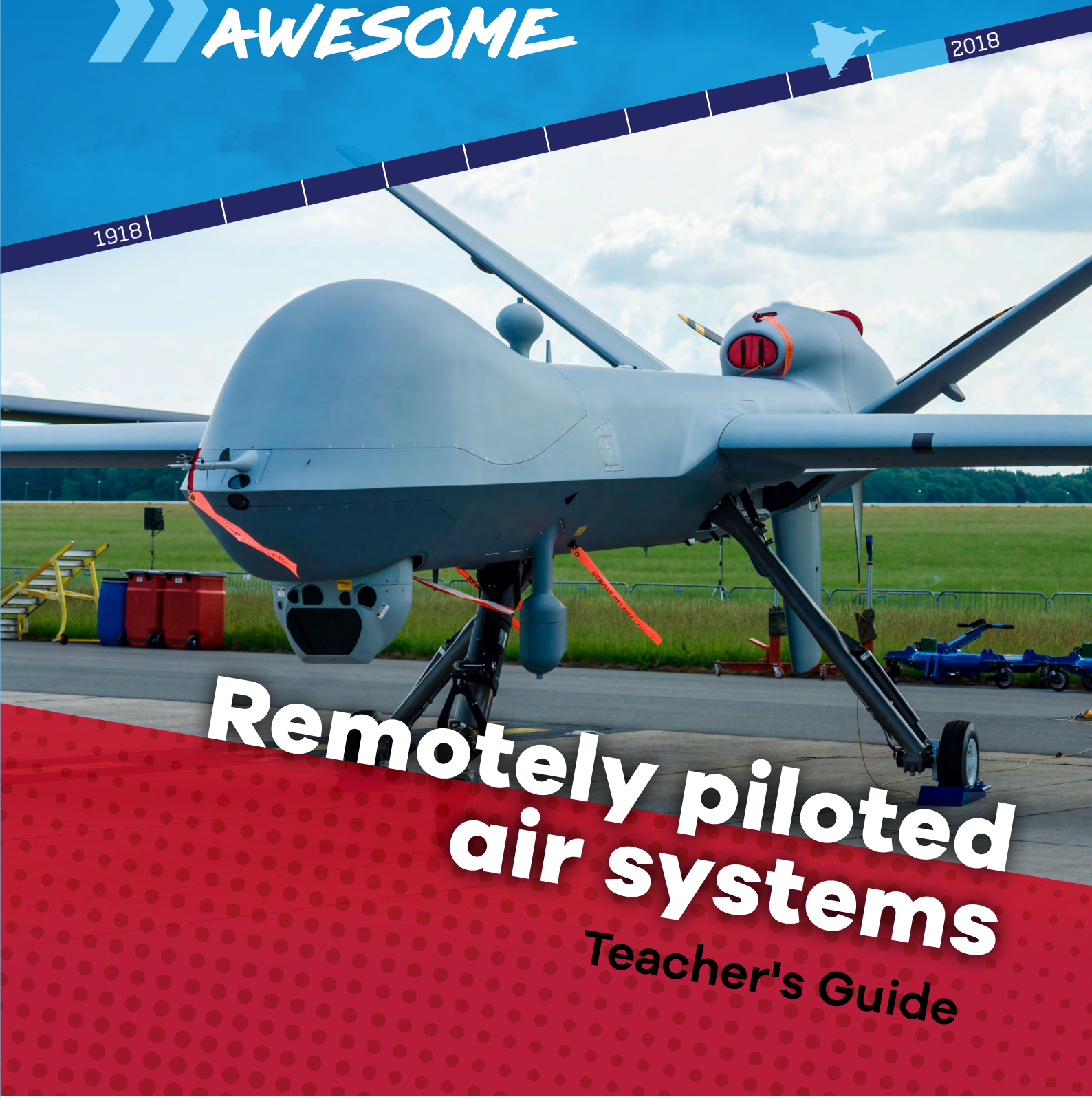
AIMING FOR AWESOME

1918 2018



Remotely piloted air systems

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 design, production and control of Remotely Piloted Aircraft Systems.

Curriculum links

England

Activity	Key Stage	Subject	National Curriculum
Time to think	KS3	*Computing*	Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.
Time to investigate	KS2	*Computing*	Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts
Time to investigate	KS2	*Mathematics*	Geometry – properties of shape: angles at a point and one whole turn (total 360°), angles at a point on a straight line and ½ a turn (180°), other multiples of 90°
Stretch and challenge	KS3	*Mathematics*	Geometry and measure

Scotland

Activity	Subject	Topic	Experiences and outcomes
Time to think	*Technologies*	Technological developments in society and business	TCH 3-06a
Time to investigate	*Technologies*	Computing science	TCH 2-13a, TCH 2-14a, TCH 3-14a, TCH 2-15a
Stretch and challenge	*Numeracy and mathematics*	Angle, symmetry and transformation	MTH 2-17b, MTH 2-17c, MTH 2-17c

Northern Ireland

Activity	Key Stage	Subject	National Curriculum
Time to think	KS3	*Science and technology: technology and design*	**Objective 2:** explore issues related to ethical awareness
Time to investigate	KS3	*Mathematics and numeracy*	Developing pupils' knowledge, understanding and skills: knowledge and understanding of shape, space and measure **Objective 1:** working collaboratively in problem solving
Stretch and challenge	KS3	*Mathematics and numeracy*	Developing pupils' knowledge, understanding and skills: knowledge and understanding of shape, space and measure **Objective 1:** working collaboratively in problem solving, taking into account others' viewpoints to reach consensus; demonstrate an ability and willingness to develop logical arguments

Preparation

- Ensure all materials and equipment needed is available well in advance of the session. See the resource list below for essential materials and components.
- A full risk assessment should be conducted prior to the session.
- 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:

- One copy of Remotely piloted air systems support sheet one
- One copy of Remotely piloted air systems support sheet two
- Model aircraft from Remotely piloted air systems support sheet three

Unmanned vehicles

Unmanned vehicles are becoming increasingly common, with driverless pods at Heathrow airport that transport passengers between terminals and self-driving cars due to hit roads by 2020.

Unmanned vehicles are not just confined to the roads though, they can be designed to travel across any terrain , even if it is unreachable or dangerous to humans.

This allows us to explore more and previously unreachable areas of the world, and the universe. Unmanned vehicles have been used to research the deepest depths of the oceans and the furthest reaches of the solar system.

In 2005 the RAF began to use remotely piloted air systems (RPAS) when a new unit, No. 1115 Flight, was formed at Creech Air Force Base in Nevada. The squadron has now relocated to RAF Waddington in Lincolnshire.

As of March 2009, the squadron operated 12 three-man teams to pilot its Reaper aircraft, supporting intelligence specialists, information communications technicians, signallers, and meteorologists.

TIME TO THINK

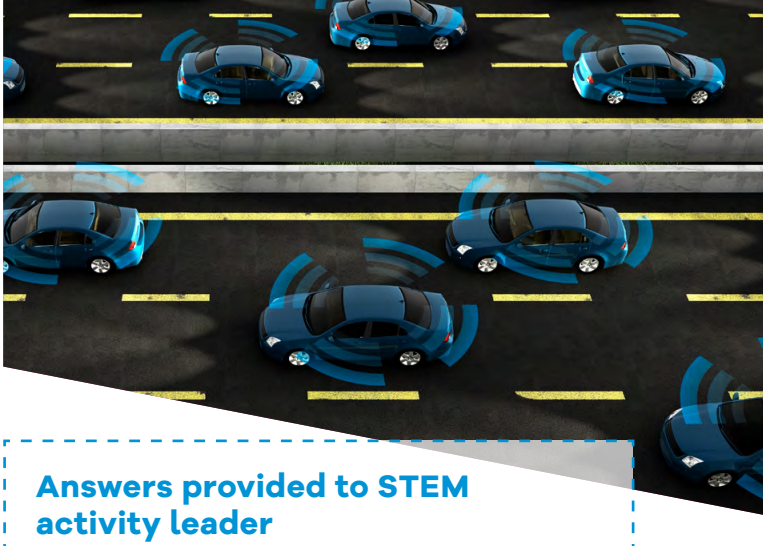
Self-driving cars move autonomously. The vehicles have a variety of sensors, such as radar, lasers and GPS to navigate their surroundings without a driver.

Advanced control systems interpret the information to identify the best route to take, as well as obstacles in the road.

Automated cars permitted on public roads are not yet fully autonomous. They all require a human driver at the wheel who is ready to take control of the vehicle at a moment's notice.

Do you think self-driving cars are a good or bad idea?

In pairs, come up with three positives and three concerns about self-driving cars.



Answers provided to STEM activity leader

For this activity, it might be interesting to have the students place themselves on a continuum before and after the discussion. One side of the classroom could be for self-driving cars, and the other side against self-driving cars. Students could position themselves on the continuum as to how strongly they agree with the statement.

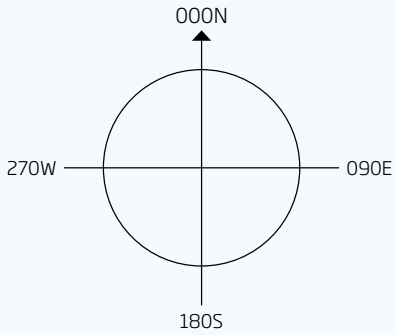
Positives	Negatives

TIME TO INVESTIGATE

You need to write a flight plan for the RPAS to get from base to landing strip A.

To avoid being detected you must not fly over radar towers. Which of the three programmes below should you use?

In these flight plans the aircraft is told which direction to travel in using bearings. For example, if the flight plan says "turn to 090" the aircraft should turn to face east.



Flight plan A	Flight plan B	Flight plan C
Turn to 180	Turn to 090	Turn to 000
Move forward one square	Move forward five squares	Move forward three squares
Turn to 090	Turn to 000	Turn to 090
Move forward five squares	Move forward two squares	Move forward three squares
Turn to 000	Turn 090	Turn to 180
Move forward two squares	Move forward one square	Move forward one square
Turn to 090		Turn to 090
Move forward one square		Move forward three squares

Can you write a simpler flight plan to get to landing strip A?

You have been given the following flight plan to fly the RPAS from landing strip A to landing strip B, however there is a problem with the plan.

The flight plan now tells the aircraft how many degrees to turn. The aircraft starts by facing east. Debug the flight plan so that the RPAS can land safely on landing strip B.

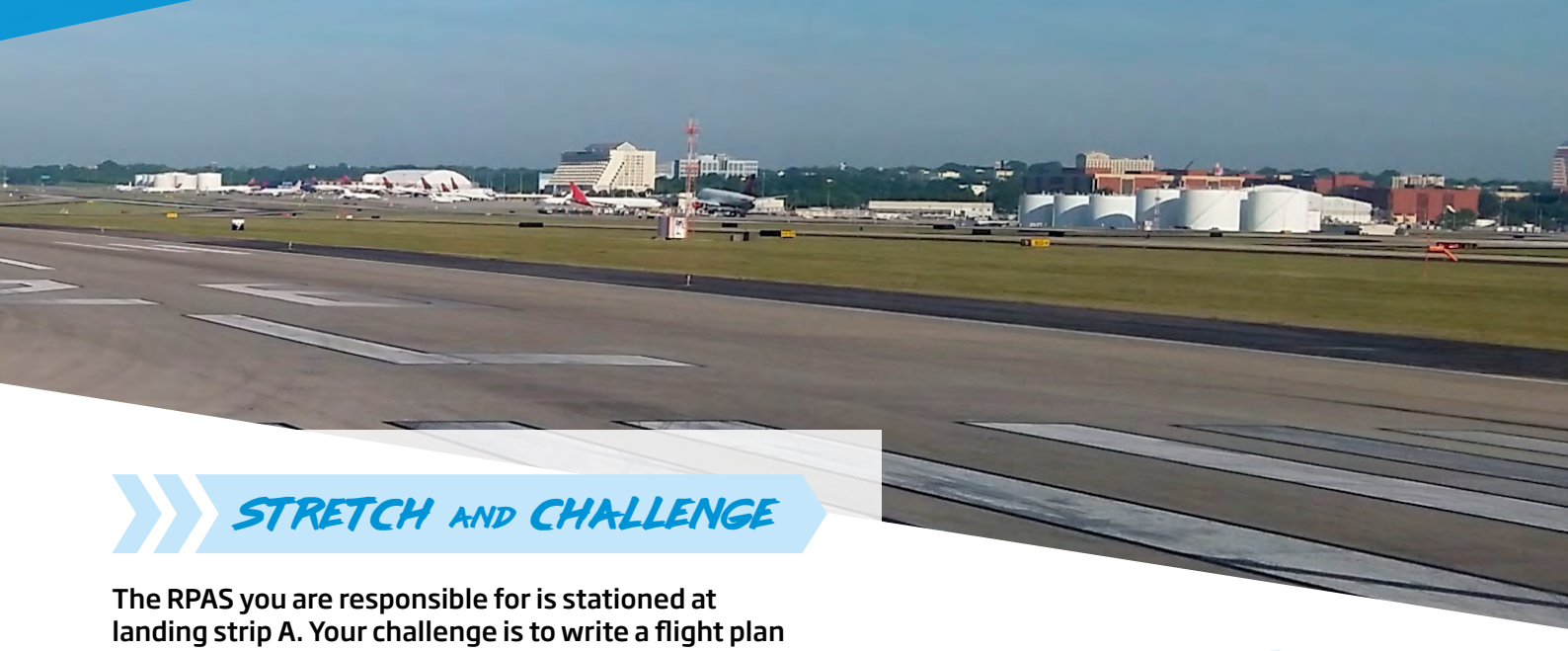
Flight Plan

Turn 090
Move forward three squares
Turn -090
Move forward two squares
Turn 090
Move forward one square

Guidance provided to STEM activity leader

For this activity, students will need remotely piloted air systems support sheet 1 and a cut out of an aircraft from remotely piloted air systems support sheet 3.

Flight plan C will get the aircraft to landing strip A. Flight plan B will also land the aircraft at landing strip A, however the aircraft will be detected by one of the radar towers.



STRETCH AND CHALLENGE

The RPAS you are responsible for is stationed at landing strip A. Your challenge is to write a flight plan to deliver aid to a village at B and return to base.

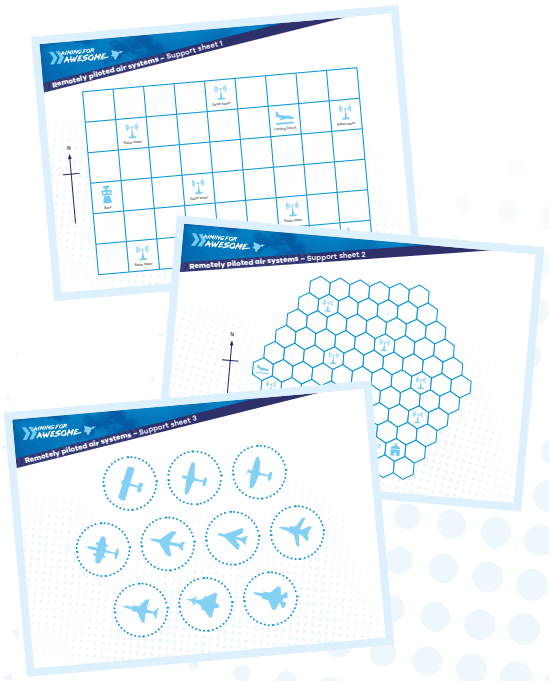
In pairs, test each other's flight plans.

Are your flight plans the same? If not, which flight plan is more efficient?

Guidance provided to STEM activity leader

For this activity, students will need remotely piloted air systems support sheet 2 and a cut out of an aircraft from remotely piloted air systems support sheet 3.

Students might need support creating a flight plan for a hexagonal grid. There are a variety of ways they can do this, for example using hexagonal grid coordinates or angles to turn the aircraft.



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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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