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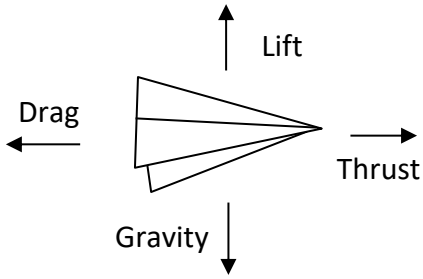
DIY Library Program

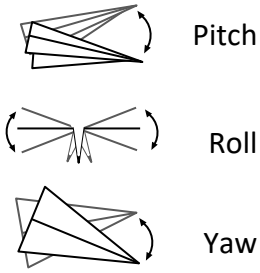
PAPER AIRPLANES
LEARNING TO FLY

Recommended for Ages 8 and up

What makes an airplane fly? It's a balance between thrust, drag, lift, and gravity.



Thrust is the forward motion of the plane. In the case of paper airplanes, thrust comes from your arm when you throw the plane. Drag slows the plane down and comes from friction between the air and the plane. Lift is the force that keeps the plane elevated, while gravity pulls the plane down. Keeping a plane in the air is a matter of keeping all of these elements balanced. These same four principles apply to jetliners as much as they do to paper airplanes.



Stability in a paper airplane means that the plane flies straight and steady, rather than tilting, diving, or veering. These types of rotations are called pitch, roll, and yaw. Pitch refers to the angle of the nose (up or down), while roll refers to the level across the wings, and yaw refers to a side to side motion (whether the nose of the plane is facing forward or to the right or left).

The design and launch of your paper plane will determine how the plane flies. Even with a finished plane, you can adjust its flight by tweaking the plane or changing the way you throw it. If your plane spins or turns upside down, you might want to adjust the roll by checking to see how symmetrical the level of the wings is when you look at the plane straight on. If your plane takes a nosedive, you can try curling the backs of the wings to add extra lift. A subtle adjustment can make a difference, so make small tweaks first and build on those. Experiment with your plane, try throwing it gently and strongly, angling it up, straight and to the side. Try curling the wings or changing the angle of the wings. See what happens!

Before you start, beware of a few things:

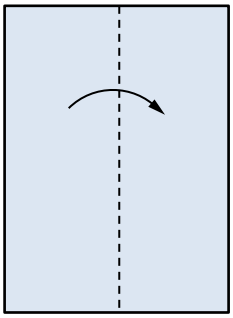
- Be careful when throwing. Some planes have sharp noses and could do some damage if they fly into someone's face or eyes. Warn people that are nearby before you throw. You could even fold the tip a bit so it's not so dangerous.

- Wind can have a serious impact on your paper airplane. If you want to fly your plane outside and it's windy, you may want to wait for another time. If there's a breeze, try to position yourself with your back toward the wind so that the breeze will help your plane instead of hindering it. Go with the flow, and not against it!
- Last but not least, be precise when folding. Make sharp creases (try using your fingernail). Every detail counts, and the more precise you can be, the better your plane will fly.

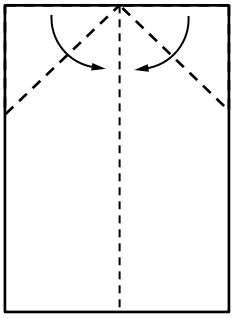
Activity: Make and Tweak a Classic Dart Plane

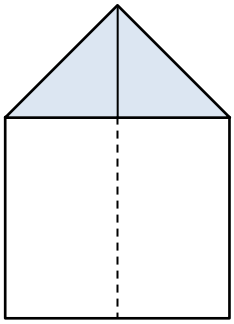
Materials: 1 sheet of 8.5" x 11" paper (or A4 size, 210 × 297 millimeters)

1. Fold the sheet long edge to long edge. Crease and unfold.

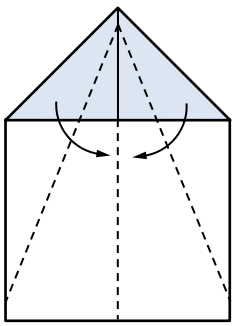


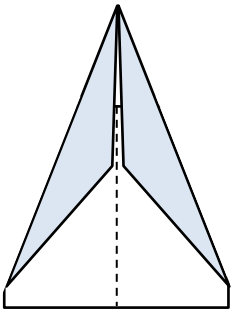
2. Flip the paper over. Fold the upper corners to the center crease so that the top edges of the paper follow the center crease.



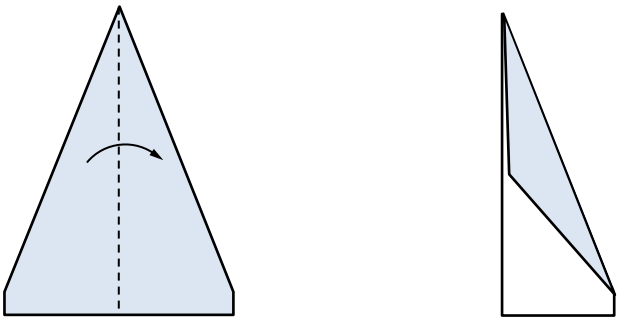


3. Fold the newly folded upper edges to the center crease.

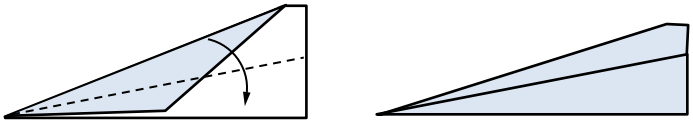




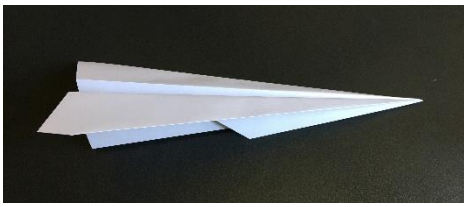
4. Flip over, and fold in half along the center crease.



5. Rotate so that the creased center faces down. Fold the upper creased wing down so that it lies along the folded center of the plane.



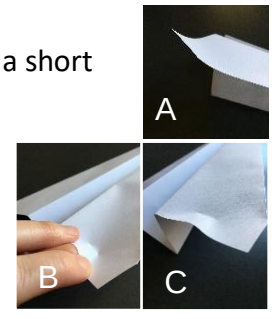
6. Repeat on the other side.



Challenge: How can you change the flight of your plane?

Try the following tweaks individually or in combination to see how the flight is affected:

- Throw the plane hard and then throw it softly. Try a quick flick, and try using your whole arm, as if you were throwing a football or a javelin.
- Launch the plane from different angles (pointing up, pointing straight, turn it to the side)
- Curl the back corners of the wings (trailing edges) up. (Figure A)
- Create elevators on the back edges of the wings by pinching them so a short section is moved up. (Figures B & C)
- Change the dihedral angle (the angle of the wings when looking at the plane straight on). Try these three different angles:



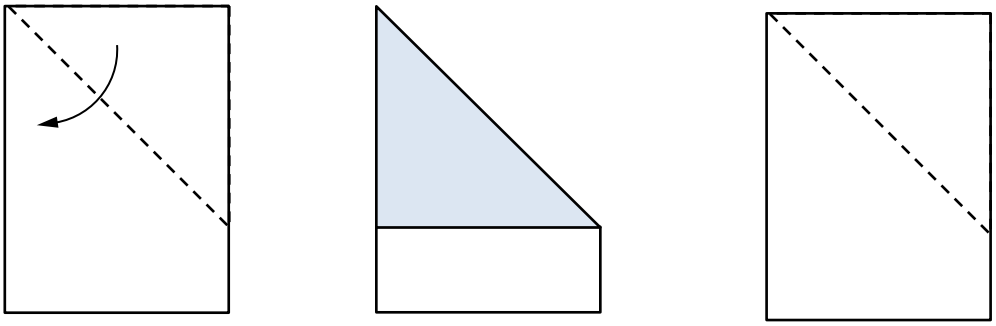
How did the flight of the plane change?

Activity: Make the World Record Paper Airplane

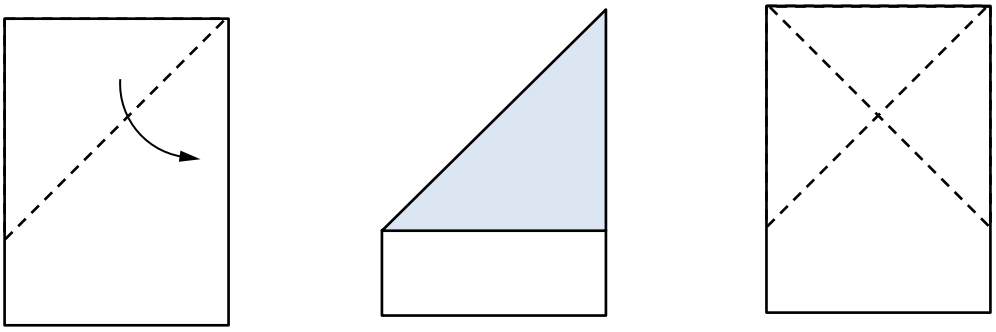
On February 26, 2012, John Collins, with the help of quarterback Joe Ayoob's arm, broke the world record for the longest paper airplane flight. The plane he designed flew 226 feet and 10 inches. This is how to make that airplane. You can also watch John Collins provide folding instructions on YouTube: https://youtu.be/EDiC9iMcWTc.

Materials: 1 sheet of 8.5" x 11" paper

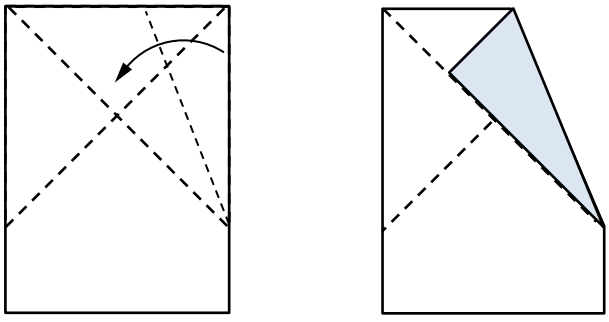
1. Fold the right corner to the left side so that the top edge aligns with the left edge. Unfold.



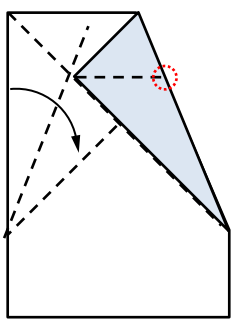
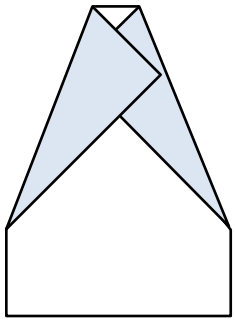
2. Repeat on the opposite side, so that the top edge aligns with the right edge. Unfold.



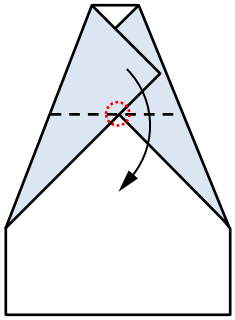
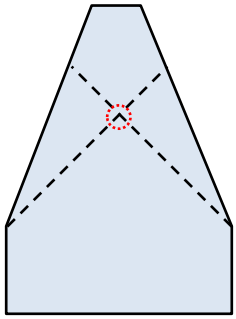
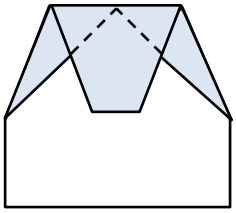
3. Fold the right edge so that it aligns with the nearest crease.



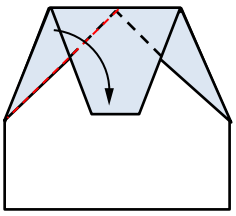
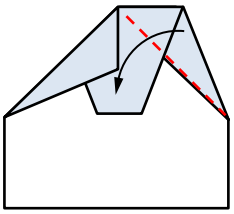
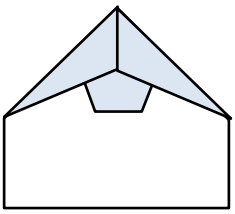
4. Repeat on the left side: fold so that the left edge aligns with the nearest crease.
   Tip: Since some of the crease is hidden, you can use where the crease and the fold intersect as a guide, as circled below.

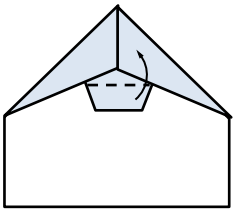
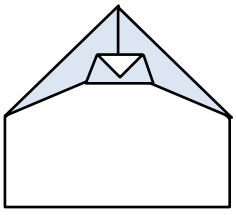
5. Fold the top partway down the paper. This new fold should cut across the center of the X fold created in steps 1 and 2. The X is fully visible on the reverse side of the plane. Once folded, part of that X should align with the folded edges on the front side.

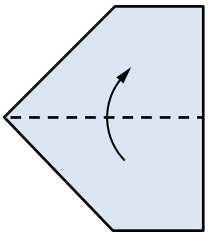
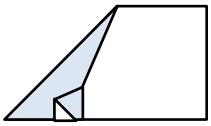
6. Fold the top corners to the center by folding along the upside-down V shaped lines created by the edges of the paper and the creases on the center flap.

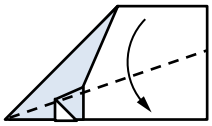
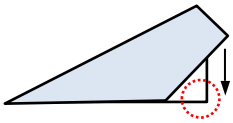
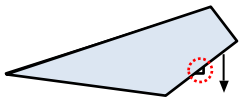
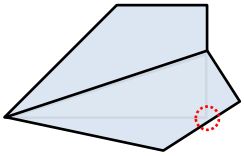
7. Fold up the small tab.

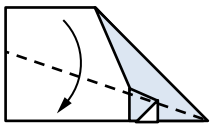
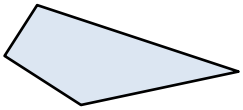
8. Flip over, rotate, and fold in half.

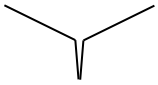
9. To fold the wings, bring the top edge down past the bottom fold (what would be the center of the plane), until the corner (on the right in the illustration) is just barely covered by the wing. Then crease the fold to the nose.

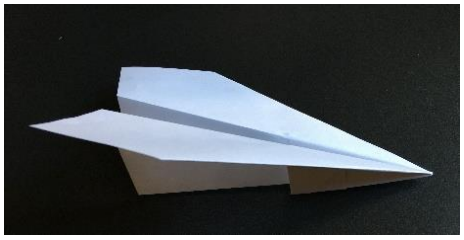
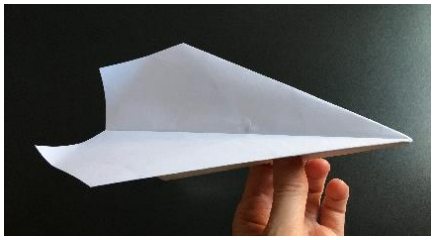
10. Repeat on the opposite side, making sure that corners and the nose match.

11. Look at your plane head on. For this plane to fly its best, adjust the wings to create a positive dihedral angle, that is, wings that slope upward as pictured below.



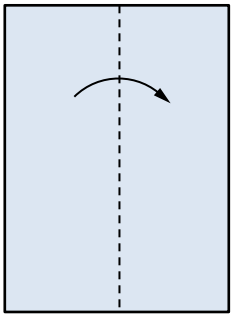
12. To get this plane to fly even farther and glide better, create elevators by curling the trailing edges (back ends of the wings) up.

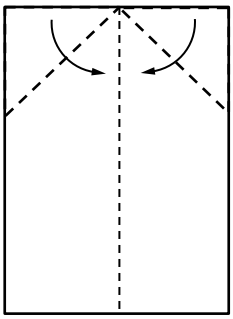
Activity: Make a Boomerang Stunt Plane[1]

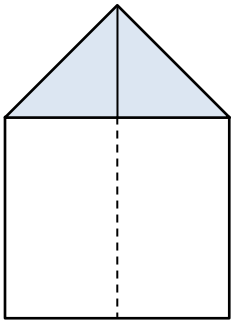
Materials: 1 sheet of 8.5" x 11" paper

1. Fold the sheet long edge to long edge. Unfold.

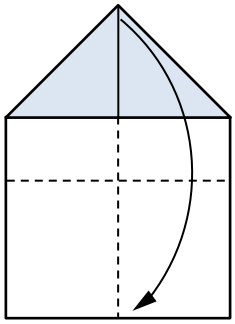


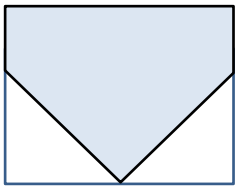
2. Flip the paper over. Fold the upper corners to the center crease so that the top edges follow the center crease.

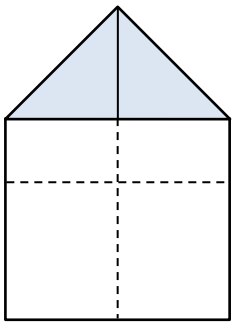




3. Fold the top point down to the bottom of the paper, so the point hits where the crease and the edge of the paper intersect. Unfold.

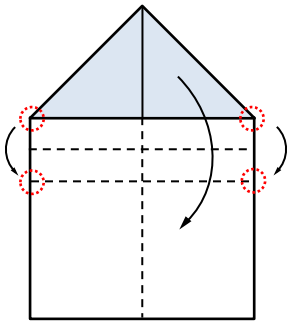


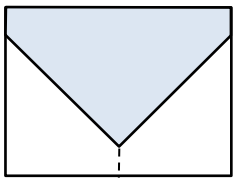




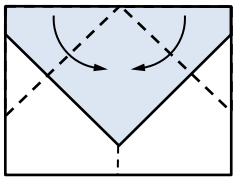
[1] "BOOMERANG PAPER PLANE TUTORIAL - How to make a Paper Airplane that COMES BACK | ReverseR." YouTube, Uploaded by TriKdanG, 9 Jan 2019. https://youtu.be/jbM56y8mmtk

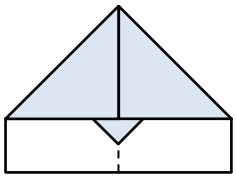
4. Fold the top point down so that the right and left edges of the triangle shape at the top meet with the newly made horizontal center crease. In the illustration below, fold so that the points circled in red meet.



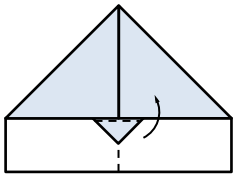


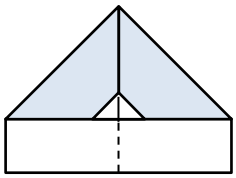
5. Fold the top corners to the center crease, so that the top edges meet in the center.



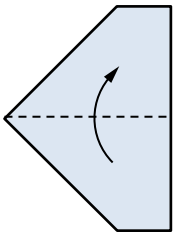


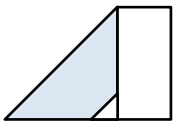
6. Fold the triangular tab emerging from underneath the newly folded panels up.



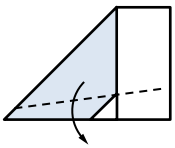


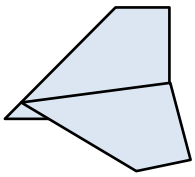
7. Flip over, rotate, and fold in half along center crease.



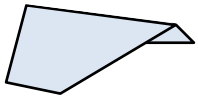


8. Fold the wing down along the following crease so that there is a slight slant.

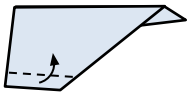
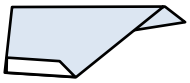
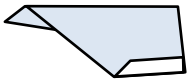




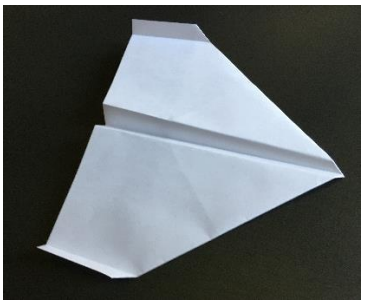
9. Repeat on the other side so the wings match.



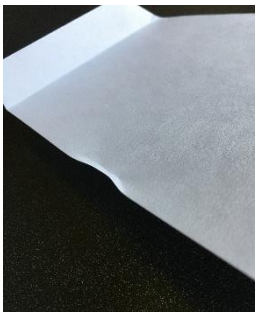
10. Fold the ends of the wings up about ½" to create stabilizers. Repeat on the opposite side.

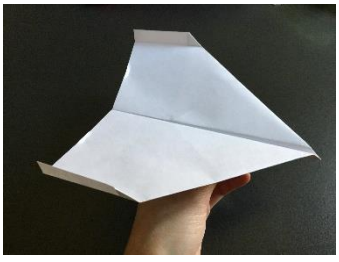
11. Unfold the stabilizers so that they are perpendicular to the wing.



12. Make elevators in the wing by pinching a small section of the back wing up:

13. Now your plane is ready to go. To get the plane to return to you like a boomerang, angle the top of the plane slightly away from you when you launch it. You can experiment with the way you launch the plane and with the size of the elevators to achieve different flight patterns or change the size of the loop it makes.

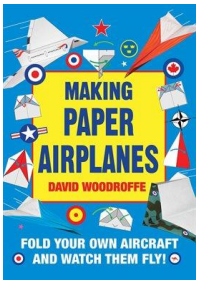


DIGITAL RESOURCES AVAILABLE THROUGH LA COUNTY LIBRARY

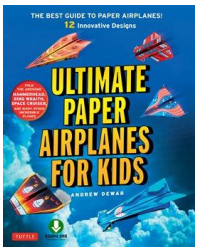
eBooks & Audiobooks

LA County Library offers numerous resources that can help you learn more about paper airplanes. Here are just a few, all of which are available as eBooks on OverDrive and Libby and Hoopla:

Idiot's Guides: Paper Airplanes **by Nick Robinson**
This book includes an overview of paper airplanes, plus twenty airplane designs with easy to follow folding illustrations and instructions.



Making Paper Airplanes **by David Woodroffe**
Pick from ninety-one aircraft designs with colorful diagrams, graphics, and instructions.



Ultimate Paper Airplanes for Kids **by Andrew Dewar**
Enjoy this collection of easy-to-fold, high-performance planes for kids who are fascinated by paper or origami airplanes.

ADDITIONAL RESOURCES

- *Wired.* Watch, "Learn How to Fold a World-Record-Setting Paper Airplane" by Wonbo Woo to learn about paper airplane design from master crafter, John Collins. https://tinyurl.com/y88wr6w6
- *Foldable Flight*. This YouTube channel features many videos on how to fold different paper airplanes, as well as videos dedicated to origami basics and how to design your own plane. https://tinyurl.com/y8ao5g5s
- *TriKdanG.* Tri Dang designs origami and paper airplanes professionally and his YouTube channel is full of paper airplane tutorials, including the Boomerang plane included in these instructions. https://tinyurl.com/ya9ztm26