

## EDUCATOR'S GUIDE

# Four Forces of Flight

## Preparation

### Overview and Objectives

This lesson is geared toward adults.

Participants will understand the four forces of flight and their effect on aircraft and spacecraft. Engineers must consider the four forces when they are designing flying vehicles. Participants will investigate each force before building their own paper airplanes.

This lesson includes a [slideshow](#) in which an instructor can lead participants through the various forces of flight and movements of an airplane.

### Instructional Modalities

This activity was designed for both synchronous or asynchronous instruction.

For **synchronous instruction**, we recommend a platform that allows both for whole group discussion and participants to interact in small groups.

For **asynchronous adaptations**, we provide suggestions facilitators to provide additional support for the activities and for participants to share their work with each other.

### Materials

- [Four Forces of Flight Slideshow](#)
- [Paper airplane visual instructions](#)
- Paper

## Lesson

### 1. Introductory Activity

- Participants will watch three-minute video of the four forces of flight and answer these questions:

### Additional Resources

<https://www.grc.nasa.gov/www/k-12/UEET/StudentSite/dynamicsofflight.html>

<https://howthingsfly.si.edu/flight-dynamics/control-surfaces>

- **What are the four forces of flight?**
- **How do the forces of flight act on a moving object?**
- Ask participants to list design features that help aircraft and spacecraft fly.
- Discuss the responses with the group:
  - **Which of the forces of flight are natural? Which are artificial?**
  - **How is thrust created in aircraft and spacecraft?**
  - **How does an airfoil create lift?**
- Share slides with participants. Encourage them to answer the following:
  - **How do the airplane's stabilizers interact with the forces of flight?**
  - **How does an aircraft's design help it take advantage of the forces of flight?**

## 2. Core Activity

- Participants will explore each of the four forces of flight. Discuss the following questions about each force.

Gravity:

- **Why is it important to know the force of gravity on aircraft and spacecraft?**
- **What effect does the weight of an aircraft have on its design?**

Lift:

- **Where did engineers get the idea for the shape of an airfoil?**
- **Why might there be different shapes of airfoils?**
- **What relationship does Bernoulli's Principle define?**

Drag:

- **When is drag harmful? When is it helpful?**
- **How are each type of drag different?**

Thrust:

- **Where else does Newton's Third Law show up in everyday life?**
- **What creates thrust in the cars that you drive? What about bicycles and scooters?**

### 3. Wrap Up

- Have participants create their own paper airplanes, using the [visual instructions](#). Test airplanes and adjust design until you are happy with it.
  - **How do paper airplanes exemplify the four forces of flight?**
  - **How are thrust and lift created in a paper airplane?**

## Asynchronous Adaptation

Have participants go through the [slideshow](#) on their own and respond to the questions about each force. They will then create a paper airplane using the [visual instructions](#).

## Extension Activities

To deepen student engagement with this content, you may choose to add the following activities :

### **Intrepid Aircraft**

Have participants examine the [aircraft in the Intrepid's collection](#) and discuss the impact of the four forces of flight on each one.

## Additional Resources/ References

### **Background Information on**

Bernoulli's Principle:

[https://www.nasa.gov/sites/default/files/atoms/files/bernoulli\\_principle\\_k-4.pdf](https://www.nasa.gov/sites/default/files/atoms/files/bernoulli_principle_k-4.pdf)

**The Museum is deeply grateful to the funders that make our education programs possible:**



*This project was made possible in part by the  
Institute of Museum and Library Services, Award ID:  
CAGML-247144-OMLS-20*