Make it Fly PPT

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Weight (W)

Lift (L)

Drag (D)

Thrust (T)
A-10 Thunder Bolt Weight

Mass \( m \) = 13800 kg
A-10 Thunder Bolt Weight

Mass (m) = 13800 kg

W = ?
A-10 Thunder Bolt Weight

Mass(m) = 13800 kg

\[ W = m \cdot g \]
A-10 Thunderbolt Weight

\[ W = m \cdot g = (13,800 \text{ kg}) \cdot (9.81 \text{ m/s}^2) \]
A-10 Thunder Bolt Weight

\[ W = m \cdot g = 135,378 \text{ kg} \cdot \text{m/s}^2 \]
A-10 Thunderbolt Weight

$W = 135,378 \text{ N}$
A-10 Thunderbolt Level Flight

\[ W = 135,378 \text{ N} \]

\[ L = ? \]
A-10 Thunderbolt Level Flight

L = W

W = 135,378 N
A-10 Thunder Bolt Level Flight

\[ L = W = 135,378 \text{ N} \]

\[ W = 135,378 \text{ N} \]
A-10 Thunder Bolt Level Flight \((L = W)\)

\[ L = 135,378 \text{ N} \]

\[ W = 135,378 \text{ N} \]
SR-71 Blackbird Steady Flight

$T = 290,000 \text{ N}$
SR-71 Blackbird Steady Flight

$T = 290,000\, \text{N}$
SR-71 Blackbird *Steady Flight* \((T = D)\)
Basic Aerodynamics
Two Sheets of Paper (No Airflow)
Two Sheets of Paper (No Airflow)

\[ P = P_{\text{atm}} \]
Two Sheets of Paper (No Airflow)

\( P = P_{\text{atm}} \)

\( P = P_{\text{atm}} \)

\( P = P_{\text{atm}} \)
Two Sheets of Paper (with airflow)
Two Sheets of Paper (with airflow)

\[ P = P_{\text{atm}} \quad \text{P} < P_{\text{atm}} \quad P = P_{\text{atm}} \]
Two Sheets of Paper (with airflow)

\[ P = P_{\text{atm}} \quad P < P_{\text{atm}} \quad P = P_{\text{atm}} \]
Two Sheets of Paper

No Airflow

Airflow Between Sheets

$P = P_{\text{atm}}$  $P = P_{\text{atm}}$  $P = P_{\text{atm}}$

$P < P_{\text{atm}}$

$P = P_{\text{atm}}$  $P = P_{\text{atm}}$
(No) Airflow w/ Straw

Balanced Air Pressure
(No) Airflow w/ Straw

Balanced Air Pressure
(No) Airflow w/ Straw
Airflow w/ Straw

Blow

Blow
Airflow w/ Straw

Blow

Blow
Airflow w/ Straw

Blow

Blow
Airflow w/ Straw

Blow

Blow
Forces on our ping pong ball
Forces on our ping pong ball
Forces on our ping pong ball

- Weight
- Wind
- Hair Dryer
Forces on our ping pong ball

- Weight
- Wind
- Hair Dryer
Forces on our ping pong ball

- Weight
- Wind
- Drag
- Hair Dryer
Forces on our ping pong ball

- Drag
- Weight
Forces on our ping pong ball

- Weight
- Wind
- Hair Dryer
Forces on our ping pong ball

Hair Dryer

Wind

Weight
Forces on our ping pong ball

- Wind
- Weight

Hair Dryer
Forces on our ping pong ball
Forces on our ping pong ball
Forces on our ping pong ball

- Lift
- Drag
- Weight
- Wind
- Hair Dryer

Weight

Wind

Lift

Drag

Weight
Forces on our ping pong ball
Bernoulli's Principle

\[ P = P_{\text{atm}} - \frac{1}{2} \rho V^2 \]

Hair Dryer

Wind

\[ P < P_{\text{atm}} \]
Forces on our ping pong ball

- Lift
- Drag
- Weight
Forces on our ping pong ball/ Aircraft
Forces on our ping pong ball/ Aircraft
Ruler Balancing Act
Ruler Balancing Act (No Airflow)
Ruler Balancing Act (Blowing Under)

Straw
Ruler Balancing Act (Blowing Under)
Ruler Balancing Act (Blowing Under)
Ruler Balancing Act (Blowing Over)
Fan Free Stream Velocity

The Tuffs(strings) show the direction of the free stream velocity which changes depending on which part of the fan you are in front of.

(see next slide)
Air Velocity Direction
Perform experiments in the area of the fan circled.
Free Stream Velocity ($V_{air}$)
Relative Angle of Attack ($\alpha$)
Angle of Attack Demo

- Group Member 1: Hold the back ends of the popsicle sticks.

- Group Member 2: Hold the front ends of the popsicle sticks.

- Group Member 3: Control the Fan Speed