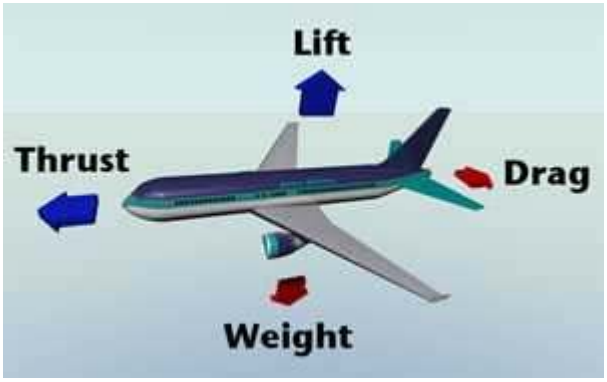
How do aeroplanes fly? How do the engines work? What if the fuel runs out? How are aeroplanes controlled in the air?



How do aeroplanes fly? A friend of mine used to say that he'd never fly, as he couldn't understand how he could trust anything with a couple of spin-dryers under the wings. I tried to explain, but he was having none of it. He just couldn't understand how something so big could fly and be safe.

So how does an aircraft actually manage to get into the air at all? It comes down to basic physics. Any object has a number of forces acting on it, and an aircraft is just the same. First, it has mass, which gravity acts on, pulling it towards the ground - we call this effect weight (objects that are in space are weightless, because they don't have gravity acting on them, but they still have mass).

An aircraft needs something to counteract its weight and get it into the air. This is called 'lift', and is generated by the wings. Wings have a special shape - usually curved on the top and flat on the bottom. As air flows over the wings, the air on the top is forced to take a slightly longer path than the air on the bottom, so it has to speed up. This causes the pressure on the top to be lower than that on the bottom, which effectively 'sucks' the wing upwards.

This is obviously a very simple explanation, as in practice there are a lot of very complex things going on. Obviously, to get air to flow over the wing means it has to be moving. For that, we need a force called 'thrust', which is provided by the engines. As any object moves through the air, it meets resistance as it has to push the air out of the way, so the designers of the aircraft try to make the shape as streamlined as possible.

It's the same problem that car designers face - certain shapes move through the air more easily than others, so cars and aircraft all tend to look similar. The force that tries to resist the forward motion is called 'drag'. Next time you're in a car going down the road, put your hand out of the window. The force you feel pressing on your hand is due to drag.

So, in summary, to get an aircraft into the air, we use engines to supply thrust to counteract drag, which causes air to flow over the wings, which generates lift, and when the lift is greater than the weight, the aircraft takes off. You may of heard of aircraft 'stalling'. This is not the same as in a car, where the engine stalls and the car stops. When an aircraft stalls, it means the wings are no longer generating lift, which can happen for a number of reasons. A stall usually occurs when the aircraft is going too slow for the flow of air going over the wings to generate enough lift, but it can also occur if the angle the aircraft is flying at becomes very steep. The airflow becomes turbulent, and the lift is lost.

It's easy to recover from a stall, as it usually means pointing the nose of the aircraft downwards to increase speed, or applying more thrust. Almost all modern aircraft are controlled by computers, which know all about stalls, and won't allow the pilot to fly in a way that would allow a stall to happen. They effectively monitor what the aircraft is doing, and if it looks like something like a stall is about to happen, they take steps to avoid it. This system is called 'Fly by Wire', which means that the pilot's commands are transmitted along wires, rather than the old-fashioned pulleys and cables method.

COURSES TO HELP COMBAT THE FEAR OF FLYING.....click here for more details **LEARN ABOUT TURBULENCE AND WINDSHEER**.....click here for details

How do the engines work? The modern jet engine is amongst the most reliable pieces of engineering we have today. Its development can be traced back to before WWII, and it's been developed and refined ever since. The engines we see on most commercial airliners are really huge fans, powered by a turbine in the middle.

The basic principal relies on one of the laws of motion defined by Sir Isaac Newton, which states that 'to every reaction, there is an equal and opposite reaction'. Thrust is generated by pushing something out of the back of the engine, which generates an equal and opposite force that pushes it forward. This force is proportional to the mass being expelled, and the speed it's expelled at. In commercial engines, the mass being expelled is mainly air, which is sucked in by a fan, compressed, accelerated and pushed out of the back. In the middle of the engine there is a turbine, which burns fuel, together with compressed air, to turn the fan. The hot gases are expelled from the back, adding to the thrust. That's where we get the name 'turbofan' - it's a combination of a turbine and a fan.

What if the fuel runs out? Before an airliner can take off, a lot of work has to be done, including how much fuel must be carried. This calculation is based on the weight of the aircraft, the weather conditions and the distance to be travelled. An amount of fuel is added which will allow the aircraft to fly to a neighbouring airport if required, plus some flying time at that airport.

Airlines don't like to do this as it means moving large amounts of fuel around, but airliners are checked on landing to make sure they have carried this reserve, and are severely punished if they don't. Also, if the fuel levels become low, the pilots will inform the air traffic controllers who will give them priority to land. Incidents caused by aircraft running out of fuel are exceedingly rare.

How are aeroplanes controlled in the air? Unseen, high above our heads, there are highways for aircraft. They work like corridors, with aircraft flying inside them. On the ground, air traffic controllers keep track of all air movements using sophisticated radar systems, identification equipment on the aircraft, and years of training and experience. I worked at the Civil Aviation Authority for a while, and knew many Air Traffic Control Officers (ATCO's).

Seeing them at work was like watching the inner workings of a complex and beautifully engineered machine. The level of concentration and discipline was astonishing. On one occasion, an airliner had taken off from Heathrow heading for Glasgow, when it declared that one of its engines had a problem. Immediately, a sequence of events took place that allowed the aircraft to return, while a runway was cleared and prepared for its return. Simultaneously all the aircraft in the vicinity were seamlessly directed onto other flight paths, or kept in holding patterns until the returning airliner was safely on the ground, and then everything was quickly returned to normal. I doubt if anyone on the other planes even knew that anything had happened. What was most remarkable was that everyone knew immediately what to do, and did it automatically - calmly, quietly, and with absolute confidence.

The image of Air Traffic control is of a darkened room, filled with glowing radar screens and flashing lights - but what happens when all the technology fails? Don't the lose track of all those planes? The answer is no - all Air Traffic Controllers are extensively trained for such eventualities, and can still control the skies using tried and tested methods that don't rely on technology more complex than a pencil and paper. Whatever eventuality you can think of, they've thought of it too, and are trained to deal with it safely.

Article by: Adrian Mann (info@adrianmanndesign.co.uk)