



# STEM AERONAUTICS

Resources





# Aeronautics SCIENCE Resources

## Where in the Air?

<https://www.nasa.gov/aeroresearch/stem/where-in-the-air-activities>

Students will learn about the layers of Earth's atmosphere and what flies or can be found in each layer. This activity is great for individuals or groups.

## Science Behind Quadcopters

**Teacher's Guide:**  
[https://www.nasa.gov/sites/default/files/atoms/files/aam-science-behind-quadcopters-educator-guide\\_1.pdf](https://www.nasa.gov/sites/default/files/atoms/files/aam-science-behind-quadcopters-educator-guide_1.pdf)

**Student's Guide:**  
[https://www.nasa.gov/sites/default/files/atoms/files/aam-science-behind-quadcopters-student-guide\\_1.pdf](https://www.nasa.gov/sites/default/files/atoms/files/aam-science-behind-quadcopters-student-guide_1.pdf)

Did you ever wonder how a quadcopter-type drone can move in all different directions using only propellers that face in the same direction? This activity will teach you how it is done!

## Seeing Sound

[https://www.nasa.gov/sites/default/files/atoms/files/seeing\\_sound\\_k-8-v2\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/seeing_sound_k-8-v2_0.pdf)

We often teach about sound being made of waves, but students have a hard time envisioning this. This activity makes it possible for students to actually visualize sound waves in motion.

## Four Forces

[https://www.nasa.gov/sites/default/files/atoms/files/four\\_forces\\_5\\_8.pdf](https://www.nasa.gov/sites/default/files/atoms/files/four_forces_5_8.pdf)

Flight may seem magical to some students, but most students can understand the science behind flight. This activity introduces students to the basic forces involved in flight.

## Aeronautics for Introductory Physics

<https://www.nasa.gov/aeroresearch/resources/k-12/introductory-physics>

This textbook style resource contains a wealth of information for high schoolers learning about physics.

## Fan-tastic Forces

<https://www.nasa.gov/sites/default/files/atoms/files/stem-ed-resources/fan-tastic-forces.html>

In this activity, students experiment with different shapes to see how much drag they create in a wind stream.

## Bernoulli's Principle

[https://www.nasa.gov/sites/default/files/atoms/files/bernoullis\\_principle\\_k-4-02-09-17-508.pdf](https://www.nasa.gov/sites/default/files/atoms/files/bernoullis_principle_k-4-02-09-17-508.pdf)

Bernoulli's principle is an extremely important concept in flight (as well as other applications). The activities in this lesson allow students to see this principle in action while learning more about it.

## DID YOU KNOW?

### X-59



NASA's X-59 will be a supersonic plane that doesn't produce a loud sonic boom. Instead, it will create a series of quieter sonic "thumps." It's intended to prove that using scientific principles, quiet supersonic flight is possible.



# Aeronautics

# TECHNOLOGY

Resources

## Package Delivery Drone Simulation

[https://www.nasa.gov/sites/default/files/atoms/files/aam-package-delivery-drone-simulation-activity-guide\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/aam-package-delivery-drone-simulation-activity-guide_0.pdf)

In this Scratch coding activity, students program the flight path of a delivery drone so that it avoids geofenced areas.

## Video: X-59 and How Sound Travels

<https://www.youtube.com/watch?v=IRUoL4SBljM>

This engaging video talks about how sound travels and how NASA engineers use this information when designing airplanes.

## Aeronautics AR

### Apple Version:

<https://apps.apple.com/us/app/aeronautics-ar/id1473958826>

### Android Version:

<https://play.google.com/store/apps/details?id=com.aeronauticsar.nasa>

This augmented reality (AR) app is available for either Apple or Android devices and allows you to view some of NASA's X-planes in the area around you.

## Make Your Own Battery

[https://www.nasa.gov/sites/default/files/atoms/files/power\\_it\\_up.pdf](https://www.nasa.gov/sites/default/files/atoms/files/power_it_up.pdf)

This activity guides students through the process of creating a working battery using common household resources.

## Video: NASA Mars Helicopter Technology Demonstration

<https://www.youtube.com/watch?v=oOMQOqKRWjU>

This video discusses some of the technology used on NASA's Mars Perseverance, the first helicopter to fly on another planet.

## Attack of the Drones – Coding Activity

[https://www.nasa.gov/sites/default/files/atoms/files/aam-attack-of-the-drones-coding-activity-guide\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/aam-attack-of-the-drones-coding-activity-guide_0.pdf)

This activity takes students through the process of coding a side scrolling game before challenging them to add to it.

## Light-Up Paper Helicopter

<https://www.nasa.gov/sites/default/files/atoms/files/x-57-maxwell-circuits-student-activities.pdf>

Teach students about simple circuitry as they build a paper circuit on a paper helicopter template.

## Mars Perseverance Parachute Coding Activity

<https://www.nasa.gov/aeroresearch/stem/mars-perseverance-parachute-coding-activity>

In this activity, you will learn how JPL engineers used a binary code to include a hidden message in the parachute used to help the Mars rover, Perseverance, land successfully on Mars.

## DID YOU KNOW?

### X-57



NASA's X-57 is an airplane powered completely by batteries. The technologies and verification and testing processes used for this plane will be instrumental in creating future aircraft that are environmentally friendly.



# Aeronautics

# ENGINEERING

Resources

## Circuits Activity

<https://www.nasa.gov/sites/default/files/atoms/files/x-57-maxwell-circuits-student-activities.pdf>

Students learn about basic circuits while creating a paper helicopter that lights up.

## X-Plane Glider Design Challenge

<https://www.nasa.gov/stem-ed-resources/x-plane-glider-design-challenge.html>

Students use household items and apply the engineering design process to create X-plane gliders that can fly at least 3 meters and must remain intact when landing.

## Air Taxi Design Challenge

### Educator Guide:

[https://www.nasa.gov/sites/default/files/atoms/files/aam-air-taxi-design-challenge-educator-guide\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/aam-air-taxi-design-challenge-educator-guide_0.pdf)

### Student Guide:

[https://www.nasa.gov/sites/default/files/atoms/files/aam-air-taxi-design-challenge-student-guide\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/aam-air-taxi-design-challenge-student-guide_0.pdf)

Students learn about futuristic air taxis, come up with a design for an air taxi, and then make a model of their design.

## Explore Flight – Wind Tunnels

### Educator Guide:

<https://www.nasa.gov/sites/default/files/atoms/files/wind-tunnels-educator-guide-v2.pdf>

### Student Guide:

<https://www.nasa.gov/sites/default/files/atoms/files/wind-tunnels-student-guide-v2.pdf>

Students use an easy-to-build wind tunnel to test the performance of a plane they design.

## Video: Sonic Booms and the X-59

<https://www.youtube.com/watch?v=OmXdeov-nYo>

In this video, you can learn how NASA engineers are working on a quiet supersonic airplane.

## Drag and Aircraft Design

<https://www.nasa.gov/sites/default/files/atoms/files/drag-and-aircraft-design-lesson-sm.pdf>

Through a series of simple hands-on activities, students learn about engineering design, drag and why these are important to aeronautical engineers.

## Make an Aeolipile (Hero Engine)

[https://www.nasa.gov/sites/default/files/atoms/files/make\\_an\\_aeolipile.pdf](https://www.nasa.gov/sites/default/files/atoms/files/make_an_aeolipile.pdf)

In this activity, you will explore how thrust is produced by creating a Hero Engine.

## Make Your Own X-59

[https://www.nasa.gov/sites/default/files/atoms/files/make\\_your\\_own\\_x-59\\_directions.pdf](https://www.nasa.gov/sites/default/files/atoms/files/make_your_own_x-59_directions.pdf)

Students construct a paper airplane version of the X-59.

## DID YOU KNOW?

### TTBW



The Transonic Truss-Braced Wing (TTBW) aircraft will be a full-scale technology demonstrator X-plane used to test new green technologies and solve the challenges of integrating those technologies to prove their benefits in flight.



# Aeronautics MATH Resources

## Flight Control Math

Links for all the Flight Control Math Lessons can be found at:

<https://www.nasa.gov/aeroresearch/stem/AAM>

This series of lessons use advanced air mobility (AAM) to have students complete a series of math exercises.

- Flight Control Math 1 (Graphing)
- Flight Control Math 2 (Using the Distance Formula)
- Flight Control Math 3 (Using the Distance and Speed Formulas)
- Flight Control Math 4 (Using the Pythagorean Theorem)
- Flight Control Math 5 (Finding the Equation of a Line and the Point of Intersection for Two Lines)

## Sonic Boom Flight Recommendations

### Educator Guide:

<https://www.nasa.gov/sites/default/files/atoms/files/x-59-performance-assessmen-educator.pdf>

### Student's Guide:

<https://www.nasa.gov/sites/default/files/atoms/files/supersonic-flight-recommendations.pdf>

### Data File:

<https://www.nasa.gov/sites/default/files/atoms/files/supersonic aircraft data file.xlsx>

Students use authentic data to determine how airplanes react at different speeds.

## Mystery Picture Graphing Activities

[https://www.nasa.gov/sites/default/files/atoms/files/seeing\\_sound\\_k-8-v2\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/seeing_sound_k-8-v2_0.pdf)

Reveal the mystery aircraft by plotting points on an x-y graph and then connecting the dots.

## Noise – Speed of Sound

[https://www.nasa.gov/sites/default/files/atoms/files/speed\\_of\\_sound\\_9-12.pdf](https://www.nasa.gov/sites/default/files/atoms/files/speed_of_sound_9-12.pdf)

This activity, which is designed for high schoolers, allows students to collect data and calculate the speed of sound.

## Smart Skies – LineUp With Math

<https://smartskies.nasa.gov/lineup/index.html>

Problem sets and hands-on math activities teach students about distance, rate, and time through the lens of air traffic control.

## Living in the Age of Airplanes Educator Guide

<https://www.nasa.gov/sites/default/files/files/Living-in-the-age-of-airplanes-resource-guide.pdf>

To accompany the documentary Living in the Age of Airplanes, four algebra and geometry activities use flight paths, flying and walking speed, and air traffic control to engage students in real-world math problems.

## DID YOU KNOW?

### Advanced Air Mobility



The vision of AAM is that of a safe, accessible, automated, and affordable air transportation system for people and cargo capable of serving previously hard-to-reach urban and rural locations, using revolutionary new aircraft only now becoming possible.