Wings from Nature

Birds and insects in flight

If you study birds and some insects you will see that although they use their wings to keep them in the air and move them along, they don't all fly in the same way.
Some insects fly by beating their wings very quickly, some using one pair of wings, others using two pairs.
The best insect flyers are the ones with a single pair of wings, such as hoverflies, which can fly forwards, backwards, and up and down, as well as hovering on the spot.
Small birds also need to flap their wings quickly to stay up. Larger birds, such as eagles and buzzards, have much larger wings and are good gliders. They can soar on rising air currents without having to flap their wings at all.

Man's early attempts at flight

The story of man's attempt to fly as a bird is as old as human race. In Greek mythology we have the story of Icarus who had wings of feathers sown on with threads and fastened with wax. He flew too near the Sun and the wax melted. He fell into the sea and was drowned.
Oliver of Malmesbury, an English monk, Tower Jumped with wings in 1020 and survived with injuries.
Man's early attempts at flight tried to imitate the way in which birds flap their wings. They failed because man does not have the same muscle and bone structure as birds and because no one understood how a bird really flew.

Balloons

It had been known for centuries that hot air rises. Early cave dwellers must have sat around their fires and watched smoke go up into the sky. Hot air is lighter than cool air and floats above it. A balloon captures hot air and therefore it can lift a load off the ground as it rises. Because balloons float in the air they are called lighter than air aircraft. Some balloons use hydogene or helium rather than hot air.

Two French Brothers, Joseph and Etienne Montgolfier, were the first people to build successful hot-air balloons. The first living things to go up in a balloon were a sheep, a duck and a cockerel in September 1783. The first manned flight took place in November of that year.
The balloon was filled with air heated by a fire on the ground. Then it was released and quickly rose to a height of 1800 metres. As the air cooled down, the balloon slowly descended. It landed about two kilometers from were it took off.
The Montgolfier brothers' balloon was made from linen and paper. In later years, silk covered in rubber was used. Modern balloon envelopes are made from lightweight synthetic fabrics.

In a modern hot-air balloon, the air is heated to about 100 degrees centigrade by a propane gas burner located above the passenger basket. If the air is allowed to cool down, the balloon gets heavier and descends. The

burners are used in-flight to re-heat the air and keep the balloon in the air. Balloons can only be made to go up and down. Once in the air they are blown along by the wind.

Gliders

In 1804 an English engineer, Sir George Cayley, made a small glider. He then went on to do many experiments with wings and developed the theory of flight. Cayley's first full-scale glider had three wings mounted above each other. On one occasion he allowed one small boy to glide a few metres on the craft.

Perhaps the greatest of the 19th century gliding pioneers was a German engineer, Otto Lilienthal. He went to great lengths to test his inventions. He even built an artificial hill from which to take off. Lilienthal made thousands of short glider flights over a five year period before he was killed in a crash. He tried to discover how birds keep airborne, and how gulls glide in rising air currents. These were some of the first experiments in the science that we now call aerodynamics.
Modern gliders are high tech flying machines. They are launched by being towed by a plane or by a winch on the ground.
A glider flies gradually downwards pulled along by gravity, but it can find rising air currents, or thermals to fly in.

DID YOU KNOW...
That perhaps the most amazing paper aircraft flight happened in August 1933. C.O. Reinhart launched his

aircraft from the 10th floor of a New York office building. It landed on the other side of the East River in Brooklyn, two kilometers away. Witnesses said that the aircraft was helped by hot air currents rising from a nearby coffee roasting factory!
....during World War Two, huge troop carrying gliders called Horsas were used by the British forces. These aircraft could descend quietly behind enemy lines, but they often broke up on landing, injuring the troops!

Airships

The airship was the natural development of the balloon. The large round bag of gas was replaced with a cigar-shaped envelope. An engine with a propeller and rudder for steering was also added. This meant that the airship could go where the pilot wanted, rather than where the wind blew it.
The first successful airship, La France, was built in 1884 by the French engineers Renard and Krebs. During World War One, German Zeppelin airships were used to drop bombs on British cities. The Zeppelins had a rigid aluminium framework covered with fabric. Inside there were several gas-filled bags. The crew's quarters were slung in a gondola under the nose.
After World War One, other countries, including the United States and Britain, produced airships. In 1919 the British R34 became the first airship to cross the Atlantic Ocean.
In 1929 the German built Graf Zeppelin flew right around the World in 21 days, covering a distance of over 30,000 kilometers. In the 1930s huge airships were a luxurious way to travel. But the airship age came to an end

because of several disasters. In 1930, 44 people were killed when the British R101 was wrecked on its way to India. Seven years later, the German airship Hindenburg caught fire and exploded, killing 37 people. Some of the disasters were caused by the highly flammable hydrogen gas used for lift.

DID YOU KNOW....

The Hindenburge was the longest airship ever built. It weighed over 200 tonnes and measured 247 meters – as long as four Jumbo Jets placed end to end. Despite its huge size it could carry only about 100 passengers – less than a quarter as many as a single Jumbo Jet.

Modern Airships

In the 1970s the idea of the airship was revived. People thought that airships might be used for cheap freight transport. Airships are now much safer because they are filled with helium gas , which is not flammable.
Today, airships carry cameras for aerial photography, especially at major sporting events like the Olympic Games. Many also have large advertising logos on the side. Airships will probably never be used for passengers transport again, but they will always have an important place in aviation history.

Powered Flight

In the last year of the 19th century, attempts were made at powered flight using steam engines. The engines

were powerful enough to get an aircraft moving fast, but they were very heavy.
Successful flight was not possible until the invention of the petrol engine. Petrol engines were developed for use in cars, and were much lighter than the steam engine.

The date was 17th December 1903; the scene: the cold windy hills of North Carolina; the name of the place which was to go down in history: Kitty Hawk; the occasion: man's first powered flight. The aeroplane had arrived. Orville Wright was at the controls. The aircraft powered by a four cylinder engine, careered through space for twelve seconds at 48 km.p.h. airspeed, swept down and landed in soft sand. Orville wrote: 'This flight lasted only twelve seconds but it was, nevertheless, the first in the history of the world in which a machine, carrying a man, had raised itself by its own power into the air in full flight, had sailed forward without reduction of speed and had finally landed at a point as high as that from which it started'. The Wrights aircraft (since Orville did all this along with his brother Wilbur) was called Flyer. Only five people were there to watch it make history. One photograph recorded the scene. It was not until three years after Kitty Hawk that the Scientific American wrote: 'In all the history of invention there is probably no parallel to the unostentatious manner in which the Wright Brothers of Dayton, Ohio, ushered into the world their epoch making invention of the first successful aeroplane flying machine'.
Note: Later that day of 17th December 1903 another flight of 59 seconds was recorded.

Worldwide pioneers of flight followed the Wright brothers' lead. In 1909 Louis Bleriot, a French pilot, flew his small single-wing monoplane across the English Channel from Calais to Dover.
During World War One, aircraft development speeded up as air forces were formed. By 1918, planes were efficient, powerful and deadly.
In 1919, Alcock and Brown made the first flight across the Atlantic. The next logical step was the development of aircraft to carry passengers across continents.

Jet Engines

A British engineer, Frank Whittle, realized that propeller-driven aircraft would soon reach their limits of speed and altitude. A new type of engine, which could operate at high altitudes and high speeds, was needed for the next generation of aircraft. Whittle experimented with new materials which would survive the very high temperatures and forces in the new engine.
On 27 April 1937, Whittle's prototype engine was tested successfully on the ground. At about the same time, however, another designer in Germany was developing the same idea.
Although Whittle's engine was working first, Hans von Ohain's German design provided the power for the Heinkel He-178, which made the first jet-powered flight on the 27 August 1939. The Gloster Meteor, with Whittle's engine on board, did not fly until 15 May 1941.
Jet powered aircraft have had a dramatic effect on modern life, making the world seem a smaller place. Today you can travel to the other side of the world in a day, and cross the Atlantic in just three hours. Jet

fighters fly at speeds that a pilot of World War Two can only have dreamed about.

Space Flights

Rocket Technology made great advances following the end of World War Two, based initially on Germany's V-2 guided missile. During the 1940s both the USA and the Soviet Union were launching research rockets and by 1957 the Soviet Union was able to launch the first Satellite into space, Sputnik 1.
The USA launched its first satellite, Explorer 1 the following year.
First man in space was Yuri Gagarin a Soviet Cosmonaut followed by the American astronaut Alan Shepherd both in 1961.
First astronauts to travel to the Moon were the crew of Apollo 8. Though all Apollo missions to the Moon 12 men have walked on its surface. First man was Neil Armstrong of Apollo 11 crew 21st July 1969.
The first Space Shuttle took off in 1981 with the ability to land back on earth.

The Three Axis About Which an Aircraft can Move

Vertical Axis
Longitudinal Axis
Lateral Axis

Vertical

Plane Yawing

Manoeuvre Change of Direction or Heading

Control Directional – Right Pedal / Left Pedal

Longitudinal

Plane Rolling

Manoeuvre Banking

Control Stick Left / Stick Right

Lateral

Plane Pitching

Manoeuvre Nose up Nose down

Control Stick backwards (Nose Up) Stick Forward (Nose down)

Aircraft Parts

The Fuselage

The fuselage serves several functions to the whole aeroplane. Besides from being a common attachment point for major components of the aeroplane it also houses the electronics of the model and the fuel tank.

The Wing

When air flows around the wings of an aeroplane it generates a force called lift that helps the aeroplane fly. Wings may be attached to the Top, Middle or Bottom portions of the fuselage. These are referred to as High winger (Top) Mid Winger (Middle) and Low Winger (Bottom). The number of wings can also vary. Aeroplanes with a single set of wings are referred to as Monoplanes while those with two sets are called Biplanes.
The wings have two types of control surfaces attached to the trailing edges.

The ailerons and flaps

Ailerons extend from around the midpoint of each wing outward to the the tip. They move in opposite directions when one aileron goes up, the other goes down. Flaps extend outward from the fuselage to the midpoint of each wing. They always move in the same direction.

The Empennage

The Empennage consists of the Vertical Stabilizer, (or Fin) and the Horizontal Stabilizer. These two surfaces are stationary and act like feathers on an arrow to steady

the aeroplane and help you maintain a straight path through the air.
The Rudder is attached to the back of the vertical stabilizer. You use it to move the aeroplane nose left and right. The Elevator is attached to the back of the horizontal stabilizer. During flight you use it to move the nose up or down so you can direct the aeroplane to the desired height.

Landing Gear

The landing gear (undercarriage) absorbs the landing load, and support the aeroplane on the ground. It typically is made up of three Wheels. The two main wheels located on either side of the fuselage. The third may either be positioned at the nose or at the tail, the later is called a tail wheel. In this case it is called a conventional landing gear. Aeroplanes with this type of landing gear are more difficult to handle on the ground. When the wheel is located on the nose it is called a nose wheel. This is referred to as Tricycle gear. The gear can be either fixed or retractable depending on the design.

Navigation

Navigation is planning your way from A to B prior to Flight.

Map Reading is finding your way from A to B during Flight.

Position Plot

Earth is divided up into Segments by lines of LATITUDE and LONGITUDE

LATITUDES: Horizontal

LONGITUDES: Vertical

Degrees of LATITUDE and LONGITUDES are broken down into ‘Minutes’ with 60 minutes equal to ONE DEGREE.

In Terms of DISTANCE: ONE MINUTE IS = TO ONE NAUTICAL MILE (one Nautical Mile = 1.15 Statute Mile)

Compass Reading

Compass Readings are in degrees from 001 degrees to 360 degrees.

There is a discrepancy between the Geographical North (TRUE NORTH) and direction in which a compass needle will point (MAGNETIC NORTH).

Variation
This is an Angle which can vary both with time and position on Earth's surface.

Magnetic Field

Magnetic Field created by Aircraft itself.

The further difference between the Magnetic North and direction in which compass needle points (COMPASS NORTH) is the angle known as DEVIATION.

Track and Heading

The line drawn on your map depicting your route from A to B is known as the TRACK REQUIRED (Tr.Req)

By measuring the angle of the Track in relation to a line of Longitude (Vertical) you establish the direction you must travel in relation to TRUE NORTH. This direction is known as your TRUE HEADING (Hdg.T). To this must be applied VARIATION to establish your MAGNETIC HEADING (Hdg.) to ensure that your travel will be along the TRACK REQUIRED (Tr.Req) in relation to TRUE NORTH.

Air

It is all around us, but cannot be seen. We can only feel it when it blows on our face. We can only hear it as it rustles the trees and whistles past buildings. Yet we need to breathe it, or we die. It is air. Our World is covered with Air, called the ATMOSPHERE. The Earth's gravity keeps it near its surface. Otherwise our spinning planet would fling it off into space.

The Atmosphere

The air in our atmosphere is made of a mixture of colourless gases. These are mainly Nitrogen (almost four-fifths), Oxygen (one-fifth), plus many other gases, such as Argon and Carbon Dioxide, in tiny amounts.
The air in the atmosphere is densest, or 'Thickest', near the ground. As we travel higher it becomes thinner, or more rarefied.
Air in our atmosphere has also its weight. This is called Air Pressure, and it pushes down about 1kilogram per Square centimetre.

The Atmosphere's different Layers

The different layers of the Atmosphere reach up to about 1,600 kilometres above the Earth's Surface. Beyond the Atmosphere is the beginning of Space.
Most of Our Weather happens in the TROPOSPHERE. At the top of this layer is the Tropopause, which forms the boundary between the Troposphere and the next layer.

Air Temperature

Air like most substances, becomes bigger –Expands- as it is heated.
Air Temperature is the Hotness of Coldness of the Air. This is measured by an instrument known as Thermometer.
A scale on the Thermometer shows the temperature, which is usually measured in Degrees Celsius. Weather experts use different types of Thermometers for different jobs.

Moisture in the Air

The Air in the Atmosphere is hardly ever dry. It contains Water Vapour, which is the GAS form of Water. Like other atmospheric gases, Water Vapour turns to Liquid (CONDENSES) it forms small floating droplets of water, which we see as CLOUDS, MIST and FOG. When the droplets become too big, they come down as rain.

Humidity

The amount of water in the air is called HUMIDITY. When the Humidity is low, sweat evaporates quickly from the body, and our skin feels dry. In High Humidity, sweat cannot evaporate easily since the air already carries much Water Vapour. We say the Weather is Sticky. Humidity level is measured by a psychrometer

Clouds

One of the most obvious features of our Weather are the Clouds floating across the sky. They are made of billions of Water Droplets formed from condensed Water Vapour, or of Ice Crystals made from frozen water droplets.

There are several main types of clouds, according to their shape and their height above the Earth's surface. For example, Cirrus Clouds are thin, wispy streams at heights of over 10 kilometres. Cumulus Clouds have flat bases and billowing, cotton-wool tops. Experts can predict the weather from the Cloud Types and the speed at which they move, blown by the Wind.

Air is hardly ever perfectly clean. Tiny particles of dust float on the slightest wind. This is important, because each water droplet or ice crystal, in a cloud or fog, needs a tiny particle around which it can form or grow.