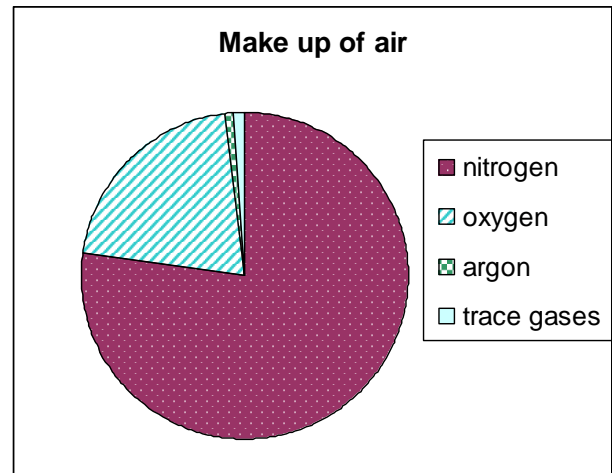


## Air and Aerodynamics Study guide

**Air** – the air we breathe is made of different gases

| Gas               | Percent in Air |
|-------------------|----------------|
| Nitrogen          | 79 %           |
| Oxygen            | 21 %           |
| Argon             | 1 %            |
| Other trace gases | Less than 1%   |



**Air exists** because:

- ♦ It takes up space
- ♦ It has volume
- ♦ It has weight
- ♦ Air has mass
- ♦ It has pressure

**Air takes up space**

- ♦ Run a garbage bag through the air- it fills with air = air takes up the space in the bag
- ♦ Put a cup upside down in water. The cup will not fill with water because air is taking the space up in the cup. You must let the air out (by tipping the cup) in order for water to fill up the space.

**Air has volume**

- ♦ You can measure the volume of air in a room- take the measurements of the room ( length X width X height). This will equal the volume of air in the room.

**Air has weight**

- ♦ tie two equal size balloons on the ends of a stick. Balance them. Pop one balloon. The other balloon filled with air will fall towards the ground because it has weight.

**Air has mass**

- ♦ measure a balloon that is not blown up on a scale. Record its mass. Blow up the balloon with air. Remeasure the balloon on the scale. The difference is the mass of the air

**Air has pressure**

- ♦ air pressure increases the closer you are to sea level
- ♦ air pressure decreases as you go up a mountain.

| Air        | Higher or Lower Pressure |
|------------|--------------------------|
| Cold air   | higher                   |
| Warm air   | lower                    |
| Still air  | higher                   |
| Moving air | lower                    |

**Bernoulli's principle** states that faster flowing fluids (gases and liquids) have lower pressure than slower flowing fluids

## Hot Air Balloons

- Hot air balloons work because hot air rises. Blowing hot air into the envelope of the balloon makes the air in the balloon less dense. Once the air in the balloon is less dense than the outside air, the balloon will rise (it is more buoyant).
- Hot air balloons use the blower to create lift and the air currents to create thrust.
- Air balloons are controlled by the slits in the envelope- opening the slits causes the balloon to descend.

**Aerodynamics** is the study of air and how it moves around objects

To make objects more aerodynamics:

- you can study how air moves around the object in a wind tunnel

Objects that are aerodynamic tend to be rounder (curved) and lighter.

## Forces in Flight

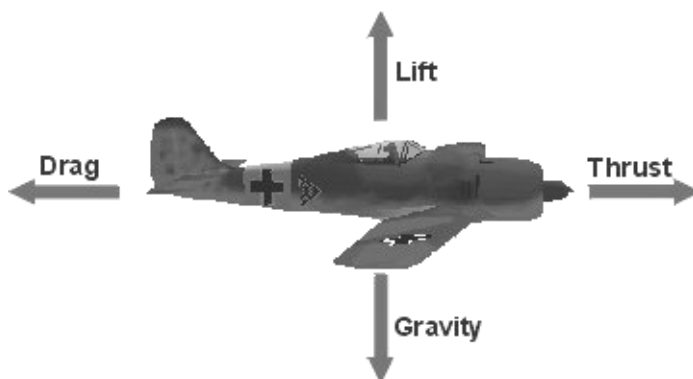
**Lift**- upward force

**Gravity**- downward force

**Drag**- backwards force

**Thrust**- forward force

| Force  | Opposite force | Greater force = What happens  |
|--------|----------------|---|
| lift   | gravity        | Lift is greater = plane will go up<br>Gravity is greater = plane will go down     |
| thrust | drag           | Thrust is greater = plane will speed up<br>Drag is greater = plane will slow down |



## **Parachutes**

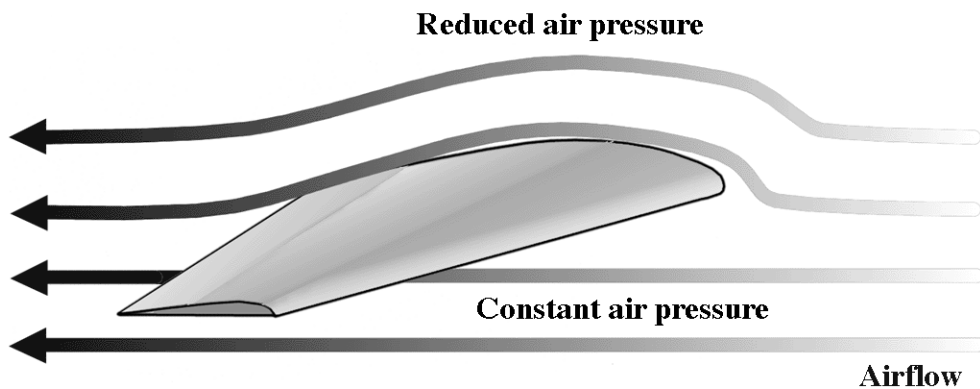
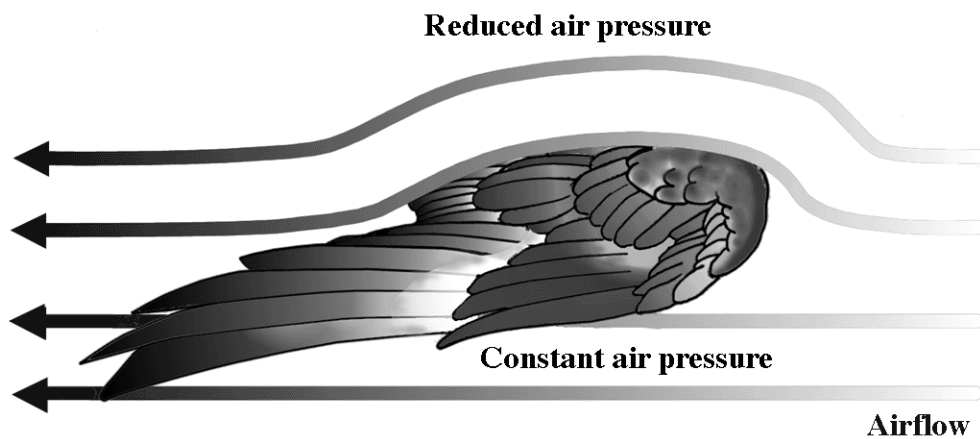
Parachutes work by increasing drag. The design of a parachute will determine how fast it falls and lands and if you can maneuver in the air.

A large canopy will increase drag

A wide narrow canopy will allow for greater control in the air.

## **Airfoils**

Air foils are curved on the top and flat on the bottom. Air moves faster over the top of the airfoil than on the bottom. The air on the top of the airfoil has low pressure and the air on the bottom, because it is moving slower, has high pressure. This creates lift.



## **Things that fly**

Birds and insects have special adaptations for flight

| <b>Birds</b>   | <b>Insects</b>  |
|--|---|
| <ul style="list-style-type: none"><li>• have hollow bones that make them lightweight but strong</li></ul>  | <ul style="list-style-type: none"><li>• Light weight and small</li></ul>  |
| <ul style="list-style-type: none"><li>• Have feathers</li></ul>  | <ul style="list-style-type: none"><li>• May have one or two sets of wings</li></ul>   |
| <ul style="list-style-type: none"><li>• Have strong pectoral muscles that allow them to flap their wings</li></ul>   | <ul style="list-style-type: none"><li>• Have strong pectoral muscles that allow them to move wings</li></ul>                      |
| <ul style="list-style-type: none"><li>• Wings shaped like an airfoil</li></ul>   | <ul style="list-style-type: none"><li>• Wings shaped like an airfoil</li></ul>  |
| <ul style="list-style-type: none"><li>• Aerodynamic shape</li></ul>  | <ul style="list-style-type: none"><li>• Aerodynamic shape</li></ul>   |
| <ul style="list-style-type: none"><li>• Primary and secondary feathers each have a role in flight. Primaries allow the bird to maneuver in the air. Secondaries catch air.</li></ul> | <ul style="list-style-type: none"><li>• Wings are very thing with a network of veins. Veins make the wings very strong.</li></ul> |