

EDUCATOR'S GUIDE

Airheads: Generating Lift

Preparation

Overview and Objectives

This lesson is geared toward families.

Participants will learn about how airflow can generate the force of lift that helps things to fly and why it is so important for the aircraft on board the *USS Intrepid*.

This lesson includes a [slideshow](#) in which an instructor can lead participants through various activities.

Standards

Common Core Anchor Standards

CCSS.ELA-LITERACY.CCRA.R.7

National Core Arts Standards

Creating Anchor Standard #1

Methods of Instruction

This activity was designed for both small groups in a public setting such as a library or community center, as well as in a private home in a family setting.

For **Public Settings**, we recommend a space that allows both for whole group discussion and for participants to interact in small groups with enough space to launch their magnus glider (see core activity below) .

For **Home Settings**, we recommend one adult member control the presentation and guide participants through the lesson providing support where necessary while allowing for participants to share their work with each other and full group discussion.

Materials

- Airheads: [Generating Lift slideshow](#)
- [Magnus Gliders Visual Instructions](#)

Lesson**• Introduction**

- Participants will go through the [slideshow](#) and answer these questions:
 - **What is the force of lift?**
 - **How does airflow generate lift?**
 - **What are some different ways of generating lift?**
- Begin the lesson by using the slideshow to introduce how airflow can produce lift and make things fly. This is something physicists and engineers are still exploring today. There are different ways of manipulating airflow to produce lift.
- Briefly introduce Daniel Bernoulli and try the paper activity. Then participants will see how generating lift is important in order for the aircraft that served aboard Intrepid to operate and perform their missions. End by having participants make and test their magnus glider.
- Guiding questions
 - **Why do aircraft need to produce lift in order to fly?**
 - **What are some different ways of generating lift?**
- Discuss the responses with the group:
 - **How do you think lift was generated by the different aircraft on Intrepid?**
 - **Imagine you are an aircraft. How would you generate lift?**
- Participants may bring up or ask how birds fly
 - **How do birds generate lift?**

• Core Activity

- Share [Airheads video](#) for discussion on lift and demonstration of the magnus effect. Explain to participants that they will be making a magnus glider. The magnus glider takes advantage of the magnus effect to generate lift. It is named after Heinrich Gustav Magnus, the German physicist who investigated it. The magnus glider is an excellent example of Isaac Newton's 3rd law of motion: For every action (force) in nature there is an equal and opposite reaction. The magnus glider also acts similarly to an airfoil, although it is not an airfoil.
- How does it work?
 - Your magnus glider is launched with a backspin. When spinning, some of the air it is traveling through will stick to the surface of the glider and be forced downward behind the glider therefore making the glider go up, briefly gaining lift. The faster your glider

spins, the more lift it will generate and the longer it can resist the downward pull of gravity.

- Have participants create a Magnus Glider by using the [visual instructions](#). We can use all of these concepts to make some pretty weird and unconventional things fly by taking advantage of the way air moves. Look at these Styrofoam cups. Do they look like wings? Of course they don't, but we can generate lift on them by making them move in a special way through the air.
 - **What causes the glider to work this way?**
- The cups glide down to the ground because the backwards spin produces lift. This spin will direct air flowing over the top of the cups to turn down, producing an upward lift force. This is the same reason why athletes put spin on the ball used in sport. It can create a force that will make them go farther, longer, or change direction in the air.

Extension Activities

Have participants create variations to their magnus gliders by adding cups, creating a glider out of cups with different materials, or adding rubber bands to their rubber band change. How does it compare? What makes it glide similarly or differently?

Additional Resources/ References

Bernoulli and Newton:

<https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/bernoulli-and-newton/>

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MAGNUS GLIDER VISUAL INSTRUCTIONS

Materials: What you need

- 2 – 12 oz. Styrofoam cups (note, the cups in the picture are paper. Styrofoam is recommended)
- 4 – Rubber bands, #19
- Masking Tape



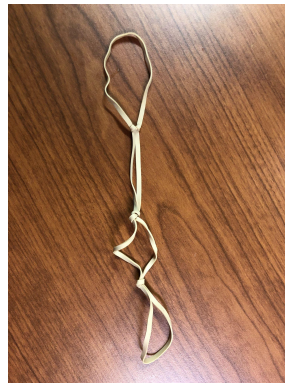
Step 1: Build the glider

- Tape the bottoms of the cups together so that the open mouths face away from each other.
- Make sure the cup bottoms line up evenly with each other. Use several wraps of tape.



Step 2: Make a rubber band chain

- Take two rubber bands and loop one around the edge of a second, then back through itself.
- Pull to make the knot tight. Repeat to connect the other bands to the chain.



Step 3: Wrap the rubber band

- Use your thumb to hold one end of the chain in the center of the cups.
- Stretching the rubber bands, but not so tight they damage the cups, wrap the chain around the taped part of the cups while holding onto the end of the chain.
- Once almost completely wrapped, hook the other end of the chain over your other thumb so that the chain is coming out under the cups.

**Step 4:** The launch

- To launch, hold the hand with the cups behind the other hand. Make sure the rubber band chain is coming out under the cups.
- Aim your forward hand up in the air, pull the cups back (unwind a little if needed) and let go of the cups.
- It won't fly high, but rather glide gently to the ground. It is especially cool if you do it at the top of the stairs or off a balcony!

**Variations:** Try the following changes and compare your results

- Try creating a magnus glider with four cups instead of two
- Try different size cups
- Try longer or shorter rubber band chains
- Try different types of cups (paper, plastic, etc.)