**4 Forces in Flight**

<https://www.youtube.com/watch?v=i4ZPanubec0>

* Lift is produced by airflow over the wings – the faster the aircraft flies, the faster the airflow … leading to more lift
* Drag is produced by air resistance – the faster the aircraft flies the more drag

You have felt this when riding a bicycle, or walking into a strong wind

* When Lift is greater than Weight the aircraft climbs
* When Lift is less than Weight the aircraft descends
* When Thrust is greater than Drag the aircraft speeds up
* When Thrust is less than Drag the aircraft slows down
* When Thrust equals Drag and Lift equals Weight the aircraft flies level at a constant speed

**Clouds:**

<https://www.youtube.com/watch?v=-YySltYzvtU>

Air is warmer closer to the ground – as it rises it cools.

Clouds form when the air cools to a temperature, known as the dew point, when the water vapour, in the air, starts to condense.

This is what you see coming out of a kettle as it boils.

There are 3 main reasons air rises:

* Wind blowing onto the side of a hill
* The ground warms the air, which then starts rising – these are called “thermals”
* Weather fronts – when cold air meets warm air it forces itself under the warm air, causing the warm air to rise

The first 2 tend to cause “Cumulus” clouds to form – these are the fluffy / cotton wool clouds.

Cumulus clouds tend to be fairly low level – though they can rise up to tens of thousands of feet.

When a Cumulus cloud gets too much water in it rain results – this type of cumulus cloud is called Cumulo-Nimbus.

When the clouds are formed by fronts they can take many different forms:

They are broken down into 4 main types:

* Cirro-form The Latin word “cirro” means curl of hair.

Cirro-form clouds are ALWAYS very high

* Cumulo-form Generally not attached to surrounding clouds they look like fluffy cotton balls

The bottom of Cumulo-form clouds is usually flat

* Strato-form From the Latin word for “layer”. They look more like a blanket.
* Nimbo-form “Nimbus” is the Latin word for rain

<https://scijinks.gov/clouds>

These are then further sub-divided into 10 types: <https://www.noaa.gov/jetstream/clouds/ten-basic-clouds>

When a cloud is “mid-level” it may have “alto” in the name

Clouds are an issue for aviation because:

* Light Aircraft:

These aircraft will not have an auto-pilot and, in all likelihood, the pilot will not have been trained to fly in them. An untrained pilot entering cloud is likely to have difficulty keeping the aircraft the right way up.

Also these aircraft will not have the necessary tools to allow the pilot to land – if the clouds are very low.

* All Aircraft:

Large CumuloNumbus clouds can have VERY strong up and down draughts – these can be so strong an aircraft can not maintain altitude. Also flying through these up & down draughts puts a lot of strain on the aircraft

For the above reasons it is really important to know what clouds might be encountered on a flight and if it is possible to avoid them.

**Wind Direction and Strength:**

When an aircraft takes off, or lands, the speed over the ground at which it leaves, or returns to, the ground is governed by the speed of the air flowing over the wings.

If an aircraft takes off into wind then it needs to gain less speed than if it takes off with the wind.

Example:

* An aircraft flies at 45 knots and there is a 10 knot wind
* Taking off into wind the aircraft needs to accelerate to 35 knots on the ground
* Taking off with the wind the aircraft needs to accelerate to 55 knots on the ground

If the wind is blowing across the runway then it makes it more difficult to take off or land.

All aircraft will have a maximum “cross wind” specified in their manuals – this is the safe limit.

**Forecasting:**

Temperature is measured using 2 thermometers:

* Dry bulb: Ambient temperature
* Wet bulb: Dew point

Sometimes, instead of a Wet Bulb thermometer, a Hygrometer is used – this measures humidity.

When you have:

* Temperature and Dew point you can calculate Humidity
* Temperature and Humidity you can calculate Dew point

… so you don’t need all 3.

These thermometers are installed in a “Stephenson Screen” – a standard box a set height above the ground … this ensures that it doesn’t matter if the weather station is in sunlight or shade, what the wind is doing, …

Pressure is measured using a simple pressure gauge.

In most cases this will be a mercury barometer – as this removes any mechanical errors.

**Flight Time:**

Distance / Speed over the ground

A tail wind will increase speed over the ground

A head wind will decrease speed over the ground

If no wind: 60 / 90 hours = 2/3 hour == 40 minutes

If 10 knot tail wind: 60 / (90 + 10) = 3/5 hour == 36 minutes

If 10 knot head wind: 60 / (90 – 10) == 3/4 hour == 45 minutes

**Air Traffic Control:**

<https://www.youtube.com/watch?v=EIKfHOk8rx0>

When you talk to an airfield, or airport, there are 3 levels of service that may be provided:

* Air-Ground Small airfields

Callsign: Radio

* + Not able to give Instructions
	+ Provides Information to assist a pilot in the safe conduct of his/her flight
* Airfield Information Small / Medium airfields

Callsign: Information

* + Provide Instructions to aircraft on the ground
	+ Provide Information to assist a pilot in the safe conduct of his/her flight
* Air Traffic Control Medium / Large airports
	+ Pilot MUST ask for permission to do ANYTHING (including starting engines)
	+ Pilot MUST obey any instruction given (unless safety is compromised)

Callsign: Ground

* Manages traffic on the Ground
* Directs traffic to/from their parking places
* Gives permission to start engines

Callsign: Tower

* Manages aircraft close to the airport
* Gives permission for aircraft to land / takeoff
* Provides instruction on where they must go after takeoff

Callsign: Approach

* Manages aircraft when they are approaching / leaving the airport (further away than Tower)
* Tell them how to approach the airport / if they have to “hold” / …

Callsign: Radar

* Manage aircraft that are passing through local airspace

**Pre-Flight Checklist:**

Set of instructions to follow / checks to perform to ensure aircraft is correctly configured for take-off.

Glider:

* C Controls: Full and Free movement, controls moving surfaces in correct direction (sense)
* B Ballast: Weight of pilot (and passenger) within limits
* S Straps: Everyone’s straps are done up and tight
* I Instruments: Instruments are set correctly for the flight – e.g. Altimeter set QNH or QFE
* F Flaps: Flaps (if fitted) are set correctly for takeoff
* T Trim: Trim set correctly for takeoff type
* B Brakes: Airbrakes deploying symmetrically and then locked
* E Eventualities: Run through what actions to take in the event of launch failure
* C Canopy: Lower and check the canopy is locked

Light Aircraft:

* T Throttle Friction: Set so that throttle will not move by itself
* T Trim: Set correctly for takeoff
* M Magnetos: Both on
* M Mixture: Fully rich
* P Pitot: Pitot cover off
* P Primer: Primer locked
* P Pitch: Propellor pitch set fully fine
* G Gear: Undercarriage is locked down
* G Gyros: Gyroscopic instruments powered up and set as required
* F Fuel: Sufficient fuel for the flight, fuel pump on
* F Flaps: Flaps set correctly for takeoff
* I Instruments: All instruments set correctly and displaying as expected
* I Indications: Engine instruments all “in the green”
* C Controls: Full and free movement, correct sense
* C Carb Heat: Carburettor heat is set to cold
* H Hatches: Hatches are closed and locked
* H Harnesses: Harnesses (straps) are done up and tight