Flight Study Guide (Science 6)

Organizing things that fly:

- **Floaters** could include items such as balloons, dandelion seeds, parachutes, poplar fluff or bubbles. Technically, a floater does not really fly. The wind controls the speed and direction of flight.

  Examples of floaters:

- Paper airplanes, flying squirrels or hang gliders would be classified as **gliders** because their wings (or membranes) interact with air currents (moving air). In still air, gliders will always finish lower than their beginning altitude.

- **Powered flyers** use engine or body energy to fly or gain altitude; some examples are insects, flying birds and airplanes. Hot air balloons could be classified as either floaters or gliders and some birds may be categorized as either gliders or powered flyers.

Parachutes:

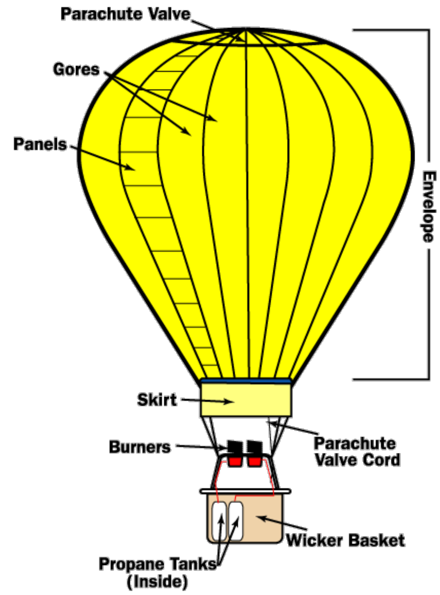
Parachutes operate on the principle of drag and work as a result of their mass to surface area ratio. Two things affect the descent rate of an object falling through the air. The first of these is gravity, and the second is wind resistance (drag). A small hole in the center of the canopy prevents the parachute from wobbling. The hole lets air escape out the top rather than spilling out one side and then the other. Most parachutes are circular. However, parachutes with special shapes, movable panels or small openings are often used in air shows because they can be steered more accurately.

		
Parachutes shaped like an airfoil, decrease the rate of descent because extra lift is created.	Parachutes with holes in the canopy, help the parachute descend without wobbling.	Hang gliders work similar to parachutes, but are shape much more like a wing to glide for longer periods of time.

Hot Air Balloons:

Hot air balloons operate on **Archimedes Principle** which states that objects suspended in a fluid (such as a boat in water or a balloon in air) have a buoyant force equal to the weight of the fluid displaced.

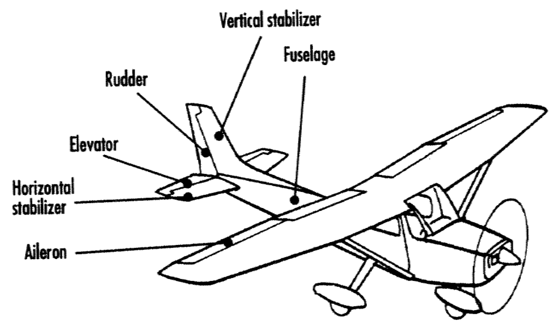
This principle helps explain why hot air balloons must have a large envelope. In hot air balloons, the heated air expands, filling the envelope. Heated, expanded air weighs less by volume than cooler air. Cold air is denser than warm air, so warm air will float on top of cold air. The envelope of the hot air balloon keeps the cold and warm air from mixing, permitting the colder, denser air outside the balloon to support the mass of the balloon and keep it aloft.



To keep the balloon aloft, a blast from the burners is given every thirty seconds. As the air inside the balloon cools and contracts, the balloon loses altitude since less air is being displaced. To allow for a quick descent, a Velcro vent at the top of the balloon can be opened by means of a rope, speedily dispelling warm air speedily. In this way the pilot can control the up and down movement of the balloon. In the air, the hot air balloon's lateral movement is at the mercy of the prevailing winds.

Gliders / Modifying Flight Patterns:

On an airplane the elevators help to control **pitch**, the upward and downward motion of the nose. The **elevators** are located on the horizontal stabilizer section of the airplane's tail. When the elevator is in the up position, the tail section of the plane goes down, raising the nose. The plane climbs. Conversely, when the elevator is down, the tail section lifts, lowering the nose and the plane heads downward. Bernoulli's Principle allows us to understand the operation of elevators. Raising the elevator creates drag. The air moving over the elevator is slowed down; the slower moving air has higher pressure relative to the faster moving air under the stabilizer. This results in the tail section dropping, pointing the nose upward. The opposite happens when the elevator is lowered.

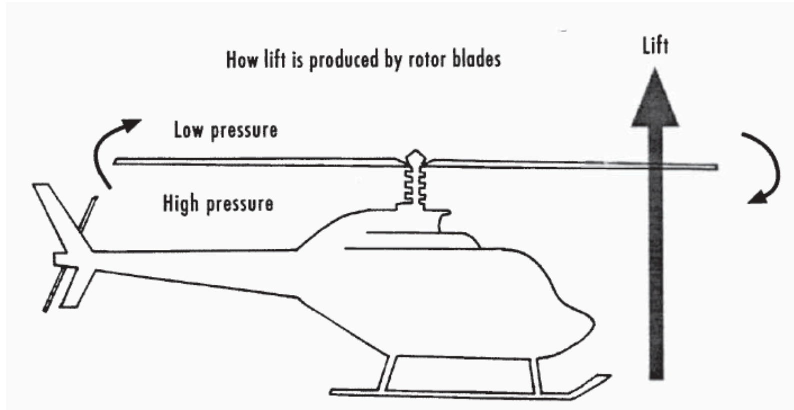


A plane uses **ailerons**, hinged flaps, located on the trailing edge (back) of its wings, to help it tum. To turn, a plane must bank (**roll**), or tip a little on its side in much the same way as a cyclist leans when turning a comer. When an aileron is raised, drag is created and this slows the air moving over the upper surface of the wing, thereby increasing pressure. The result is less lift to the wing. If the aileron is lowered, the air speed over the top of the wing is faster relative to the speed under the wing. The pressure on the top of the wing decreases which makes the lift greater. What happens if the right aileron is raised and the left one lowered? The right wing drops because it loses lift and the left one raises because it gains lift and the plane as a whole banks to the right. When the aileron positions are reversed, the plane banks to the left.

To assist these movements, the **rudder** is turned right for a right tum and left for a left tum. When one aileron is raised, the other one on the other wing, is automatically lowered. The rudder controls **yaw**, the right-left movement of the nose. If the rudder is turned to the left, the nose of the flyer yaws left. Conversely, if the rudder is turned to the right, the nose yaws right. Why does this happen on an airplane? When the rudder which is located on the vertical stabilizer is angled right, it creates drag on the right side of the stabilizer which results in higher pressure.

Propellers:

Helicopters, with their horizontal propeller called a rotor, do not require forward propulsion. Each of the long, thin blades of the rotor is shaped like an airfoil. The spinning blades create an area of high pressure under them and an area of low pressure over the top of them; this produces the lift needed to take the helicopter into the air. When the helicopter's blades are tilted, it flies in the direction of the tilt.



Propeller-driven aircraft are pushed forward by the pressure imbalance set up by the spinning propeller. Basically a propeller is a twisted airfoil. The spinning propeller produces a low-pressure area in front of it and a high-pressure area behind it; the propeller, and plane, are pulled forward. How do jets achieve forward motion? They take in air through the front of the engine and compress it into a small space. The compressed air is mixed with fuel and burned. The hot air and fuel expand creating a jet of hot gases, which are shot out of the rear of the engine. The action of the hot gases being forced from the rear of the plane causes a reaction on the plane, which moves it in the opposite direction. This is an illustration of Newton's Third Law of Motion: For every action, there is an equal and opposite reaction.

Spacecraft vs. Aircraft:

Sending aircraft into outer space presented new design problems for engineers. Beyond the thin layer of atmosphere surrounding the earth there is no air to hold up an airplane or balloon. The absence of air means there is no oxygen to burn liquid fuel, as in a jet engine. The absence of air in space makes having control surfaces pointless. Rockets were designed to overcome these differences. To get into space, a rocket must move fast enough to break away from the earth's gravity, but once the rocket is in orbit around the planet, it does not need any rockets engines to keep it moving. **Rockets** have streamlined bodies to minimize drag while traveling through the earth's atmosphere; although once in space, their shape or configuration is of little matter. While within the blanket of air around the earth, air pressure on tail fins keeps the rocket flying straight and steady; in space, thruster jets are employed to turn or maneuver the rocket. Rockets must carry their own oxygen supply in the form of a chemical called an oxidizer. The hot gases produced in the firing chamber rush out the nozzle, pushing the rocket in the opposite direction. The burning fuel makes enough heat to burn through the walls of the firing chamber so designers had to incorporate coils of cooling pipes around the chamber to reduce the heat.