

Fundamentals of Flight

A Basic Introduction to Aerodynamics



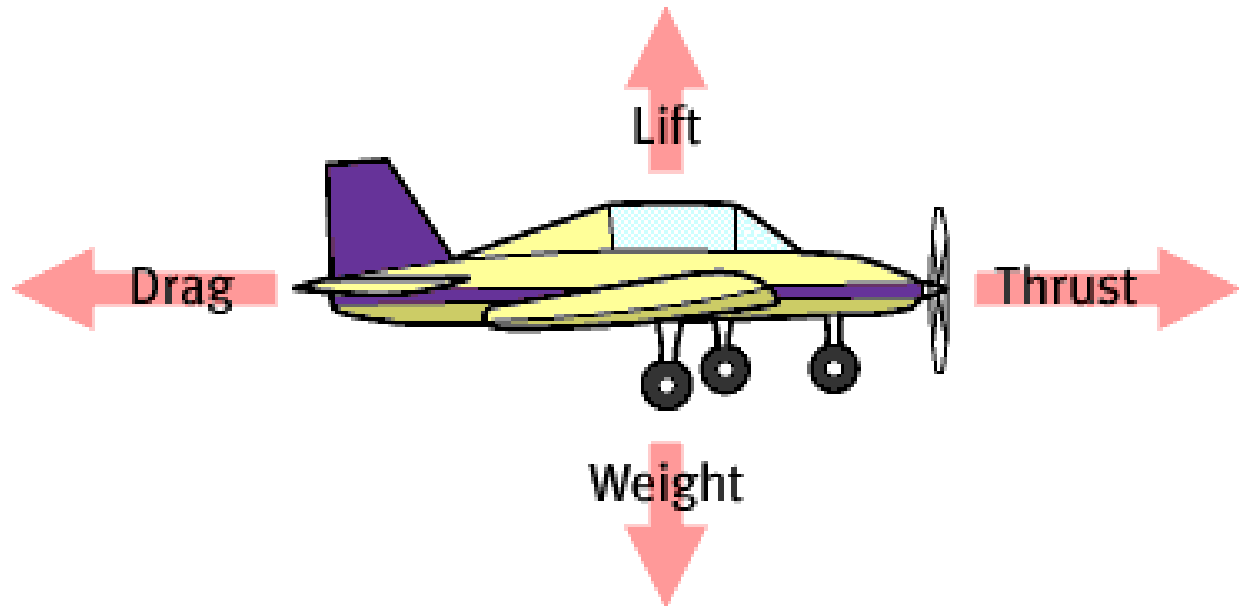
The Four Forces of Flight

- Weight

- Lift

- Drag

- Thrust



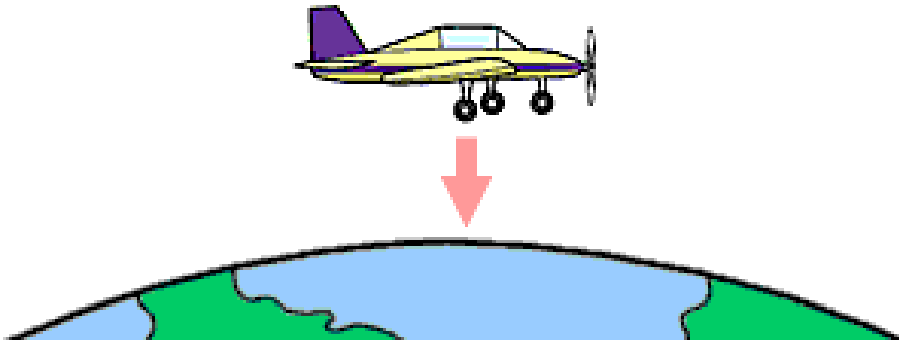
The four forces act on the airplane in flight and also work against each other.

Four Forces of Flight

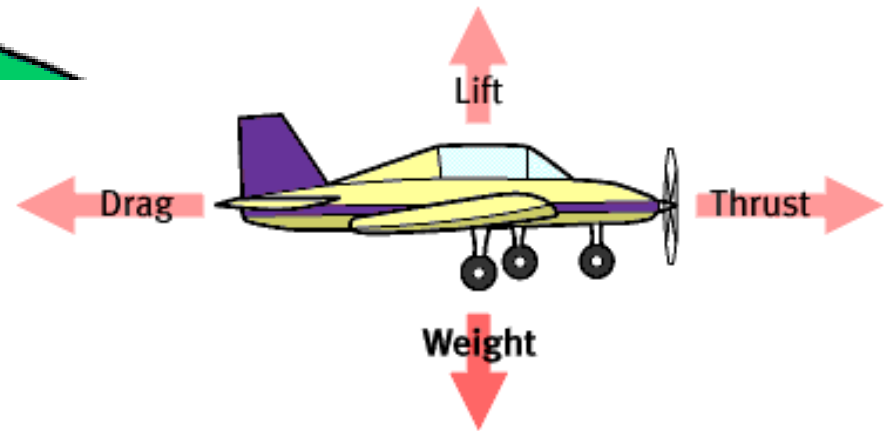
- ◆ Lift is a force used to stabilize and control the direction of flight.
- ◆ Drag is the force of resistance an aircraft 'feels' as it moves through the air.
- ◆ Weight is the force generated by gravity on an object.
- ◆ Thrust is the force which moves the vehicle forward.

Weight

The earth's gravity pulls down on objects and gives them weight.



Weight counteracts lift.



The Airplane and Lift



What's it take to create lift?

Air and Motion

- ◆ Newton's Laws of Motion and Bernoulli's Principal are used to explain lift.

How do we explain lift?



Bernoulli and Newton

Glenn
Research
Center



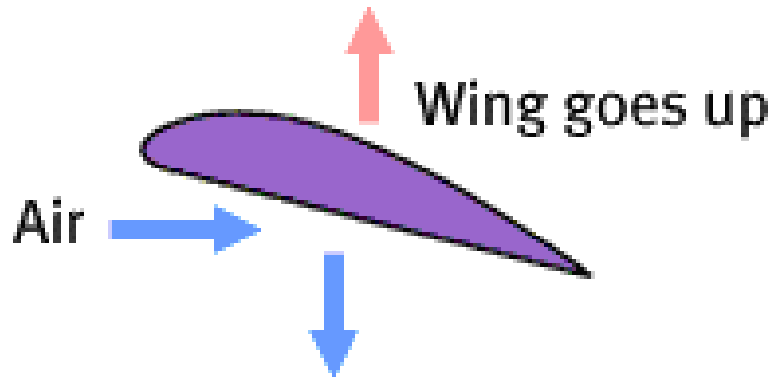
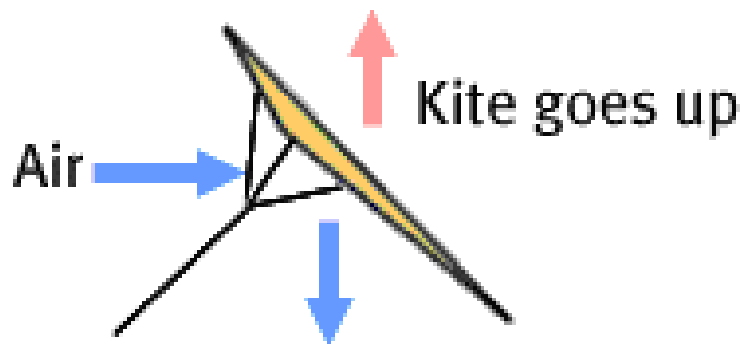
Daniel Bernoulli



Sir Isaac Newton

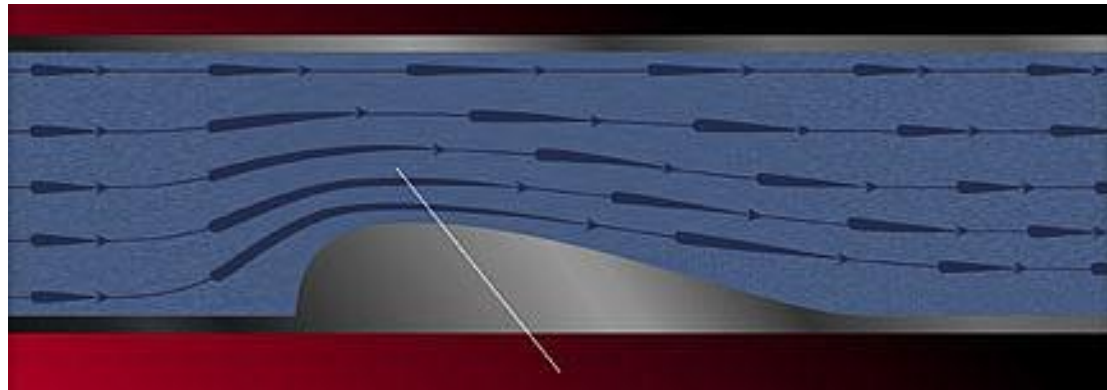
Using Newton to Explain Lift

Newton's Third Law states that for every action there is an equal and opposite reaction.

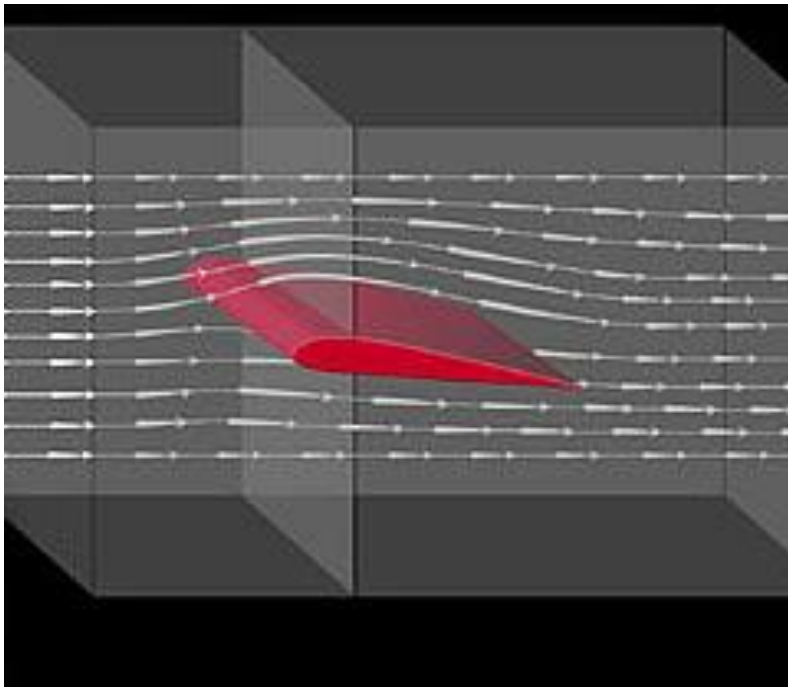


Using Bernoulli's Principle to Explain Lift

- ◆ Air acts as a fluid
- ◆ Bernoulli's Principle states that:
 - ◆ A fluid speeds up as it moves through a constricted space
 - ◆ As a fluid speeds up, its pressure goes down



Using Bernoulli's Principle to Explain Lift



- Air moving over the wing moves faster than the air below. Faster-moving air above exerts less pressure on the wing than the slower-moving air below. The result is an upward push on the wing—lift!

Newton and Bernoulli

A wing creates lift due to a combination of Bernoulli's Principal & Newton's Third Law

