



Radka Píro • Diarmuid Ó Catháin

PLANE



ALL ABOARD!

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Take a look at the many birds crossing the sky! Karl the kiwi is sad. Every day he looks up at the sky until he gets a crick in his neck, wanting to take off. He'd love to get up there to see the world from high above, just like other birds. But how to go about it?

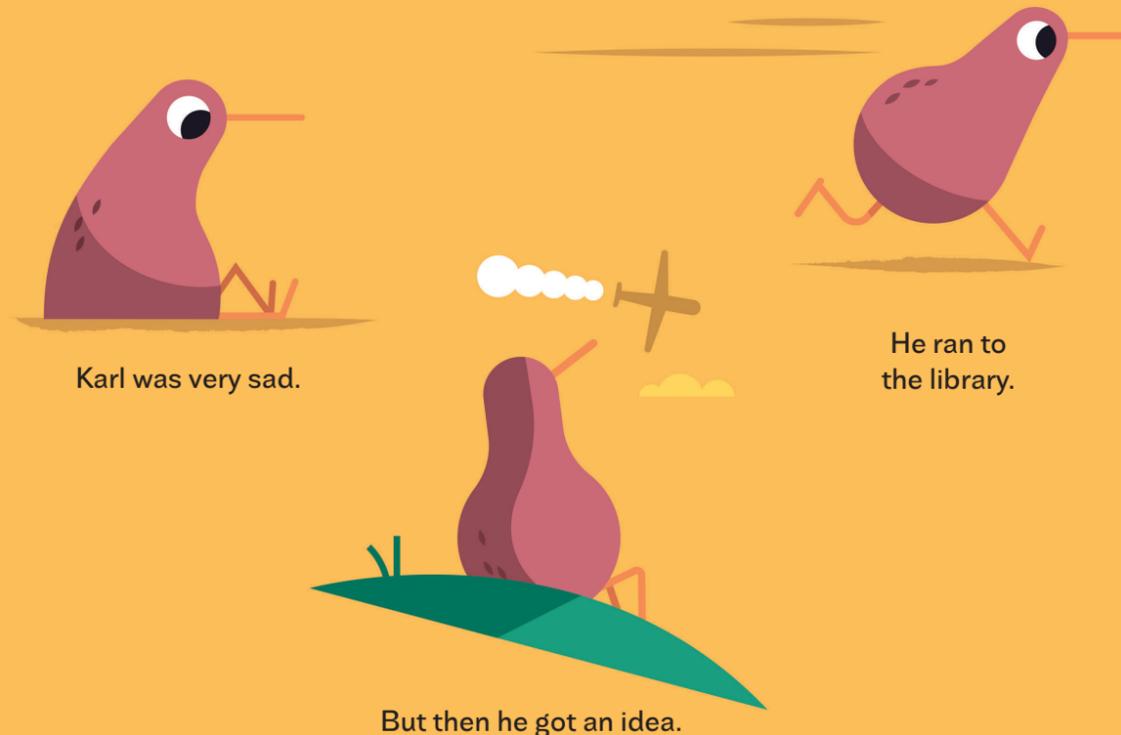


Perhaps if he jumped from a high place he'd learn to fly in no time? But it didn't work.



Maybe a balloon could carry him?

Or what if someone took him up there? So Karl tried thumbing a lift with one of the flying birds. But it didn't like the idea.



Karl was very sad.

He ran to the library.

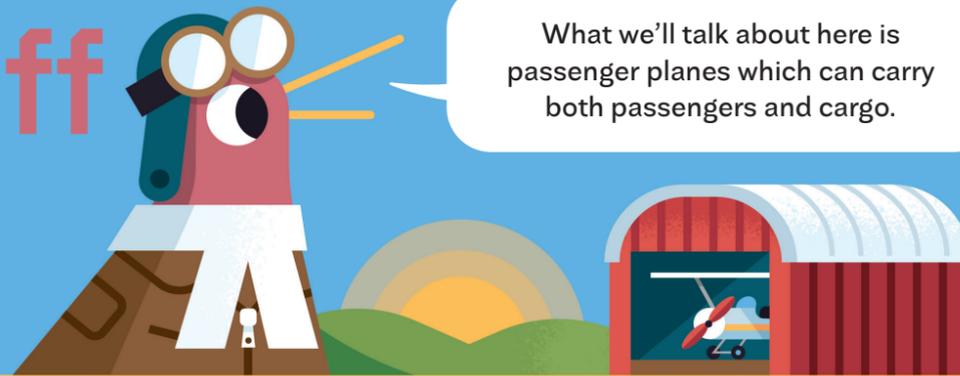
But then he got an idea.

A plane could get me up there! I must become **A PILOT!**



Before take-off

Just like Karl, so did humans envy birds' ability to fly. It took quite a lot of time and failed attempts before they managed to mimic them and invent machines that carried them high up in the sky. These machines are called planes.



PILOT TRAINING



To learn how to pilot a plane the trainees need to spend a lot of time in the cockpit. During test flights, overseen by an instructor, they can apply their knowledge in practice and try steering various machines.



Becoming a passenger plane pilot isn't easy. The training takes several years and the prospective pilots have to pass many tests and test flights. The trainees hone their knowledge of navigation, meteorology, and communication.

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The applicants also need to be in excellent physical shape. They have to undergo a medical examination and psychological testing. Pilots can't suffer from any illness that requires them to take medication over long periods of time.

WHAT'S AERODYNAMICS?

To understand how flying works, it's a good idea to delve into aerodynamics—a scientific discipline studying the way gases move around solid objects. For example, if you obstruct an air current, the air starts flowing around it like river water flows around a rock. This is exactly how air moves around a moving plane. The knowledge of aerodynamics allows us to build very efficient machines.



Four forces

When in the air, a plane is subjected to four opposing forces called lift, weight, thrust, and resistance. It's they that keep the plane moving through air without crashing down.

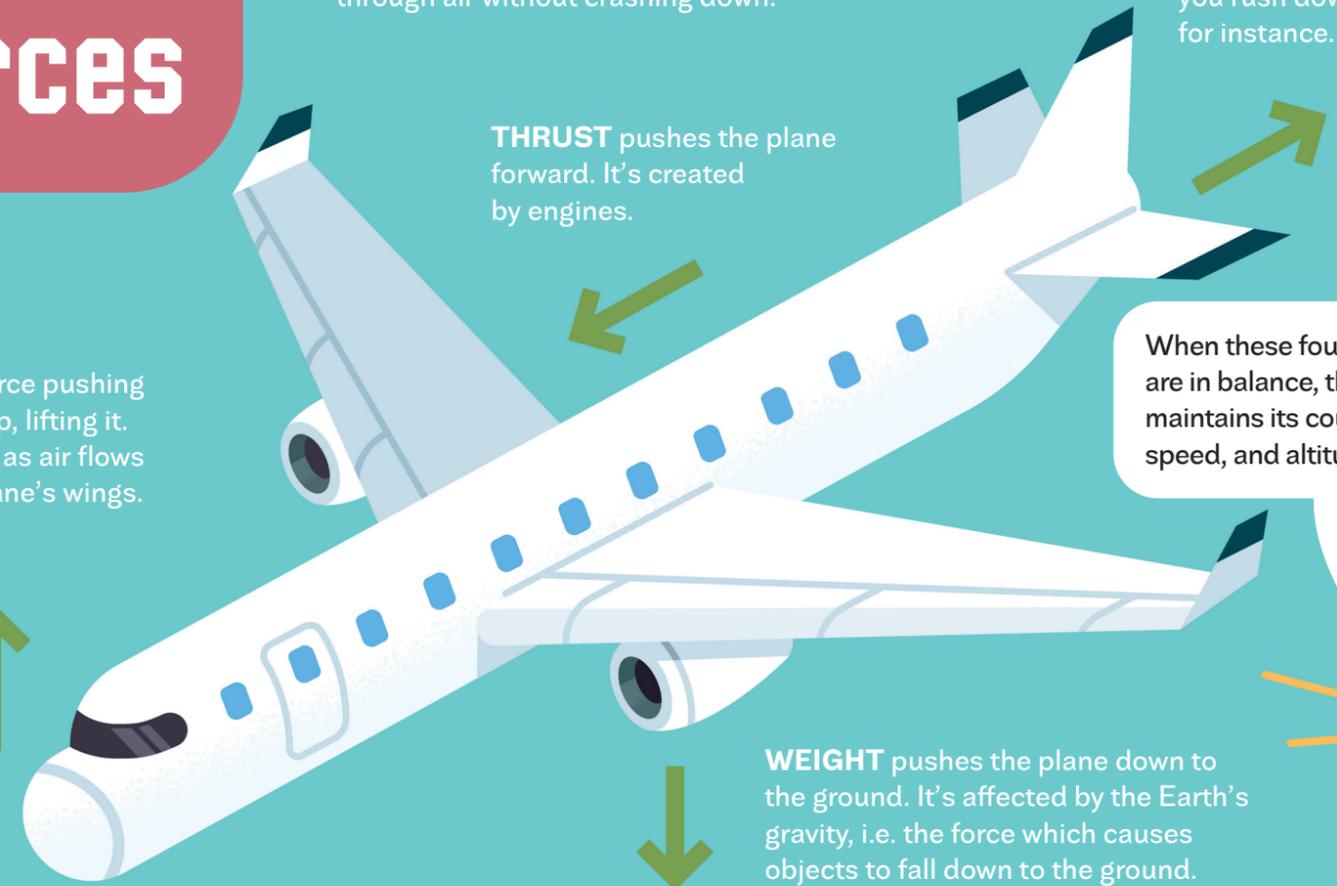
RESISTANCE acts against thrust. You can feel it for yourself when you rush down a hill, for instance.

THRUST pushes the plane forward. It's created by engines.

LIFT is a force pushing the plane up, lifting it. It's created as air flows past the plane's wings.

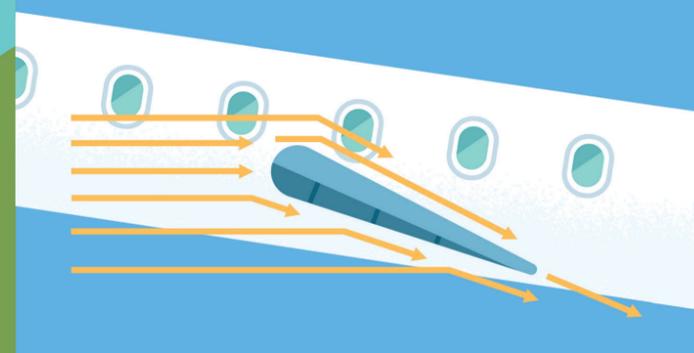
When these four forces are in balance, the plane maintains its course, speed, and altitude.

WEIGHT pushes the plane down to the ground. It's affected by the Earth's gravity, i.e. the force which causes objects to fall down to the ground.



WING

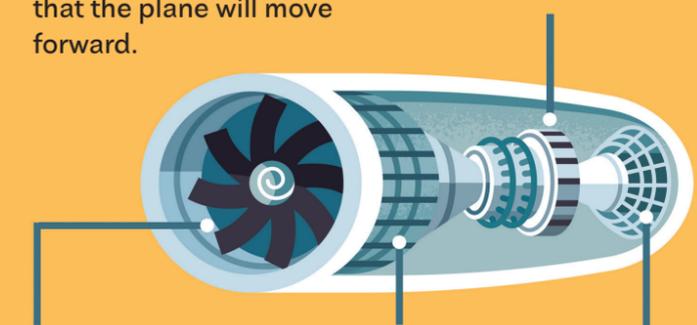
Lift is provided by the plane's wings. Their shape ensures that when the plane starts moving fast, individual air particles begin hitting the wing's bottom part quicker and stronger than the upper one, pushing the plane up.



ENGINE

The plane's engines ensure that the plane will move forward.

The air mixes with fuel in a **COMBUSTION CHAMBER**. The mixture ignites and spins a turbine at the end of the engine.



A **BLOWER** sucks air into the engine.

The air is compressed in a **COMPRESSOR**, becoming hotter.

The air shoots out of an **EXIT JET** faster than when it was sucked into the engine, propelling the plane forward.

The **TURBINE** spins the blower and the compressor's rotors.

Ready for take-off!

3 ... 2 ... 1 ...

Planes are swishing along the runway. Some are landing, others getting ready for take-off. All traffic at the airport is controlled, everything has its place and time. But the moments right before take-off are the most suspenseful!

Taking off! It will be awesome!

Control tower

Welcome to the control tower! This is the place that tells pilots it's safe to take off. The control tower must be located somewhere where there's a good view as it controls all traffic at the airport. The people working there are called air traffic controllers.

WHAT GOES ON AT THE AIRPORT

There's a plane getting ready to take off. Air traffic controllers must make sure that it's parked in the right spot and everything has gone the way it was supposed to. Before the take-off, luggage is stored and fuel needs to be refilled. Only when the crew finishes the necessary preparations can the passengers board and assume their seats.



Take-off

First, a plane needs to pick up great speed. The shape of the wings then causes the front part of the plane to get off the ground, creating an angle known as the angle of attack. Along with the speed, the angle makes sure the plane starts rising.



Landing

The control tower must confirm to the pilot it's safe to land. What a mess it'd be if two planes attempted to land on the same runway!



Planes that went down in history



In 1903, the first controlled flight took place, lasting only 12 seconds. After several years of planning and testing, Wilbur and Orville Wright, the Wright brothers, built a plane which took off only four times in total but still went down in history.



Louise Blériot, a French pilot, made his mark in 1909 when he was the first person ever to fly over the English Channel, sitting in his single seat **Blériot XI**. The triumphal flight lasted 36.5 minutes.

This beauty became the first ever all-metal plane with space for passengers. Apart from the pilot, the **Junkers F13** could fit only four other people. The aircraft was also notable for being equipped with safety belts for the passengers. Truly unusual for the time!



The **De Havilland Comet** was the first ever commercial jet-powered aircraft. Today, planes make extensive use of the jet engine. The De Havilland Comet began flying regularly in 1952.



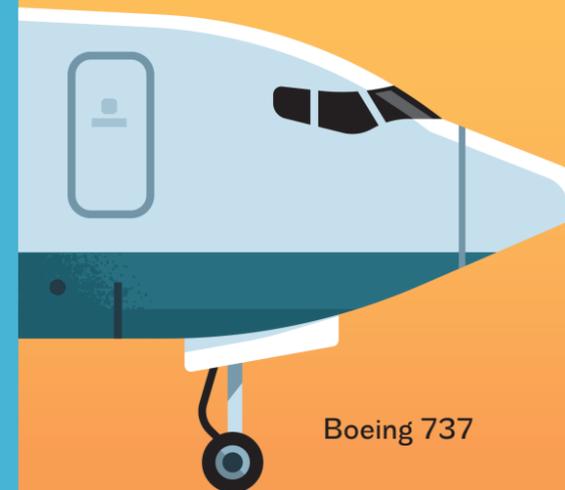
This peculiar-looking beauty was called the **Concorde**, one of only two passenger planes capable of breaking the sound barrier. The Concorde was able to achieve such a speed due to its innovative wing and fuselage shape. It could cover the distance from Paris to New York twice as quickly as other planes can today. Its last flight took place in 2003.



The Ukrainian **Antonov An-255** was one of the largest planes in the world. This giant could transport up to 250 tonnes of cargo and was an incredible 84 metres long. No wonder it was called Mrija, meaning “dream” in Ukrainian. The fact that such a huge plane was able to stay in the air seems like the stuff of dreams indeed.

Boeing or Airbus?

If you've ever flown in a passenger plane, it's highly likely it was either an Airbus or Boeing model. It's these two companies which are the largest passenger plane manufacturers in the world. They're also each other's great competitors. Airbus comes from Europe while Boeing was founded in the United States.



Boeing 737



Airbus A320

The Earth's Envelope

To understand flying, you need to understand the Earth's atmosphere. Our planet is wrapped in a protective layer, like an orange is wrapped in its peel. This protective layer is called the atmosphere and is held together by the Earth's gravity. It has several layers.

The **exosphere** is the furthest from our planet. This is where most satellites orbit the Earth, sending us information on weather and facilitating navigation and communication.

The **thermosphere** is home to the International Space Station, the only permanently manned space station around. By the way, the thermosphere is where aurora forms.

The **stratosphere** can be reached by weather balloons. This layer contains the ozone layer which protects the Earth against the harmful effects of solar radiation.

The **troposphere** is the layer closest to the planet. Pretty much all weather occurs here and it's teeming with planes, birds, and hot-air balloons. Breathable air comprises only a tiny part of the troposphere.

The **mesosphere** is a very cold layer. Most meteors entering the atmosphere burn up there, something we can watch from down below. Only spaceships can reach this place.

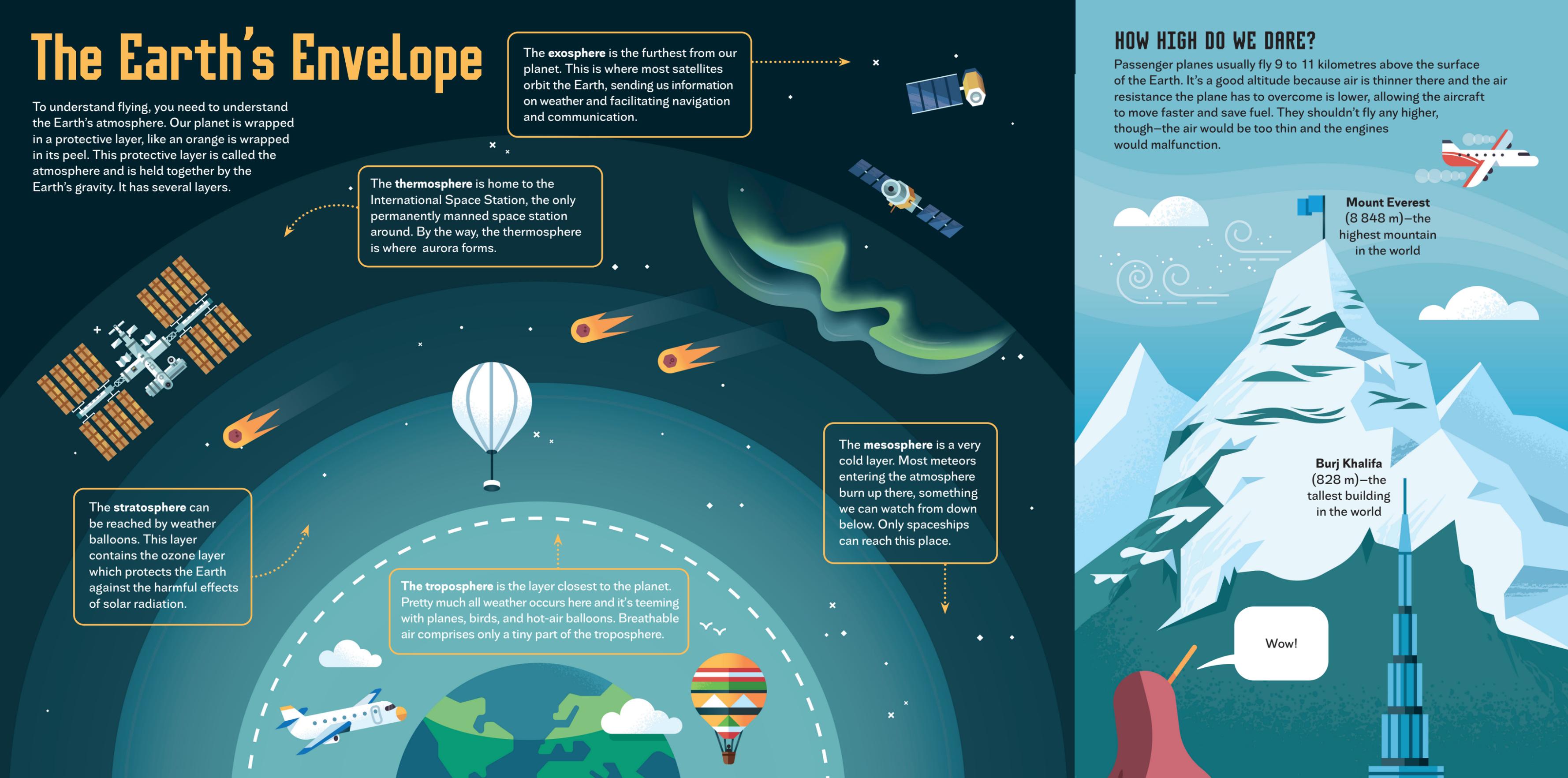
HOW HIGH DO WE DARE?

Passenger planes usually fly 9 to 11 kilometres above the surface of the Earth. It's a good altitude because air is thinner there and the air resistance the plane has to overcome is lower, allowing the aircraft to move faster and save fuel. They shouldn't fly any higher, though—the air would be too thin and the engines would malfunction.

Mount Everest
(8 848 m)—the highest mountain in the world

Burj Khalifa
(828 m)—the tallest building in the world

Wow!



Planes and weather

The weather forecast is as vital to pilots as the knowledge of waves is to sailors. You can often tell what weather has in store for you by looking at the clouds which differ in appearance, formation, and altitude.

The **cirrus** looks like individual threads with "hooks" at the end. It heralds good weather.

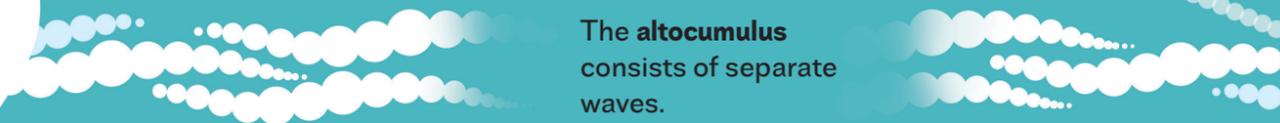


The **cirrocumulus** is a thin layer of regular small waves.

The **cirrostratus** looks like a white misty veil.



The **altocumulus** consists of separate waves.



The **altostratus** is a thin grey layer and often heralds rain.



The **stratocumulus** is whitish or greyish in colour and has a cylindrical or round-shaped bottom.



The **nimbostratus** is a dark, shapeless cloud that can yield lots of rain.



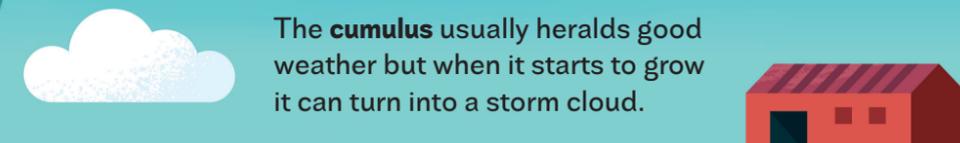
The **cumulonimbus** is a threatening cloud which brings storms, torrential rain, or hail.



The **stratus** is a shapeless grey matter that covers the sky. Sometimes it produces drizzle.



The **cumulus** usually heralds good weather but when it starts to grow it can turn into a storm cloud.



Weather forecast

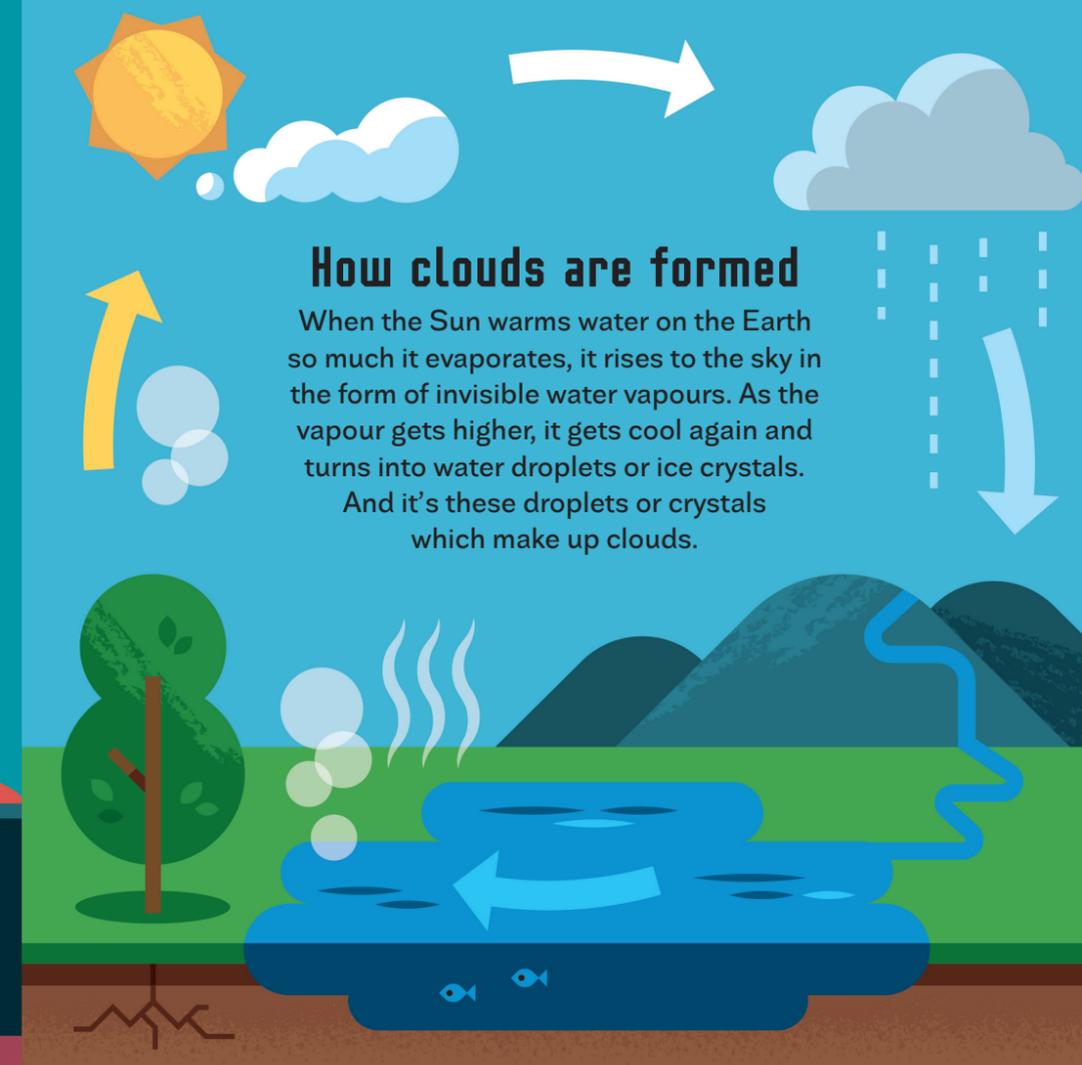
Pilots train to recognise and predict weather patterns and work closely with meteorologists. When flying, modern planes also constantly measure the surrounding temperature, air pressure, wind speed, or air humidity and send the data to meteorologists so they can make the most accurate weather prediction possible.



How clouds are formed

When the Sun warms water on the Earth so much it evaporates, it rises to the sky in the form of invisible water vapours. As the vapour gets higher, it gets cool again and turns into water droplets or ice crystals.

And it's these droplets or crystals which make up clouds.



At night

Flying at night is a different kettle of fish to flying during the daytime. The pilot needs to be prepared for various sensory illusions, like vertigo or optical illusions, as well as poor visibility or glare during landing.



Weather balloons

These balloons contain a radiosonde that measures such values as pressure, temperature, or humidity and sends the data to meteorologists. The balloons can reach all the way to the stratosphere.



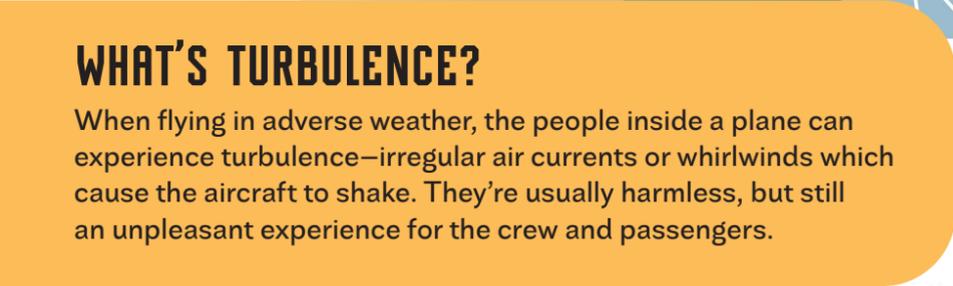
Poor weather

Sometimes poor weather can make things pretty hard for pilots. It may surprise you to learn that planes can fly in storms. Often, they're even struck by lightning. Nowadays that isn't much of an issue because the all-metal outer layer simply conducts the lightning along the surface and sends it to the ground. Still, pilots usually choose routes to fly past storms as bad weather does pose some danger.



WHAT'S TURBULENCE?

When flying in adverse weather, the people inside a plane can experience turbulence—irregular air currents or whirlwinds which cause the aircraft to shake. They're usually harmless, but still an unpleasant experience for the crew and passengers.



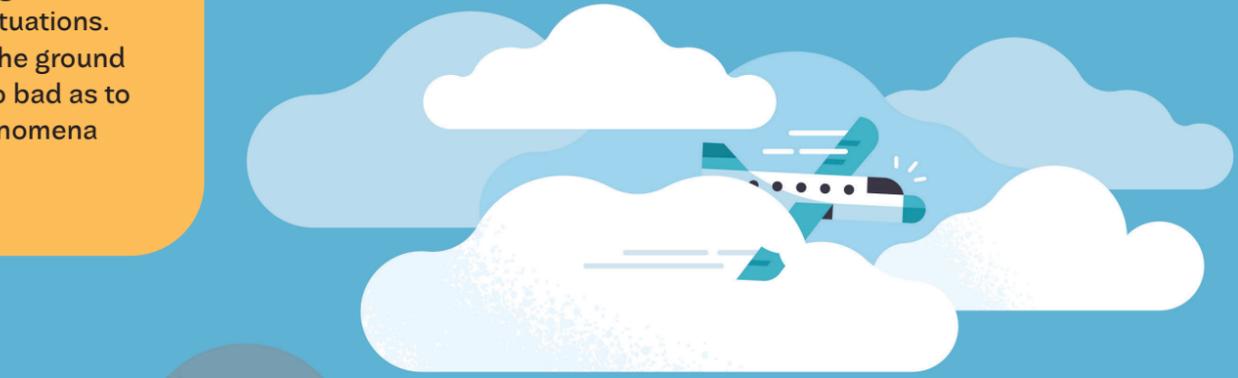
Pilots need to know what the dangers are and how to react in threatening situations. Sometimes it's better to stay on the ground or land quickly if the weather is so bad as to make a flight unsafe. Several phenomena can lead to problems.



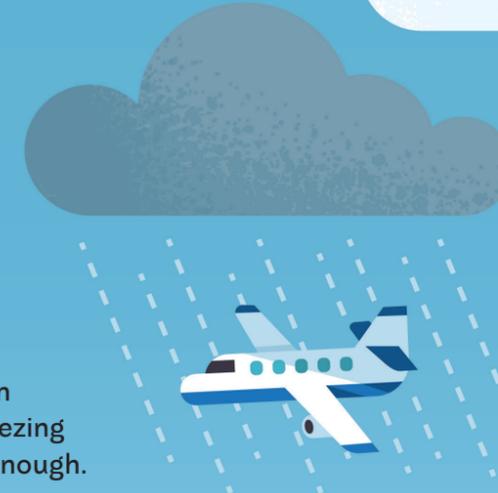
Frost affects the plane's ability to stay in the air. Although modern planes are equipped with anti-freezing technology it may not always be enough.



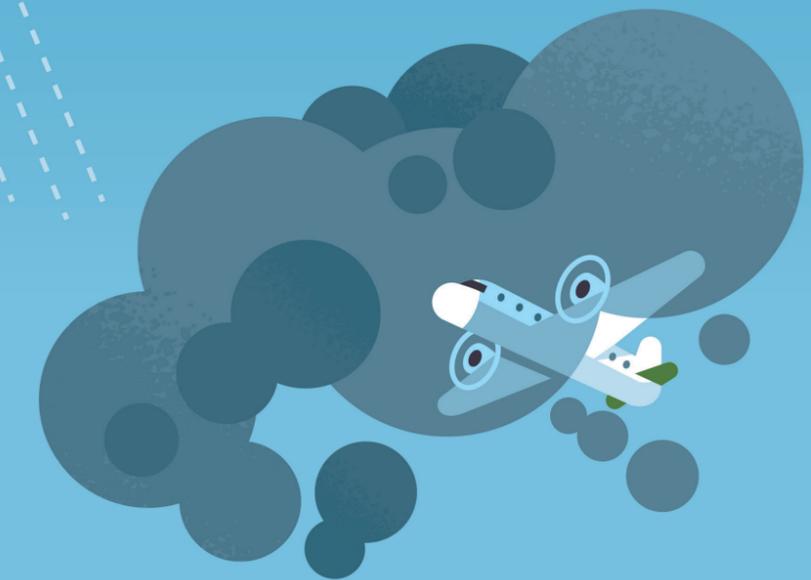
Taking off and landing is very difficult if the **wind** is strong. Plus, the people on board can become sick.



Clouds aren't dangerous in and of themselves but they do block the view, preventing pilots from seeing what's in front of them.



Strong rains cause low visibility. When the rain starts to freeze that's also a problem.



Volcanic ash can get into the plane's engines and damage them. Moreover, the wind can carry the ash far from the place of eruption.



Traffic in the sky

Helicopter

Helicopters are powered by a rotary mechanism that carries the entire machine.



Glider

This plane doesn't have an engine which is why a machine that does have an engine has to carry it up. The glider then detaches itself and continues on its own.



Hydroplane

Amphibious aircraft or hydroplanes can take off and land both on water and land.



Hot-air balloon

Hot air filling its textile dome carries the balloon up. Most balloons are spherical but there are also unusual shapes.



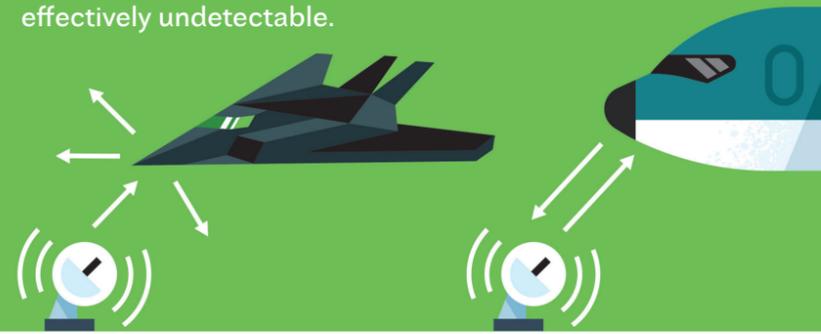
Airship

Airships are filled with a lighter-than-air gas which makes them rise and are equipped with engines. Currently, they're used mostly for advertising, not transportation.



Stealth planes

The location of regular planes can be easily detected with a radar. However, so-called stealth planes boast a particular shape and are made from special materials to reflect or absorb radio waves. This makes them effectively undetectable.



Military planes

Fighter planes destroy enemy aircraft while bombers focus on land targets. Reconnaissance planes are also used for military purposes.



Paraglider

Learning how to handle a paraglider takes a relatively short amount of time. The wing is a crucial part, controlled depending on how and where the pilot wants to go.



Birds v. humans

At first, humans attempted to copy birds. This led to the creation of the first ornithopter, a machine propelled by the flapping of wings. It turned out, though, that bird flight is hard to imitate and ornithopters never became common.



Rescue helicopter

A helicopter can rise and descend vertically. This allows it to access hard-to-reach terrains and makes it the ideal choice for rescue workers.



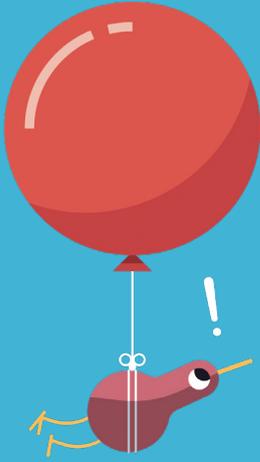


Have you ever wondered what it'd be like to sit in a plane? Would you like to see the world from high above? And are you interested in learning about the training pilots have to go through?

You are? So is Karl, a kiwi who can't fly. But he'd so love to figure it out!

Join Karl in learning what flying a plane is all about. You'll take a peek at the history of aviation and find out what kind of things can be encountered in the sky.

Board a plane with Karl and take off for the skies!



On board
and upwards!



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