The Sky's the Limit

Raytheon UK

ROYAL AIR FORCES Association
The charity that supports the RAF family

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Raytheon UK | Royal Air Forces Association
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Introduction

Do you know that the study of STEM subjects is vital to the future of the UK? Our nation needs children just like you to learn about Science, Technology, Engineering and Mathematics (STEM), so that, in the years to come, we continue to have talented people working in aviation, space, engineering, medicine and other Royal Air Force (RAF)-related careers.

The Royal Air Forces Association – the charity that looks after the RAF community – is delighted to be partnering with Raytheon UK to bring you this booklet. I trust that you will be inspired through the enjoyment of learning from its exciting activities!

Air Marshal Sir Baz North

President of the Royal Air Forces Association

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Welcome

Raytheon UK and the Royal Air Forces Association have partnered together to create a fun and educational booklet that explores the key informative themes of Science, Technology, Engineering and Maths (STEM). Equipped with challenges and puzzles, this booklet aims to inform, inspire and demonstrate how important STEM is to careers within the aerospace industry at institutions such as the Royal Air Force (RAF).

Covering a range of key topics, Raytheon UK and the Royal Air Forces Association are excited to be able to provide students with this opportunity to get involved with STEM activities and learn more about the industry.

We hope this booklet provides you with hours of fun and valuable learning.

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Introduction to Aerospace

The Royal Air Force

The Royal Air Force (RAF) is more than 100 years old! During the First World War, the Royal Flying Corps joined with the Royal Naval Air Service to create a new force – the Royal Air Force.

When the RAF was formed, it was the world's most powerful air force, with over 290,000 people and almost 23,000 aircraft.

After the First World War, the RAF was reduced in size and was used essentially as a 'police force in the skies' throughout the British Empire.

When the Second World War began, the RAF needed to grow again. Lots of new aircraft were built, and many people were trained to carry out jobs that would help to protect the UK and contribute – in many different ways – to winning the war.

During the Cold War (a time of political tension between Western countries and the Soviet Union, from around 1947 to 1991), the RAF's main job was helping to protect Europe from Soviet attacks (which thankfully never came).

The RAF has since played an important role in numerous large operations, including the Gulf War, the Iraq War and the conflict in Afghanistan.

As well as protecting the UK, the RAF also provides essential help to local communities, including logistic and medical support during the COVID-19 pandemic. The RAF is also there in a crisis, for example building flood defences to protect people's homes.

The RAF works with overseas governments and charities to deliver food and other supplies to people in countries affected by disasters.

With access to some of the world's most advanced and exciting aviation and cyber technology, the RAF (along with the Army and Royal Navy) is contributing to the newly formed UK Space Command.

Royal Air Forces Association

The Royal Air Forces Association (or RAF Association, as we're often called) is a charity that's been looking after the RAF community for over 90 years.

We help people who have worked in the RAF to keep in touch with each other, so they don't feel lonely. We also provide all kinds of services that help anyone who has been, or still is, in the RAF. We support their families, too.

We're a good friend to more than 85,000 people every year. If you join the RAF in the future, we'll be here for you!

Raytheon UK

Raytheon Technologies Corporation is an aerospace and defence company that provides advanced systems and services for commercial, military and government customers worldwide.

With facilities across the United Kingdom, Raytheon UK is invested in the British workforce and the development of UK technology. Across the country the company employs 1,700 people and as a prime contractor and major supplier to the UK Ministry of Defence, Raytheon UK continues to invest in research and development, supporting innovation and technological advances across the country.

Aircraft

The Spitfire

is the most famous British fighter aircraft in history. It became a symbol of freedom during the summer months of 1940 by helping to defeat the German air attacks during the Battle of Britain.

Did you know?
More Spitfires were built than any other British combat aircraft before or since WWII, with a total of 20,341 manufactured in total!

The Atlas c.1 A400M

is a military cargo carrier that has been in service for the RAF since 2014, and is used to transport important armed forces equipment, such as a heavy helicopters.

Did you know?
The Atlas can carry up to 37 tonnes! That's like carrying 5 male elephants!

The F35 Lightning II

acts as an intelligence gathering aircraft, and has lots of clever sensors and systems that allow the aircraft to work stealthily in enivronments without being spotted.

Did you know?
The Lightning is capable of vertical landings!

The Chinook Helicopter

is a helictoper that can support missions by providing supplies, and evacuating casualties in search and rescue missions.

Did you know?
The Chinook can carry up to 55 troops!

Images source: https://www.defenceimagery.mod.uk/fotoweb
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STEM Ambassador Profile

Corporal Amy

1. What is your current role and how do STEM subjects fit within it?

I am a survival equipment technician. We work on the equipment the aircrew have to wear to be able to fly safely, such as an oxygen mask or an anti-G-force suit, as well as the equipment they would need to survive if they were to eject or crash land, such as a parachute or life raft.

Although we are classed as technicians, we also have to have an understanding of science and maths. For example, we have to understand the effects of G-force on someone's body and then make calculated adjustments to the equipment to help counteract the G-force.

2. What educational path did you take to get to where you are today?

I went to my local comprehensive and then my local college. I studied A-levels in Fine Art, Dance, History and Communication and Culture… absolutely nothing to do with my current career! Over the last four years I have been studying for a part-time degree in Design and Innovation.

3. Who is your STEM role model and why?

One of my favourite people in history is a woman called Mary Anning. Mary was born in 1799, at a time when women were not allowed to attend school. Despite this, by the age of 6 she could identify fossils and had taught herself geology and anatomy. When Mary was 12, she found a 5.2-metre-long skeleton of an Ichthyosaurus (fish lizard). At 24 she was the first person to discover a Plesiosaurus (meaning near to reptile). Sadly, at this time in history, because she was a woman, she was not allowed to be a scientist and so her scientific discoveries were not accredited.

However, today, the Natural History Museum in London display several of her amazing finds and the coastal area where she made her discoveries - the Jurassic Coast - is now a UNESCO World Heritage Site.

So why is Mary a good STEM role model? Mary didn't let somebody tell her 'no' or stop her from making scientific discoveries. She had a passion for palaeontology and because of this, she made huge discoveries in her field. People come from all over the world to see her work now.

4. Why is being a STEM Ambassador important to you?

Things we do every day can be related back to STEM. We use the mineral fluoride in our toothpaste because a scientist discovered that it prevents tooth decay. When we cook, we use maths to measure out our ingredients. Our homes require engineers to build them safely, and mobile phones are designed by a team of technicians.

STEM is important because it is literally everywhere. Being a STEM ambassador means that we get to share our knowledge with young people and help them see opportunities, especially to those who may have not considered STEM or a career in STEM before.

5. What do you enjoy the most about your role and the RAF?

Since being in the RAF I have been able to travel to many different places around the world. This also means that I get to immerse myself in different cultures and speak to interesting people. This is also where I have been lucky enough to learn new things. In Sweden I learnt how to 'read the river', to identify poisonous plants and to follow animal tracks. In Oman I learnt some traditional puzzles and how to solve (some) of them.

In the USA, I was able to work alongside their Air Force and Naval Survival Equipment Technicians. They showed us their new technology and we were able to study their different symbology systems. I love any opportunity to continue learning and the RAF has enabled me to do this.

6. What is the most challenging obstacle you have faced and how did you overcome it?

One of my biggest challenges, and still is a challenge, is keeping up with the volume of work I put on myself. I work for several charity groups as well as my job in the RAF. I am a STEM ambassador and an ambassador for two mental health organisations. On top of this I am also studying a degree and additional courses when I can. It's a lot.

Sometimes I can get really overwhelmed, but when I do, I take a deep breath and write down some organisation and time management skills I can put in place to help me. Things like a daily tracker that divides my time up ensuring I cover everything, but I also give myself time to relax and rest.

This structured schedule allows me to focus on the task at hand. If this doesn't work, I simply reach out and ask for help. Everything I learn I try to use the next time things get on top of me.

7. What advice would you give to someone who wanted to study STEM subjects or follow a STEM career path?

STEM based subjects can give you a lot of important transferable skills like problem solving or critical thinking. COVID-19 has highlighted the need for new science and technology. Studying STEM means you could make a meaningful change, developing ways of accessing clean water or improving the human immune system.

If you want to study STEM then go for it, there is a whole wealth of opportunities waiting.

Aircraft Wordsearch

T	K	W	I	A	T	Y	P	H	O	O	N	Y	W
Y	E	R	E	T	S	A	C	N	A	L	Y	T	S
P	N	H	C	O	H	S	S	H	A	A	O	E	A
Y	A	A	C	O	A	S	H	A	D	O	W	T	L
O	C	W	R	W	O	U	O	V	Y	A	A	T	T
E	I	K	O	S	T	Y	S	H	R	O	O	O	A
A	R	P	T	E	G	R	E	N	T	N	R	N	A
E	R	V	C	E	N	C	H	I	N	O	O	K	H
O	U	T	E	E	I	W	S	I	E	O	L	S	C
I	H	R	T	G	T	A	Y	I	S	A	T	O	H
C	O	R	O	I	S	P	I	T	F	I	R	E	N
E	H	R	R	I	R	I	F	U	K	S	T	L	C
O	T	O	P	V	O	Y	A	G	E	R	I	H	P
E	V	R	E	P	A	E	R	N	O	I	N	O	K

Find the following words in the puzzle.
Words are hidden ← → ↑ ↓ and ↘

CHINOOK
LANCASTER
SHADOW
TYPHOON
HURRICANE
PROTECTOR
REAPER
VOYAGER
SPITFIRE
ATLAS
SENTRY
HAWK

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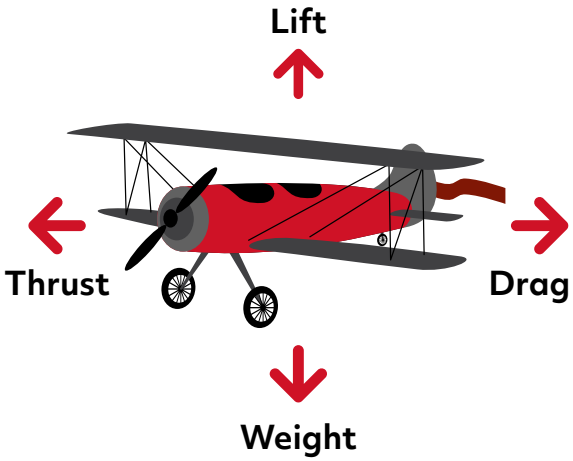
Science
Aerodynamics



When building and operating an aircraft, it's important to understand what problems and forces might prevent the aircraft from flying smoothly. One factor that must be taken into consideration is the scientific laws of gravity.

Have you ever heard of the well - known phrase "what goes up must come down"? Well, Sir Isaac Newton watched an apple fall from a tree and wondered why it fell – the answer is gravity! Gravity is an invisible force of attraction that exists between any two objects. There is force between the Earth and the Sun and between us and the Earth – it's what keeps our feet firmly on the ground! This was first recognised and explored by Sir Isaac Newton in the late 1600s.

So why is it so important to know how gravity affects aircraft flying in the sky, and what is it called to learn about this?

The name given to understanding the affects gravity has on air worthy objects is... aerodynamics! The word comes from two Greek words: aerios, concerning the air, and dynamis, which means force. Aerodynamics is the study of forces and the resulting motion of objects through the air.

There are four key forces that allow an aircraft to be able to fly and those are:

1. **Lift**
2. **Thrust**
3. **Weight**
4. **Drag**

An aeroplane can fly because it is able to generate a force called **Lift**, which moves the plane upwards. **Thrust** is the force that pushes the aircraft forward and is created by the power of the engine.

Weight is the force created by the pull of gravity. As the plane takes off the gravity pulls down towards the centre of the Earth. You can feel this force too – try jumping up and down, you'll notice that your weight will be forced back down by gravity!

Drag is the force that is produced by the resistance of the air to the forward motion of the aeroplane. So, another way to understand this is to swish your hand rapidly from side-to-side, can you feel the resistance on your hand?

So that's how gravity affects aircraft, but does gravity affect the pilot too?

YES! **G-force** stands for "Gravitational Force", and is the force used to measure an object's acceleration relative to free fall. Your body can feel the force of acceleration. For example, have you ever been in a fast car or roller coaster and felt an invisible force push you back in your seat?

A roller coaster takes advantage of this as it constantly changes its acceleration and its position to the ground, making the forces of gravity and acceleration interact in many interesting ways. When you plummet down a steep hill, gravity pulls you down while the acceleration force seems to pull you up. At a certain rate of acceleration these opposite forces balance each other out, making you feel a sensation of weightlessness.

You can read more about this here: **Roller Coasters and Your Body - Roller Coaster G-forces | HowStuffWorks**

So, when a plane is taking off and the thrust is driving acceleration and creating lift, the resistance from gravity creates this G-force. In super-fast jets used by display teams such as the Red Arrows, which fly upside down, the pilots can feel even more G-force.

STEM Ambassador Profile

Aircraft Fitter Rosie

1. What is your current role and how do STEM subjects fit within it?

My role as an aircraft fitter means that I use STEM subjects every day. Working on the aircraft itself I need to know the how the aircraft operates, how all the different systems work and know the effects of any tasks I may carry out. In my everyday work I could be measuring the angles of the flying controls, calculating distances between components, converting drill sizes, mixing ratios of paints or adhesives and calculating acceptance limits.

2. What advice would you give to someone who wanted to study STEM subjects or follow a STEM career path?

My advice to people wanting to pursue engineering would be to go for it. Don't worry about what people say, and throw yourself into it. Talk to people who do the job, maybe get some work experience and ultimately do what you think is best for you.

3. Who is your STEM role model and why?

My STEM role model would be my dad. He was an aircraft engineer himself so has given me a lot of advice about the industry. Outside of work he builds and races cars. My earliest memory is being in the garage with him and going around the country racing with my family. This is what made me want to pursue a career in STEM.

4. What career path did you take to get to where you are today?

When I left school, I went to college to gain a bit more experience and make sure that this is what I wanted to do. By doing this I gained a level 3 BTEC in engineering. Following from my college course I started my apprenticeship with Raytheon UK. I recently completed my 3-year apprenticeship scheme and I am now a Qualified Aircraft Fitter at Raytheon UK.

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Technology
Communication

Technology is an ever evolving part of science that has allowed humans to invent useful and innovative products. One piece of technology that has allowed us all to lead a more connected life is the advancement and development of electrical communication methods. Let's look at some of the methods the RAF once used to communicate previously!

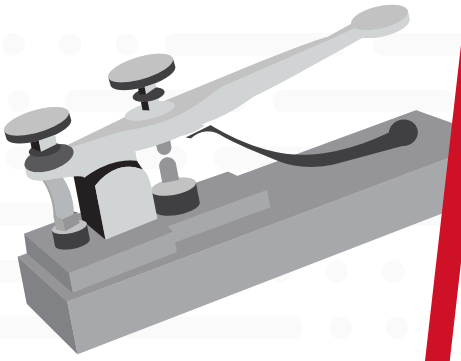
In the old days the best way to stay connected with each other was through letters, and depending on where you were sending them to depended on how long you had to wait! Famously in the Wild West days, in the USA ,the Pony Express was the fastest way to get information and letters to each other, with an average delivery time of 10 days!

In 1844, **Samuel Morse** and his assistant, **Alfred Vail**, developed the famous coding system — Morse Code, which was developed to allow messages to be sent over long distances. Morse Code messages can be sent using light or by pulses, which creates a sound to the receiver. When Morse Code was invented, the most common way to send a pulse message was via a telegraph.

A telegraph sends pulses in the form of electrical currents based on the message that was tapped out using the telegraph key. The tapped out pulses – also known as dots and dashes – can be seen on the Morse Code alphabet on the next page, and the receiver would have to spell out the message.

Morse Code was used by pilots during the First World War to communicate back to the ground. On 6th September 1914, while flying during the first Battle of the Marne in France, Lieutenant Donald Lewis spotted a 50km gap in the enemy line. He sent a wireless message using Morse Code reporting what he saw, and British and French troops charged the gap - it was the first time that a wireless message sent from a British plane was received and acted upon!

Woman sending Morse code using telegraph Stock Photo – Alamy



A ·–	B –···	C –·–·	D –··	E ·	F ··–·
G ––·	H ····	I ··	J ·–––	K –·–	L ·–··
M ––	N –·	O –––	P ·––·	Q ––·–	R ·–·
S ···	T –	U ··–	V ···–	W ·––	X –··–
Y –·––	Z ––··	1 ·––––	2 ··–––	3 ···––	4 ····–
5 ·····	6 –····	7 ––···	8 –––··	9 ––––·	0 –––––

1. Write your name in morse code

2. Spell out in Morse Code: The top speed of a Spitfire was over 400 miles per hour

3. Write out the names of the Morse Code founders

As technology advanced, the RAF started using the North Atlantic Treaty Organisation (NATO) phonetic alphabet rather than Morse Code. The NATO phonetic alphabet is a system where a letter is exchanged for a full word, and this is used to support clear communication in instances where pilots need to identify aircraft by a series of letters and numbers.

The RAF changed the codes during the Second World War, particularly with the arrival of the Americans in 1943. Check out the phonetic alphabet below!

Letter	1939-42	1942-43	1943-45	Today (2021)
A	Ace	Apple	Able	Alpha
B	Beer	Beer	Baker	Bravo
C	Charlie	Charlie	Charlie	Charlie
D	Don	Dog	Dog	Delta
E	Edward	Edward	Easy	Echo
F	Freddie	Freddie	Fox	Foxtrot
G	George	George	George	Golf
H	Harry	Harry	How	Hotel
I	Ink	In	Item	India
J	Johnnie	Johnnie	Jig	Juliet
K	King	King	King	Kilo
L	London	Love	Love	Lima
M	Monkey	Mother	Mike	Mike
N	Nuts	Nuts	Nab	November
O	Orange	Orange	Oboe	Oscar
P	Pip	Peter	Peter	Papa
Q	Queen	Queen	Queen	Quebec
R	Robert	Robert	Roger	Romeo
S	Sugar	Sugar	Sugar	Sierra
T	Toc	Tommy	Tare	Tango
U	Uncle	Uncle	Uncle	Uniform
V	Vic	Vic	Victor	Victor
W	William	William	William	Whiskey
X	X-Ray	X-Ray	X-Ray	X-Ray
Y	Yorker	Yorker	Yoke	Yankee
Z	Zebra	Zebra	Zebra	Zulu

STEM Ambassador Profile

Flying Officer Fred

1. What is your current role and how do STEM subjects fit within it?

My current role as a communication engineer presents different challenges daily. Understanding the science behind the electromagnetic spectrum and soundwave propagation is vital. On some days I can be calculating microwave angles and distances between various equipment. On others, I am dealing with ones and zeroes in computing to improve or monitor network traffic.

2. What educational path did you take to get to where you are today?

I studied Physical Education (for team building), Maths and Physics at A-level. I then completed a Marine Engineering degree and spent two and a half years working at sea as a marine engineer. I then joined the Army, gained an NVQ Level 3 in Aeronautical Engineering and spent three and a half years fixing aircraft with the Army. I decided to switch to the RAF as I loved working within aviation, and I have been in my current post for almost two years.

3. Who is your STEM role model and why?

I have had different role models at various stages in my life, however, Sir Isaac Newton has been the one constant. His work on the laws of gravity and how he used simple daily activities to come to his conclusions was brilliant. It shows you don't need to be super smart to understand Science or Maths, you just need to be able to apply simple reasoning.

4. Why is being a STEM Ambassador important to you?

Being a STEM ambassador gives me the opportunity to share my experiences and knowledge with young people to make them aware of the various opportunities around them. Going through school or college and studying many subjects, you may not grasp their importance and application in real life. However, having someone translate that to you so you understand its real-world application makes things a lot clearer. We are in the information age and the world is more and more reliant on STEM.

5. What do you enjoy the most about your role and the RAF?

I love the travel to different places in the world and the variety of roles that I can transition between as I progress in my career.

6. What is the most challenging obstacle you have faced and how did you overcome it?

I found leading my team during the last year very challenging with most people working from home. So, getting that work/life balance for everyone while ensuring their safety was tricky. Providing IT resources and using Skype and Teams for meetings reduced the need to be at work. We realised an increase in performance in some areas and will look at implementing lessons learnt in the future.

Engineering
Aerodynamics

Engineering draws on all the STEM fields and applies them to solve problems and to create innovative devices, structures, and software applications. Did you know that almost everything made by people started with the ideas and work of engineers? Just look around at the things that make your life interesting, comfortable, and fun — the dishes and cutlery you eat with, television sets, cars, video games, the bridges you cross on roads, aircraft, ships, and spacecraft — even make-up — all take the work of engineers.

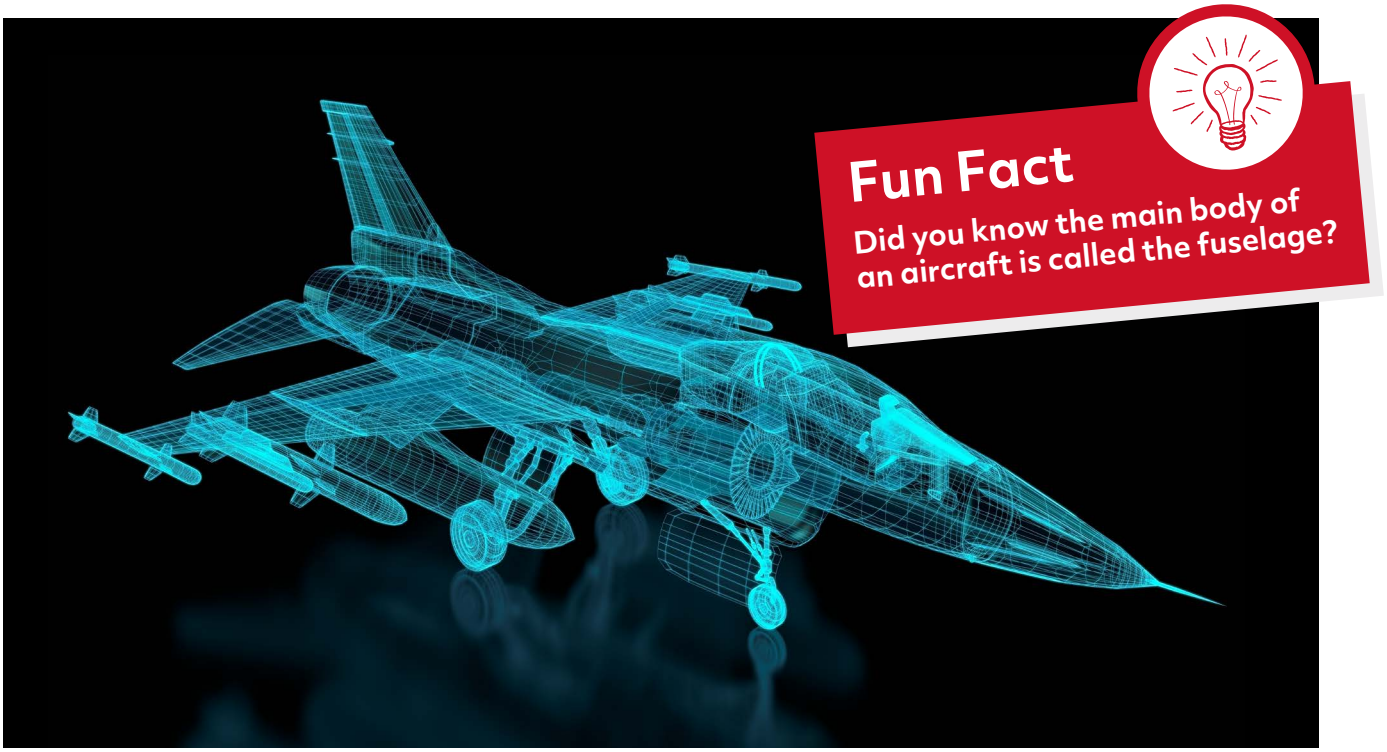
Engineers are the people who make things work, who imagine, design and invent, and create amazing products. There are many kinds of engineers and the RAF needs lots of aerospace engineers to make flight possible.

One area of focus that aerospace engineers need to understand and think about when they are building aircraft is how the structure will be used and which materials will be required to ensure maximum flying capabilities.

There are many factors aerospace engineers need to think about when building an aircraft. Forty years ago, aluminium dominated the aerospace industry and was considered to be lightweight, inexpensive, and state-of-the-art — in fact, as much as 70% of an aircraft was once made of aluminium! However, as technology and engineering has advanced, there is now greater demand for more lightweight, robust materials that can withstand extreme temperatures and help the aircraft be faster and more fuel efficient.

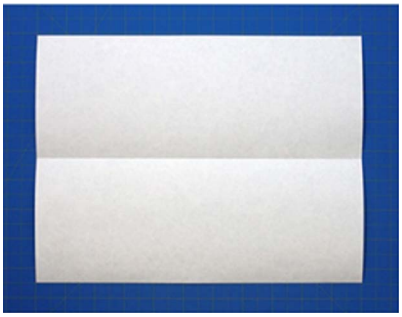
Another key element that goes hand in hand with selecting the right material is understanding the design of the aircraft and ensuring aerodynamics are not compromised. This can be done by analysing streamlines and making the aircraft as efficient as possible.

In nature, the bodies of all flying birds are shaped like teardrops, allowing them to be streamlined. This is achieved by specially arranged feathers that reduce the friction that would otherwise act as a drag against the forward-moving body.

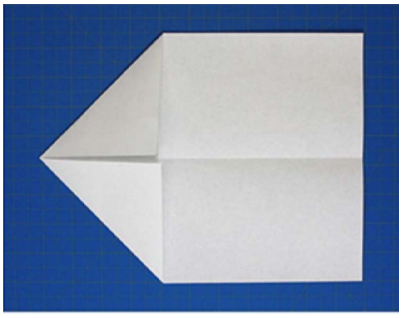


Paper Aeroplane

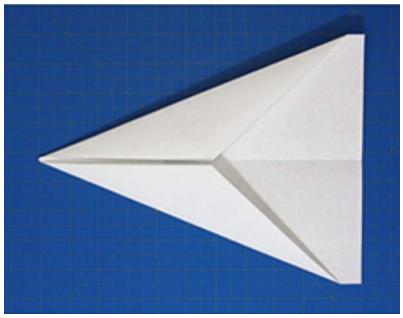
Have a go at making your own paper aeroplane. You can experiment with thicker paper that creates larger and more rounded corners, and with thinner paper that allows for a sharp edge to see how important streamlining is!



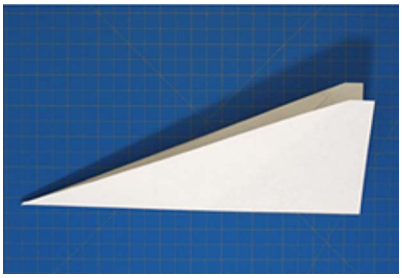
1. Fold the paper in half



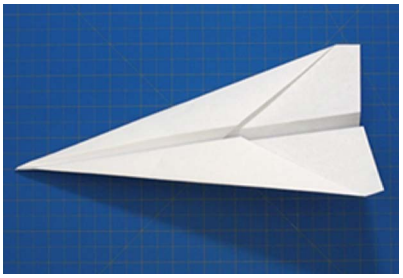
2. Unfold and then fold the corners into the centre line



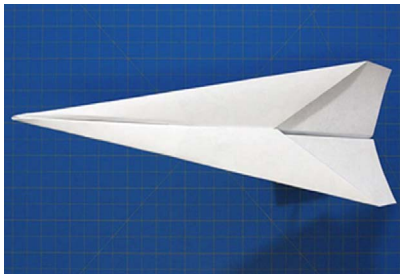
3. Fold the top edges to the centre



4. Fold the aeroplane in half



5. Fold the wings down to meet the bottom edge of the aeroplane's body



Final paper aeroplane design

STEM Ambassador Profile

Flight Lieutenant Jamsyn

1. What is your current role and how do STEM subjects fit within it?

My current job is as a helicopter instructor where I teach the next generation of pilots. STEM fits into this role on a continual basis, as I need to be able to understand how all the technology on our aircraft work. I need to do mental arithmetic to work out how much fuel I need for my flight, I need to be able interpret weather charts, and so many other tasks – this list is never ending!

2. What educational path did you take to get to where you are today?

I completed my GCSEs and went on to study Maths, Chemistry and Biology at A-level (mainly because they were the subjects I enjoyed most). I went on to complete a degree in Biology at university and while there I was introduced to the University Air Squadron which piqued my interest in flying and the military.

3. Who is your STEM role model and why?

My STEM role models would be all the women in the Second World War who took on work that they never would have been historically allowed to do. All those women who became engineers, pilots, farmers, mechanics, drivers etc. They paved the way to show that women were perfectly capable of performing these tasks in demanding situations.

4. Why is being a STEM Ambassador important to you?

I want to ensure that nobody feels their options are limited – they shouldn't feel that they can't do something because it isn't 'stereotypically' done. I feel this is particularly pertinent for girls and it disappoints me that there aren't more girls going through the helicopter training system than when I went through it nearly 20 years ago.

5. What do you enjoy the most about your role and the RAF?

I think my role has the best of both worlds in that I'm part of the military and enjoy the ethos that it encompasses, but I also get to teach and pass on my knowledge to the next generation. I also had the privilege of flying Search and Rescue missions for the RAF for 10 years before becoming an instructor.

6. What is the most challenging obstacle you have faced and how did you overcome it?

I think the most challenging obstacle I have had to overcome is the ability to portray a confident demeanour even when I haven't necessarily felt it. I have a naturally quiet and introverted character and have had to adapt to be able to lead a crew in demanding situations.

7. What advice would you give to someone who wanted to study STEM subjects or follow a STEM career path?

If you want to study STEM, then do it! Above all, you should do what you enjoy. Your working life makes up a significant portion of your time on this earth, and therefore you should follow something that gives you fulfilment and satisfaction. For lots of people this can be achieved through the vast array of careers that STEM offers.

Mathematics
Distance, Speed & Time

Maths is the fundamental foundation of aerospace engineering. From modelling shapes, to calculating fuel consumption or determining maximum weight capacity, maths is present in all these areas. Before a flight, a pilot should make calculations to determine the time, speed, and distance, and the amount of fuel required for the flight.

Frequently, it is necessary to convert minutes into equivalent hours when calculating speed, time, and distance problems. To convert minutes to hours, divide by 60 (60 minutes = 1 hour).

To find the time in flight, divide the distance by the ground speed. The time to fly 210 nautical miles at a ground speed of 140 knots is 210 ÷ 140 or 1.5 hours which is 1 hour 30 minutes.

To find the distance flown, multiply the ground speed by the time. The distance flown in 1 hour 45 minutes at a ground speed of 120 knots is 120 × 1.75 or 210 nautical miles.

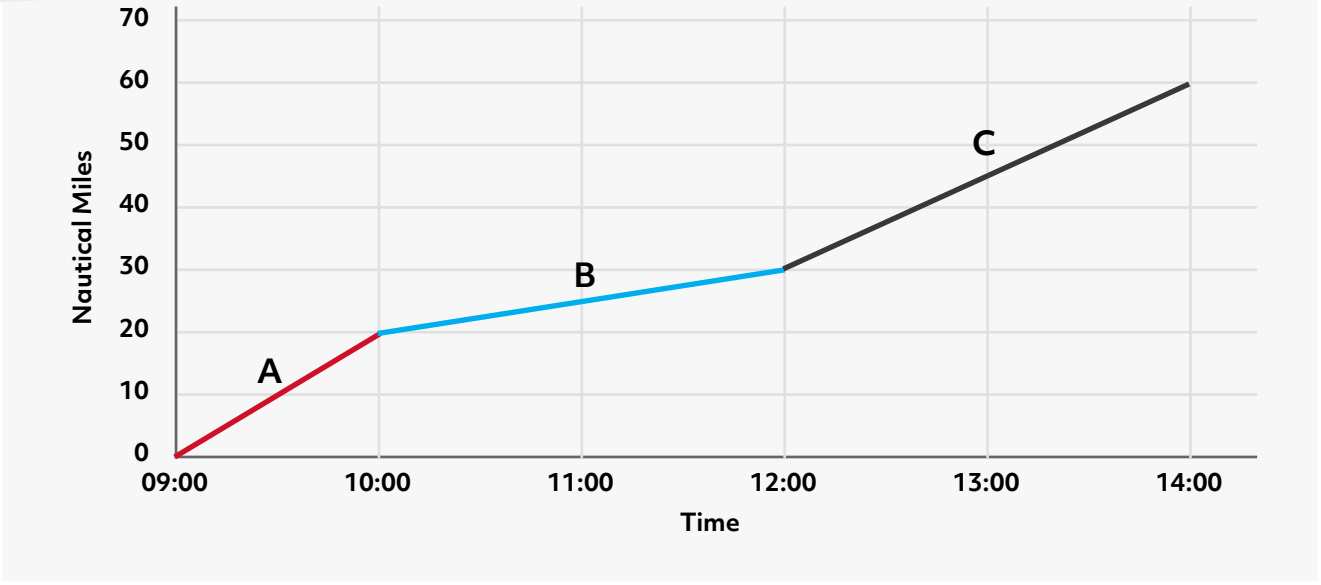
To find the ground speed, divide the distance flown by the time required. If an aircraft flies 270 nautical miles in 3 hours, the ground speed is 270 ÷ 3 = 90 knots.

Another conversion is that of changing knots to miles per hour (mph). The aviation industry is using knots more frequently than mph but it is important to understand the conversion for those that use mph when working with speed problems or wind strength.

To convert knots to mph, multiply speed in knots by 1.15. For example, a wind speed of 20 knots is equivalent to 23 mph.

To learn more about the basic calculations pilots need to make, head over to Flight Literacy: Basic Calculations (flightliteracy.com)

What is the speed of the aircraft at each part of the journey (in knots)?
Bonus Question:
What is the speed at each part in mph?



Answers

Page 8
Wordsearch

T	K	W	I	A	T	Y	P	H	O	O	N	Y	W
Y	E	R	E	T	S	A	C	N	A	L	Y	T	S
P	N	H	C	O	H	S	S	H	A	A	O	E	A
Y	A	A	C	O	A	S	H	A	D	O	W	T	L
O	C	W	R	W	O	U	O	V	Y	A	A	T	T
E	I	K	O	S	T	Y	S	H	R	O	O	O	A
A	R	P	T	E	G	R	E	N	T	N	R	N	A
E	R	V	C	E	N	C	H	I	N	O	O	K	H
O	U	T	E	E	I	W	S	I	E	O	L	S	C
I	H	R	T	G	T	A	Y	I	S	A	T	O	H
C	O	R	O	I	S	P	I	T	F	I	R	E	N
E	H	R	R	I	R	I	F	U	K	S	T	L	C
O	T	O	P	V	O	Y	A	G	E	R	I	H	P
E	V	R	E	P	A	E	R	N	O	I	N	O	K

Page 12
Morse code

Q2.
THE TOP SPEED OF A SPITFIRE WAS OVER 400 MILES PER HOUR

Q3.
SAMUEL MORSE

ALFRED VAIL

Page 18
Distance, Speed, Time

Main Answers
Speed = Distance / Time
A = (20-0) / (10:00-09:00) = 20 nautical miles / 1 hour = 20 knots
B = (30-20) / (12:00-10:00) = 10 nautical miles / 2 hours = 5 knots
C = (60-30) / (14:00-12:00) = 30 nautical miles / 2 hours = 15 knots

Bonus Answers
mph = knots x 1.15
A = 20 x 1.15 = 23 mph
B = 5 x 1.15 = 5.75 mph
C = 15 x 1.15 = 17.25 mph

ROYAL AIR FORCES Association
The charity that supports the RAF family

THE FACTS

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people

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In one year...

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individuals to remain active, thriving and valued members of their local communities, helped by our field force of **1,100** highly-trained welfare volunteers

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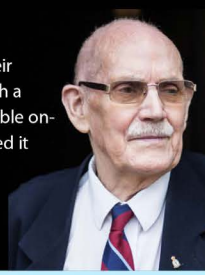
people to retain their independence - with a helping hand available on-site should they need it



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300

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Our free WiFi on RAF stations is used over

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times and **26,500** separated family members stay in the 'homes from home' we refurbish

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