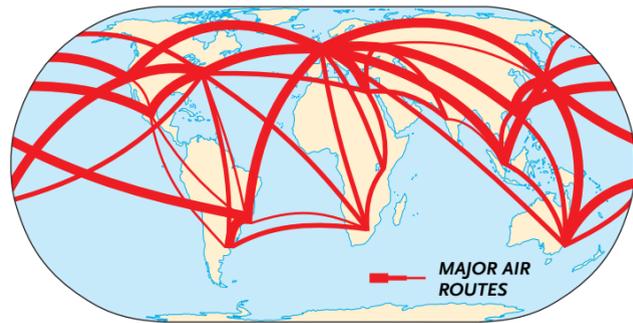


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## AIR TRAVEL

Air travel has grown enormously in the last 50 years. For the first 50 years after aeroplanes were invented (1903), only the wealthy could afford to travel by air. The development of the jet airliner in the 1950s made it possible for everyone to fly to destinations across the world. As the map above shows, air routes now link all the world's major cities.

# AIRPORTS

THOUSANDS of people are employed at a large, modern international airport. They include the flight crews, security guards, baggage handlers, air traffic controllers, officials and check-in staff. Many people also work in the shops, banks, bars and restaurants. An airport is like a miniature city. Tens of thousands of passengers arrive or depart from early in the morning to late at night.



## THE CONTROL TOWER

Air traffic controllers work in the control tower, directing all aircraft to and from runways and deciding when it is safe to take off or land. They have powerful radar equipment to keep watch over the whole airspace around the airport.

## KEY

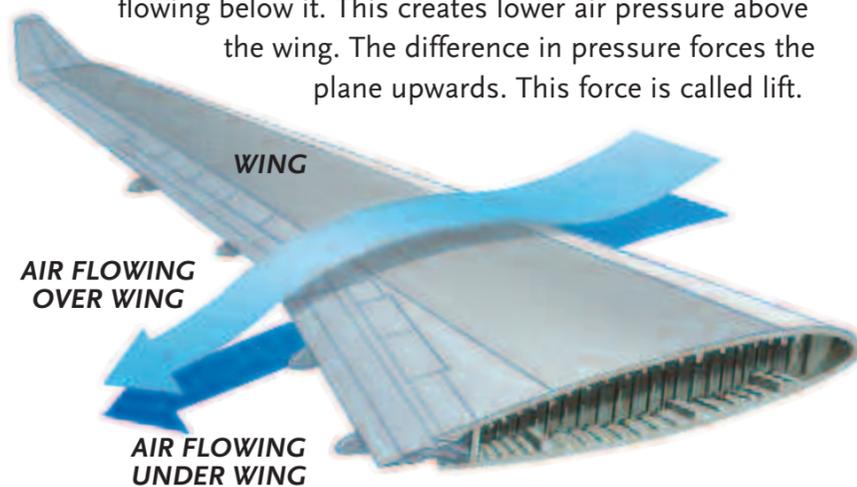
- 1 Radar
- 2 Runway
- 3 Control tower
- 4 Gangway
- 5 Waiting area
- 6 Moving walkway
- 7 Gate to gangway
- 8 Security X-ray
- 9 Escalators
- 10 Check-in desks
- 11 Fuel tanker
- 12 Baggage loading
- 13 Fire engine
- 14 Airport bus
- 15 Baggage trolley
- 16 Jumbo Jet
- 17 Mobile stairway

# HOW DO PLANES FLY?

**H**OW DOES an aeroplane weighing many hundreds of tonnes fly through the air? It relies on its engines to drive it forward at speed and its wings to provide lift (*right*). For a plane to climb into the air its lift must be greater than its weight. Lift can be increased if the plane goes faster or by raising the angle at which the front edge of the wing strikes the air. This is called the angle of attack.

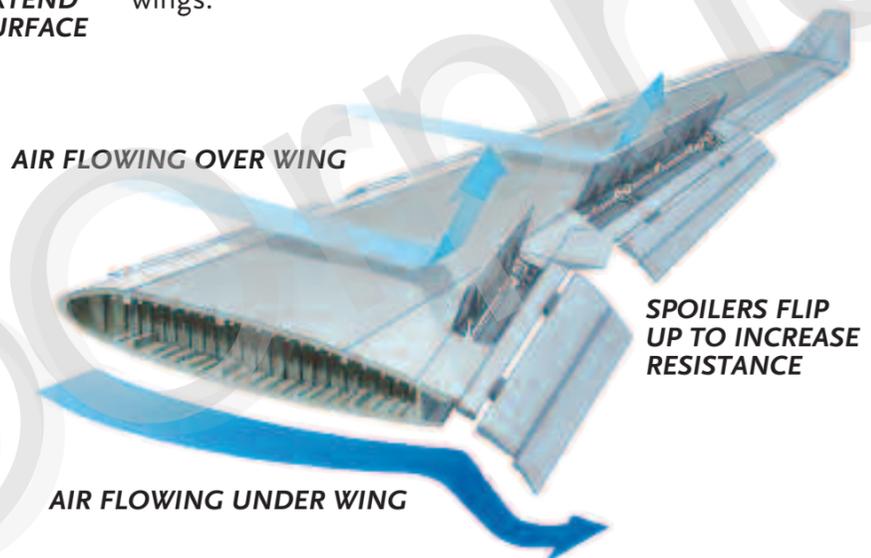
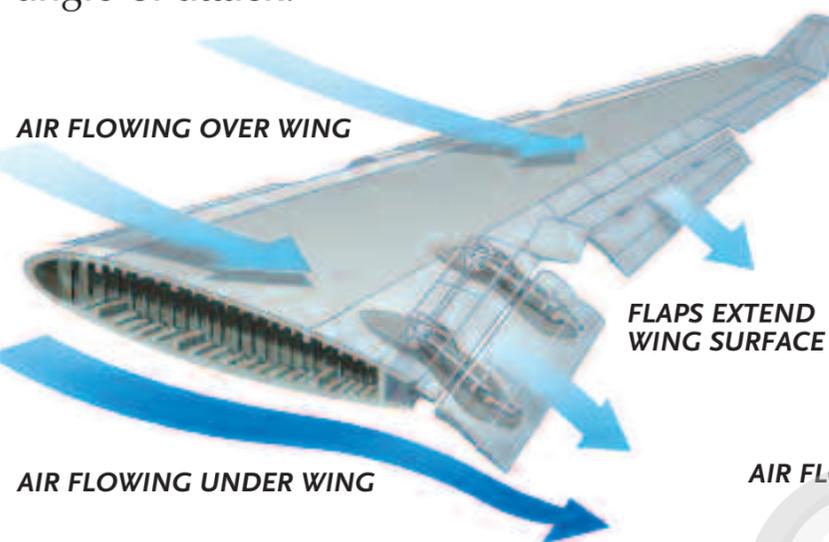
## LIFT

The curved shape of a plane's wing (the aerofoil) causes the air flowing over the wing to travel faster than that flowing below it. This creates lower air pressure above the wing. The difference in pressure forces the plane upwards. This force is called lift.



## EXTENDING THE WING

Maximum lift is needed at take-off and landing, when speeds are slower. Flaps fitted to the wing are used to extend the wing surface and exaggerate its curved profile in order to provide extra lift (*left*). When a plane takes off or lands, flaps extend outwards at the rear edge of the wings.

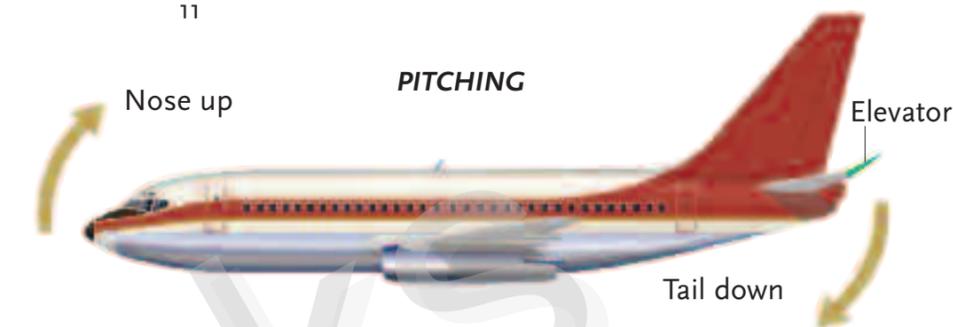


## COMING TO A HALT

Spoilers are used to help bring a plane to a halt after it has landed. These flat surfaces mounted on the upper side of the wings flip upwards (*right*). This increases drag, slowing the plane down. It also increases the weight on the wheels, making the brakes more effective.

## STEERING

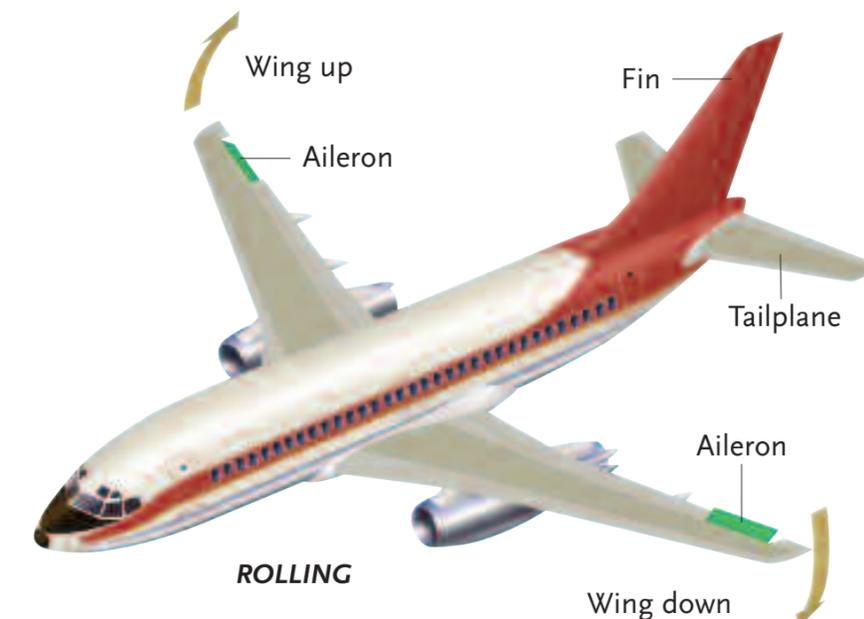
An aeroplane moves in three different ways. It can climb or dive (pitching), it can turn to the left or right (yawing), and it can bank to one side or the other (rolling). Hinged sections called control surfaces allow the plane to be steered. The control surfaces are the rudder, elevators and ailerons (*see opposite*). The fin and tailplane keep the plane flying straight, and level.



To cause an aeroplane to climb, the pilot pulls the control column back. This raises flaps, called elevators, on the tail. The airflow is turned upwards, causing the aeroplane's tail to drop and its nose to rise. To make the aircraft dive, the pilot pushes the control column forwards. This has the opposite effect on the airflow. The tail rises and the nose drops. To turn the aeroplane to the right or left, the pilot uses the ailerons, small flaps on the main wings, to roll the aircraft into the desired turn. The rudder on the tail is also used to make the turn smoother and more comfortable for the passengers.

## HELICOPTERS

Most larger helicopters are powered by a turboshaft engine—a jet engine that turns a shaft. The rotor blades spin round very quickly, pushing the air downwards and so lifting the helicopter upwards. Helicopters can take off and land vertically. They can hover and fly in any direction.



# BOEING 747

THE ONLY aeroplane better known by its nickname, "Jumbo Jet", the Boeing 747 is perhaps the most famous airliner in the world. The Boeing 747, then the world's largest airliner, first flew on 9th February 1969. This very first 747 is now on show at the Museum of Flight in Seattle, USA. Today, nearly 40 years

and several different versions later, the equivalent of one quarter of the world's population has been carried by a 747!

The most recent version, the 747-400, illustrated here, has engines that are 50 per cent more powerful than the original and only half as noisy.

## EXTRA ENGINES

The Auxiliary Power Unit (APU) is an extra, very small gas turbine engine fitted into the tail cone. It supplies the aeroplane with electricity and air conditioning while it is on the ground. The main engines

provide this function while the plane is in the air. The APU may provide emergency electrical power for the plane's flight control hydraulics (which work the ailerons, flaps etc.) while in the air.

## CABIN COMFORTS

Passengers stow their "carry-on" luggage in overhead luggage compartments. For each person there are fold-away tables, reading lamps, air vents and headsets that allow you to listen to music or watch films. Passengers' seats can be adjusted to lean backwards. During the journey, flight attendants serve food and drinks from trolleys wheeled up and down the aisles.

## INSIDE THE BODY

The main body of the aeroplane, known as the fuselage, is a framework of beams and ribs in the shape of a large tube. All the parts are made of lightweight aluminium alloys. The outer skin, also made out of aluminium alloy, is just five

millimetres thick. Installed between it and the internal panels are soundproof and heat-resistant insulation materials. Only 19 centimetres separate passengers in their warm, comfortable cabin from the freezing, air-less exterior! Up to 270 kilograms of paint are used on the plane's exterior.

## ON THE GROUND

The 747-400 has 18 wheels, known as the landing gear. Two wheels are positioned beneath the nose. The other 16 are located beneath the centre of the plane. This many wheels are needed to spread its enormous weight on the runway.

The main landing gear consists of four four-wheeled carriages or bogies, one under each of the wings and two on the underside of the fuselage. The huge impact of landing is absorbed evenly by all four bogies through their shock absorbers.

## ELECTRICITY

Besides driving the plane through the air, the engines supply the power needed for the electricity used on board and to work its array of hydraulic pumps. A gearbox takes power from the engine to drive an electric generator.

## THE BLACK BOX

For safety reasons, a Boeing 747 is equipped with a cockpit voice recorder and a flight recorder, sometimes known as the "black box" (although it is actually a bright orange colour). These instruments always record every manoeuvre the aircraft makes during a flight. In the event of an incident or, worse, a crash, the recordings can be played back and perhaps provide evidence for what went wrong.

### KEY

- 1 APU
- 2 Rudder
- 3 Hydraulic actuator (moves rudder)

- 4 Tail fin
- 5 Tailplane
- 6 Rear pressure bulkhead
- 7 Lavatory

### KEEPING UP THE PRESSURE

The rear pressure bulkhead is a wall partition that seals off the pressurized cabin. Air is pumped into the cabin to keep conditions comfortable for passengers, at pressure levels similar to those we are accustomed to on the ground.

### KEY

- 8 Crew rest area
- 9 Economy class seating
- 10 Waste tanks
- 11 Winglet

- 12 Insulation
- 13 Leading edge flap mechanism
- 14 Rear baggage hold
- 15 Air supply duct

### AT THE WINGTIPS

The 747-400 has winglets at the tip of each wing. They jut out at a 29-degree angle from the main wings in normal flight, giving a greater wingspan, without taking up more room at the airport.

### KEY

- 16 Reverse thrust outlets
- 17 Engine cowling
- 18 Air supply ducts
- 19 Communications aerial

- 20 Emergency door
- 21 & 22 Landing gear assembly
- 23 Wheel retraction hydraulics

- 24 Fuel distribution pipe
- 25 & 26 Air supply ducts
- 27 Exterior of engine
- 28 Overhead luggage compartments

- 29 Engine air intake
- 30 & 31 Galley (kitchen)
- 32 Water tank
- 33 Air conditioning intake ducts

### KEY

- 34 Staircase to upper deck
- 35 Emergency door
- 36 Communications aerial
- 37 Emergency door

- 38 Anti-collision light
- 39 Lavatory
- 40 Forward baggage hold
- 41 Upper deck seating

- 42 Emergency door
- 43 Pilot's rest bunks
- 44 Steering mechanism
- 45 Cockpit or flight deck
- 46 First class seating

- 47 Wheel retraction hydraulics
- 48 Nose landing gear
- 49 Rudder pedals
- 50 Weather radar

