
AERO
FAIR

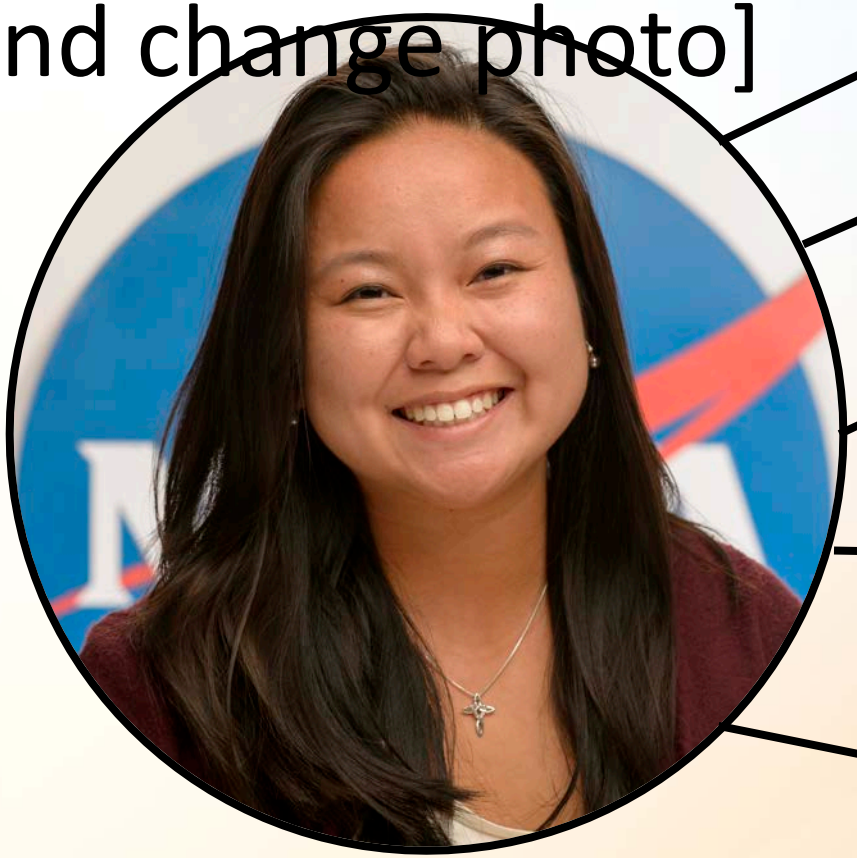
NASA AMES RESEARCH CENTER



Welcome to Day 1!

[Enter Presenter Name]
[Enter Back Up Name]

[Enter Presenter Name and change photo]



[Enter Degrees]

[Enter pathway to NASA]

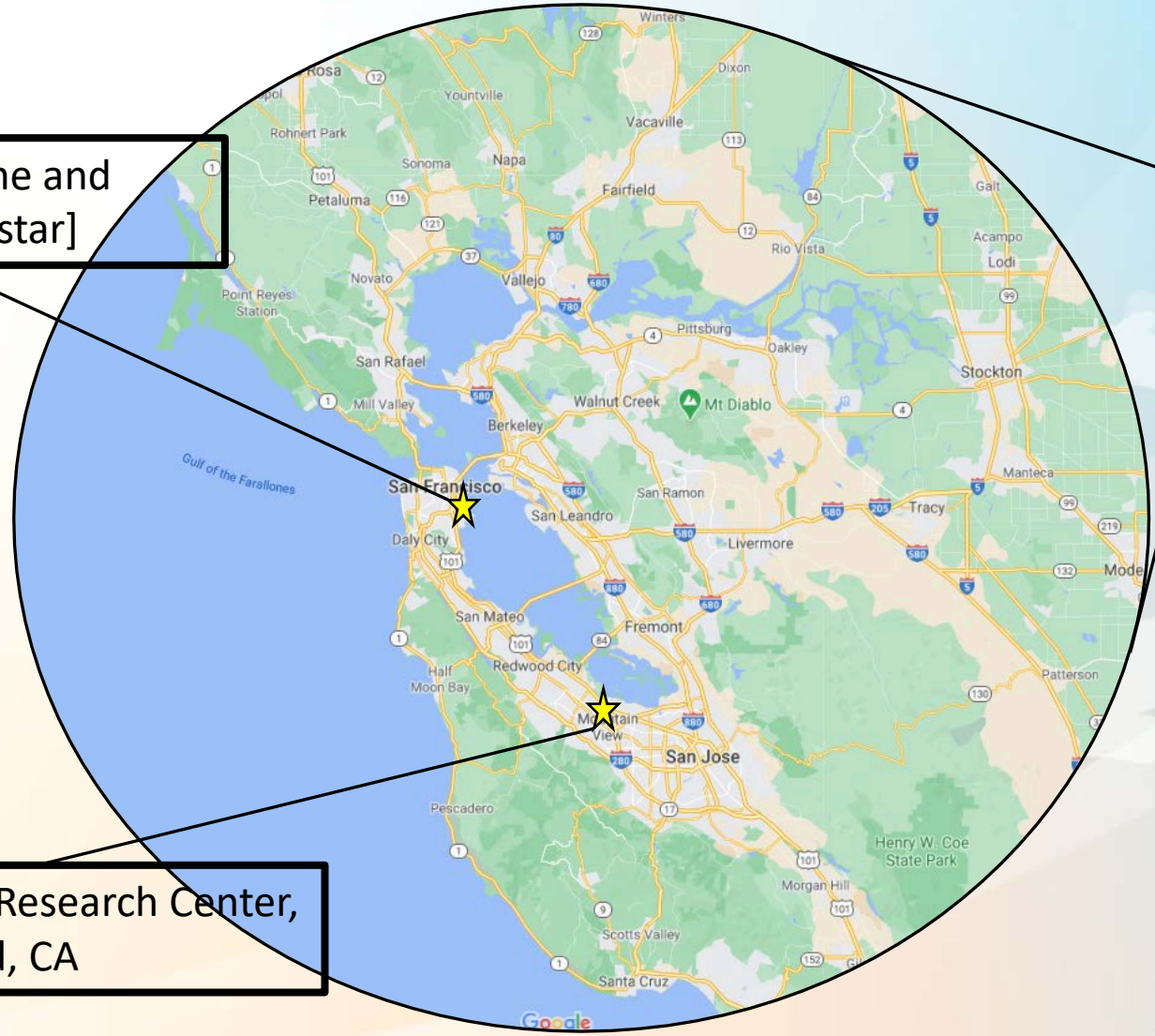
[Enter Current NASA Projects]

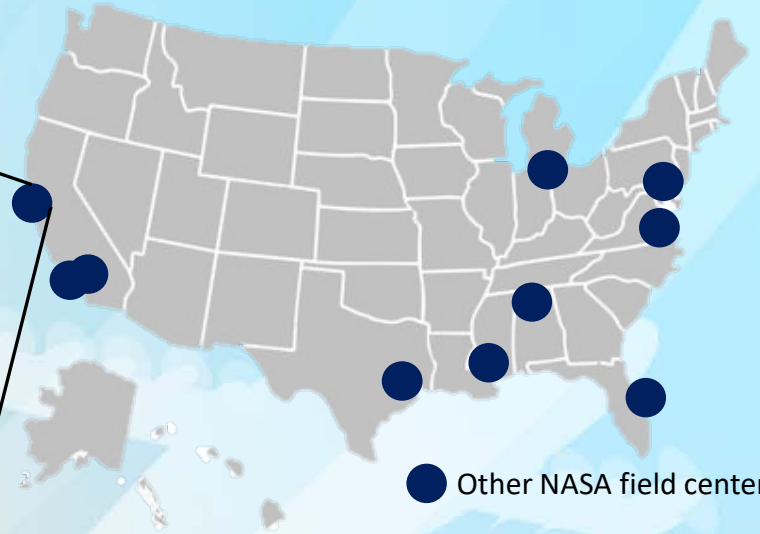
[Enter favorite thing about working at NASA]

[Enter Fun Fact]

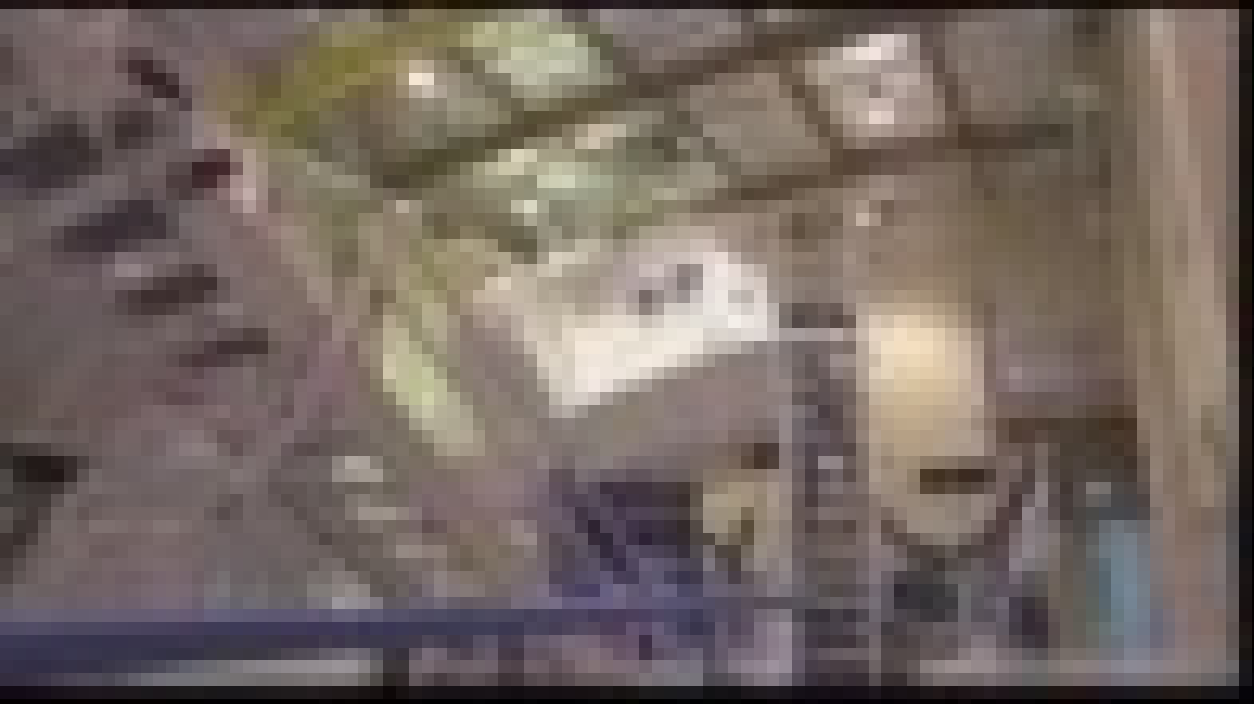
NASA Ames Research Center

[Enter School Name and adjust location of star]





NASA Ames Research Center, Moffett Field, CA









Overview for the day

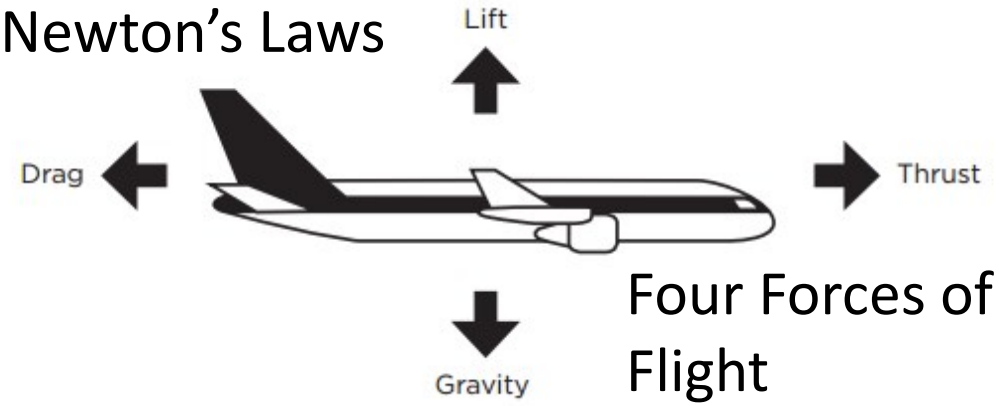


History of NASA Ames Research Center Aeronautics

Aeronautics Pre-Challenge!

Kahoot!

Newton's Laws



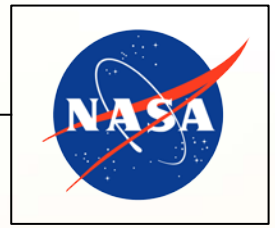
Four Forces of Flight

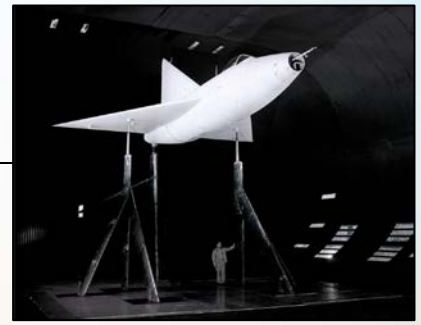


Build Your Own Paper Plane

NASA Ames Research Center Aeronautics









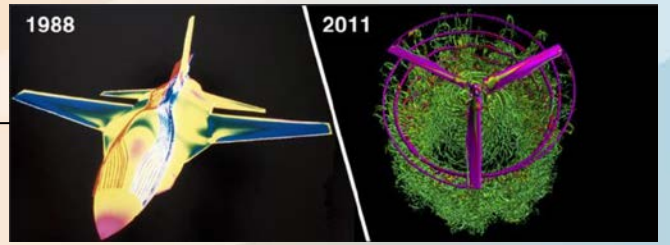


1930's | 1940's | 1950's | 1960's | 1970's | 1980's | 1990's | 2000's | 2010's | 2020's









AERO FAIR

Kahoot! – Aeronautics Pre-Challenge

How To Participate:

1) Go to www.kahoot.it and type in the code.
2) Choose the correct answer to each of the questions.
3) Have Fun!

Newton’s Laws of Motion

Newton's Laws of Motion

Who is Sir Isaac Newton?



Credit: Britannica.com/biography/Isaac-Newton

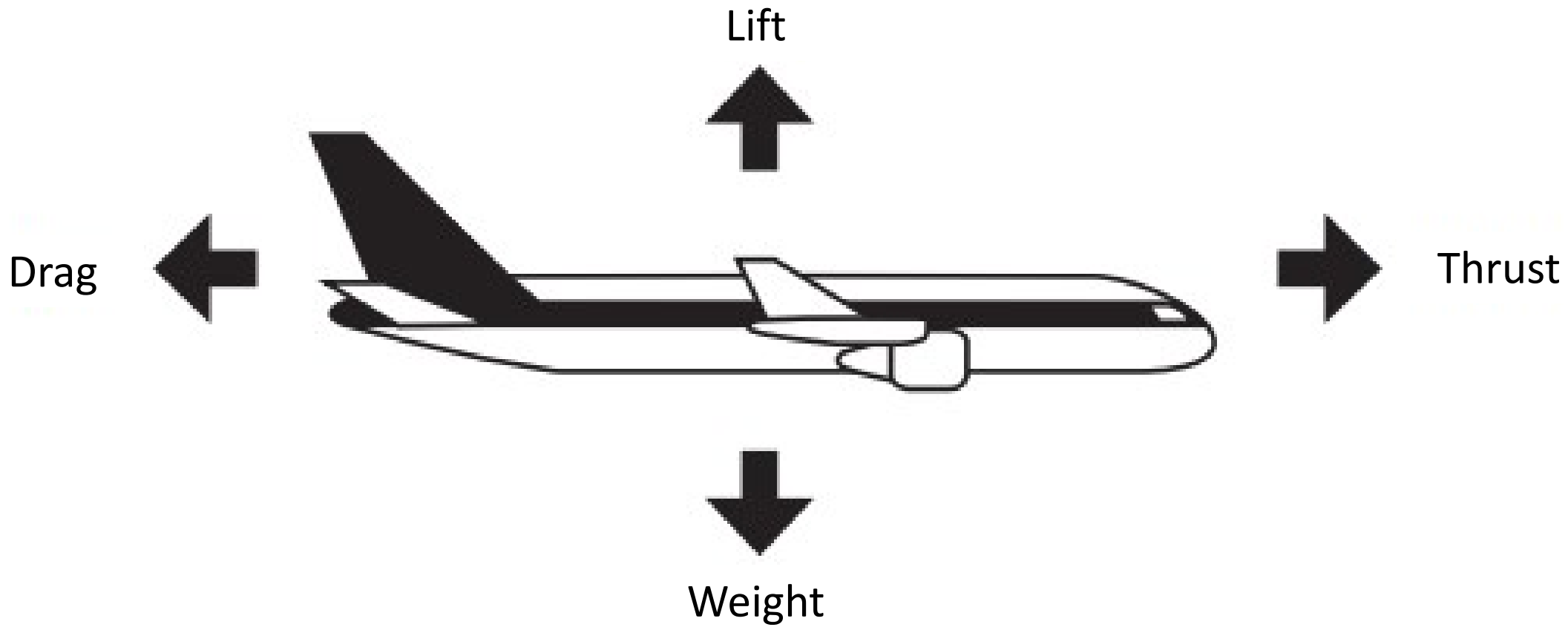
Newton's Laws of Motion:

1. An object in motion stays in motion, and an object at rest stays at rest until an unbalanced force acts upon it.
2. The force of an object is equal to its mass times its acceleration.
3. For every action there is an equal and opposite reaction

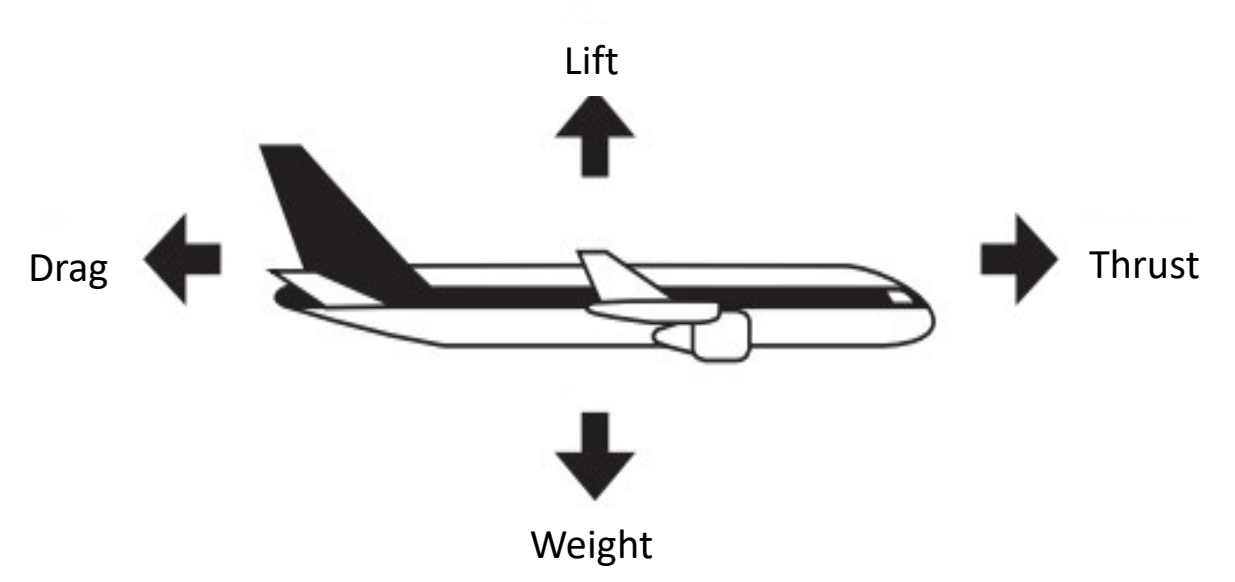


What does this have to do with airplanes?

Four Forces of Flight



Four Forces of Flight



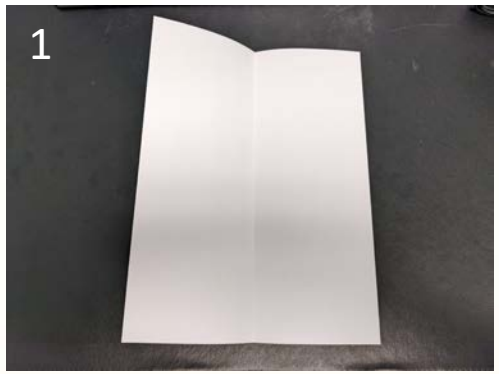
Balanced Forces of opposite directions do not result in any changes in motion

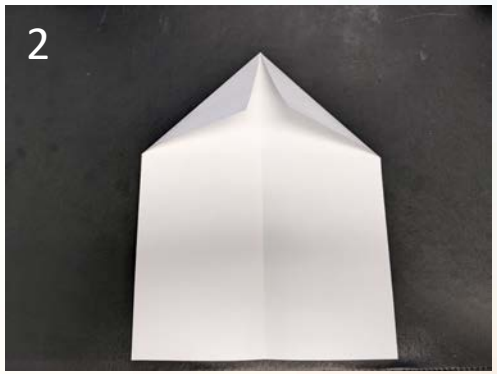
What happens if…?
Drag = Thrust
Lift = Weight

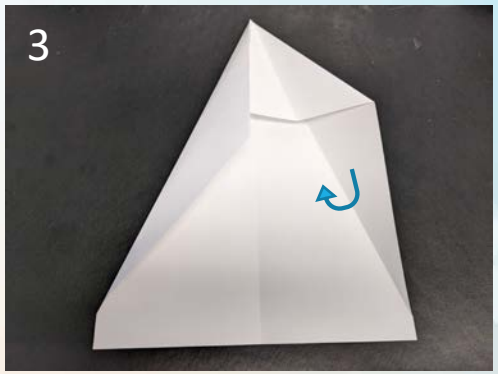
Unbalanced Forces result in a change in motion

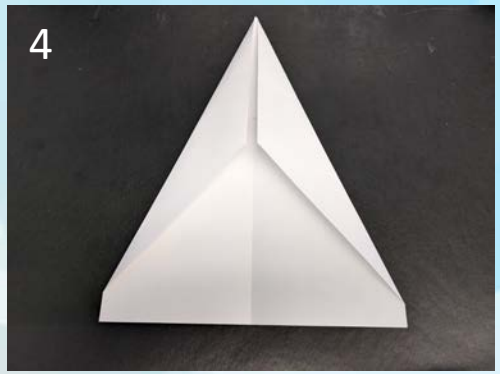
What happens if…?
Lift > Weight
Lift < Weight
Drag > Thrust
Drag < Thrust

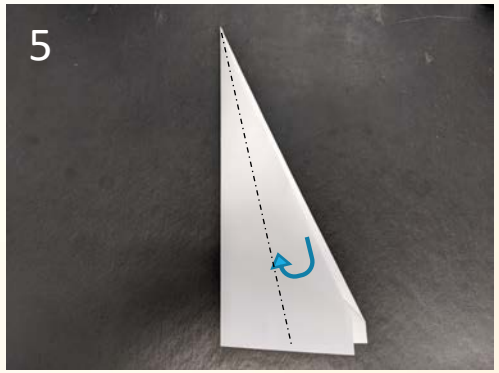
Build Your Own Paper Airplane

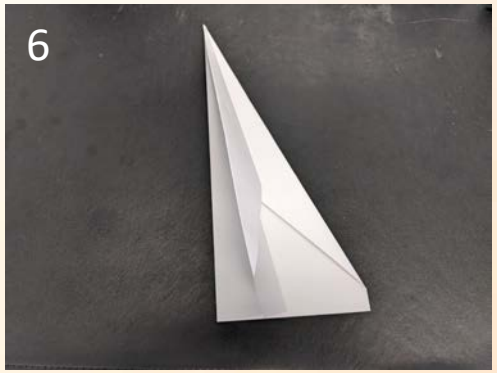


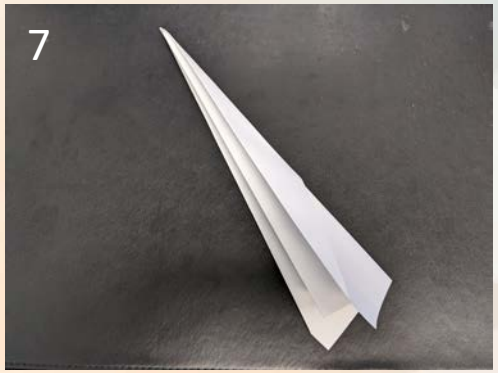


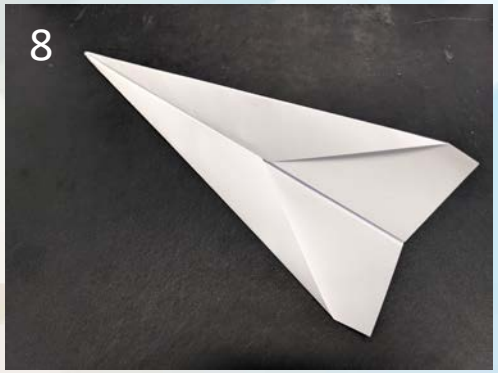












Let’s label the plane with the Four Forces of Flight together!

Ask Me Anything!

What to look forward to next time…

- Changing Pressure: Exploring Bernoulli’s Principle
- Sound and Aircraft

NASA AMES RESEARCH CENTER



Welcome to Day 2!

[Enter Presenter Name]
[Enter Back Up Name]

Let’s Review!

Let’s Review:

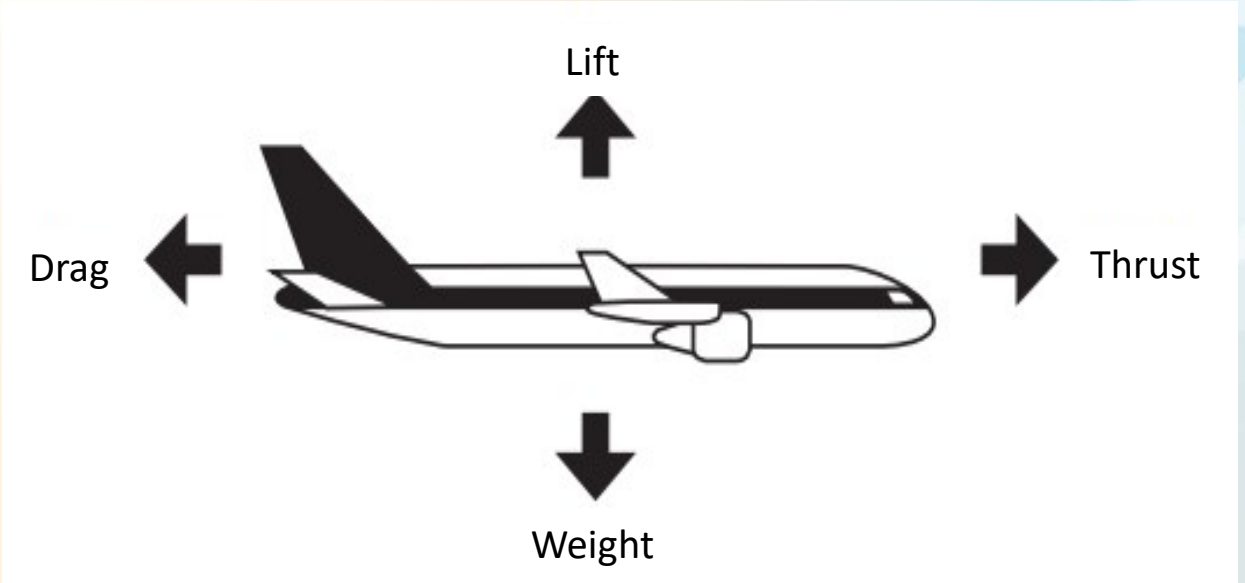
- Q: What four forces are at work to make this airplane fly?



https://gifimage.net/plane-taking-off-gif-1/

Let’s Review:

- Q: What four forces are at work to make this airplane fly?
- A: Thrust, Drag, Lift, Weight

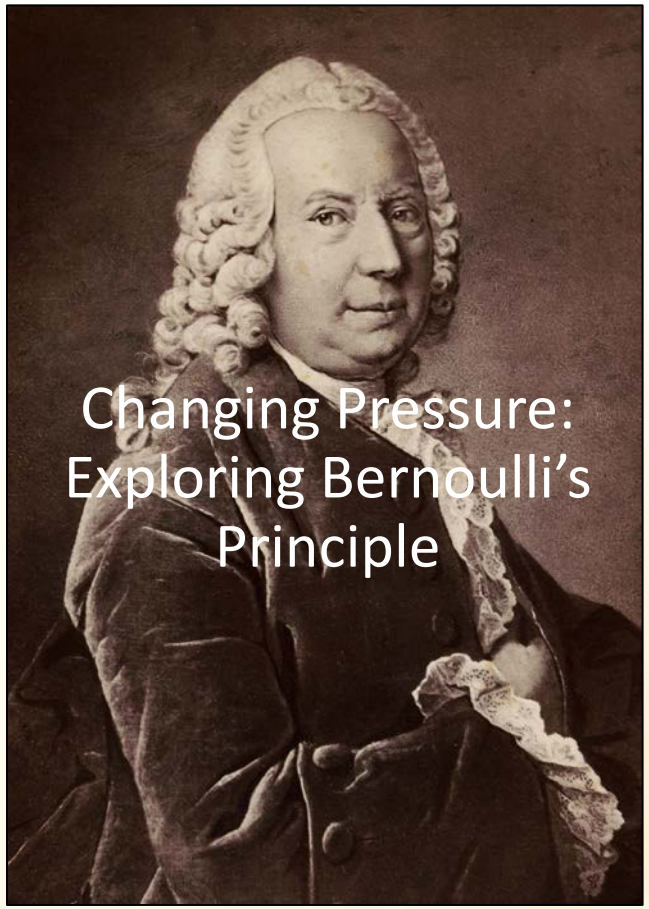


Let’s Review:

- Q: What four forces are at work to make this airplane fly?
- A: Thrust, Drag, Lift, Weight

Today we will learn the principles behind lift specifically and see it in action!

Overview for the Day





Changing Pressure: Exploring Bernoulli's Principle

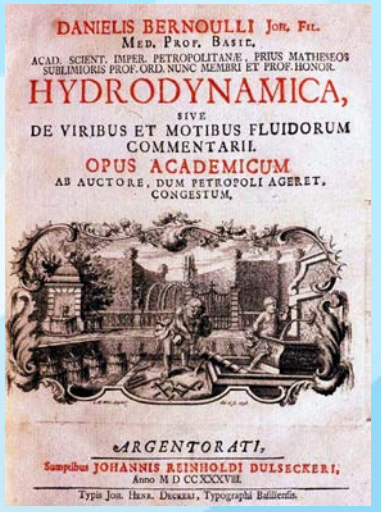
Changing Pressure: Bernoulli's Principle

Who was Bernoulli?

- Daniel Bernoulli, Swiss mathematician, 1700 – 1782
- Author of *Hydrodynamica* 1738

Bernoulli's Principle: The pressure of a fluid *decreases* as the speed of fluid *increases*.





Speed ↑ **Pressure** ↓

Speed ↓ **Pressure** ↑

Bernoulli's Principle explains how objects fly and is an important concept in aerodynamics and fluid flow

Activity #1 – Bernoulli's Sheet of Paper

What you'll need:

- Half sheet of printer paper
- Scissors



https://letstalkscience.ca/educational-resources/interactives/sciencexplosion-painting-bernoulli

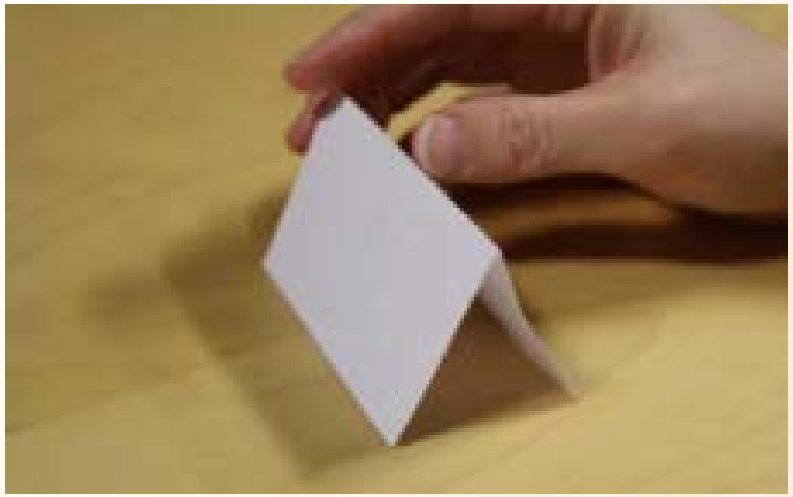
How you do it:

- Fold a piece of printer paper in half
- Cut along the fold so that you have half a sheet of paper
- Place and hold the half sheet of paper slightly below your mouth
- Blow across the top of the paper
- What happens?

Activity #2 – Paper Tent

What you'll need:

- Half sheet of printer paper (same paper from Activity #1)



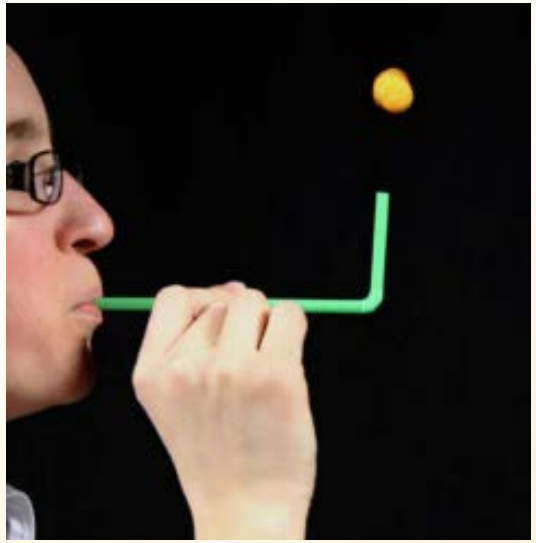
How you do it:

- Fold the piece of paper in half and set it up on a table as a tent
- Gently blow air into the paper tent
- What happens?
- What does this experiment have to do with Bernoulli's Principle?

Bonus Demonstration – Balancing Cheese Puff

What you'll need:

- One cheese puff
- Flexible straw



How you do it:

- Bend your straw into an "L" shape
- With the short end of the straw pointing up, blow steadily into your straw and try to make the cheese puff balance
- What happens if you try to balance the cheese puff while also tilting the straw?
- How does this activity relate to Bernoulli's Principle?

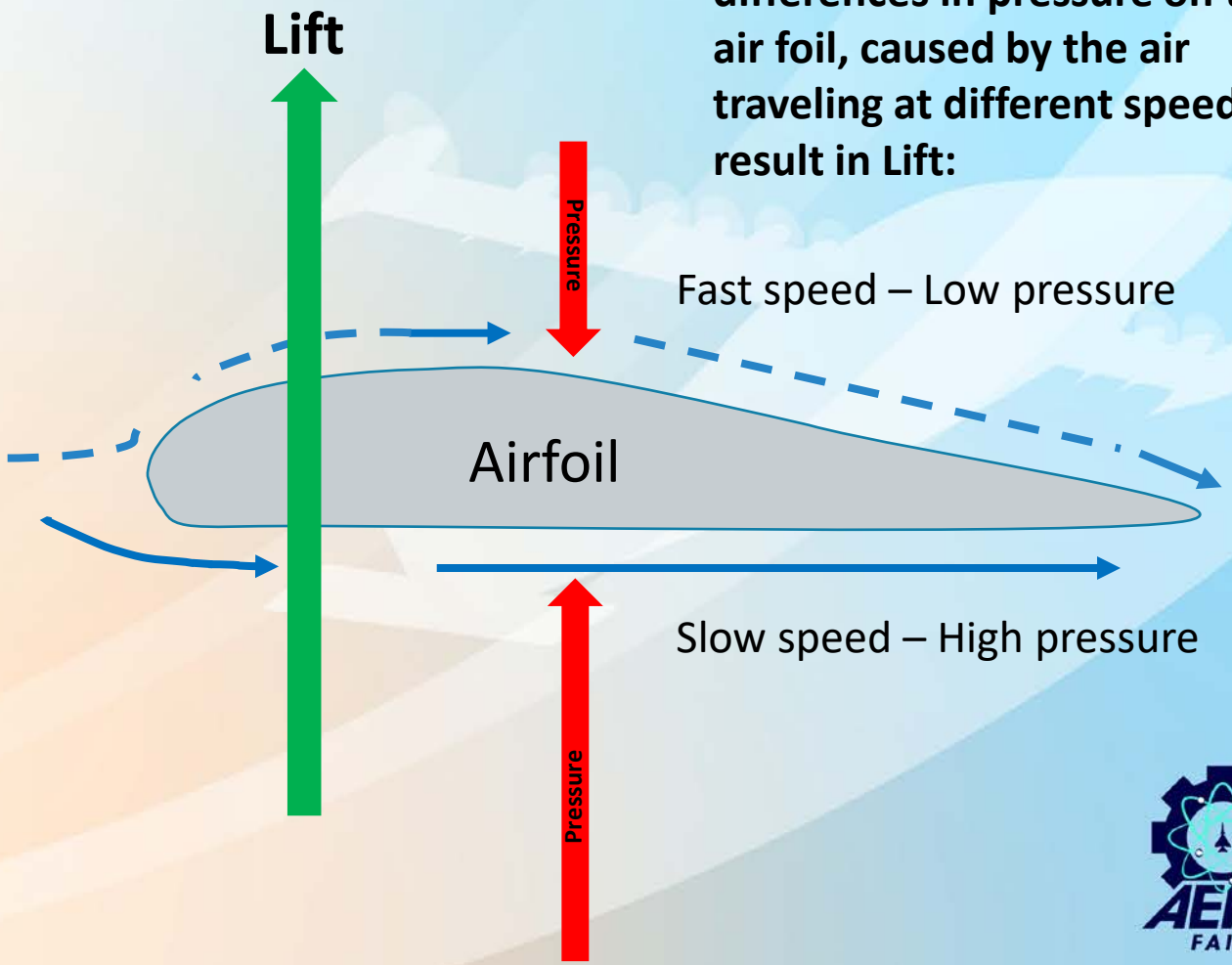
What does this have to do with airplanes and lift?

Bernoulli's Principle helps generate Lift!



This Photo by Unknown Author is licensed under CC BY-NC-ND

Unbalanced Forces: The differences in pressure on the air foil, caused by the air traveling at different speeds, result in Lift:



Q: As air flows slower under the wing, is the pressure under the wing greater than or less than the pressure on top?

Q: As air flows slower under the wing, is the pressure under the wing greater than or less than the pressure on top?

A: Greater. Greater pressure beneath the wing pushes the wing up resulting in lift.

Ask me anything!

Aircraft Sound

Why is studying sound important?

- Reduces noise pollution of aircraft so it doesn't disturb people and wildlife
- Sounds that are too loud can be dangerous. You can even go deaf!



https://newatlas.com/aircraft/joby-aviation-toyota-evtol-air-taxi/



Speed of Sound

- The speed of sound is constant at about 343 meters per second.
- This is about 767 miles per hour.
  - That's **10X faster** than you probably go on the highway!
- Mach Number is the ratio of the speed you are traveling over the speed of sound. Mach 1 = speed of sound

$$M = \frac{v}{c}$$

- Example: 767 mph/ 767mph = Mach 1 and 1534 mph/767mph = Mach 2



Mach Number $M = \frac{v}{c}$

0

SUBSONIC

0.8

Transonic — 1 — Speed of Sound

1.2

SUPERSONIC

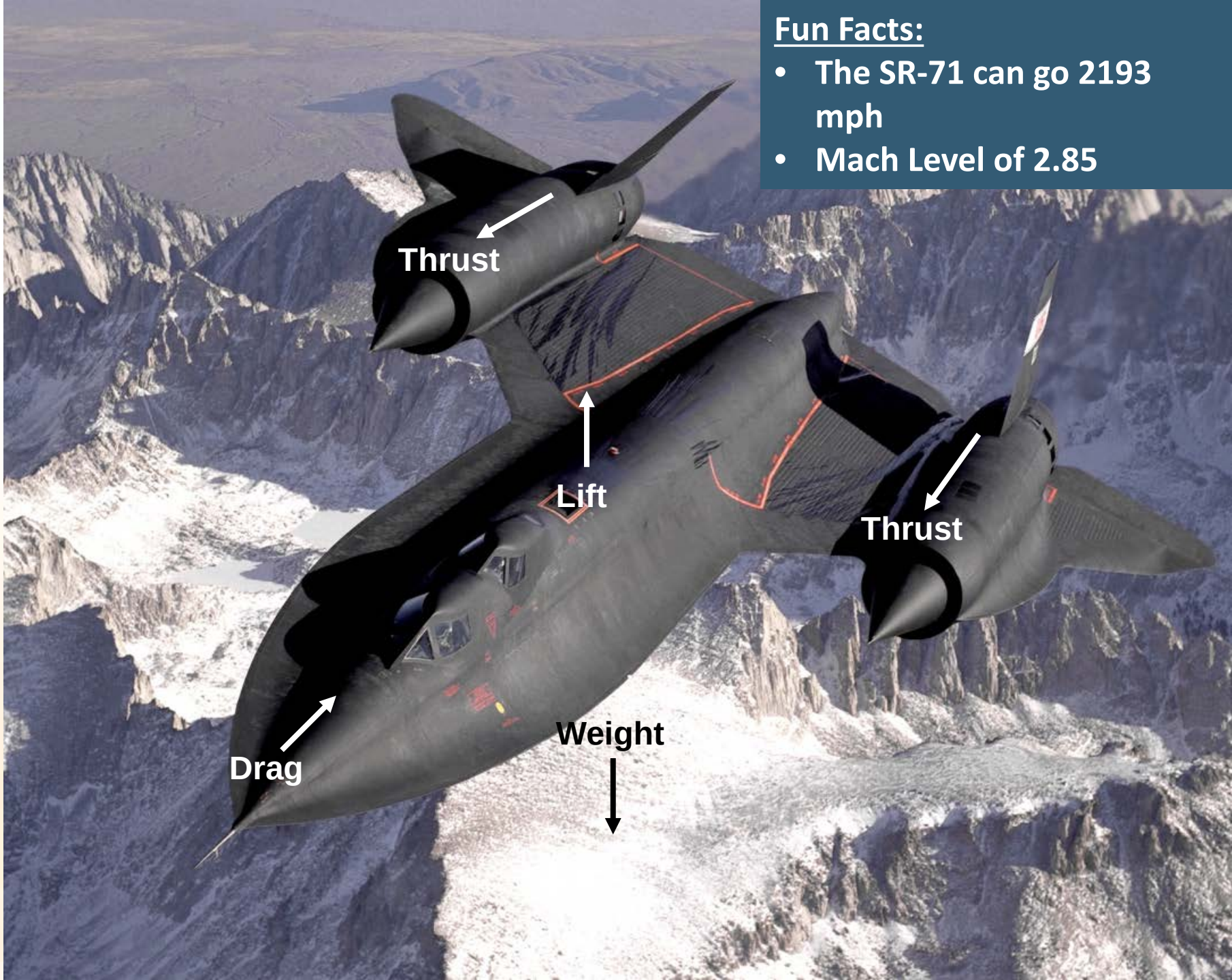
5

Hypersonic

??

Mach 1 @ sea level

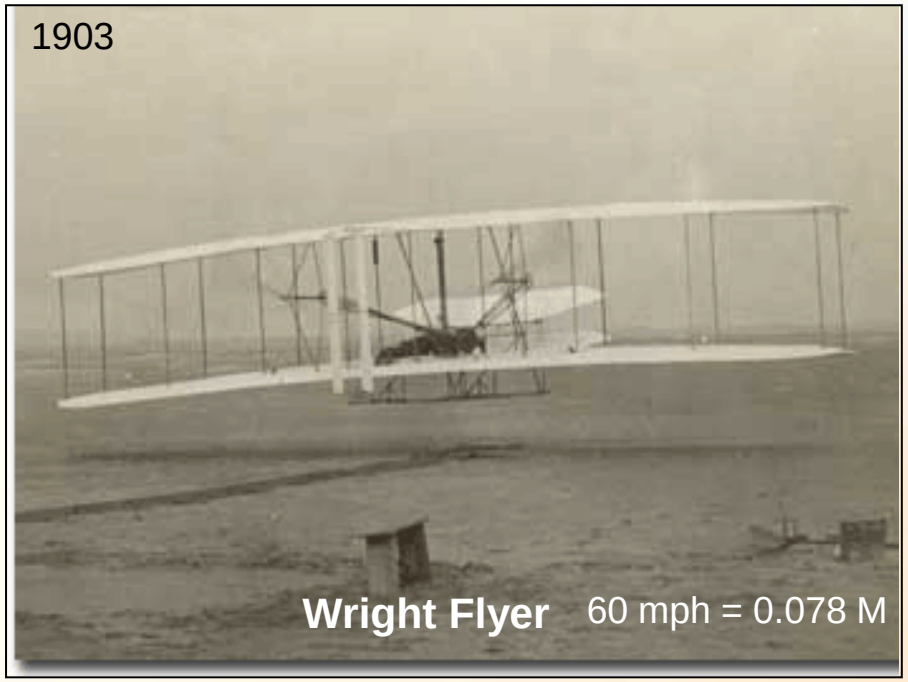
770 mph or 344 m/s



Fun Facts:

- The SR-71 can go 2193 mph
- Mach Level of 2.85

Subsonic Aircraft







Supersonic Aircraft

Supersonic Aircraft Design

- Sharp, needle like nose
- Very thin wings and tail surfaces
- Slender fuselage



1954 **F-104** 1,300 mph = 1.694 M



1969 **Concorde** 1,300 mph = 1.694 M



1964 **SR-71** 2,200 mph = 2.867 **M**

Hypersonic Aircraft



ORION DURING REENTRY The Orion crew capsule reenters Earth's atmosphere.



Space Crew Dragon Endeavor approaching International Space Station.



Space Crew Dragon Endeavor retrieved after reentry into Earth and splashdown.

Ask me anything!

Kahoot!

How To Participate:

1) Go to www.kahoot.it and type in the code.
2) Choose the correct answer to each of the questions.
3) Have Fun!

What to look forward to next time…

- Exploring Mars
- Build Your Own Mars Helicopter
- Aeronautics Challenge!
- Let’s Talk STEM!

NASA AMES RESEARCH CENTER



Welcome to Day 3!

[Enter Presenter Name]
[Enter Back Up Name]

Let’s Review!

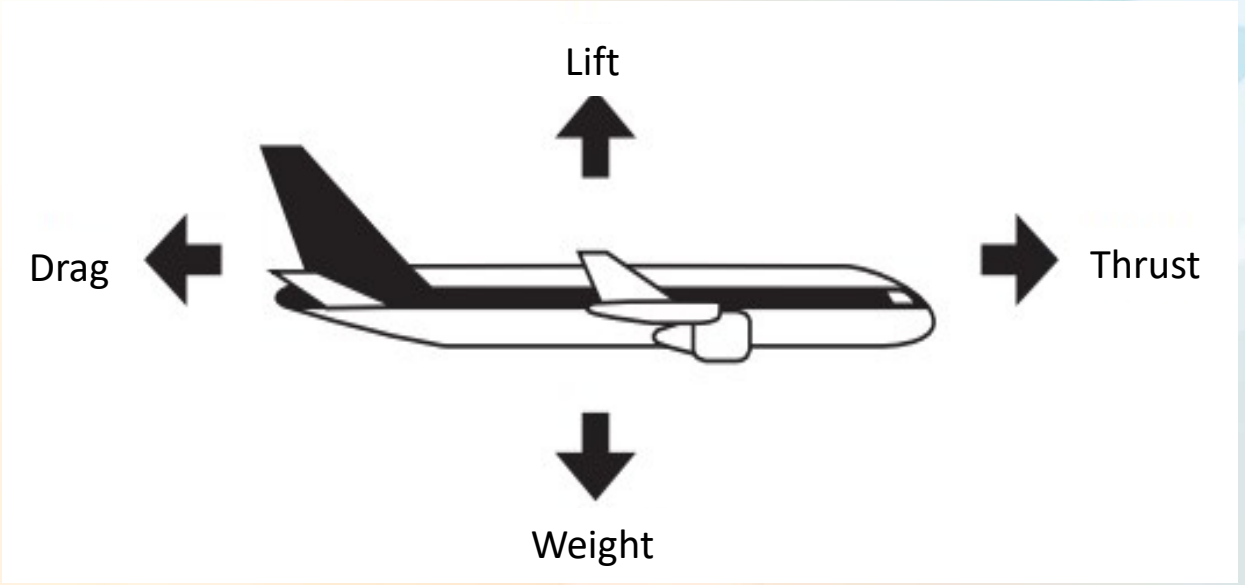
Let’s Review:

Q: What are the four forces of flight?

Let’s Review:

Q: What are the four forces of flight?

A: Lift, Thrust, Drag, Weight



Let’s Review:

Q: When air flows faster on top of the wing, is the pressure above the wing greater than or less than on the bottom?

Let’s Review:

Q: When air flows faster on top of the wing, is the pressure above the wing greater than or less than on the bottom?

A: Less than. The pressure above the wing is less than on top of the wing than on the bottom of the wing.

Let’s Review:

Put these aircraft in order of their speeds from slowest to fastest:







Let’s Review:

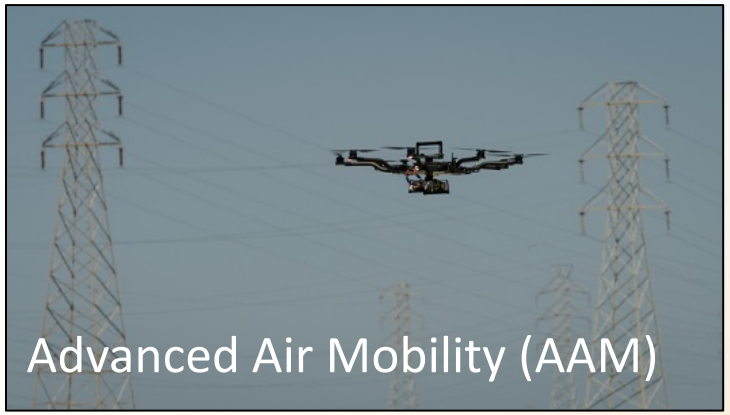
Put these aircraft in order of slowest to fastest:







Overview for the Day



Aeronautics Challenge!

Kahoot!

Let's Talk STEM!

INSPIRE - ENGAGE - EDUCATE - EMPLOY

The Next Generation of Explorers

Advanced Air Mobility (AAM)

What is Advanced Air Mobility (AAM)?



The vision of AAM is to ensure a safe, accessible, automated, and affordable air transportation system for passengers and cargo capable in urban and rural locations.

It is predicted that by the year **2030**:
-**500 million flights** per year for package delivery
-**750 million flights** per year for air taxi/metro services

AAM will help to ensure this new airspace will be properly managed.



AAM In Our Lives

What are some ways AAM helps us in our society?

- Emergency Response
- Healthcare
- Automation
- Vertiports
- Decreased Travel Time
- Infrastructure
- Future Airspace
- Safety
- Ride Quality
- Accessibility

NASA is writing the playbook on how this will be incorporated into our everyday lives!

Advanced Capabilities for Emergency Response Operations (ACERO)

- Aerial wildfire fighting is dangerous. Right now, it is limited to daytime hours and clear visibility.
- ACERO will safely integrate remotely piloted aircraft into wildfire operations. This means we could monitor and fight wildfires 24/7.
- Advanced communication technologies will let responders collect and share live fire information more quickly with crews on the ground and the public.
- ACERO will make wildland fire operations safer and more effective, saving property and saving lives.



What types of aircraft are part of AAM?



Quadcopter



Quiet Single Main Rotor (QSMR) Helicopter



Lift + Cruise



Tiltwing



Side-by-Side

UAVs – Unmanned Aerial Vehicles

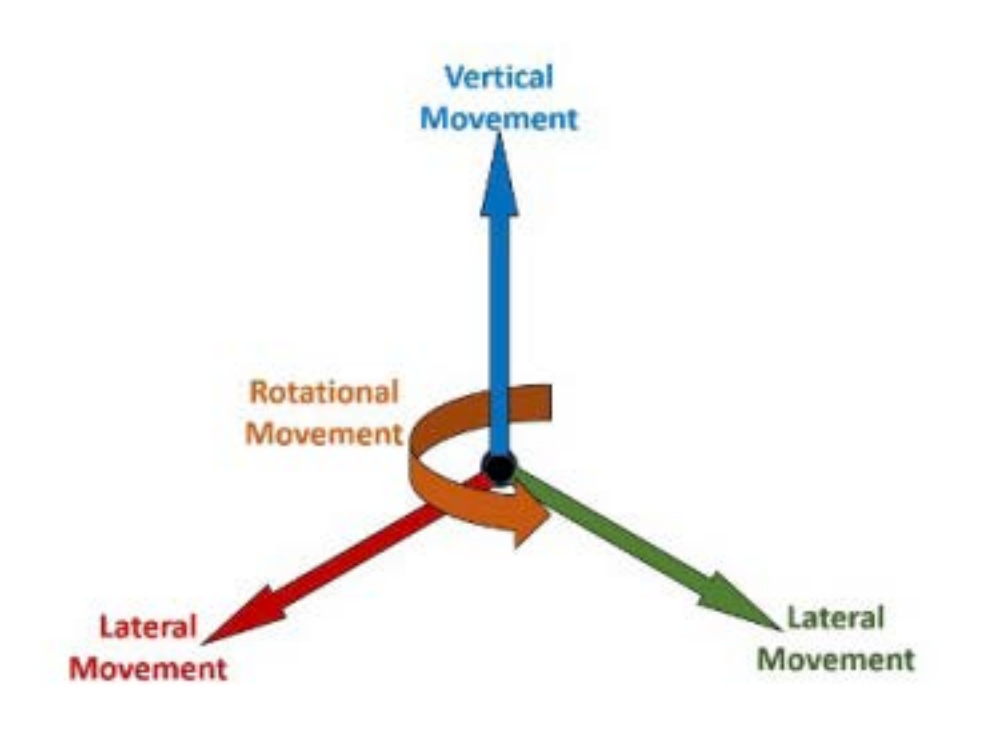
What is a UAV?

- Small aircraft that can be remotely or autonomously controlled





How do UAVs fly? – Three Different Types of Movement

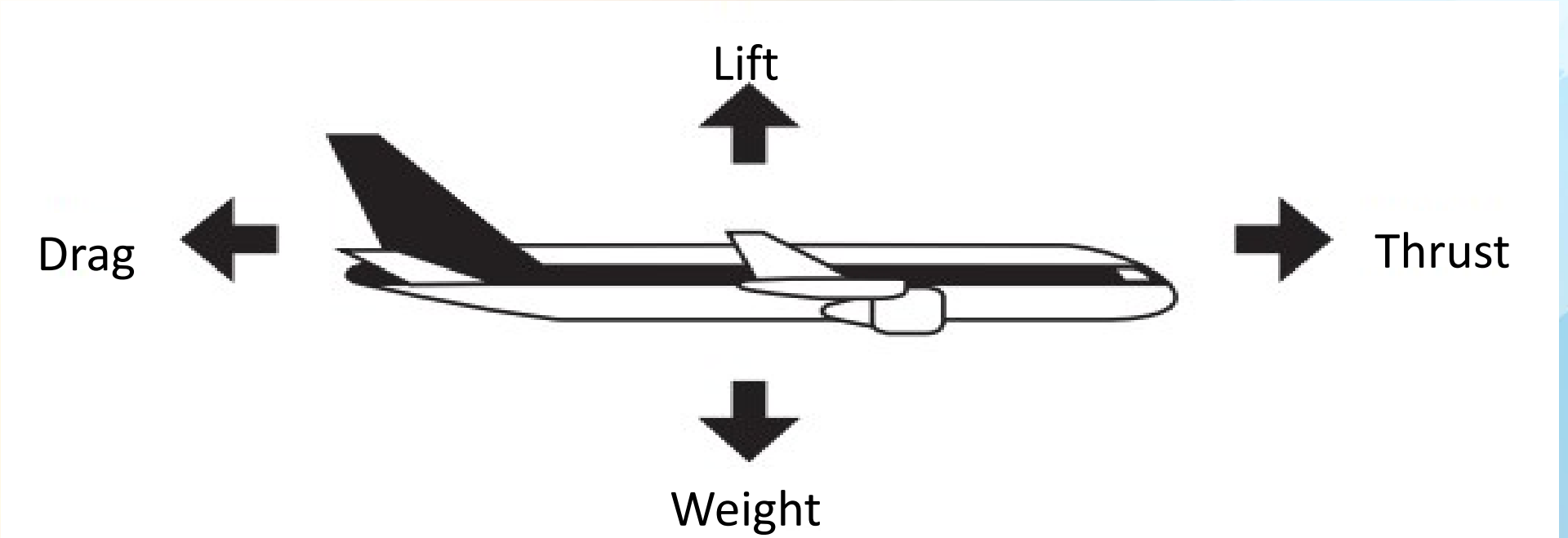


- Vertical
- Lateral
- Rotational

How do UAVs fly? – Unbalanced Four Forces of Flight

Review:

- Newton's Third Law:
  - For every action there is an equal and opposite reaction
- Four Forces of Flight:



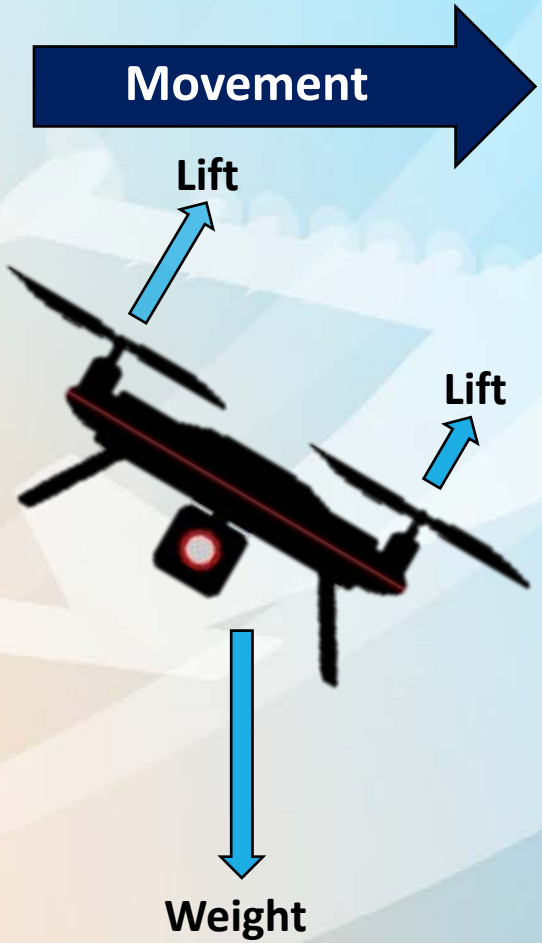
How do UAVs fly? – Unbalanced Four Forces of Flight

- Vertical Movement
- We have two forces to consider for up and down motion:
  - Lift
  - Weight



How do UAVs fly? – Unbalanced Four Forces of Flight

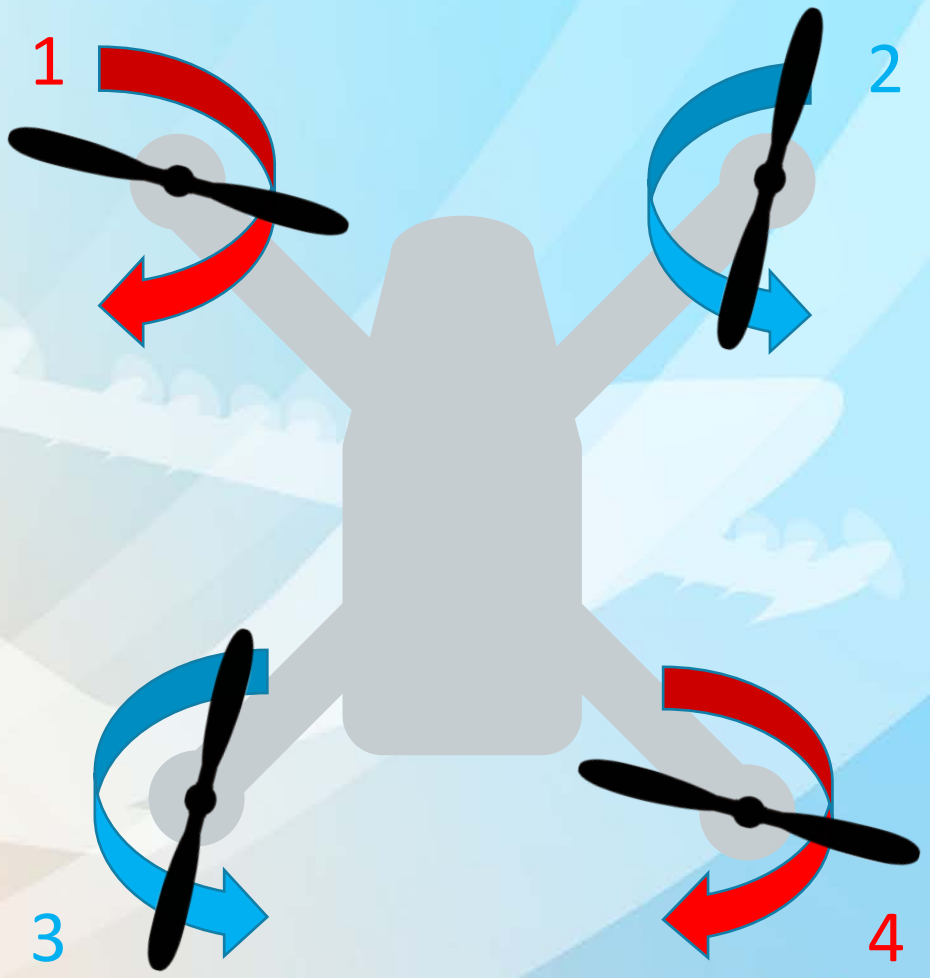
- Lateral Movements



How do UAVs Fly? – Torque?

- Rotational Movement
- Torque

- All of three movements work together to help UAVs fly where we want it to go.



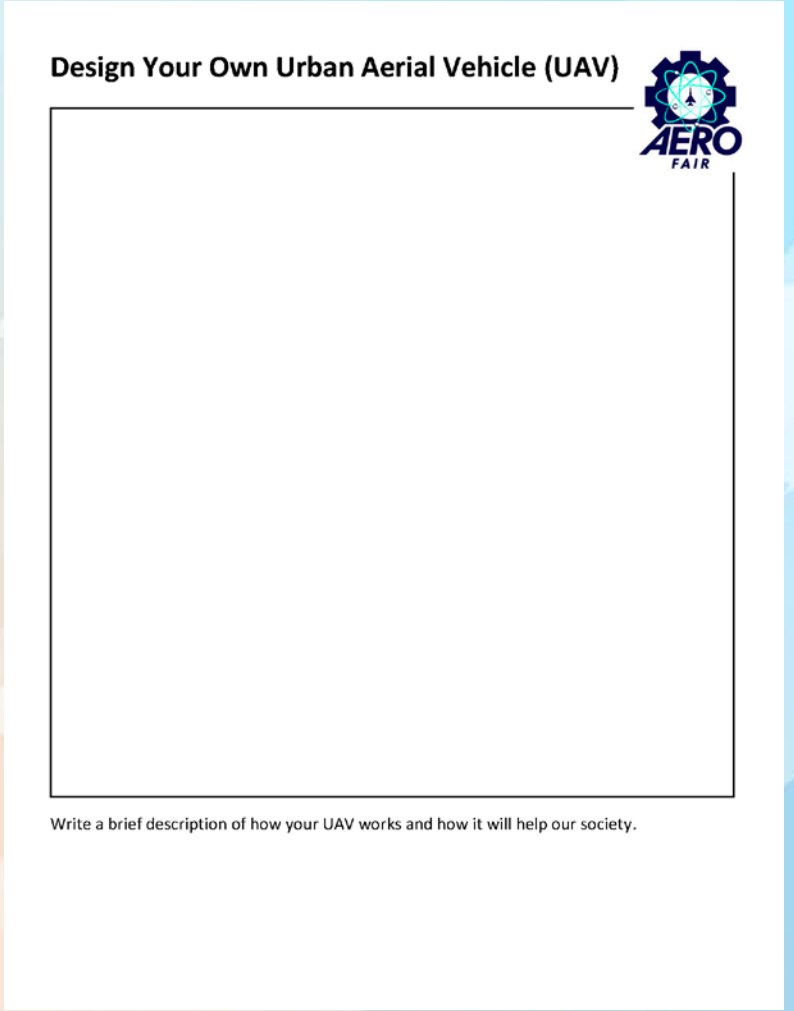
How will UAVs Fly in our Skies?

- UAVs are just a small piece of the much bigger unmanned aircraft system (UAS).
  - What is included in UAS?
    - Vehicle
    - Software for navigation
    - Tracking Equipment
    - Communication Equipment
    - Humans that control all of the above

This is just a small part of the overarching AAM transportation ecosystem that NASA is leading.

Design Your Own Urban Aerial Vehicle

1. Take 10 minutes to draw your very own UAV.
2. Write a brief description of how it works and how it will help our society.
3. Share it with the class.



Game: 3, 2, 1…Lunch!
(Aero Fair edition)

Game: 3, 2, 1…Lunch! (Aero Fair edition)

Instructions:

- Get into teams of 4-6 players
- Each team will use their own gameboard
- Create the shortest flight plan using the measurements on the game board to record the x, y coordinates of segments that the UAV will travel in the Game Tracker.
- Show your work by drawing the segments and calculating the total distance the UAV must travel.



Insert actual copy of grid with obstacles here

Game: 3, 2, 1…Lunch! (Aero Fair edition)

Rules

- UAV flight plan must reach at least these blue points (in this order):
  - Start: Home (0,0)
  - School (26,36)
  - Mall (25,9)
  - End: Home (0,0)
- All the points on the UAV flight plan must be connected
- UAV must fly around the Forest keeping at least a 1-unit perimeter around it.
- UAV must stop at the top right corner of the Mall (star) to pick up your items before finishing at Home.
- You must SHOW YOUR WORK by the Game Tracker table in order to get credit.

Ways to Measure Distance

- Count the units using the measurements on the x, y axis (no diagonals).
- Use a ruler to measure the distance between two points, and round to the nearest tenth of a cm.
- Use the Pythagorean theorem and Distance formula to calculate the distance of each segment.

Team with the shortest distance from Home, to School, to the Mall, and back to Home wins!

Ask me anything!

Kahoot! - Aeronautics Challenge

How To Participate:

1) Go to www.kahoot.it and type in the code.
2) Choose the correct answer to each of the questions.
3) Have Fun!

Let’s Talk STEM!

Sky for All: Imagine What the Future Holds

Discuss in your group:

1. What are some of the world's aeronautical challenges that we are or will be facing in the future?
2. How do YOU think we can solve those challenges? Describe or design your solution with your group.

Resources

- Learn More with other Aeronautics and Science Activities
  - https://www.nasa.gov/aero-at-home
  - https://www.nasa.gov/stem
- Opportunities to get involved with NASA
  - https://intern.nasa.gov
- Contact Information
  - [Enter your email if you are comfortable with this]
  - christina.l.cheung@nasa.gov
  - ARC-Aero-Fair@mail.nasa.gov