
Aero Fair
NASA Ames Aeronautics Directorate
with Ames Exploration Encounter
NASA
Welcome!
[Christina Lim]
[Joseph O'Brien]

Christina Lim

I have a Bachelor of Science degree in Biology from the University of California, Irvine, CA.

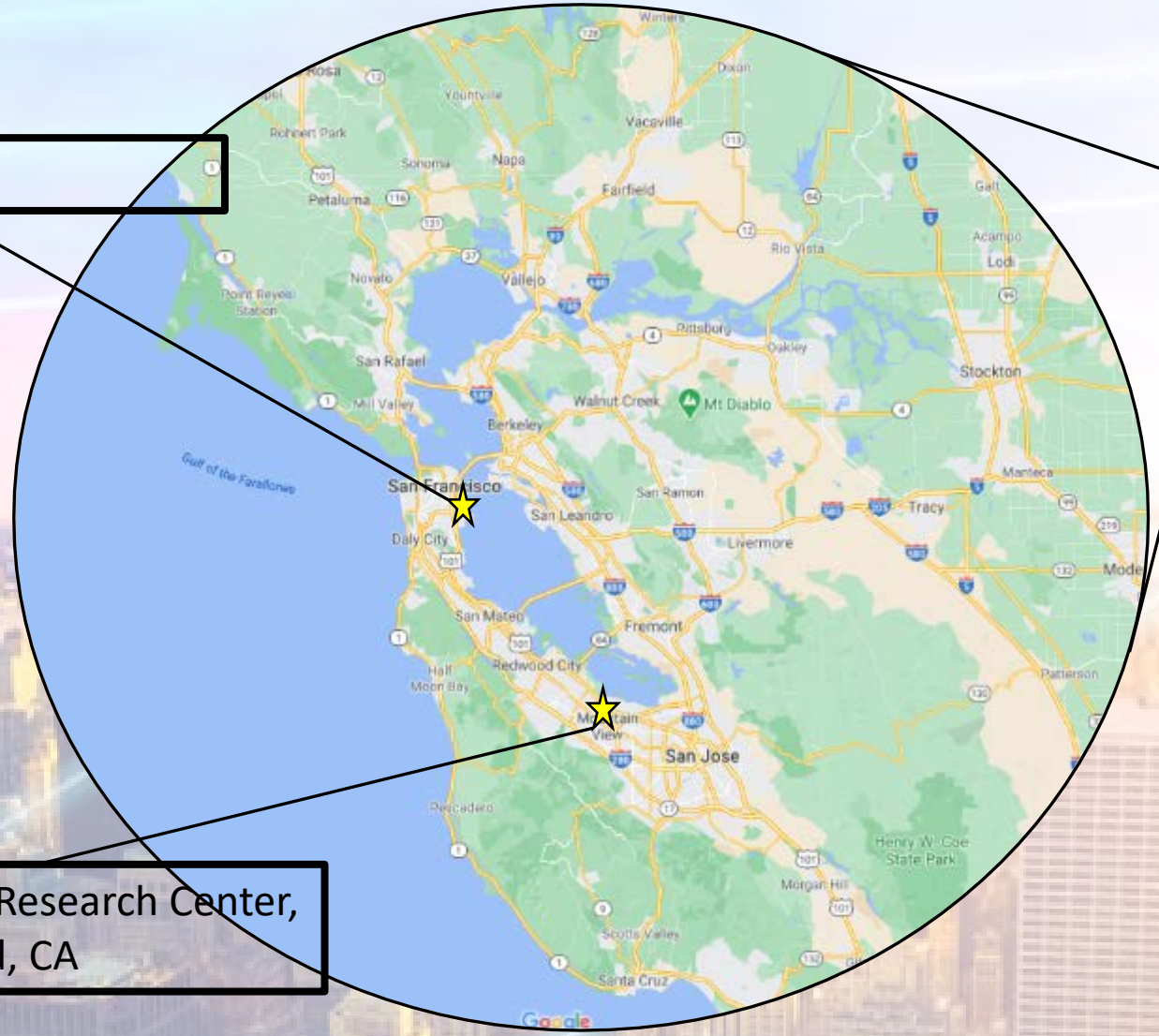
I am currently working on these NASA projects: Cell Science Project, Biospecimen Sharing Program, Aero Fair Project.

My favorite thing about working at NASA is knowing that my work is contributing to the advancement of space exploration.

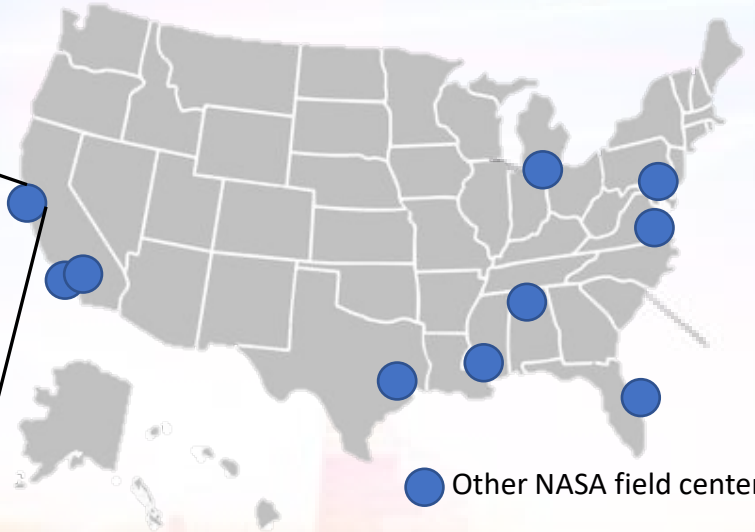
If I could visit anywhere in the universe, I would go to Pluto and make it feel better that it’s not considered a planet anymore.

NASA Ames Research Center

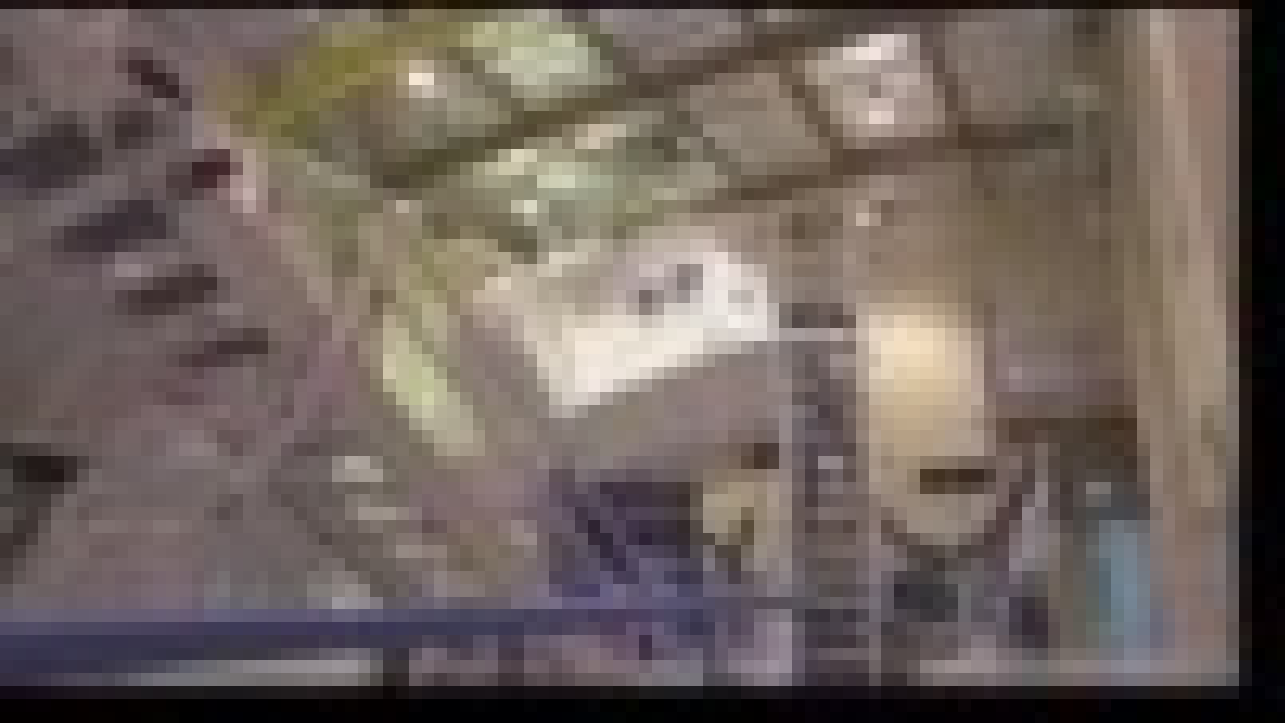
Other school



NASA Ames Research Center, Moffett Field, CA



Other NASA field centers



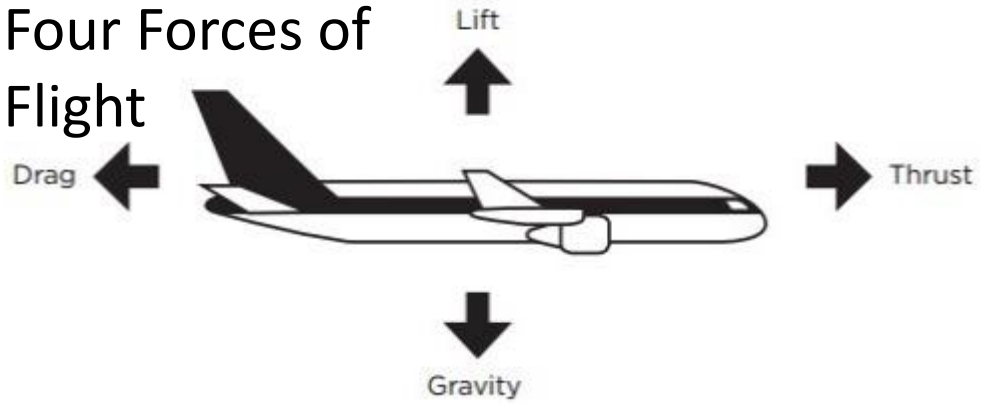

Overview for the day

History of NASA Ames Research Center Aeronautics

Aeronautics Pre-Challenge!

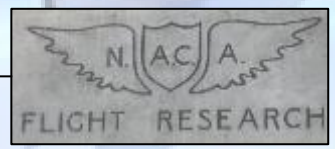
Kahoot!

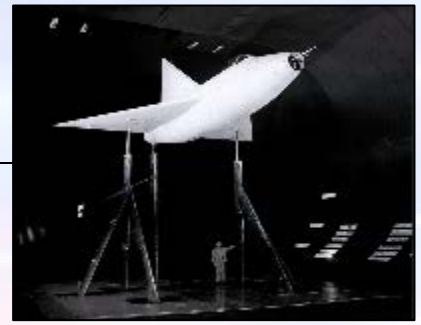
Four Forces of Flight



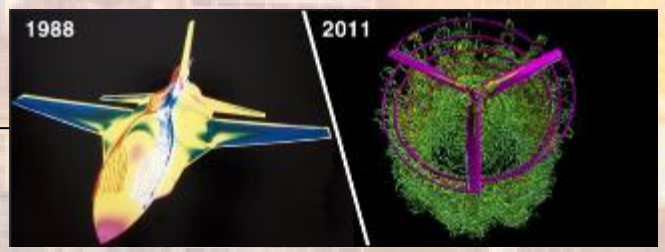
Build Your Own Paper Plane

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



Here's what you are going to learn!

- What are Newton’s Laws?
- What are the four forces of flight?
- What is the Bernoulli’s principle?
- How does the Bernoulli’s principle help planes fly?
- How fast is the speed of sound?
- How are aircraft described relative to the speed of sound?
- How is the environment on Mars different from Earth?
- What are Perseverance and Ingenuity?

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!

Four Forces of Flight

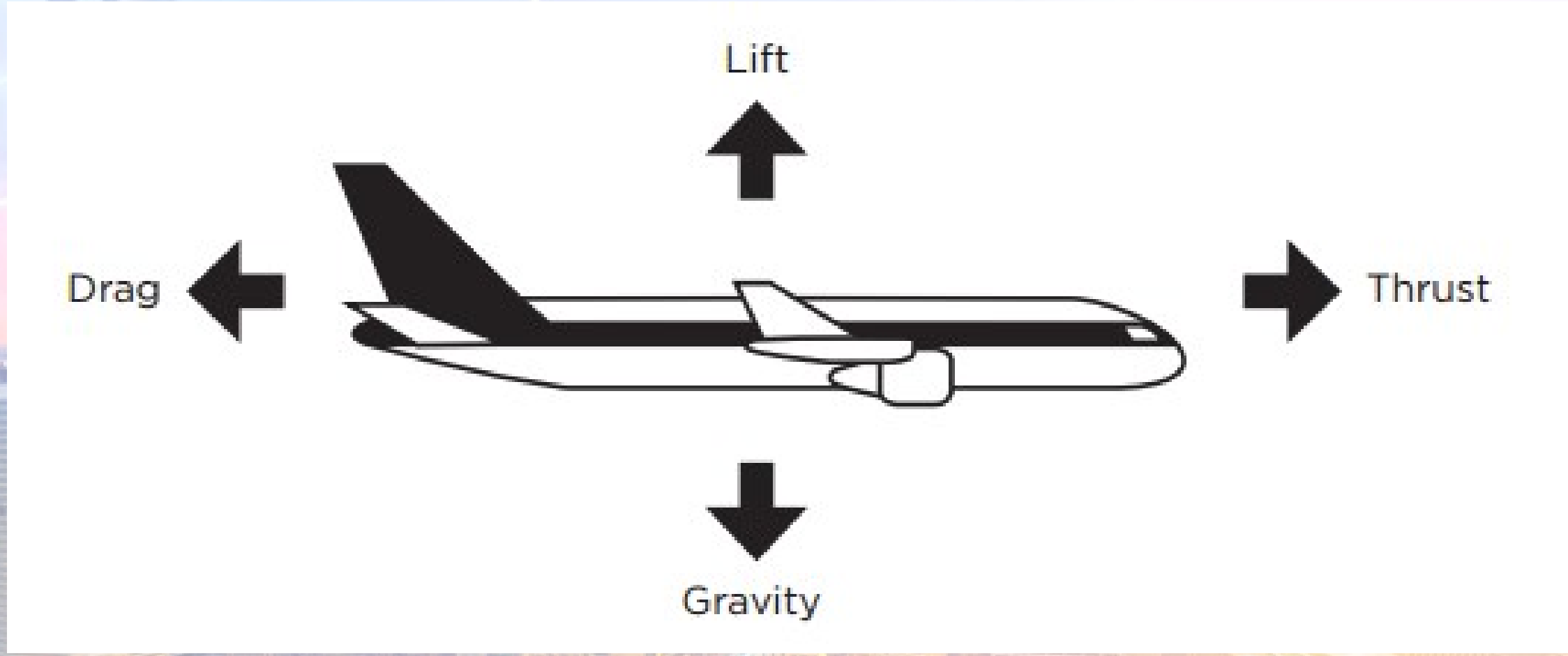
Four Forces of Flight

Credit: Britannica.com/biography/Isaac-Newton

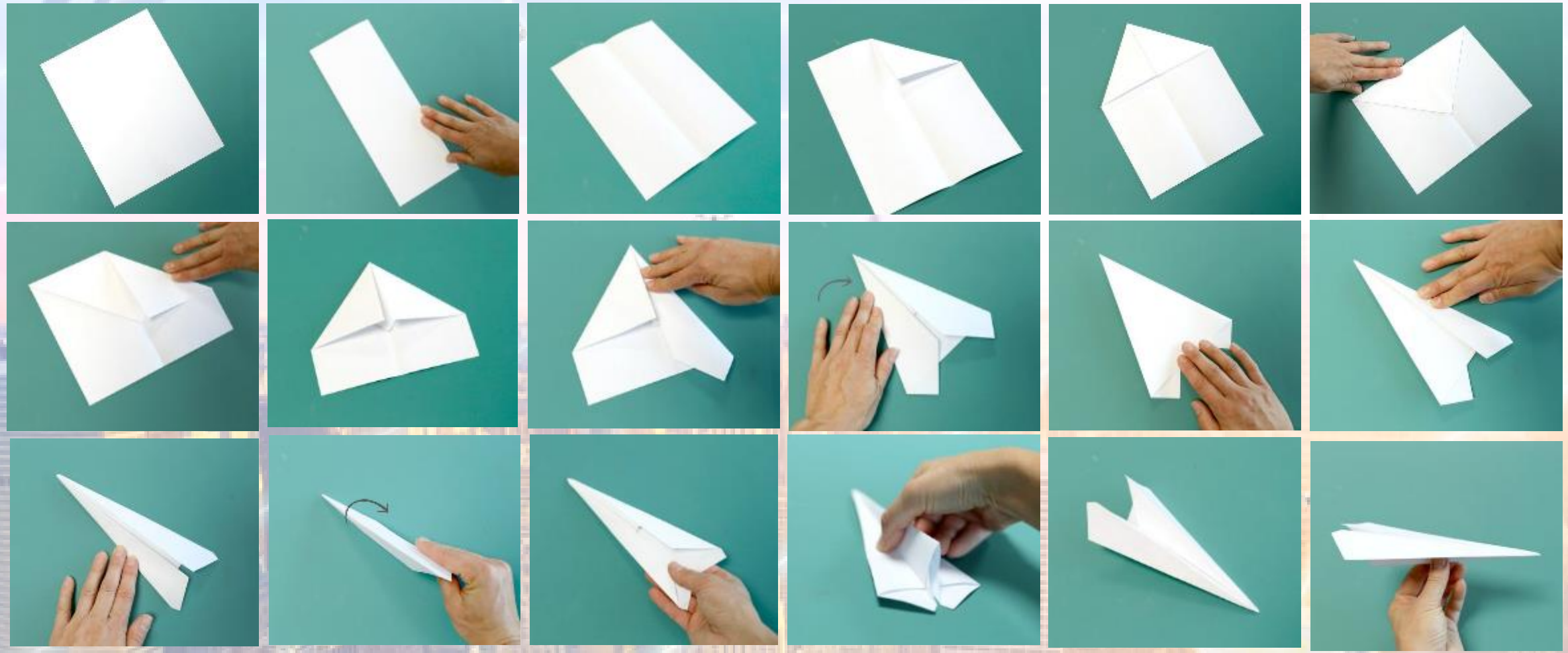
Newton's Laws of Motion

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

Four Forces of Flight



Build Your Own Paper Airplane



instructables.com/how-to-make-the-fastest-paper-airplane/

Build Your Own Paper Airplane

- Label the plane with the Four Forces of Flight
- How do Newton's Laws apply to airplanes?
- Save the airplane for tomorrow!

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…

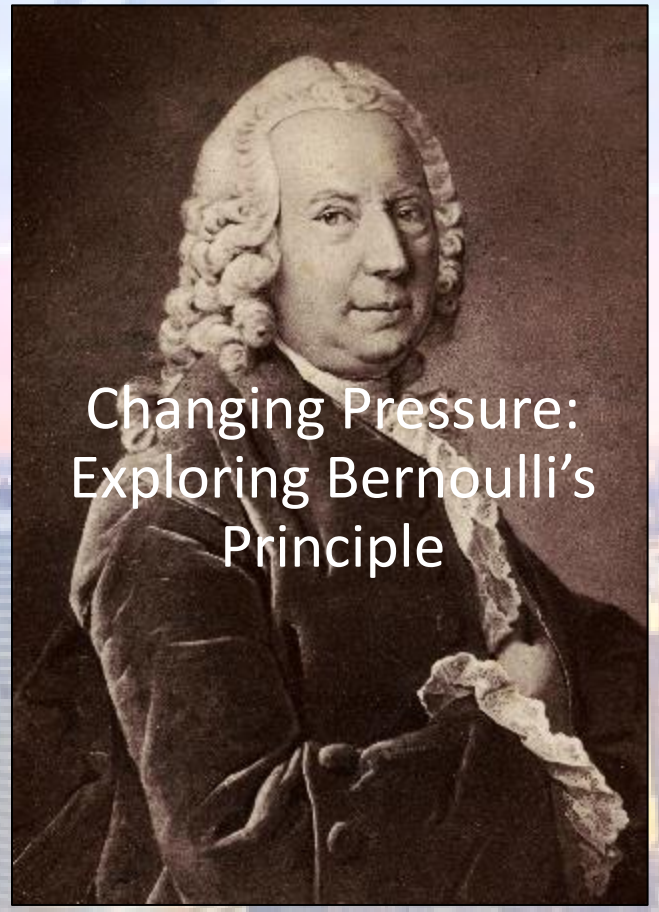
- Changing Pressure: Exploring Bernoulli's Principle
- Sound and Aircraft

Welcome to Day 2!

Christina Lim

Joseph O'Brien

Overview for the Day



Changing Pressure: Exploring Bernoulli's Principle

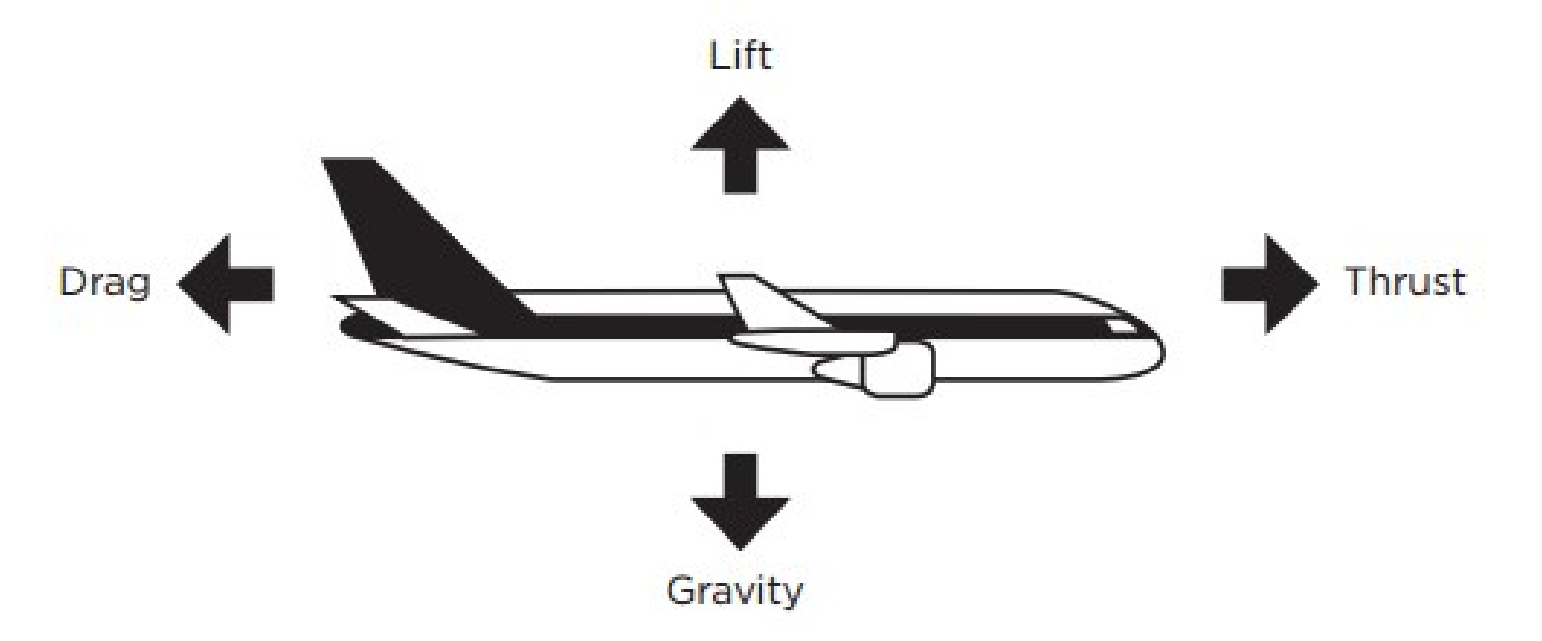
Changing Pressure

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

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

Changing Pressure

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



Changing Pressure

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

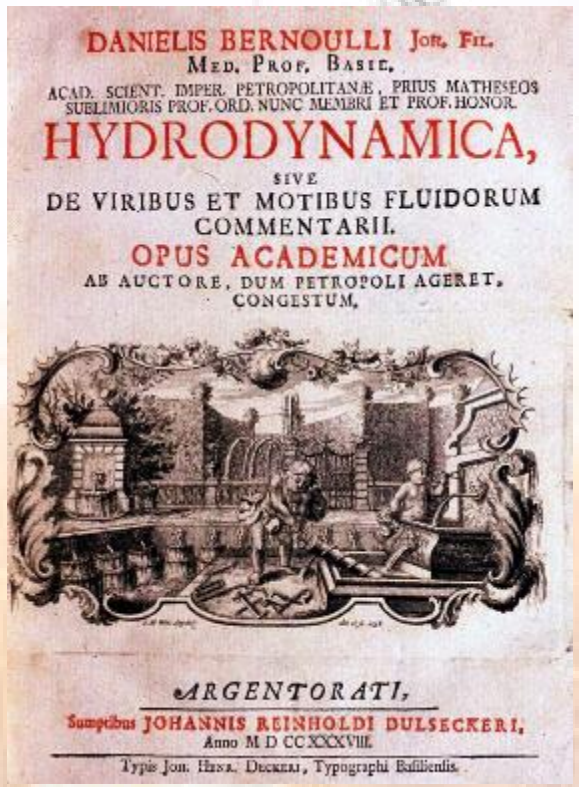
- Today we will learn the principles behind lift specifically and see it in action!

Changing Pressure

Bernoulli's Principle:

The pressure of a fluid (liquid or gas/air) decreases as the speed of fluid increases

- If the fluid is moving fast, the pressure decreases.
- If the fluid is moving slow, the pressure increases.



- Daniel Bernoulli, Swiss mathematician,1700 – 1782
- *Hydrodynamica* 1738
- Relates the velocity of a fluid to its 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

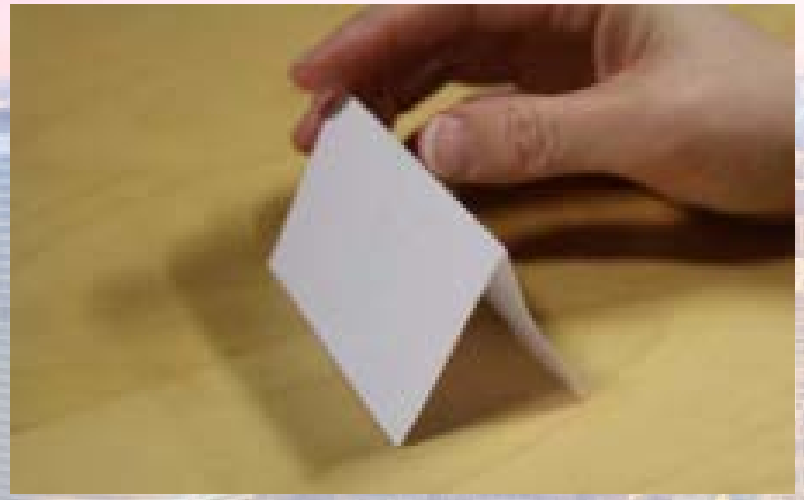
How you do it:

- 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)



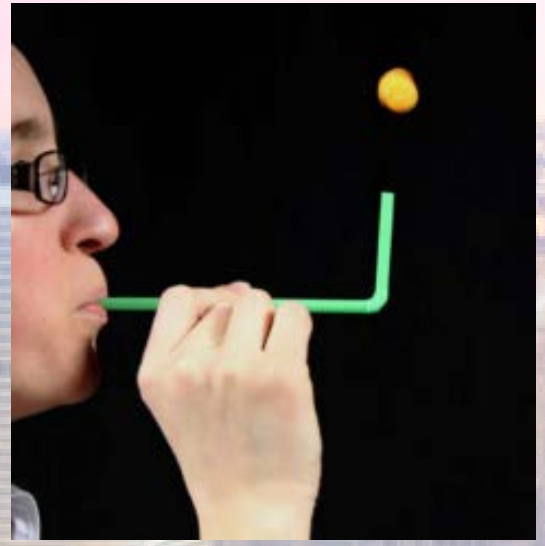
How you do it:

- 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

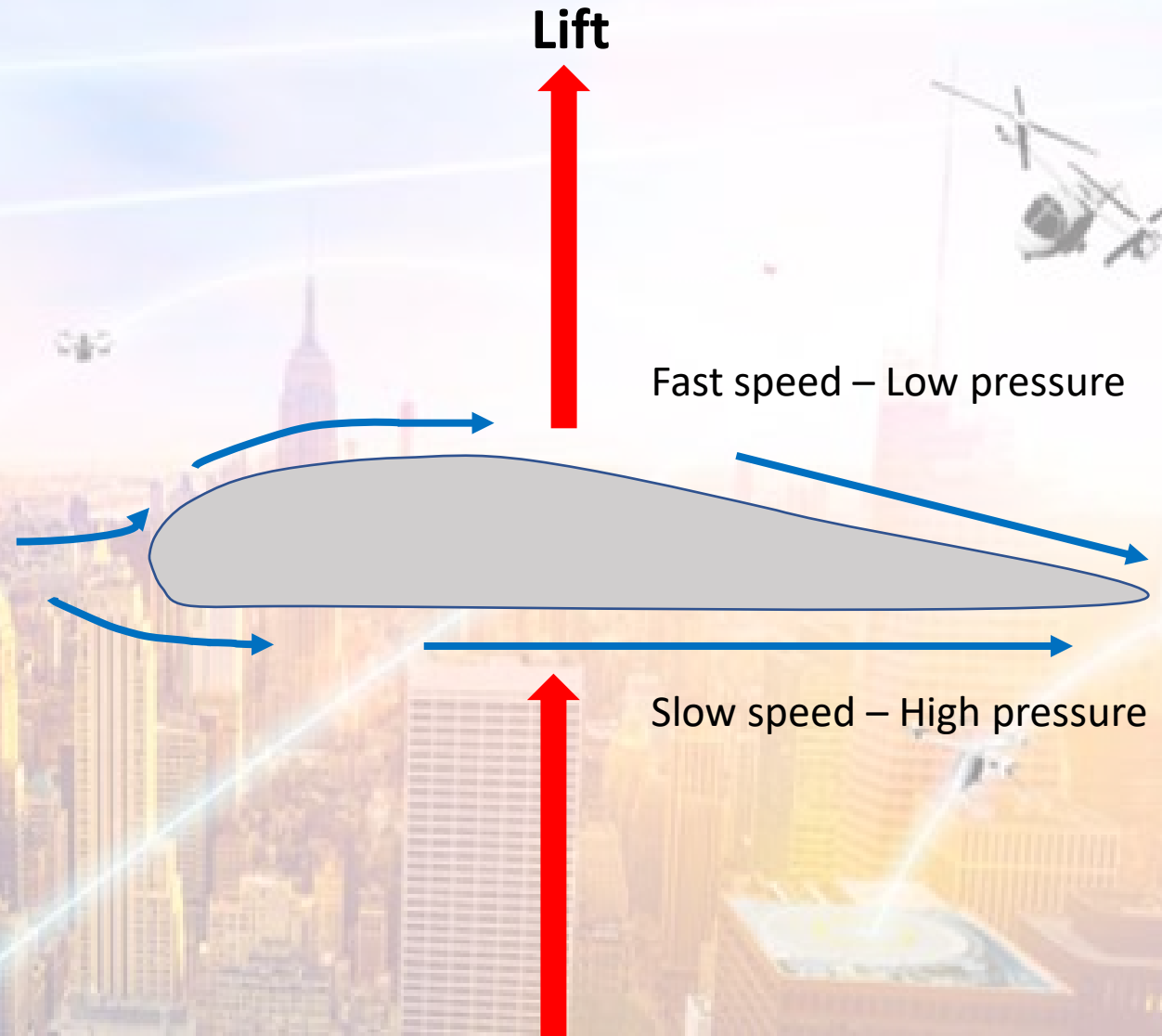


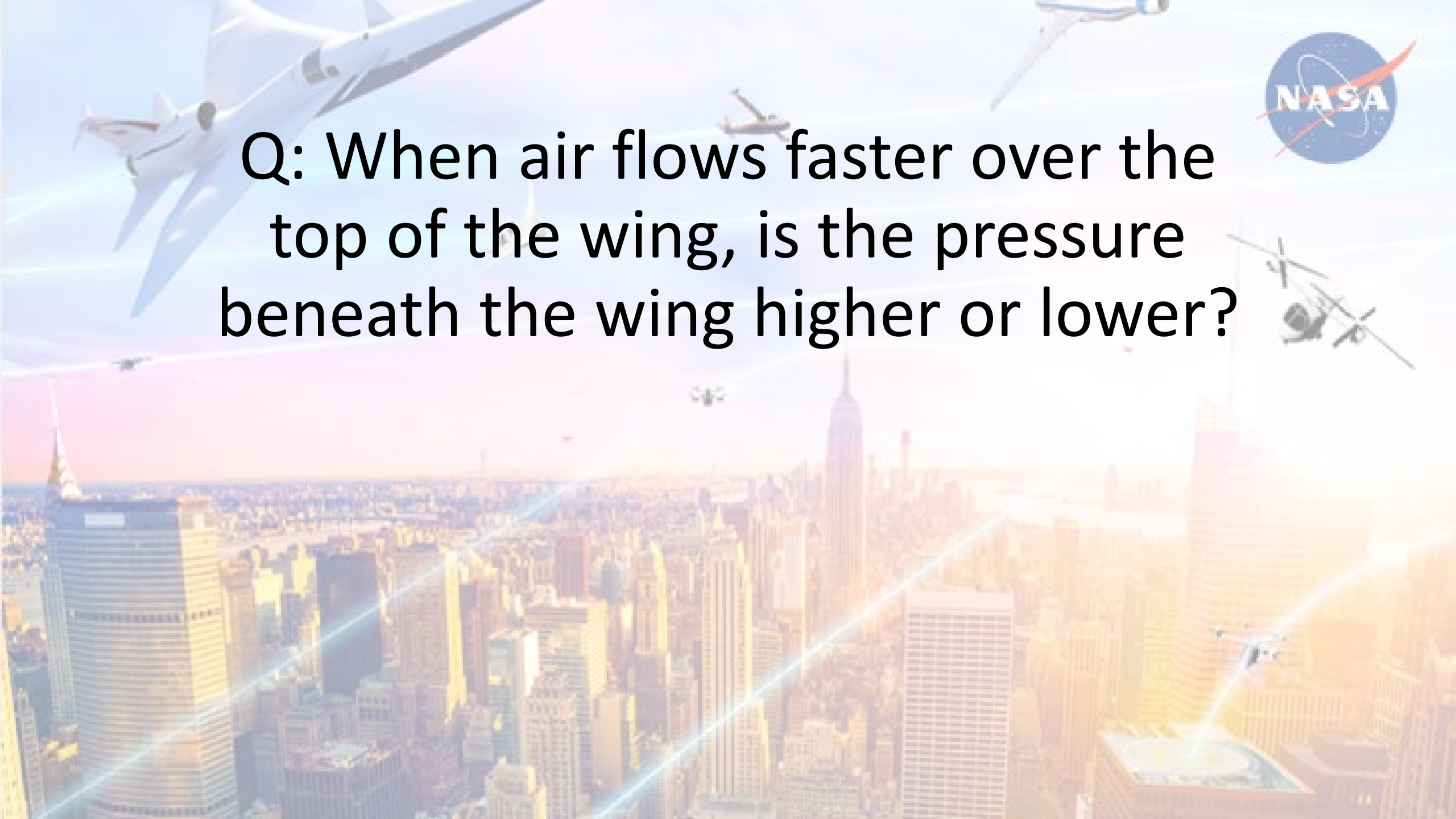
How you do it:

- 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





Q: When air flows faster over the top of the wing, is the pressure beneath the wing higher or lower?

Q: When air flows faster over the top of the wing, is the pressure beneath the wing higher or lower?

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

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!

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


NASA

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

0

SUBSONIC

0.8

Transonic — 1 — Speed of Sound

1.2

Mach 1 @ sea level
770 mph or 344 m/s

SUPERSONIC

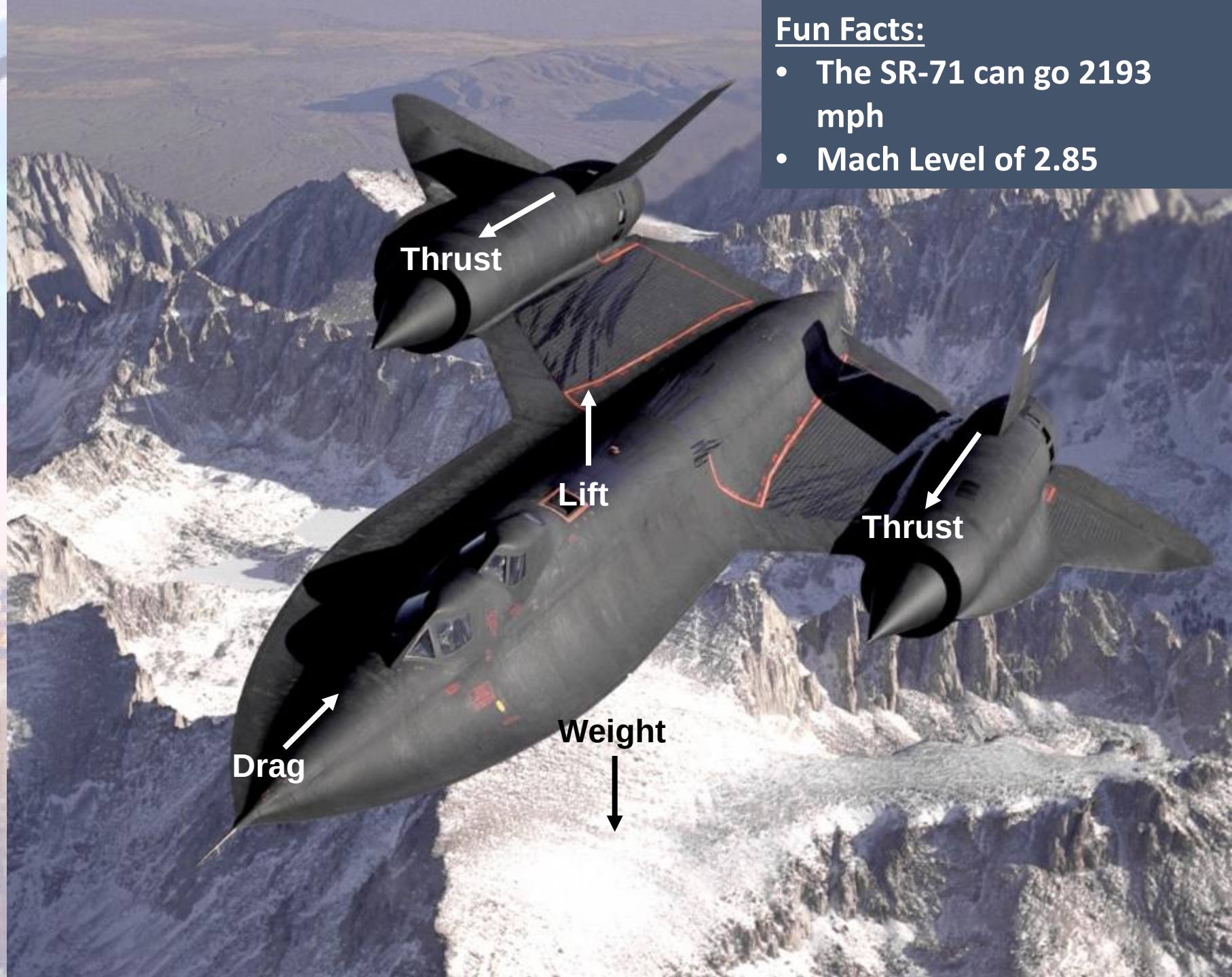
5

Hypersonic

??

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

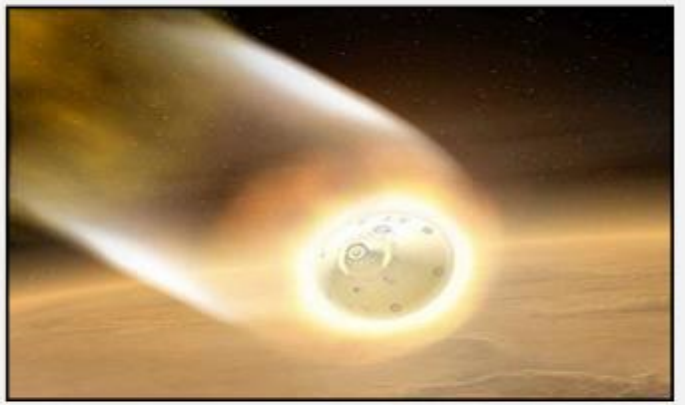
1954 **F-104** 1,300 mph = 1.694 M

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.



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…

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

Welcome to Day 3!

Christina Lim

Joseph O'Brien

Overview for the Day

Aeronautics Challenge!

Kahoot!

Let's Talk STEM!

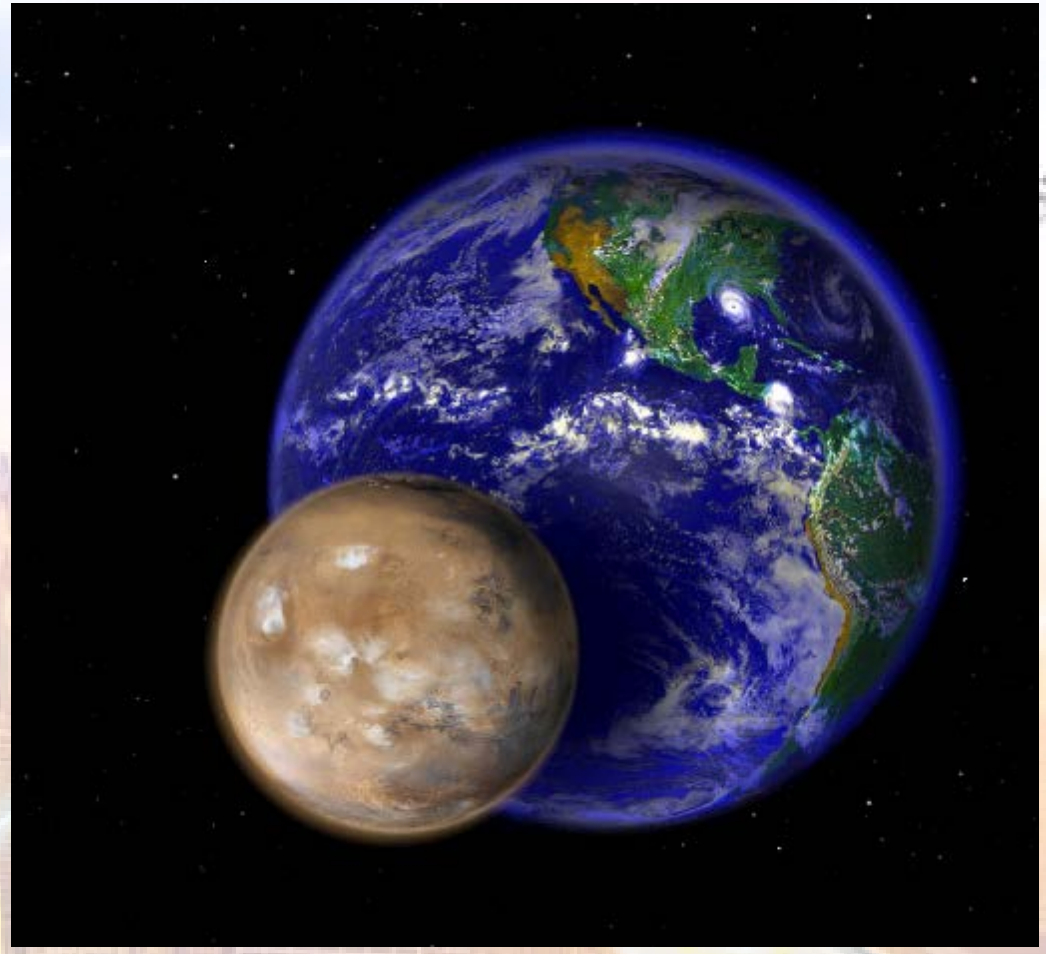
INSPIRE - ENGAGE - EDUCATE - EMPLOY

The Next Generation of Explorers

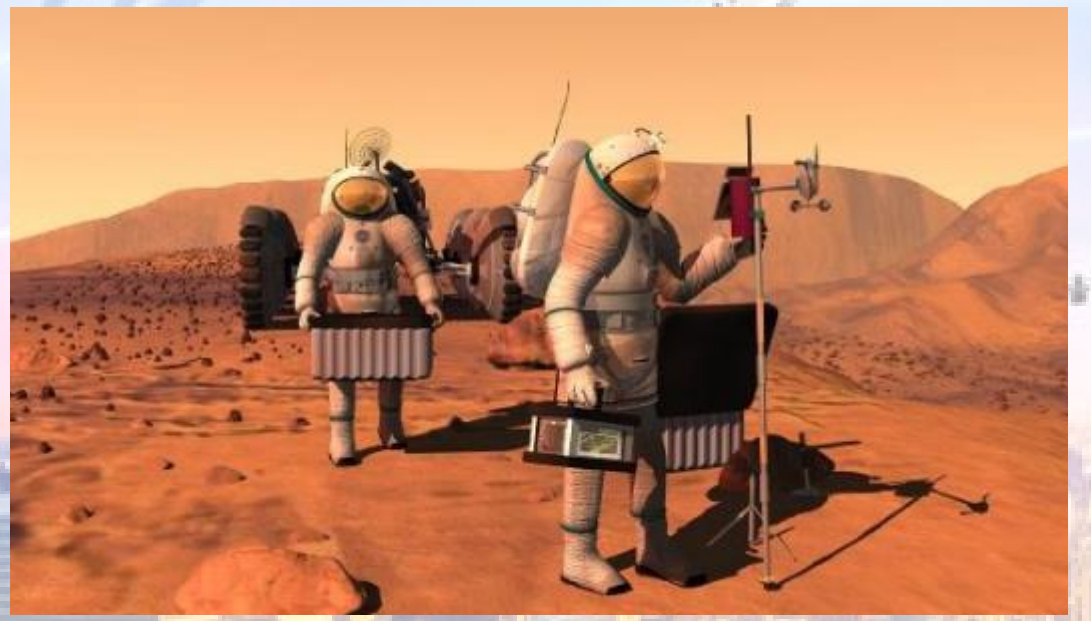
Build Your Own Mars Helicopter

Going to Mars: Understanding Martian Environment and the Possibility of Flight

- Beyond Earth, Mars is one of the only places in the solar system where humans could one day live.
- In size, Mars is about half the diameter of Earth
- Mars' surface area is equal to about 1/3 the surface of Earth.
  - Which is about the total area of Earth's continents.
  - That's a lot of territory!



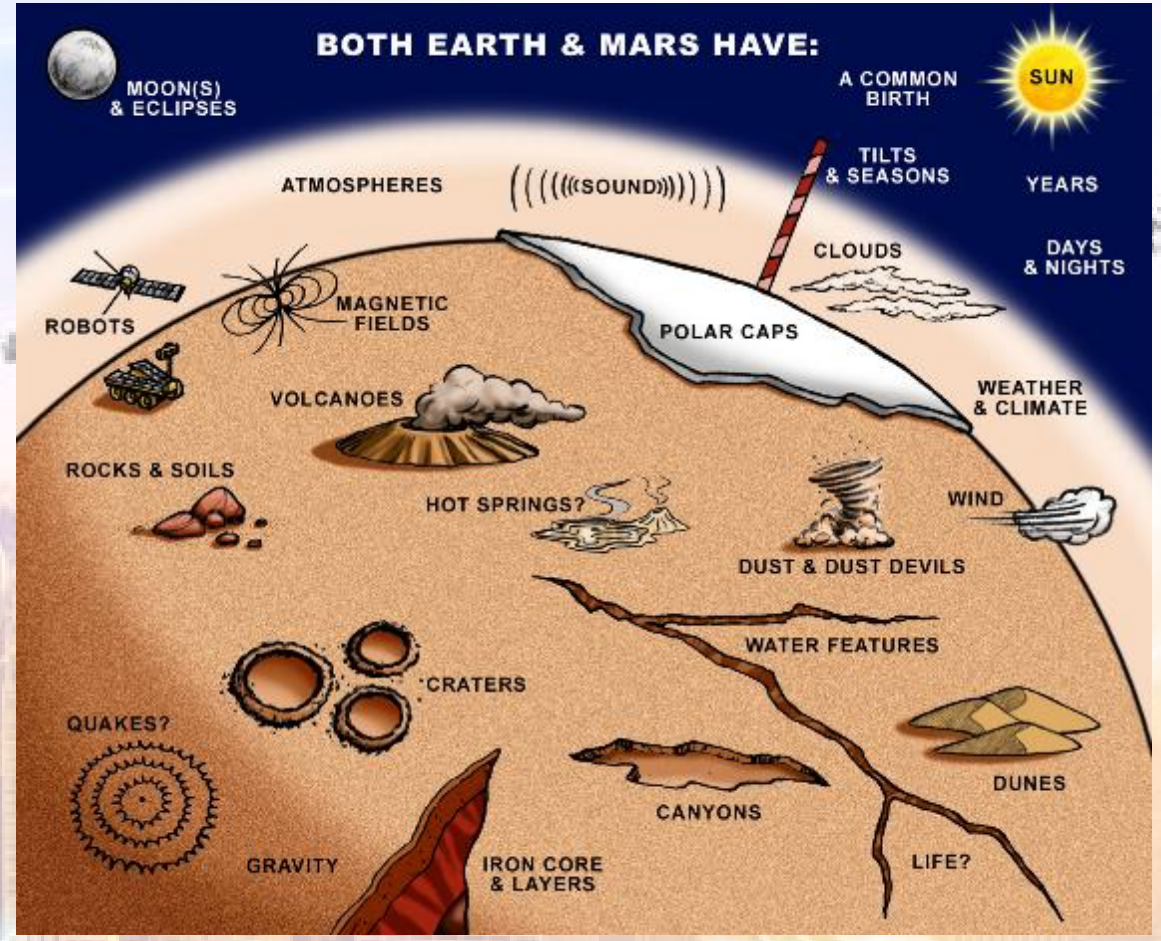
Going to Mars: Understanding Martian Environment and the Possibility of Flight



- The thin atmosphere means the surface pressure on Mars is 1% of Earth.
- No space suit = no breathable air

Going to Mars: Understanding Martian Environment and the Possibility of Flight

- Scientists and engineers from all over the world have discovered many environmental and other similarities between Earth and Mars.



Rovers on Mars

Over the years, NASA has sent five robotic vehicles, called rovers, to Mars.

NASA's five Mars rovers are named:

- Sojourner
- Spirit
- Opportunity
- Curiosity
- Perseverance

Pictured above is Perseverance

Did You Know?

- NASA's Perseverance Mars rover carried the first aircraft, Ingenuity, to the surface of Mars!

- The helicopter got its name, Ingenuity, from a high school student who entered the name in NASA's 'Name the Rover' essay contest.

Anatomy of Ingenuity

ANTENNAS

Radio antennas talk to Earth via the Mars 2020 rover and the Mars orbiters.

BLADES

Made of carbon fiber foam core provide lift in the thin Mars atmosphere.

SOLAR PANEL

A solar panel helps keep the battery charged.

BATTERIES

Batteries help power the helicopter.

AVIONICS & BODY

Its avionics — or "brains" — help the helicopter function and navigate. The body has insulation and heaters to keep sensitive electronics warm and survive cold Martian nights.

LEGS

Ultra-light legs made of carbon fiber tubes help it land after flight.

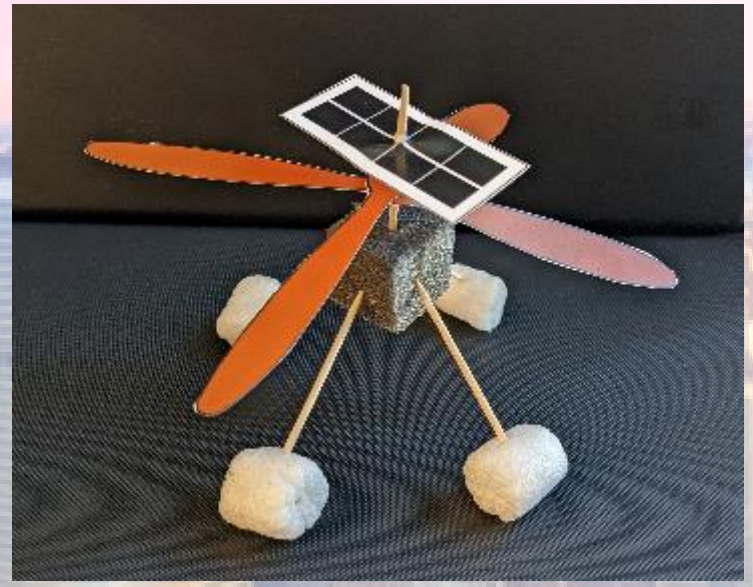
SENSORS & CAMERAS

Sensors collect data on how fast the helicopter is traveling and in which direction. Cameras help the helicopter see.

Build Your Own Mars Helicopter

What You'll Need:

- 1 large Styrofoam block
- 4 small Styrofoam blocks
- 5 toothpicks
- Cardstock with rotor and solar panel
- Scissors



How You Do It:

1. Take the Large Styrofoam block and insert 4 toothpicks into the Styrofoam block so they come out at angles as shown below.
2. Place a small Styrofoam at the end of each of the four toothpicks.
3. Using scissors, cut out **one set** of the two rotor blades and solar panel.
4. Carefully poke a small hole in the middle of each of the rotor blades and solar panel.
5. Push the remaining toothpick through the hole in the center of the rotor blade about 3/4 of an inch from the end of the toothpick.
6. Push the toothpick through the hole of the second rotor blade, leaving about 1/8 of an inch, and adjust the blades so that they are aligned in different directions.
7. Push the end of the toothpick through the center of the solar pane. There should be about 1/4 of an inch of the toothpick sticking out from the top of the solar panel.
8. Push the end of the toothpick furthest from the solar panel through the center of the top of the large Styrofoam.

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!

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
  - christina.l.cheung@nasa.gov
  - ARC-Aero-Fair@mail.nasa.gov