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# ***Forces and Motion***

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# ***FORCE ?***

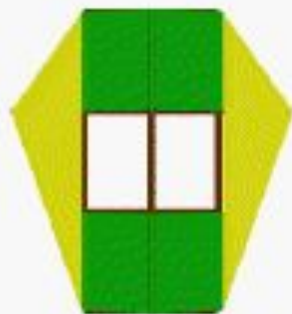
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**What is it?**

**Why is it important?**

**What does it do ?**

**How does it work?**



**Examples ?**





# Forces

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Objects generate forces.

*(objects are solid, liquid, or gas)*

Forces cause motion.



Forces produce **acceleration**.

An object's mass **resists** motion.

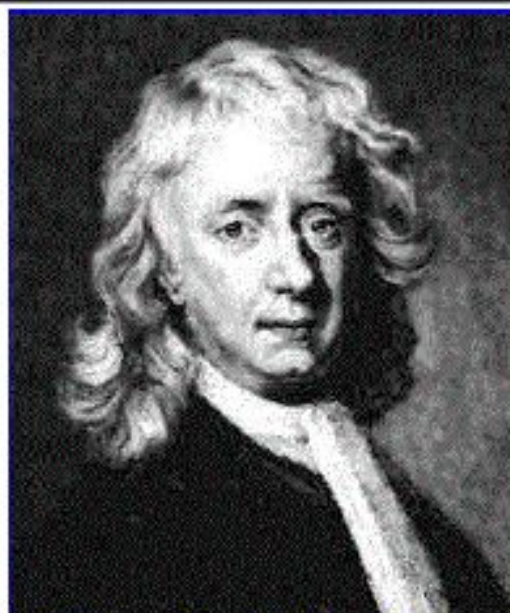
*(for the same force, heavier object accelerates less)*

Forces come in pairs.



## ***Newton's Laws of Motion***

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"Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by forces impressed on it."

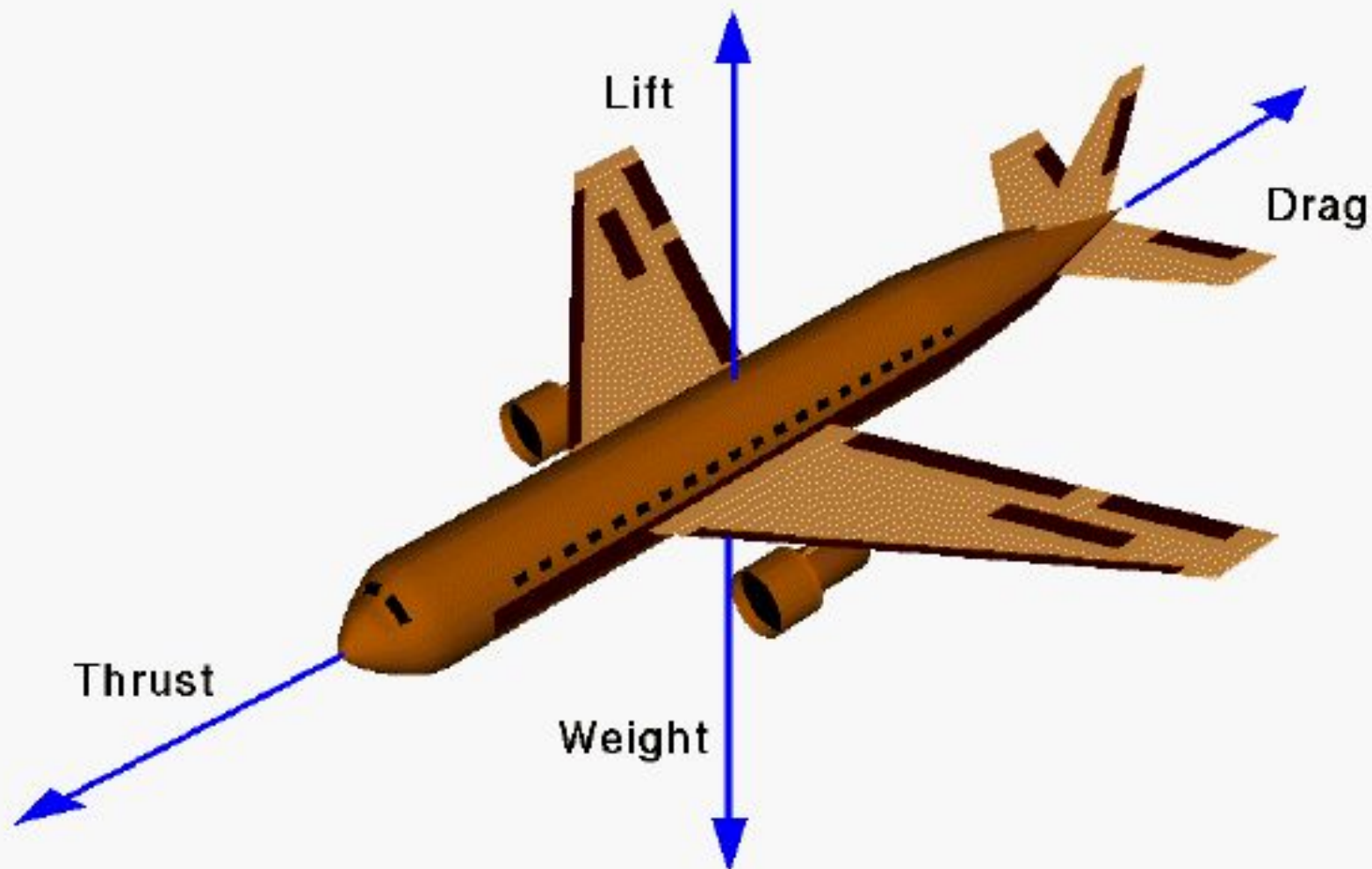
"Force is equal to the change in momentum ( $mV$ ) per change in time. (For a constant mass, force equals mass times acceleration.  $F = m a$ )"

"For every action, there is an equal and opposite re-action."



# *Four Forces on an Airplane*

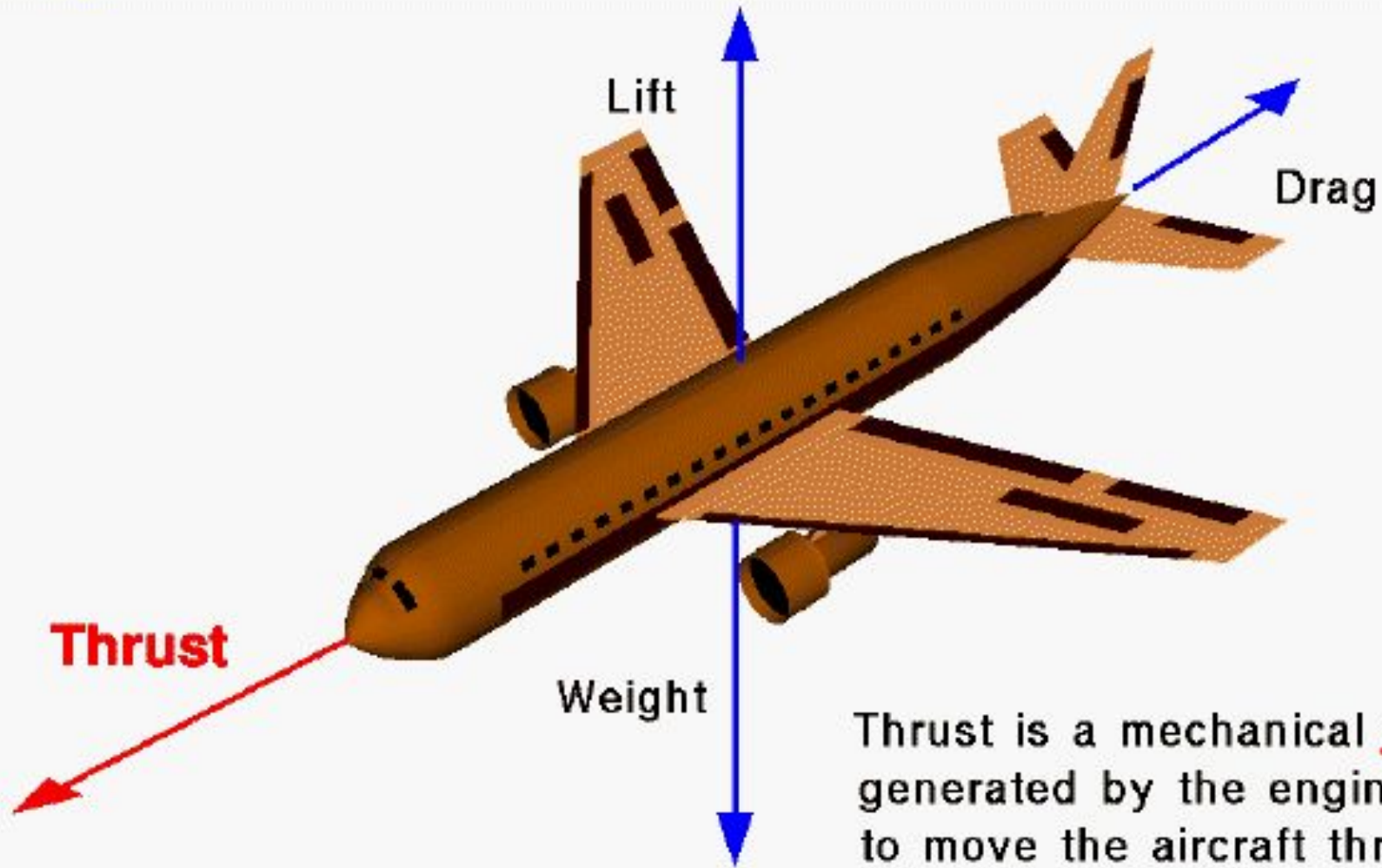
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# What is Thrust?

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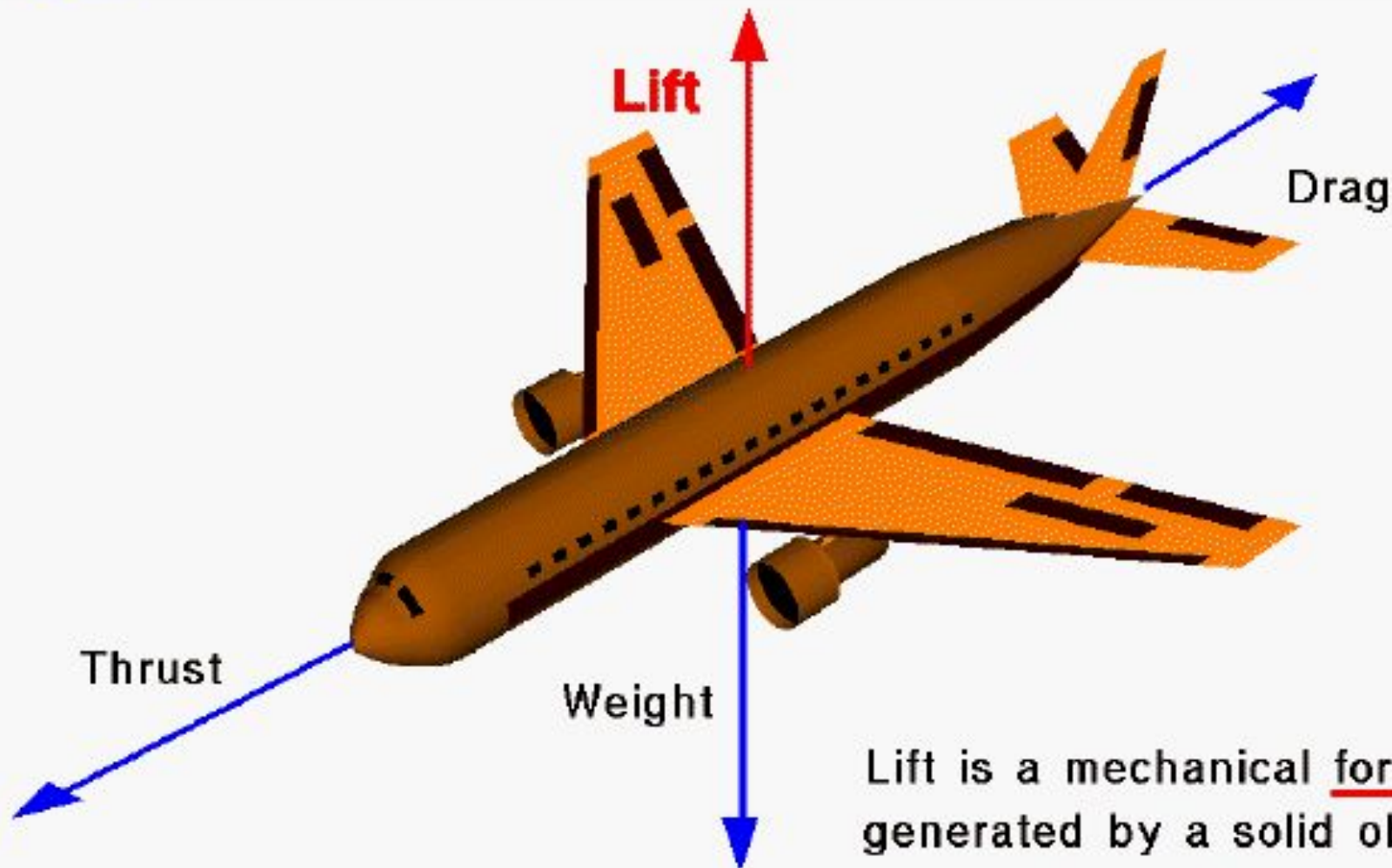


Thrust is a mechanical force generated by the engines to move the aircraft through the air.



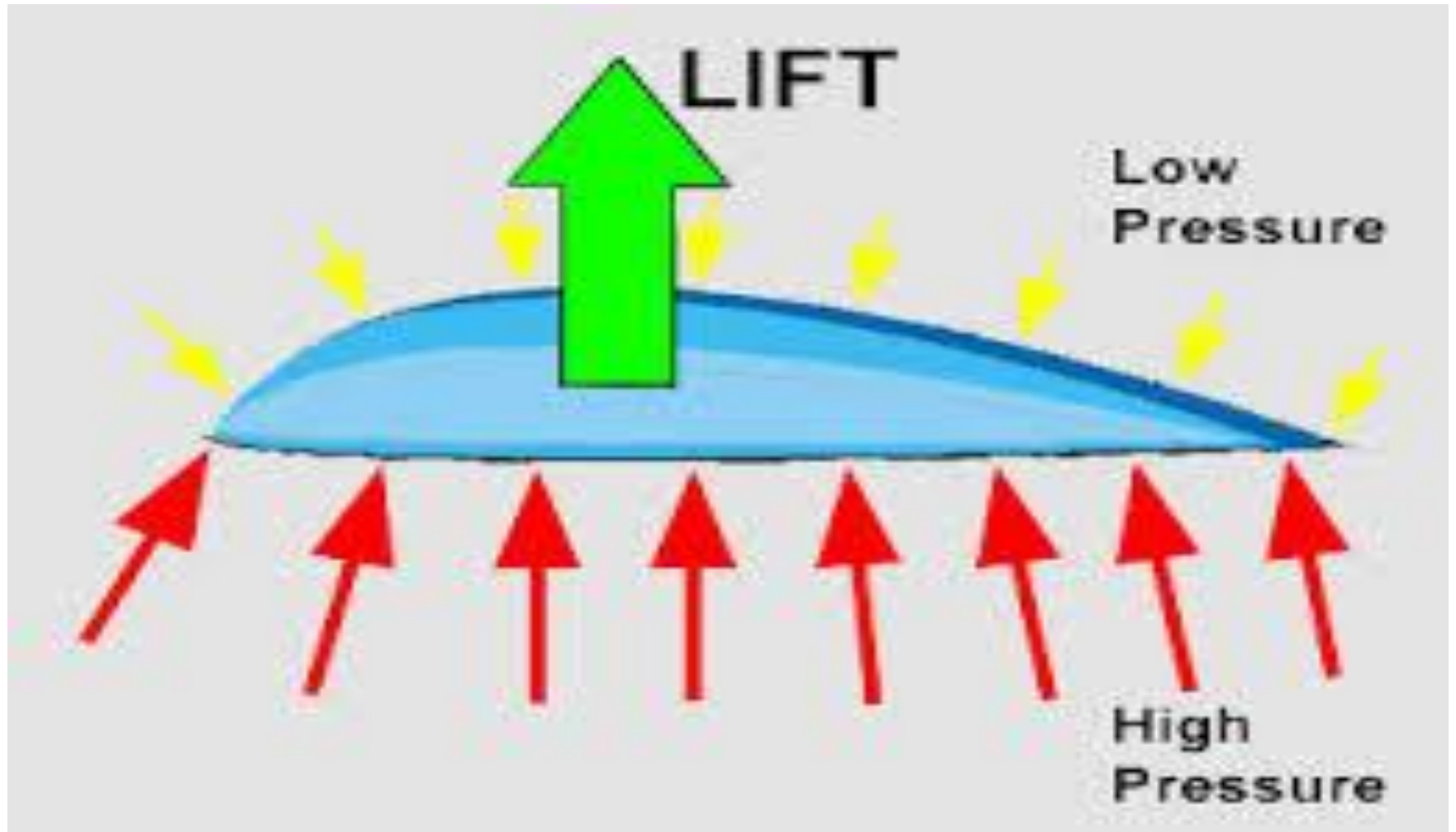
# What is Lift ?

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Lift is a mechanical force generated by a solid object moving through a fluid.

# Lift

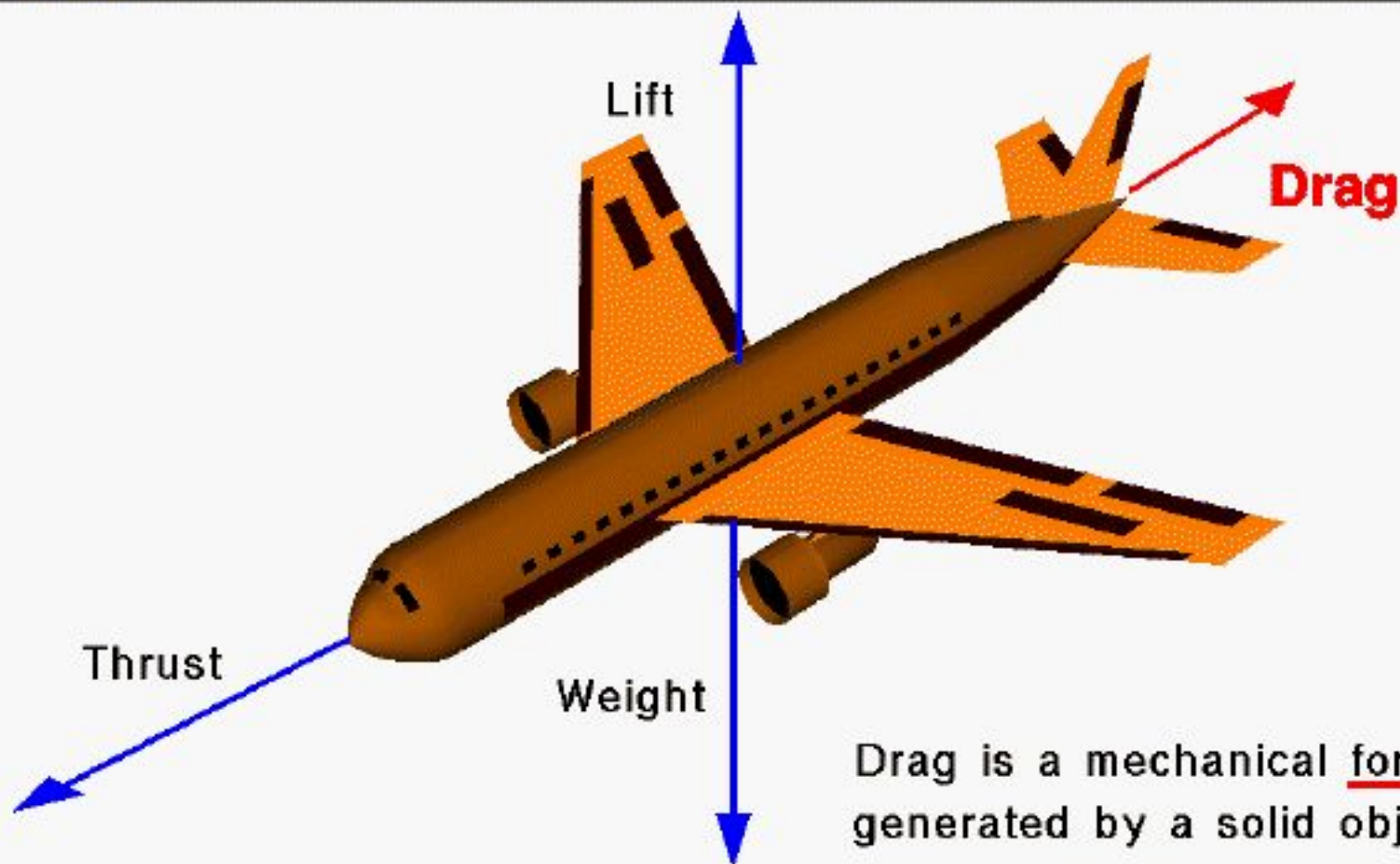






# What is Drag?

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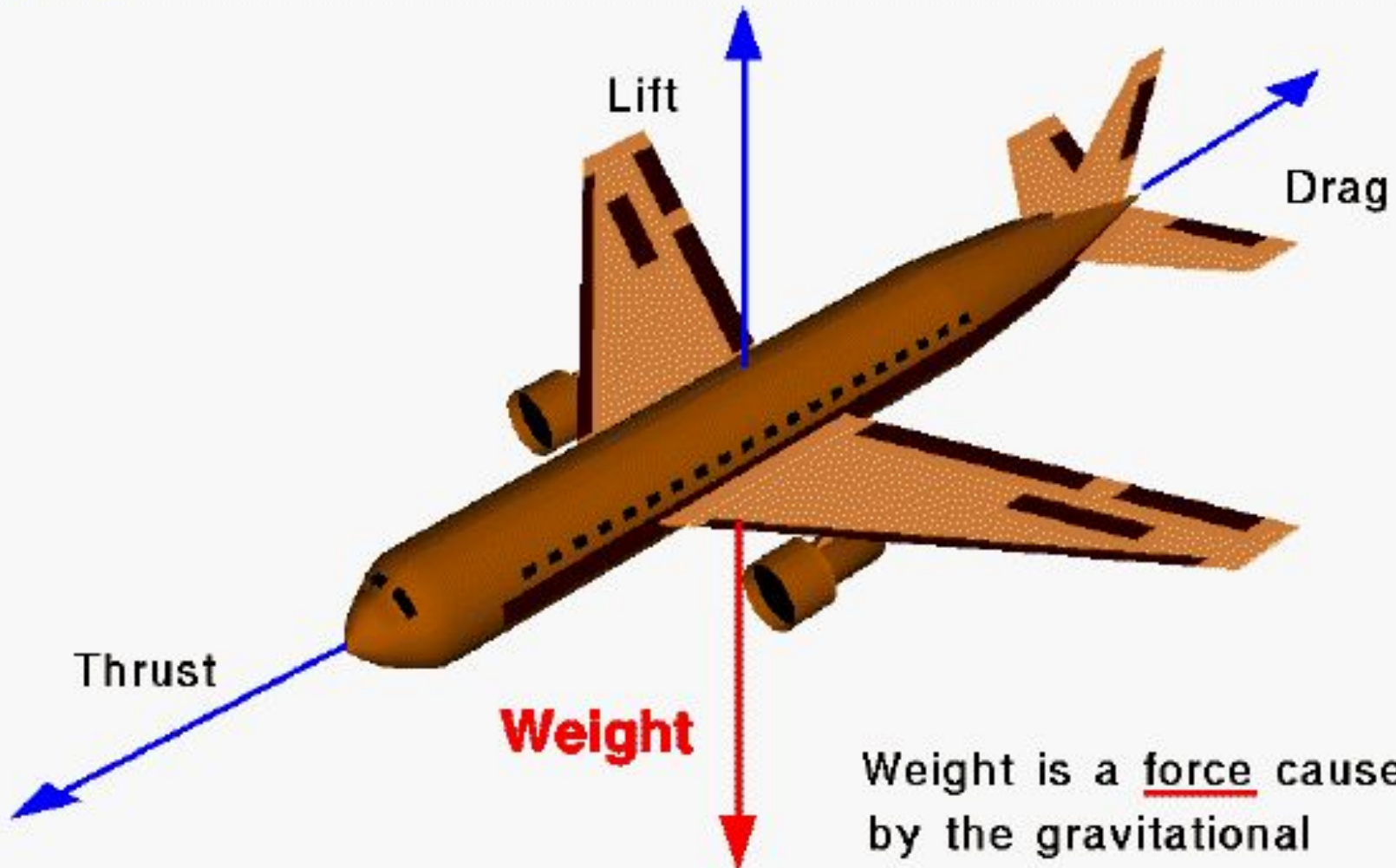


Drag is a mechanical force generated by a solid object moving through a fluid.



# What is Weight?

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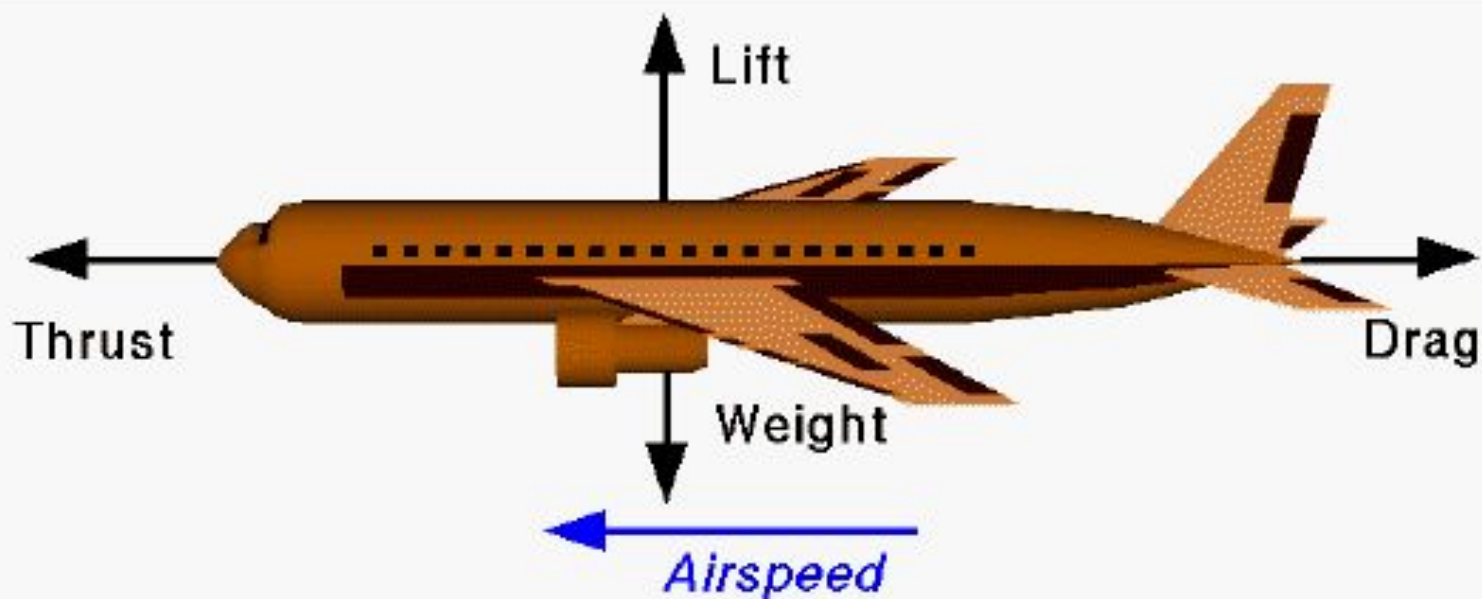


Weight is a force caused by the gravitational attraction of the Earth.



## ***Cruise - Balanced Forces***

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Lift = Weight

Thrust = Drag

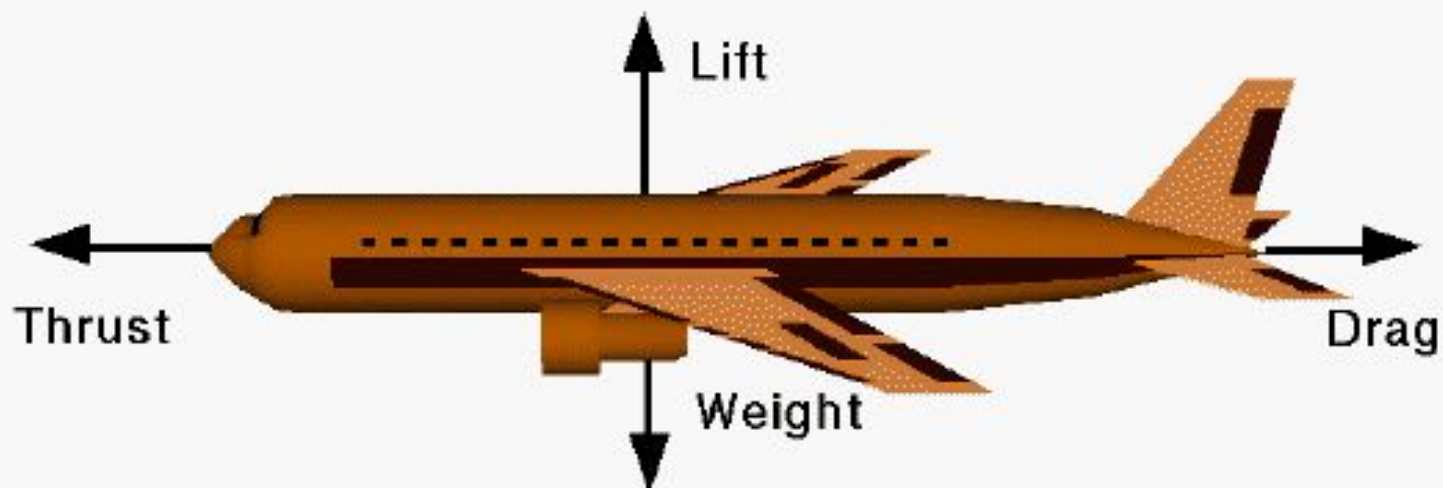
**Airplane moves in a straight line at constant airspeed.**



# Simplified Aircraft Motion

*Unbalanced Forces*

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Flight Condition	Effect
Lift > Weight	Plane Rises
Weight > Lift	Plane Falls
Drag > Thrust	Plane Slows
Thrust > Drag	Plane Accelerates



## **On-Line Educational Resources**

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### **Aerodynamics:**

<http://www.grc.nasa.gov/WWW/K-12/airplane>

### **Wright Brothers:**

<http://wright.nasa.gov/>

### **Aero Activities:**

<http://www.grc.nasa.gov/WWW/K-12/aerores.htm>

### **Help:**

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