

# SUSTAINABILITY AND SPACE











# MEET THE TEAM



### **Dylan the Designer**

As an Aerospace Engineer, Dylan works on the design, shape and style of the aircraft. He wants to design new aircraft that are better for the environment by using less fuel.





### **Ellie the Engineer**

As a software developer, Ellie works on the software and communications equipment needed to help make the aircraft fly. Ellie is currently working on some exciting projects to help astronauts communicate with Earth whilst on space missions.



# MEET THE TEAM



### **Penny the Pilot**

As a pilot Penny tests lots of aircraft to see how they fly. She is trained to fly aircraft safely and smoothly in all types of weather. Penny is interested in finding out more about how different fuels can be used to power aircraft.

### **Michael the Manufacturer**

As a manufacturer Michael helps to build and construct aircraft. He makes sure that every part of an aircraft is made correctly, and that it is safe for flight. Making aircraft by using less of the Earth's precious resources is important for Michael.









Dylan the designer knows that some large aircraft can be better for the environment because they use less fuel, can carry lots of passengers, vehicles and even other aircraft.

Can you help him to match the aircraft part name with its function on the next page?







Creates lift and allows the aircraft to glide. Also holds fuel and houses the jet engines.

Stabilises the aircraft and helps it to fly straight ahead.

Has wheels and shock absorbing devices to help the aircraft take off and land.

The very front of the aircraft usually curved to make it aerodynamic (fly faster!)



The big space underneath the aircraft where all the cargo goes.



These move the aircraft forward with a great force (thrust). This causes the aircraft to fly very fast.



# CROSSWORD



Ellie the Engineer has muddled up her definitions for her software and communication language.

Can you complete the crossword below and find the terms to match the definitions?



### Across

- 1. A type of message that can be hard to crack.
- 2. A machine you use to search the web and to create documents.
- 5. Instead of leaving a room you would ..... a room.
- 7. A unit of data used in computing.









Penny is excited to be flying an aircraft at RIAT. She knows the skies will be busy with aircraft so it is really important that when pilots communicate through radios, they use specific phrases to clearly convey their messages.

Can you match the correct phrase to its meaning below?

Distress Signal	Urgent, non-life- threatening situation
Phrase:	Phrase:
Message Received	Heard your message, await your reply
Phrase:	Phrase:
Yes	Wait a moment
Phrase:	Phrase:
Mayday Roger	Over Affirmative Pan-Pan Stand-by



# **SPACE MISSION**





Michael the manufacturer is working on the design of a rocket for a mission into space. He needs to design a cargo hold that can carry lots of equipment and supplies.

Can you help him to work out the total weight of the supplies that are required for a 10-day mission into space?

There are two astronauts undertaking the mission. Each astronaut needs the following **supplies**:

- ✓ 10 bottles of water **per day** (2kg per bottle)
- ✓ 10 meal packs consisting of breakfast, lunch, dinner per day (1.5kg per pack)
- ✓ 2 space suits (100kg each)
- ✓ 1 first aid kit (3kg)

### The mission also requires the following:

- ✓ Scientific equipment (70kg)
- ✓ Recording equipment (50kg)







COMPARE THE AIRCRAFT 🕅

There are many different types of aircraft, designed for different purposes including speed and flight duration.

Below are three aircraft, you may see some of them at RIAT. Can you answer the questions comparing them?



Supermarine Spitfire First Flight: 1936 Top Speed: 370 mph Range: 1,135 miles



Eurofighter Typhoon First Flight: 1994 Top Speed: 1,550 mph Range: 1,800 miles



Avro Lancaster First Flight: 1941 Top Speed: 287 mph Range: 2,530 miles

If you added all top speeds of the three aircraft, what speed would this be?

Which aircraft had its first flight closest to 2000?

Which has the longest range?



# COLOUR THE AIRCRAFT

The Battle of Britain Memorial Flight (BBMF) is a regular RAF unit and consists of many historic aircraft, including the Hawker Hurricane.

Colour in your own Hurricane aircraft and make it look like the one in the picture.



Look out for the Hurricane's appearance at the Royal International Air Tattoo!





# **AERODYNAMICS**



Aerodynamics focuses on how the air moves around the front of an aircraft. If an aircraft has a nose that is thin and smooth the aircraft will move faster because the air will move faster around the aircraft – making it more aerodynamic. Dylan knows that an aerodynamic design will also mean the aircraft will be good for the environment because it will also use less fuel as it flies.

Have a look at the aircraft below and number them (fastest = 1, to the slowest = 5) based on how aerodynamic it seems to be.







# AIRCRAFT SHAPE & SIZE

Dylan is carrying out some research on the different aircraft that the RAF currently operate and how they use them. Scan the QR code or <u>click here</u> to explore the aircraft currently being used or developed. There are 29 different aircraft in total.

Make some notes to identify which aircraft can fly the fastest, can hover, can move quickly, can glide, can fly for long periods of time.



### Fly the fastest:

### Can hover:

Can glide:

### Can fly for long periods:

### Can move quickly:



# **AIRCRAFT FORCES**



Dylan knows that there are four forces that act upon an aircraft as it flies: weight, thrust, drag and lift.

Can you link the forces to their description below by drawing a line between the word and its correct definition?









Write here what would happen to the aircraft if the weight increased?

Write here what would happen to the aircraft if the lift force increased?

100



Lift

Drag







Ellie the engineer has worked with lots of aircraft. She really likes the look of the F35B, which is one of the newest aircraft in the RAF fleet.

Can you help her to spot the differences in these two pictures of an F35B? There are 7 differences.







Ellie the Engineer tells us that algorithms are an important part of coding. Algorithms are step-by-step instructions a computer works through to resolve a problem or carry out a task.

Can you help her to create an algorithm so that the aircraft can safely reach the airport by avoiding the clouds? We've included the first codes in the box for you. There is more than one way to avoid the clouds to reach the airport!



 $\mathsf{START} = \mathsf{A8} \rightarrow \mathsf{B8} \rightarrow$ 





Michael the manufacturer knows lots of facts about space and space travel. He's created this short quiz for you to test your knowledge about one of his favourite subjects.

- 1. What force pushes a rocket up into space?
  - a) Gravity
  - b) Friction
  - c) Thrust
  - d) Magnetism
- 3. Which of these fuels do rockets use to launch into space?
  - a) Petrol
  - b) Rocket fuel
  - c) Coal
  - d) Electricity

### 5. What does the term "orbit" mean?

- a) To land on a planet
- b) To travel in a circle around a planet or moon
- c) To go directly into space
- d) To go through an asteroid belt

- 2. What part of the rocket holds the astronauts or equipment?
  - a) Booster
  - b) Fuel tank
  - c) Payload
  - d) Wings

4. What is the name of the rocket that first took humans to the Moon?

- a) Apollo 11
- b) Space Shuttle
- c) Voyager
- d) Falcon 9
- 6. Why do rockets need to escape Earth's atmosphere to reach space?
  - a) To avoid air pressure
  - b) To escape Earth's gravity
  - c) To avoid clouds
  - d) To avoid birds







Ellie the Engineer is trying to download some new software updates and aircraft information onto her computer. She has realised her storage is full, so needs to delete some of her less important downloads.

Can you help Ellie to get her storage down to 6GB? You will have to work out how much she is using, and then cross out the files she needs to delete.



Aircraft Maintenance 1.8 GB



Dessert

Recipes

0.5 GB

Engineering Diagrams



Software

1.3 GB



Cat Videos

1.5 GB



Communication Flight Data 1.7 GB



How much she needs to delete:

```
___ GB total - ____ = 6GB
```





The Atlas C.1 can carry up to 37 Tonnes - that's as heavy as 5 <sup>1</sup>/<sub>2</sub> Elephants! It is a very efficient aircraft because it can transport so much. Penny is taking supplies in the Atlas C.1 following an earthquake and she has already loaded the items listed below.

Can you work out how much more she can load onto the aircraft to reach its maximum load?





# **SAFE PASSWORDS**



Ellie the engineer is setting up secure communications for a new aircraft design. She's making sure all the digital parts are safe, so she wants to make a strong password.

Can you have a look at these potential passwords below and decide if they are weak or strong passwords?



Password	Weak or Strong?	Why?
123456		
M%p62@apV!		
qwerty		
AiRoad!2R1AT		
Password		

Can you come up with your own strong password?

Remember - strong passwords are long, with a mix of capital and lowercase letters. They should also include symbols and numbers.



# LIVING IN SPACE!



Michael the manufacturer is really interested in space and how astronauts live there. He's carrying out some research work on the International Space Station. He is amazed to learn that it orbits the earth every 1.5 hours (that's 90 minutes per orbit).

Can you help him to work out how many orbits of the earth it completes in the time periods below?



3 hours =	
1 day =	
2 days =	
7 days =	



## WORDSEARCH





When Penny the pilot is flying an aircraft, there are many things she needs to look out for to make sure that it's a safe flight.

# Can you find these in the wordsearch below?

Q	I	Ζ	G	J	В	Ν	I	Q	Y	G	L		Aircraft	
Н	F	Ζ	Ρ	С	Q	0	L	W	X	Т	F		Andrard	
Α	I	R	С	R	Α	F	Т	Е	W	U	W		Birds	
Α	R	Ζ	Е	F	К	R	J	Q	Е	Ν	Υ			
X	Х	F	V	Т	D	I	Н	L	Α	н	S		Weather	
К	Κ	Α	К	I	W	U	L	Ζ	Т	W	Ζ	<i>í</i>		
Υ	Κ	Ν	В	Н	Α	Е	D	U	Н	X	R		<b>Fuel Levels</b>	
S	F	G	Ρ	I	V	Х	G	Q	Е	С	J			
S	Т	К	К	Е	R	W	I	R	R	Z	С	$\sim$	Mountains	, ·
Р	F	G	L	Ζ	W	D	Ζ	Ζ	V	L	D		>< /	
W	Ν	S	U	G	R	S	S	Ζ	G	F	G	• _		
S	Ν	I	Α	Т	Ν	U	0	Μ	J	Ν	D			

**Aircraft:** To avoid collisions, pilots need to be aware of other aircraft flying around them.

**Birds:** Birds can collide with aircraft and cause damage during flight.

Weather: Storms and wind can cause turbulence and make it difficult for an aircraft to fly.

**Fuel Levels:** Pilots need to ensure there is enough fuel for the journey.

Mountains: Pilots need to take care around tall features such as mountains and buildings to avoid collisions.



# **DRAW AN AIRCRAFT**





Can you draw your own aircraft below? Use the images above to guide you through the process.

Is there anything you can include in your design to make the aircraft better for the environment?



Although Penny flies an aircraft here on Earth, she is really interested in flying aircraft to other planets. Penny knows that in our solar system the sun is at the centre, with eight different planets that travel around it. Each of these planets follow their own path, called an orbit, around the sun.

Penny needs help to place the planets in the correct order from the sun!



Can you use these distances to put the planets in order of how far they are to the Sun?

Penny has done the first one for you to get you started!

1. (Closest to the Sun) Mercury	5.				
2.	6.				
3.	7.				
4.	8.				
	(Furthest from the Sun)				



### **FUN FACTS**



Michael the Manufacturer is thinking about the special equipment that might be required for missions to other planets. He has been carrying out some research work in relation to the planets in the Solar System.

Can you help him to match the fun fact to the planet it relates to by drawing a line between them?



The only planet where there is life.

The furthest planet from the sun, and is made of dense gas.

The largest planet in the solar system, being more than 2x bigger than all other planets combined.

Also known as the 'Red Planet'.

The hottest planet in the solar system.

The planet has large visible rings made of ice and rock.



JUPITER
MERCURY
VENUS
EARTH
URANUS
SATURN
MARS





Penny flies aircraft that go really fast! At RIAT there are lots of different aircraft from all over the world. Some can fly much faster than others.

Can you help Penny to work out the speed of an aircraft using the calculation below?



You can work out the speed of an aircraft by following:

Speed = Distance ÷ Time.

Penny timed a jet travelling down the runway. It travelled 30 metres and it took the aircraft 5 seconds.

What was the aircraft speed in m/s (metres per second): (use the calculation below if you need)

Distance = (30m) Time = (5s) Distance ÷ Time= (30÷5)

Speed =





Now try these next few aircraft speed calculations. Each aircraft was travelling 1,000 metres, calculate the speed for each one depending on the time it took.

- 1. Aircraft 1 travelled for 100 seconds, what was its speed:
- 3. Aircraft 3 travelled for 50 seconds, what was its speed:
- 2. Aircraft 2 travelled for 200 seconds, what was its speed:
- 4. Aircraft 4 travelled for 20 seconds, what was its speed:





### **ANSWERS**



#### Pg 5 - Match the part

- 1 Wina
- 2. Tail Fin
- 3. Landing Gear
- 4. Nose
- 5 Fuselage 6
- Hold
- 7. Engines

#### Pg 6 - Crossword



#### Pg 7 - Speak like a pilot

Distress Signal – Mayday. Urgent, non-life-threatening - Pan Pan. Message Received - Roger. Heard your message, await your reply - Over. Yes – Affirmative. Wait a moment - Stand-by.

#### Pg 8 - Space Mission

10 bottles of water x 2kg = 20kg x2 = 40kg.

10 meal pack x 1.5kg = 15kg x2 = 30kg.

2 space suits x 100kg = 200kg x2 = 400kg.

1 first aid kit x 3kg = 3kg x2 = 6kg.

Total weight of supplies required for astronauts = 476kg.

What is the total weight for the mission into space? = 476kg + 70kg + 50kg = 596kg.

#### Pg 10 - Compare the aircraft

If you added all top speeds of the three aircraft, what speed would this be? = 370 + 1,550 + 287 = 2207 mph.

#### Which aircraft had its first flight closest to 2000? Eurofighter Typhoon.

#### Which has the longest range?

Avro Lancaster

#### Pg 12 - Aerodynamics

- Lockheed SR-71 Blackbird 1.
- 2. Boeing 787 Dreamliner
- 3 Airbus A380-800
- 4

#### Pg 13 - Aircraft shape and size

Fly the fastest = Typhoon FGR4 is the fastest aircraft in service ... but aircraft that are being developed (such as the Tempest) may be able to fly faster.

5.

Can Hover = F-35B Lightning.

Can move quickly = A number of aircraft are extremely agile and can move rapidly. These include: Hawk T2 (the Red Arrows-type aircraft), the Typhoon FGR4, Texan T1 training aircraft.

Can glide = Viking T1glider.

Can fly for long periods = A number of aircraft can fly for long periods. These include: Voyager, Globemaster C17, Atlas C.1.

#### Pg 14 - Aircraft shape and size

Weight - The force that pulls the aircraft down towards the ground because of gravity.

Thrust - The force that moves the aircraft forward, created by the engines.

Drag - The force that slows the aircraft down, caused by air pushing against the plane as it flies.

Lift - The force that pushes the aircraft up into the air, created by the wings as they move through the air.

Write here what would happen to the aircraft if the weight increased? - More thrust and lift required to take off / to keep flvina.

Write here what would happen to the aircraft if the lift force increased? - The aircraft would fly higher in the sky. Increased lift is very useful for take-off and climbing.

#### Pg 16 - The forces of flight



- Aero Spacelines Super Guppy
- Airbus BelugaXL



### **ANSWERS**



#### Pg 17 - Engineering puzzles



#### Pg 18 - Algorithms

There are a number of routes that can be taken. One example is:  $A8 \rightarrow A8 \rightarrow C8 \rightarrow D8 \rightarrow D7 \rightarrow D6 \rightarrow D5 \rightarrow D4 \rightarrow D3 \rightarrow D2 \rightarrow E2 \rightarrow F2 \rightarrow F1 \rightarrow G1$ 

#### Pg 19 - Space quiz

What force pushes a rocket up into space? (c) Thrust.

What part of the rocket holds the astronauts or equipment? (c) Payload.

Which of these fuels do rockets use to launch into space? (b) Rocket fuel.

What is the name of the rocket that first took humans to the Moon? (a) Apollo 11.

What does the term "orbit" mean? (b) To travel in a circle around a planet or moon.

Why do rockets need to escape Earth's atmosphere to reach space? (b) To escape Earth's gravity.

#### Pg 20 - Download dilemma

Storage currently used: 1.8 + 2.2 + 1.5 + 0.5 + 1.3 + 1.7 = 9 GB total.

How much she needs to delete: 9 GB total - 3 = 6GB.

#### Pg 21 - Pilot's checklist

How much more can Penny load onto the aircraft? 12 Tonnes.

She also needs to take twice as much water and three times as many toiletries. Water = 6 Tonnes Toiletries = 4 Tonnes.

#### Pg 22 - Safe passwords

123456 = Weak, easy to remember made up of numbers in order.

M%p62@apV! = Strong mix of letters,numbers, upper, lowercase.

**qwerty** = Weak, taken from a computer keyboard.

AiRoad!2R1AT = Strong, mixture of letters and numbers.

**Password** = Weak, one of the most used passwords and very weak.

#### Pg 23 - Living in space

**3 hours** = 2 orbits. **1 day** = 16 orbits. **2 days** = 32 orbits **7 days** = 112 orbits

#### Pg 24 - Wordsearch



#### Pg 26 - Place the planets

- 1. (Closest to the Sun) Mercury. 5. Jupiter.
  - Venus. 6. Earth. 7.
    - 7. Uranus.
      - 8. Neptune.

Saturn.

#### Pg 28 - Fun facts

2.

3.

4

Mars

It is the closest planet to the Sun, and has both extremely hot and cold temperatures. = Mercury.

The only planet where there is life. = Earth.

The furthest planet from the sun, and is made of dense gas. = Neptune.

The largest planet in the solar system, being more than 2x bigger than all other planets combined. = Jupiter.

Also known as the 'Red Planet'. = Mars.

The hottest planet in the solar system. = Venus.

The planet has large visible rings made of ice and rock. = Uranus.

#### Pg 28 - Calculate the speed

**Speed** = 6 m/s.

Aircraft 1 travelled for 100 seconds, what was its speed: 1000/100 = 10 m/s.

Aircraft 2 travelled for 200 seconds, what was its speed:  $1000/200 = 5 \mbox{ m/s}.$ 

Aircraft 3 travelled for 50 seconds, what was its speed: 1000/50 = 20 m/s.

Aircraft 4 travelled for 20 seconds, what was its speed: 1000/20 = 50 m/s.



