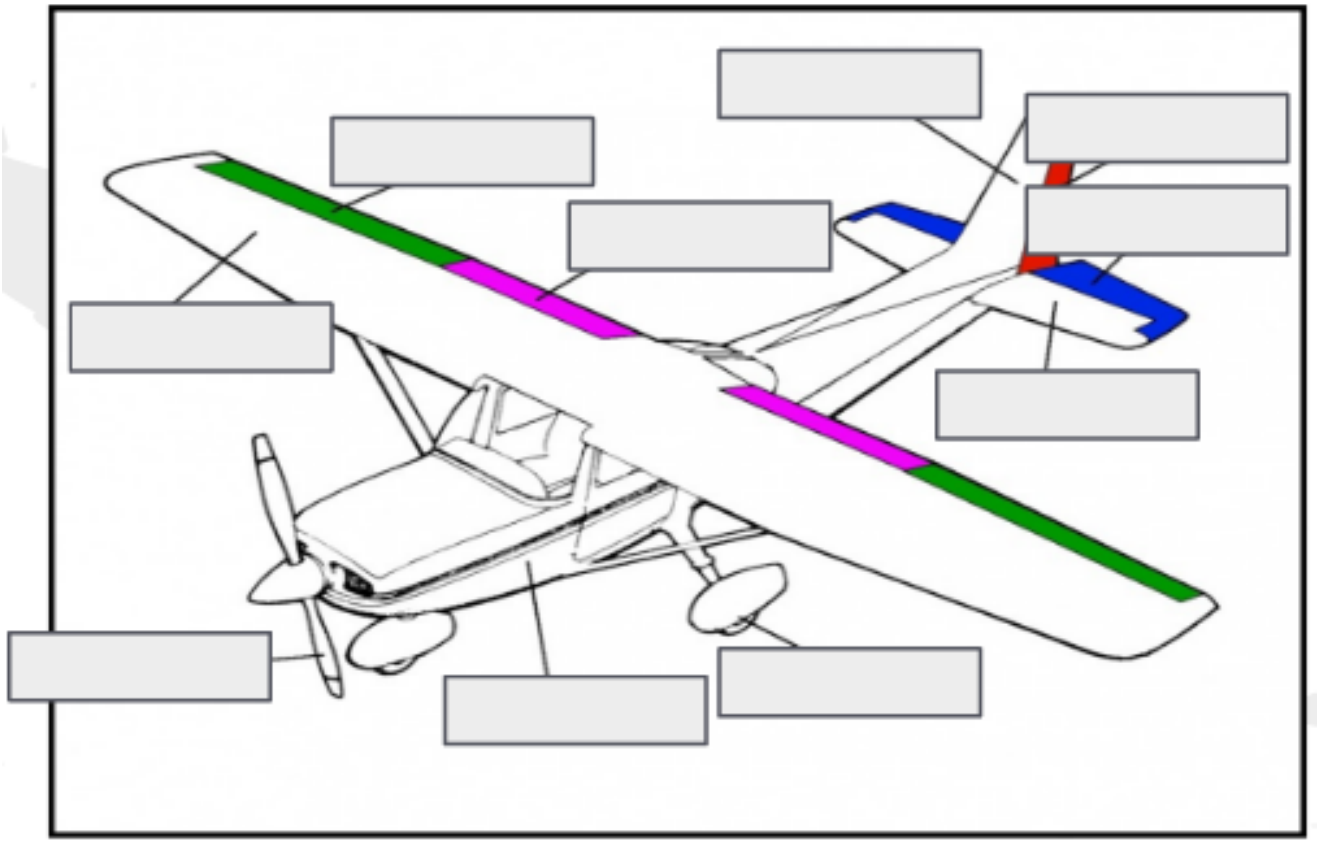
WARM-UP

Have you ever flown on an airplane? If so, where did you fly, on what kind of plane and how long was the flight?

To start off our unit on flight, we will attempt to gain an understanding of how a heavier-than-air object can actually lift off of the ground and fly. In this activity, we will identify the major parts of airplanes, what purposes these parts serve and discover the four "forces of flight" and Bernoulli's Principle.

Students who grasp these concepts well will likely be able to create a plane that will be successful. Of course, our time spent on this unit is limited, so students are encouraged to explore the principles of flight on their own outside of the classroom.

PART 1 – Consider the diagram below (we'll label it together), then explain the purpose of each one in the chart on the reverse side of this sheet. ***This is the same diagram you will see on your quiz, so make sure you study it!***



PART	PURPOSE
propeller	

fuselage	
wing	
landing gear	
ailerons	
flaps	
horizontal stabilizer	
elevator	
vertical stabilizer	
rudder	

One part that likely needs a little more of an explanation is the *flaps*. Wings will generally generate more lift when the forward velocity is increased. Conversely, as speed decreases, so too does the lift.

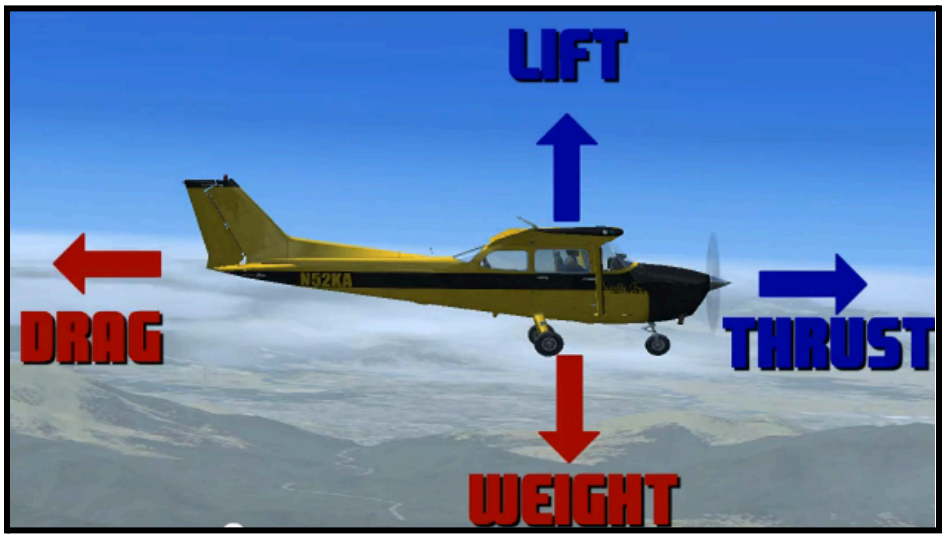
At take-off and landing, two of the most critical times during the flight, the aircraft's speed is much slower, however lift is still required. Pilots extend the wing's flaps to increase the wing's *surface area*. This increased surface area increases the wing's ability to produce lift, even at very slow speeds.

PART 2 – There are ***four forces*** or *factors of flight*. They are really two pairs of forces, each working in opposition to the other in their pair. The four forces/factors are listed below. We will define them together.

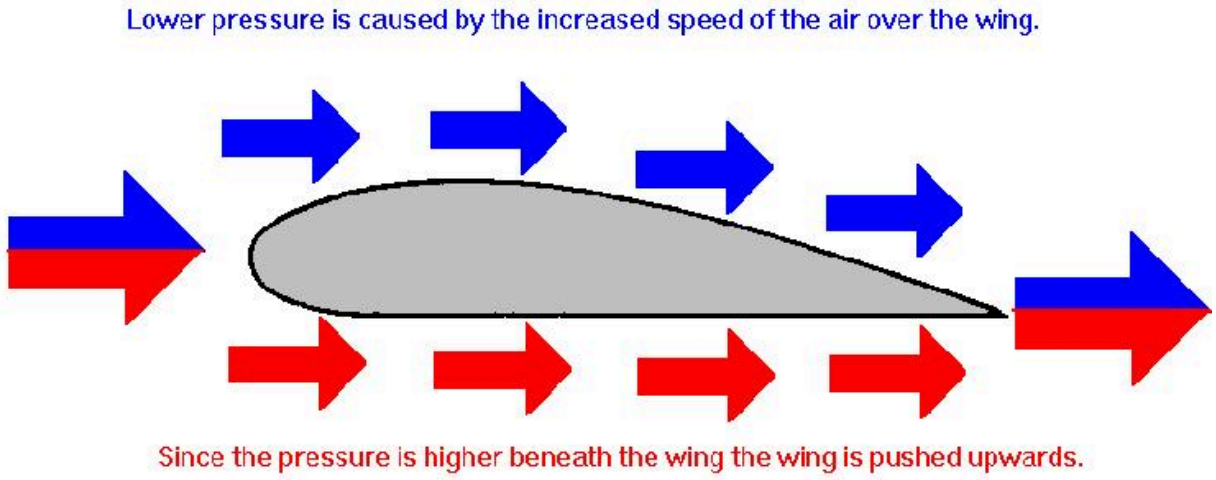
FORCE	DEFINITION
thrust	
drag	
gravity/weight	
lift	

- **In order for a plane to fly, (**thrust/drag**) must be equal to or greater than (**thrust/drag**).**

- **In order for a plane to fly, (**weight/lift**) must be equal to or greater than (**weight/lift**).**



PART 3 – Wings must have a special shape in order to take advantage of a physical science principle, called *Bernoulli's Principle*, which will help it generate lift. Below is a side/cut-away view of a wing or airfoil. We will use this diagram to define Bernoulli's Principle, and you will need to apply it when you build your airplane.



When airflow encounters the leading edge (front) of the wing, it splits being forced over the top and the bottom of the wing AND will meet up at the trailing edge (back) of the wing. Since length the air must travel over the top of the wing is greater, it must travel faster, creating a low-pressure condition. Conversely, the air traveling under the wing travels at a lower speed creating a high-pressure condition. Since there is greater pressure beneath the wing the wing will rise or lift.

In the space provided, summarize Bernoulli's Principle:

PART 4 – Four of the parts in the chart in Part I above are "movable surfaces," which must be properly manipulated to control the aircraft, whether it is a single-engine, prop-driven craft or a multi-engine jet.

Read each statement below, then fill in the blank with a direction (up, down, left or right).

- If the ***rudder*** is positioned to the left, the plane will "nose" to the _____.
- If the ***rudder*** is positioned to the right, the plane will "nose" to the _____.
- If the ***elevator*** is positioned up, the plane will go _____.
- If the ***elevator*** is positioned down, the plane will go _____.
- If the left ***aileron*** is up and the right is down, the plane will roll to the _____.
- If the left ***aileron*** is down and the right is up, the plane will roll to the _____.

PART 5 – Planes move and maneuver along three axes that are imaginary lines running through the airplane's *center of lift*. They are as follows (use the diagram at the bottom-right to help you better understand them):

- **LATERAL ROTATION** (*pitch*) – characterized by a "nose up" or "nose down" position, controlled by the _____.
- **LONGITUDINAL ROTATION** (*roll*) – clockwise or counter-clockwise rotation around the direction of flight, controlled by the _____.
- **VERTICAL ROTATION** (*yaw*) – characterized by the nose or the aircraft turning to the left or the right without a change in the direction of flight, known as "crabbing," controlled by the _____.