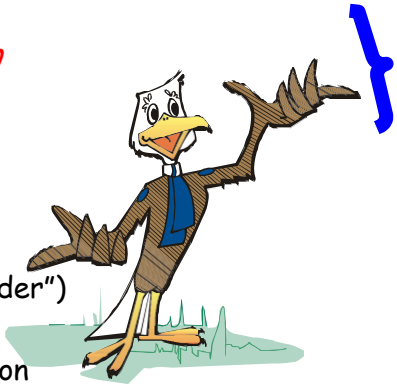
Civil Air Patrol's ACE Program



"Eggs"perimental Glider
Grade 3 Academic Lesson #3

Topic: flight (science)
(Adapted from AMA's "Priceless Fun Styrofoam® Egg Carton Glider")

Lesson Reference: Paul Billings, author of the Priceless Fun lesson courtesy of Academy of Model Aeronautics (AMA) at
"Egg Carton Glider"
"Priceless Fun Styrofoam Egg Carton Gliders" (This activity and pictures are printed here with permission.)

Length of Lesson: 45 minutes

Objectives:

- Students will build gliders.
- Students will make predictions and draw conclusions.
- Students will verbally describe the flight of their gliders.
- Students will measure and chart the distance the glider flies in different environments (inside hallway, outside), and work to predict how the environment affects the future motion of the glider.
- Students will determine the reason for weight on aircraft.

Next Generation Science Standard:

- 3-PS2-2-Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

CCSS ELA:

- RI.3.1-Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- RI.3.3-Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
- RI.3.4-Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.
- RI.3.7-Use information gained from illustrations (e.g., maps, photographs), and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- RI.3.9-Compare and contrast the most important points and key details presented in two texts on the same topic.
- RI.3.10-By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2-3 text complexity band independently and proficiently.

Background Information: (from NASA: Gliders and CAP's *Aerospace for the Very Young*)

A glider is a special kind of aircraft that has no engine. Paper airplanes are the most obvious example, but gliders come in a wide range of sizes. Toy gliders, made of balsa wood or Styrofoam, are an excellent way for students to study the basics of aerodynamics. Hang-gliders are piloted aircraft that are launched by leaping off the side of a hill. The Wright brothers perfected the design of the first airplane and gained piloting experience through a series of glider flights from 1900 to 1903. More sophisticated gliders are launched by ground-based catapults.
or are towed aloft by a powered aircraft, then cut free to glide for hours over many miles. The Space Shuttle flew as a glider during reentry and landing; the rocket engines were used only during liftoff.

How do gliders stay aloft for hours if they constantly descend? The answer is that they are designed to be very efficient, to descend very slowly. If the pilot can locate a pocket of air that is rising faster than the glider is descending, the glider can actually gain altitude, increasing its potential energy. Pockets of rising air are called updrafts. Updrafts are found when a wind blowing at a hill or mountain has to rise to climb over it. Updrafts can also be found over dark landmasses that absorb heat from the sun. The heat from the ground warms the surrounding air, which causes the air to rise. Rising pockets of hot air are called thermals. Large gliding birds, such as owls and hawks, are often seen circling inside a thermal to gain altitude without flapping their wings. Gliders do exactly the same thing.

You may wish to share this background video with your class: "Glider Planes For Kids."

Materials per student:

- 1 lid of a one-dozen-sized egg carton (top only)
- 1 penny
- 1 wing pattern (copy included)
- pen
- scissors
- tape or glue (optional)
- Teachers need a free account with Newsela.com in order to meet the ELA standards attached to this lesson. There are three Newsela articles that offer information on the Wright brothers and can be used as background building material or as an assessment at the end of the lesson.

"The Wright Brothers' Invention Process"
"Inventors and Scientists: The Wright Brothers"
"Time Machine (1908): Our aeroplane tests at Kitty Hawk"

NOTE: When you print the patterns, mark out "Location of Penny" for the purpose of this lesson. Also, if time is an issue, pre-cut wing patterns to save time.

Lesson Presentation:

1. Ask students if they know the difference between a glider and an airplane. Explain that a glider is something that flies, but has no power source, like an engine, to help keep it from falling toward the ground. Gravity causes it to glide back to earth.

   If the students participated in the "Bernoulli's Tongue" lesson, ask them if they remember what (or whose), principle helps explain how objects lift into the air. Remind them of the tongue they made that lifted into the air. The answer is Bernoulli's (burr new lee) principle. Ask students if anyone can explain what it means. (Simple answer: When air flows over a specially curved surface of an object, such as the wing of a plane, two forces lift the wing into the air. Air flowing underneath the wing creates a push, caused by high pressure. Air flowing over the top of the wing creates a pull caused by low pressure. Together these forces help the airplane sail through the air until gravity finally helps it land.) Tell students they will experiment with a glider today.

2. Ask students what they know about the Wright Brothers. Tell them that the brothers were from Ohio and were the first people to fly a heavier than air, power controlled machine. The brothers started with many ideas and experiments. One of their first designs was a 17–foot glider. The brothers took the glider to Kitty Hawk, NC hoping to gain flight experience, but (remember Bernoulli's principle), they couldn't generate the lift they needed.

   "The Road to the First Flight"

3. Tell students that you are going to give them a "lucky" penny to help them with today's glider experiment. (Either distribute pennies or have students take out their penny if they were asked to bring one from home.)

4. While one "lucky" penny is being placed on each student's desk, distribute the wing pattern, and instruct students to cut it out. (Make sure the pattern is not printed with "Location of Penny.")

5. Have students place the cut-out wing pattern inside the foam lid and trace it. (Students may want a partner to hold the pattern while they trace. Some may wish to have a piece of tape to help hold the pattern in place while tracing.)

6. Cut along the tracing on the foam egg carton lid.

7. Ask students to predict what will happen when they toss their glider forward.

8. Tell students that when you give the signal, they will gently toss their glider forward. Explain to them that you want them to observe, which means watch VERY closely, to see what happens when the glider gets tossed into the air. Tell students that they can continue to test-fly their glider until you turn the lights in the classroom on and off (or some other signal), to let them know they need to stop flying and hold onto their gliders. On your signal, instruct students to give their glider a test flight.

9. Give the signal for students to stop flying their gliders. Ask students to describe the flight of their gliders. (Possible answers include: bad, loops, flips, crashes, doesn't stay in air long, etc.)

10. Ask students to share ideas to help improve the flight of the glider. Possibly let them test some of their ideas as time permits.

11. Ask students how they might use their "lucky" flight penny to help them. Lead them to the idea that they should wedge the penny into the front part of indention in their glider (egg carton lid).

12. Have students repeat steps 7 and 8 with the penny placed in the front part of the indention in the egg carton lid. (Students may use tape or glue, if needed, to keep the penny in place.) Before they test fly again, tell them they have to be careful how they toss the glider. Tossing it too hard will not work.

13. Allow students a chance to experiment with flying the glider in different locations with and without the penny attached.

14. Ask students the following questions:
    - Why do you think the penny helped? Was it really because the penny was a "lucky" penny? (Explain that the penny added weight to the glider. For aircrafts and other flying objects to fly, more weight has to be toward the front to help it stay stable, or balanced, in the air.)
    - Once the weight was right, what helped the glider to stay airborne (in the air), for a little while? (Lift: caused by Bernoulli's principle – see step #1.)
    - What caused the glider to come back to the ground? (gravity)
    - Is there anything else you might try to help your glider either fly better or stay in the air longer? (Answers will vary.)

15. Have students read and answer questions from the Newsela article. Go over the passage vocabulary and the questions together. You will revisit this article during the summary portion of the lesson

Summarization:
Ask students to share their thoughts about today's lesson. Did they learn anything new? Did anything surprise them? Ask students how the penny affected the flight of the glider. Ask students what they learned about how different environments (inside, outside, wind), affected the flight of the glider. Did anyone's glider seem to fly better or worse than another? Any ideas why? Ask students how Bernoulli's principle is related to the Wright brothers' flight. Remind the students that fast moving air creates a low pressure system. When unequal forces are on the wings of a plane, the plane can stay in the air.

Character Connection: Ask students what would have happened if they had given up after their first test flights were not successful. Explain to students that when things don't work the way we expect, we should take time to think and decide if there is something different we can do to be successful. Even now, students can practice their tossing technique to see how they might improve their glider's performance. In real life, people tried lots of different things in order to fly. Designers and inventors learned from their mistakes and learned from other people as well. Eventually, people learned how to build planes and gliders. They didn't give up. Encourage students to keep trying, even when things are difficult. Encourage students to ask for help when they don't understand things. As people work as a team, many wonderful things can be accomplished.

Assessment:

- teacher observation
- construction of glider
- performance of glider
- Newsela articles
- anecdotal notes regarding student observations of the gliders

Additional activity ideas to enrich and extend the primary lesson (optional):

- Allow students to experiment with weight. Do two or more pennies work better than 1? What happens when weight is added to other parts of the glider?
- Have a contest to see whose glider can either stay in the air the longest or fly the farthest. Experiment with the height from which the glider starts (on the top of a hill or the top of a table).
- Allow students a chance to learn more about the Wright brothers. Allow them a chance to make a Powerpoint or other graphical representation outlining the Wright brothers timeline of flight.
- Allow students to design their own paper glider.

Associated Website:
Learn more about the Academy of Model Aeronautics.

This pattern is printable from "Priceless Fun Styrofoam Egg Carton Gliders". If you use the website, please read the “NOTE” section of this lesson plan.