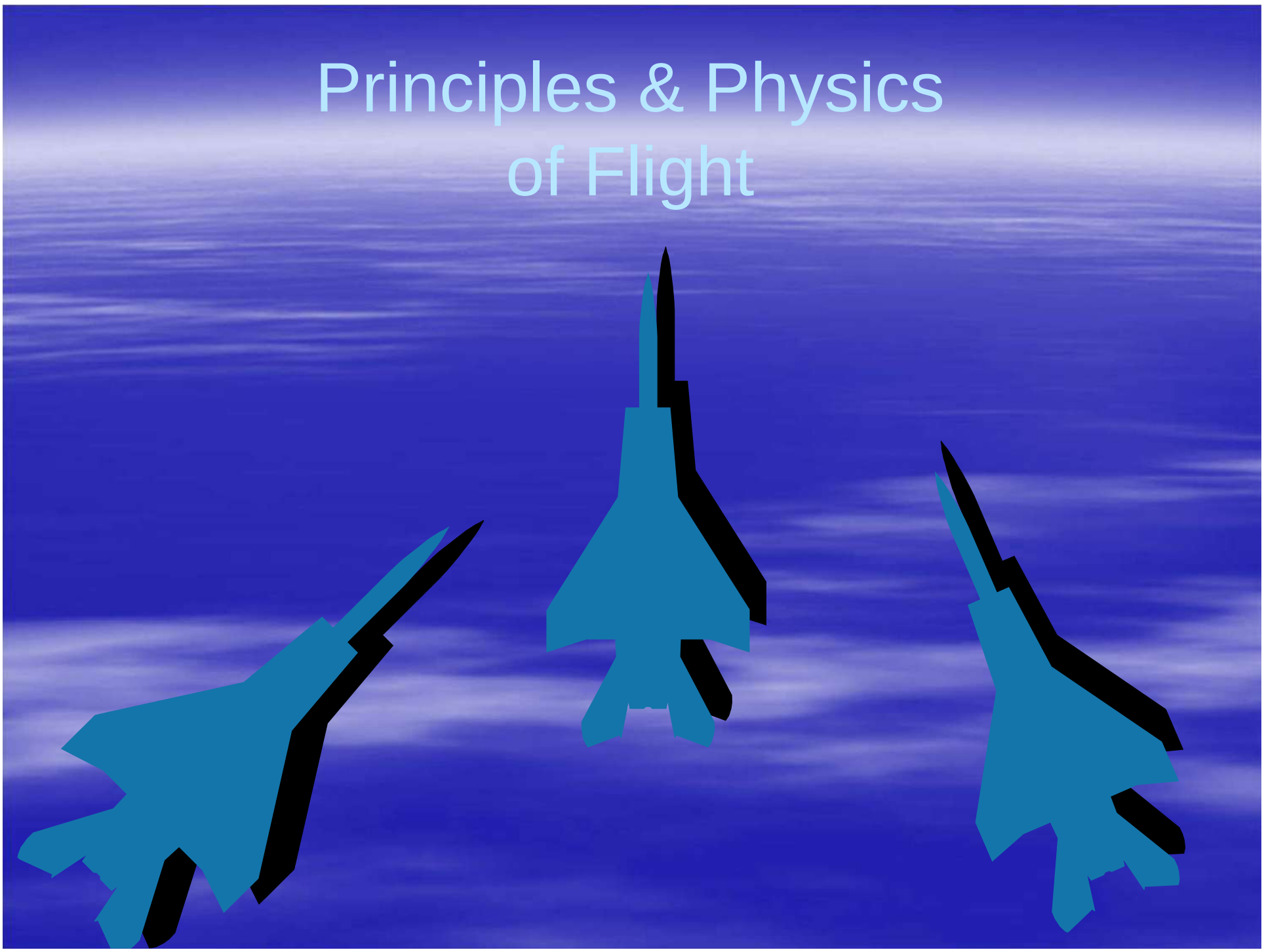
Principles & Physics of Flight



Basic Principles & Physics of Flight

1. Force applied over an object:
   a. Pressure
   b. Motion
   c. Aerodynamics

Basic Principles & Physics of Flight

2. Movement of an object:
   a. Pressure
   b. Motion
   c. Aerodynamics

Basic Principles & Physics of Flight

3. A natural force that pulls an object down:

a. Gravity

b. Lift

c. Pressure

Basic Principles & Physics of Flight

4. The upward force of an object:

a. Gravity

b. Lift

c. Pressure

Basic Principles & Physics of Flight

5. Heavy air pressure above an object:

a. Pushes it down

b. Pulls it down

c. Keeps it steady

Basic Principles & Physics of Flight

6. If air pressure ___ the object is decreased, the object is pushed up:

a. Above

b. Below

c. Besides

Basic Principles & Physics of Flight

7. ___ air can provide a sustained lifting force:

a. Moving

b. Still

c. Calm

Basic Principles & Physics of Flight

8. Pressure continues to __ as the air flow increases:

a. Increase

b. Decrease

c. Remain constant

Basic Principles & Physics of Flight

9. The ____ moving air/object, the less push downward:

a. Faster

b. Slower

c. Warmer

Basic Principles & Physics of Flight

10. The rate of motion in a given direction:

a. Velocity

b. Speed

c. Variance

Basic Principles & Physics of Flight

11. The rate of measure of the rate of motion (how fast it's going):

a. Velocity

b. Speed

c. Variance

Basic Principles & Physics of Flight

12. The Bernoulli principle states that as air velocity increases, pressure ___:

a. Decreases
b. Increases
c. Remains constant

Basic Principles & Physics of Flight

13. The Bernoulli principle also states that as velocity decreases, pressure ___:

a. Decreases
b. Increases
c. Remains constant

Basic Principles & Physics of Flight

15. One of the key words in the study of aerodynamics:

a. Power

b. Air

c. Control

Basic Principles & Physics of Flight

16. How does the Bernoulli principle relate to the flight of an airplane?

a. Less air pressure on the airfoils as they move through the air help provide lift

b. The more air pressure on the airfoils helps maintain lift

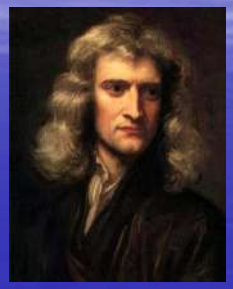
c. It just does

Basic Aerodynamics

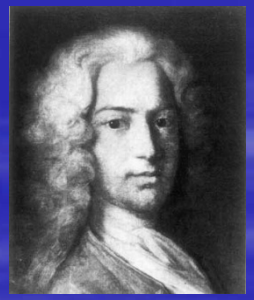
- The power of air
- The power of motion
- Working with the forces of flight
- Equal =

Basic Aerodynamics

- Newton’s Laws of motion



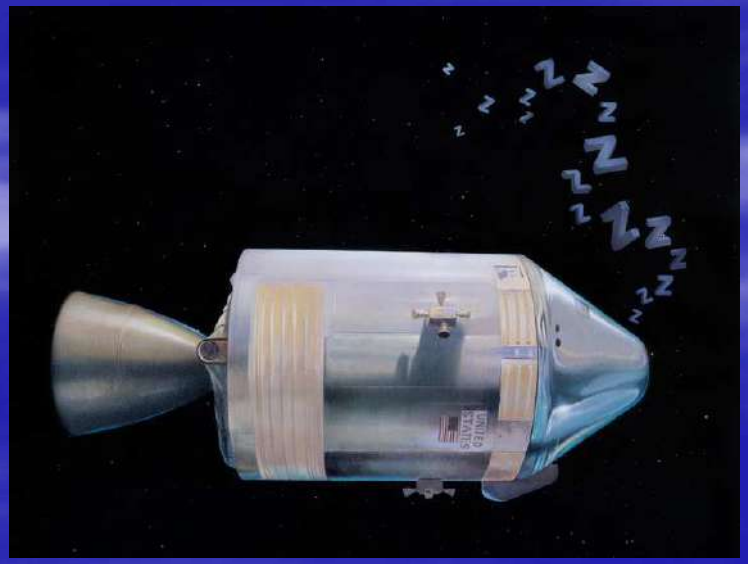
- Bernoulli Principle



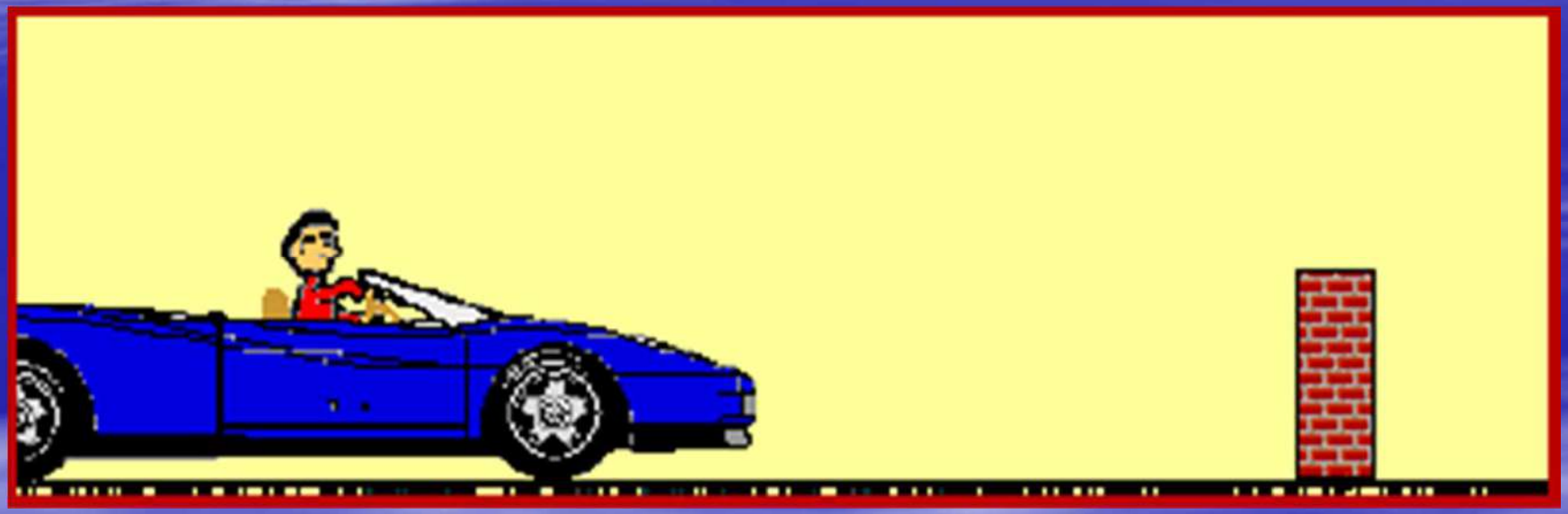
- Forces of flight

Basic Aerodynamics

- Newton's Laws of motion:
- First Law: a body at rest tends to remain at rest, and a body in motion tends to remain in motion, unless an outside force acts on the body

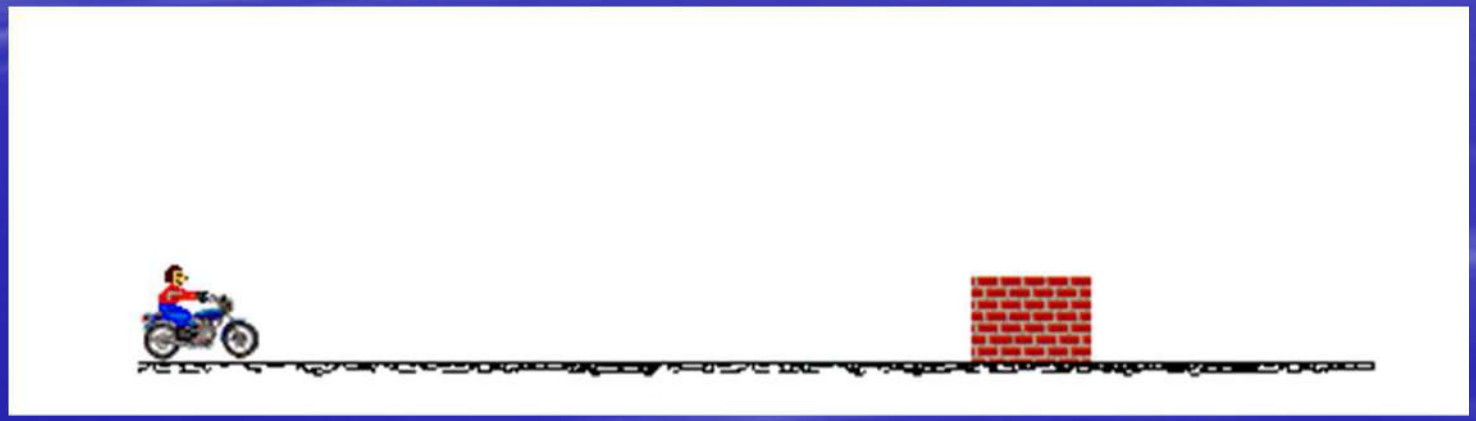


Basic Aerodynamics



Basic Aerodynamics

Basic Aerodynamics



Basic Aerodynamics

- Newton's Laws of motion:

- First Law:
  - Imagine you are standing on a fast moving car. The car is moving at 70 mph when all of a sudden the driver applies the brakes very forcefully, bringing the car to an abrupt stop, what happens to you?
  - What two forces are in the car to counter what happens to you?

Basic Aerodynamics
Newton's Laws of Motion

Inertia: lacking the ability to move

Sumo wrestlers: object to Get opponent to move From his position

Which wrestler would be Easier to move, a 500lb or 200lb wrestler

Basic Aerodynamics
Newton's Laws of Motion

What outside forces help aircraft move?

Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion:
- Second Law: the acceleration of a body is directly proportional to the force causing it and inversely proportional to the mass of the body

Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion:

- Second Law: has three basic assertions:
  - 1. When you hit something, it picks up speed
  - 2. The heavier the object is, the less rapidly it picks up speed
  - The object picks up speed and continues to move in the same direction from which you hit it

Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion:

- Second Law examples:
  - How fast is this golf ball moving as it sits?
  - If it is hit with this golf iron, would it pick up speed?

Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion:

- Second Law examples:
  - If it were a bowling ball, would it move faster or slower if hit with the same force?

Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion:

- Second Law examples:
  - If either ball is thrown toward the window, will it go in that direction?

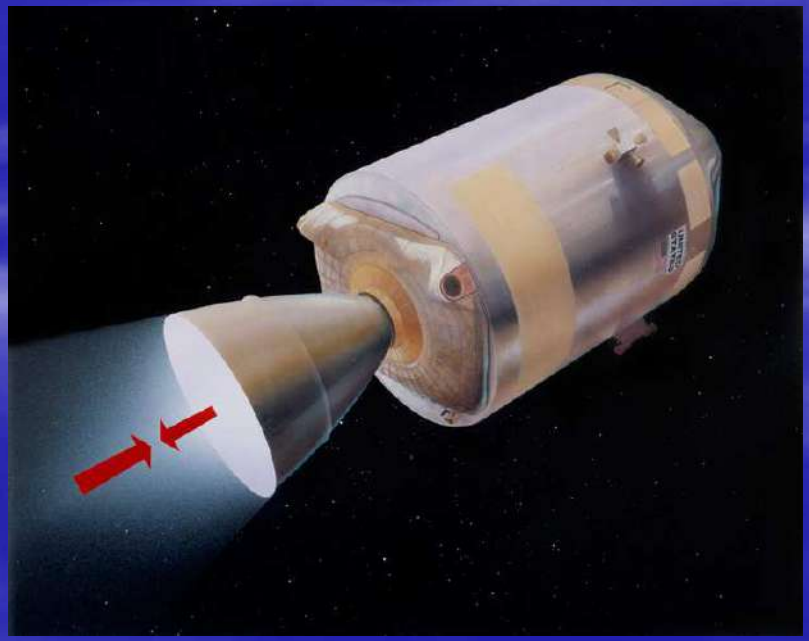


Basic Aerodynamics
Newton's Laws of Motion

The engine size required to provide the force needed for these different size aircraft varies with the size of the aircraft and its contents

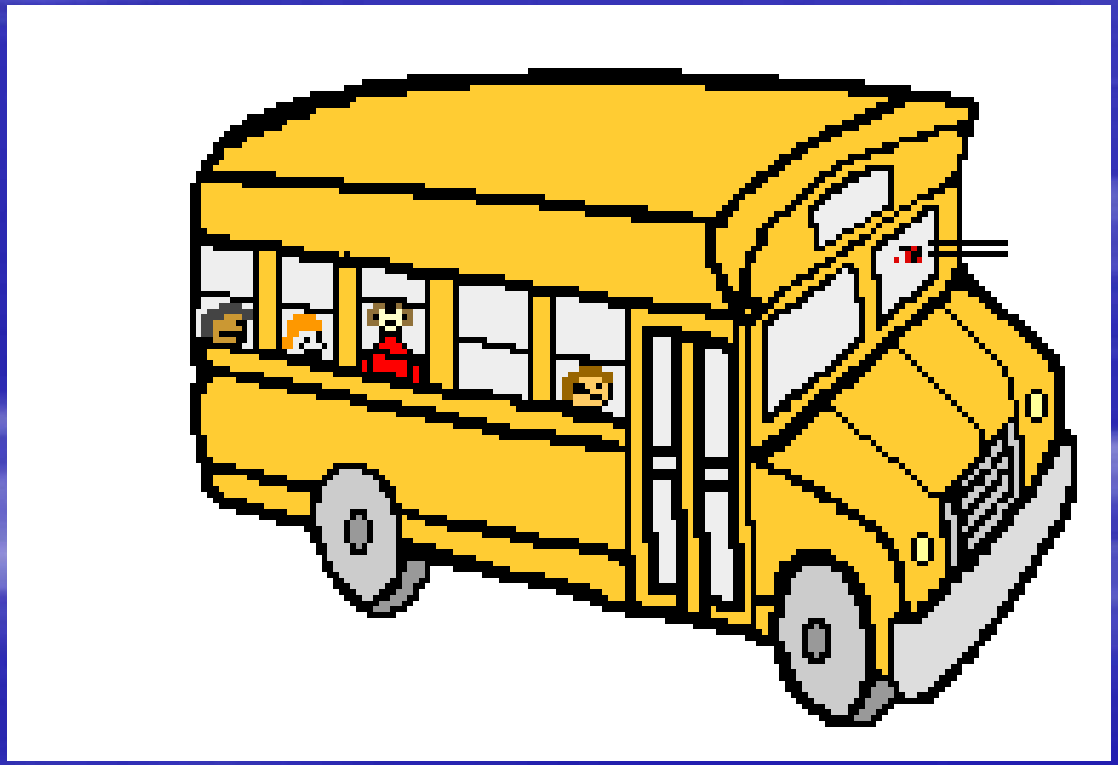
Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion:
- Third Law: for every action there is an equal and opposite reaction



Basic Aerodynamics
Newton's Laws of Motion

Firefly flies into bus, bus runs into firefly



Basic Aerodynamics
Newton's Laws of Motion

Basic Aerodynamics
Newton's Laws of Motion

Basic Aerodynamics
Newton's Laws of Motion

- Newton's Laws of motion podcast

Podcast_newton.m4v

Basic Aerodynamics

- Official Bernoulli Principle:
  - As the air velocity increases, the pressure decreases
  - As the velocity decreases, the pressure increases

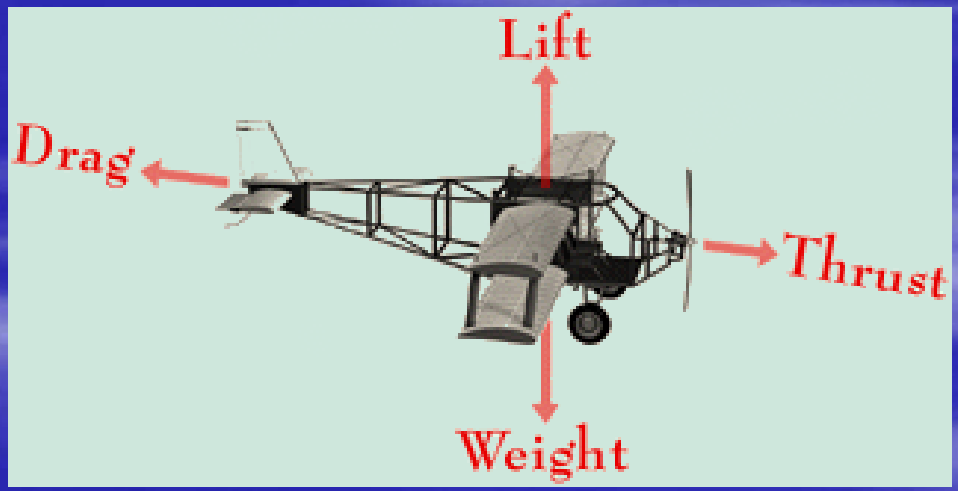
  - Velocity: rate of motion in a given direction
  - Speed: rate of measure of the rate of motion; how fast is it going

Basic Aerodynamics

- So how does the Bernoulli principle relate to the flight of an airplane?
- Play Bernoulli's Theorem video

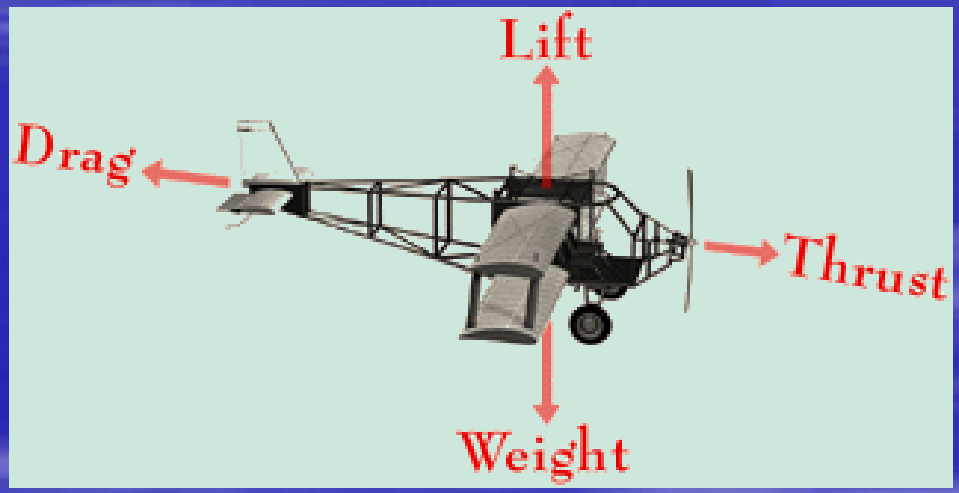
Basic Aerodynamics
Forces of Flight

- Four forces of flight: work together in pairs to get an airplane in the air and keep it there and to get it down
  - Thrust
  - Lift
  - Drag
  - Gravity/Weight



Basic Aerodynamics
Forces of Flight

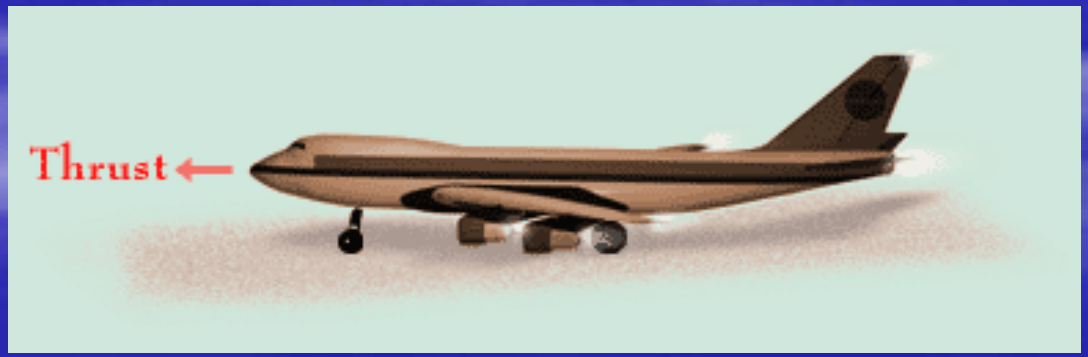
- Play the four forces video



http://howthingsfly.si.edu/activities/forces-flight

Basic Aerodynamics
Forces of Flight

- Four forces of flight:
  - Thrust: a force which gives forward motion to the aircraft



Basic Aerodynamics
Forces of Flight

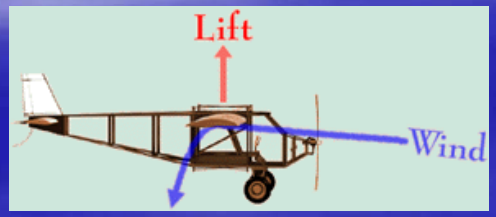
- Four forces of flight:
  - Thrust: a force which gives forward motion to the aircraft
    - The jet engine: placement, number, type
    - The propeller

Basic Aerodynamics
Forces of Flight

- Four forces of flight:
  - Lift: the upward force of an object
    - The air as it impacts with the aircraft's airfoils and wings

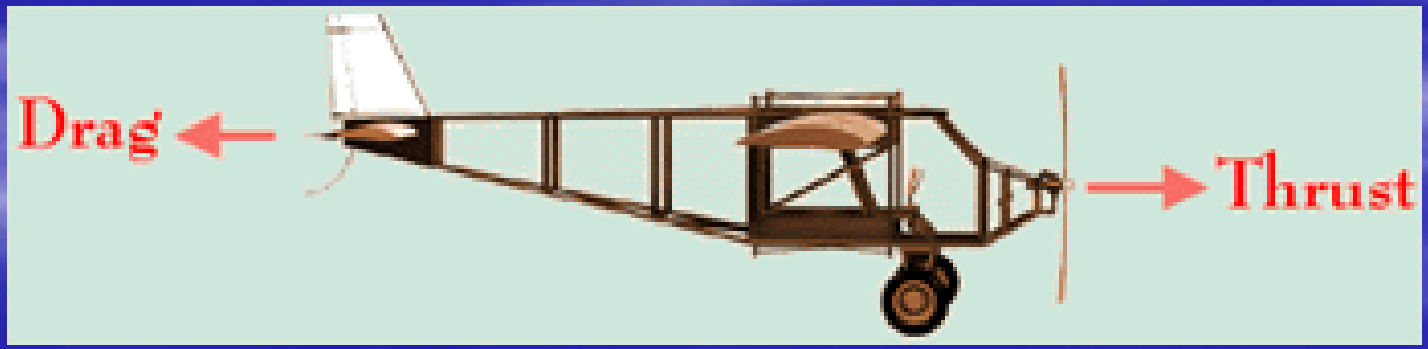
Basic Aerodynamics
Forces of Flight

- Lift is impacted by:
  - Velocity: speed and direction of the aircraft
  - Angle of attack: increasing it increases lift
  - Air density: determined by the air pressure, temperature, and humidity
    - Higher you are, the less dense the air
    - Warm air less dense than cool air
    - Moist air less dense than dry air



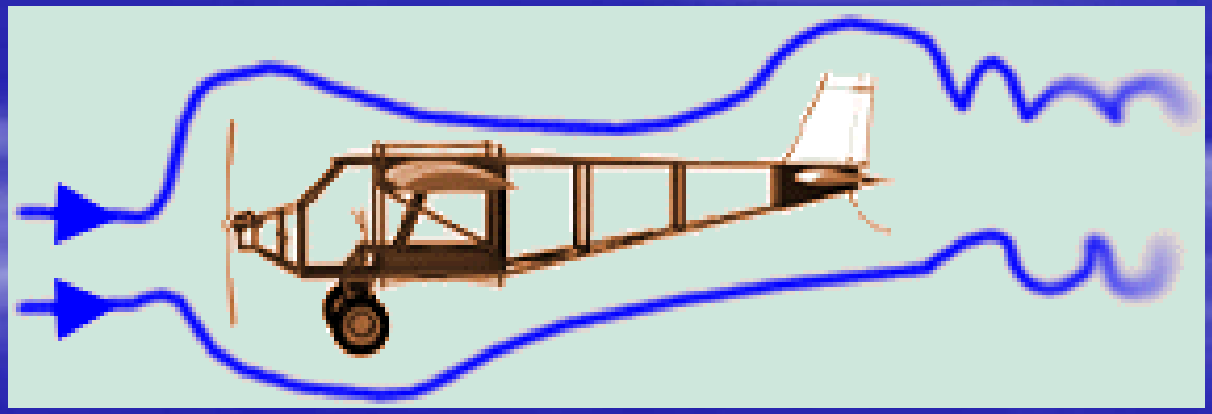
Basic Aerodynamics
Forces of Flight

- Four forces of flight:
  - Drag: the force that opposes the forward motion of the aircraft



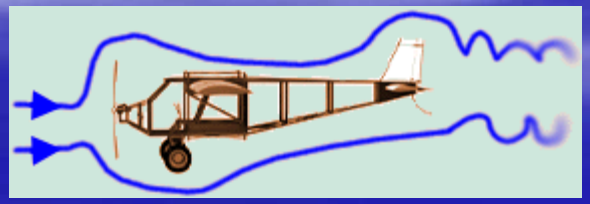
Basic Aerodynamics
Forces of Flight

- Four forces of flight:
  - Drag: caused by the resistance of the air to the aircraft passing through it



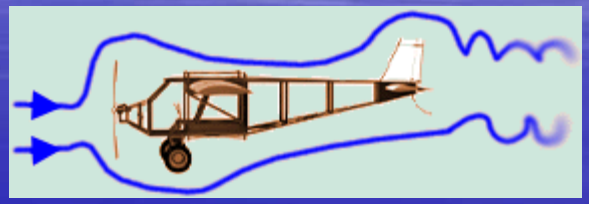
Basic Aerodynamics
Forces of Flight

- Drag results from:
  - Air resisting an aircraft's forward motion
  - An aircraft's shape, its speed, and the air's viscosity (stickiness of molecules to the airfoil surface, not allowing the air to pass by



Basic Aerodynamics
Forces of Flight

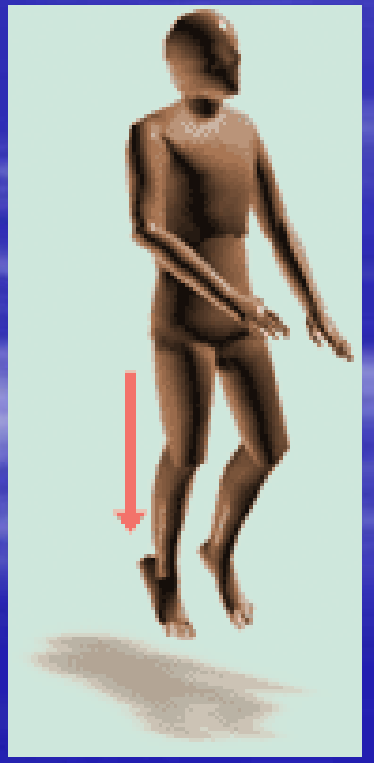
- Types of drag:
  - Parasite drag



    - Form drag: air going over aircraft parts like the antenna, engine covers, etc. having to split and rejoin
    - Interference drag: air meeting at perpendicular joints of the aircraft flows over each in different currents/waves
    - Skin friction drag: molecules sticking to the aircraft parts
  - Induced drag
    - Low and high pressure air meeting and heading toward the wing's upper surface

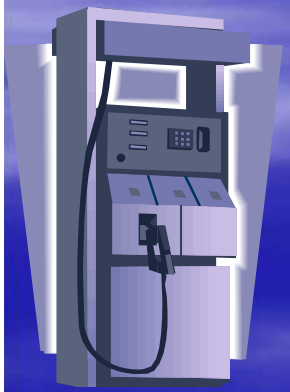
Basic Aerodynamics
Forces of Flight

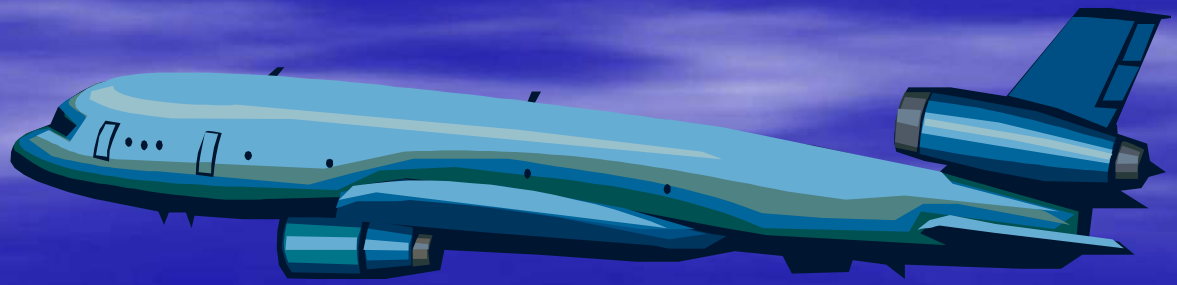
- Four forces of flight:
  - Gravity: a natural force of the earth that pulls down an object



Basic Aerodynamics
Forces of Flight

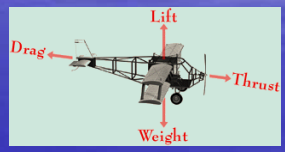
- Four forces of flight:
  - Gravity:
    - Weight: a measure of gravity
    - The aircraft itself, fuel, passengers, cargo





Basic Aerodynamics
Forces of Flight

- Four forces of flight



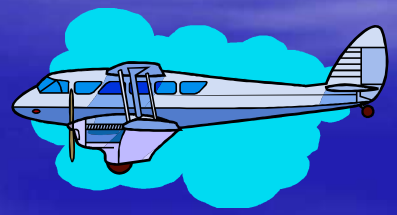
- Play the aerodynamics of flight video

Basic Aerodynamics
Forces of Flight

- Four forces of flight:

17. What two forces must be equal to keep the aircraft flying level?

a. Weight and thrust
b. Lift and weight
c. Thrust and drag
d. Drag and weight

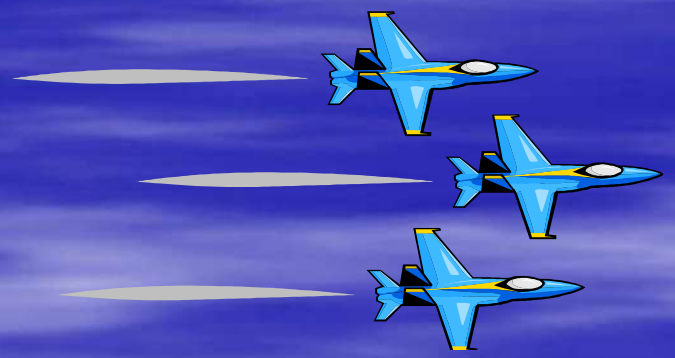


Basic Aerodynamics
Forces of Flight

- Four forces of flight:

18. What two forces must be equal for the aircraft to remain at a constant rate of speed?

a. Weight and thrust
b. Lift and weight
c. Thrust and drag
d. Drag and weight



Basic Aerodynamics
Forces of Flight

- Four forces of flight:

19. What force must be dominant to make the aircraft climb?

a. Lift
b. Gravity
c. Thrust
d. Drag

Basic Aerodynamics
Forces of Flight

- Four forces of flight:

20. What force must be dominant to make the aircraft descend?

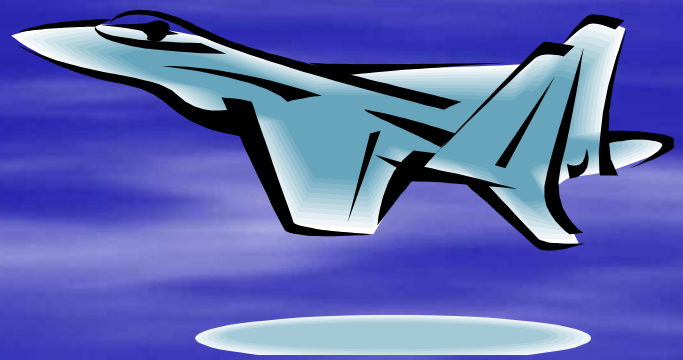
a. Lift
b. Gravity
c. Thrust
d. Drag

Basic Aerodynamics
Forces of Flight

- Four forces of flight:

21. What force is dominant when the aircraft speeds up?

a. Lift
b. Gravity
c. Thrust
d. Drag



Basic Aerodynamics
Forces of Flight

- Four forces of flight:

22. What force is dominant when the aircraft slows down?

a. Lift
b. Gravity
c. Thrust
d. Drag

Basic Aerodynamics

The power of air

The power of motion

Working with the forces of flight

Equal =