



Curiosity Guide #508

Paper Airplanes

Accompanies Curious Crew, Season 5, Episode 8 (#508)

Glider Designs

Investigation #4

Description

Let's compare gliders!

Materials

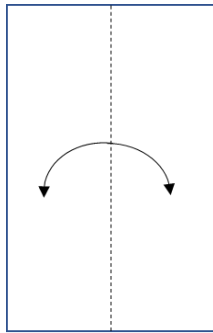
- <http://www.amazingpaperairplanes.com/Simple.html>
- <http://www.exploratorium.edu/exploring/paper/airplanes.html>
- 2 sheets of 8 and $\frac{1}{2}$ by 11-inch paper

Procedure 1: Explore making your own choice of glider

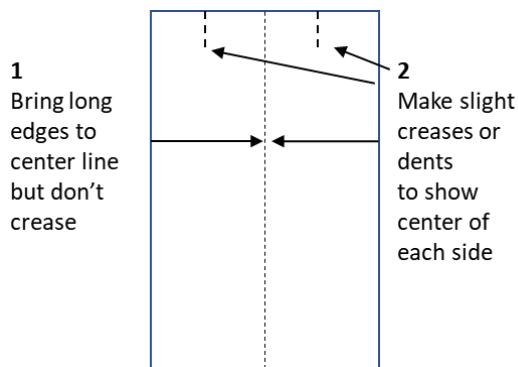
- 1) Use the links in the Materials section to select a glider template to fold.
- 2) Notice how many folds take place to increase the weight of the nose.
- 3) Try your glider out and record notes on how the glider flies. Here are some ideas:
 - a. Does your glider fly in a straight line?
 - b. How far does your glider fly?
- 4) You can adjust your glider for better performance. Open the second link listed in the Materials section and scroll down to the notes about "Trimming and Flying Your Plane." Try some of the ideas listed there.
- 5) Be sure to write down any adjustments you make and what happened when you tested your glider again.

Procedure 2: Build the glider that holds the longest flight record.

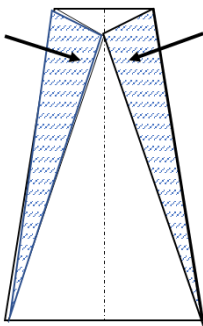
- 1) Fold the paper in half lengthwise. Crease the center fold. Then unfold the paper.



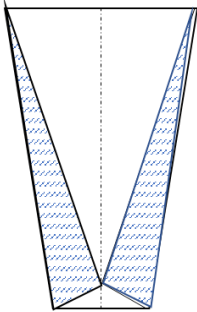
- 2) Bring each long side to the center fold to find the middle of each side. Press the top of the fold for a slight crease.



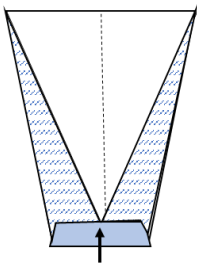
- 3) On each side, using the guide mark you just made, bring the top corner to the middle fold as shown so that the edge tapers to the bottom corner. Crease well.



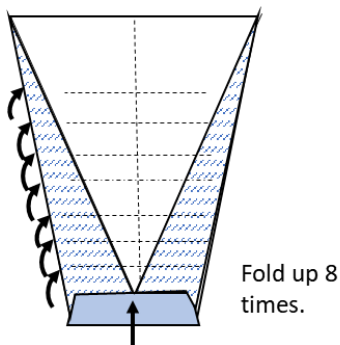
4) Rotate the paper so the small edge of the trapezoid is closest to you.



5) Fold up the edge so that the crease intersects with the points of the two folded flaps, about $\frac{3}{4}$ -inch from the small edge.

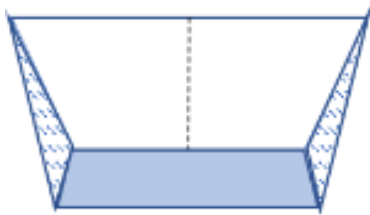


6) Continue to fold eight total times, creasing each fold well. Be careful that the top corner folds don't bubble.

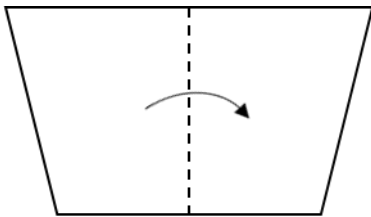


7) If the folds or edges do bubble, run your finger down the crease from each top corner under the folded strip, sharpening the fold.

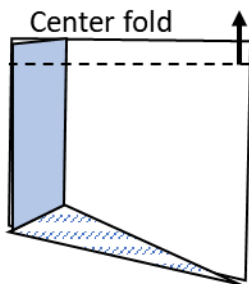
- 8) Continue folding until you have folded the short edge a total of 8 times. You may need to use a ruler or other folding tool to create crisp folds as the folded section gets thicker.



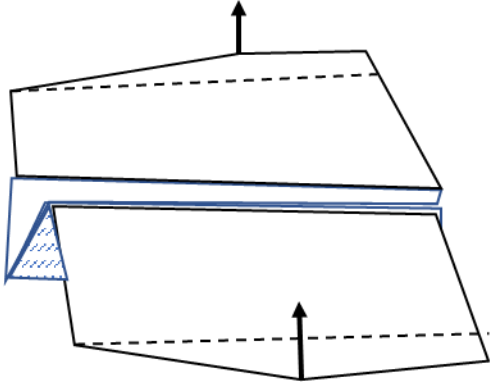
- 9) Turn the plane over. Fold the plane in half. The thick, folded part will be on the outside. Make a good crease, using a folding tool as needed.



- 10) Turn the plane so the thick fold is running along the left side. Fold the wing up on each side, leaving $\frac{1}{2}$ inch to hold and keeping the front edges perfectly in line.



12) Open the plane. Crease the side flaps on the wings so that the flaps face up and line up with the front and rear edges. These flaps will get bigger as the fold goes to the back of the plane.



13) Test this plane. Record your results and compare with the first plane you made.

My Results

Explanation

Good paper airplanes can better balance the opposing forces of thrust and drag, as well as gravity and lift. For planes to work well, the center of gravity on the plane needs to be in front of the upward center of lift force. The heavy nose will continue to move in a forward falling path, but the glider's wings provide enough upward push that the glider can glide on its way down. Ken Blackburn's glider design has a very heavy nose, with eight folds of paper bringing the center of gravity forward. As an expert thrower, he held the Guinness record for the longest time aloft of 27.6 seconds for a very long time.

Think about this! It's amazing to think that Ken Blackburn was able to keep his paper glider flying for 27.6 seconds! Ken knew how important the balance is between gravity and lift. Every object has a center of gravity. You can find a paper airplane's center of gravity by trying to balance the plane on one or two fingers. The center of lift is harder to find but try this test: turn on a fan while holding the plane's nose down. Slowly lift the plane up while sliding your fingers forward or back to find the spot where the plane will be held stable in the wind. It's great if that point is behind the center of gravity, and, if not, you might need to add some more weight to the nose. Now let's go for a record!

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