



Curiosity Guide #508

Paper Airplanes

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

Paper-Cup Helicopter

Investigation #7

Description

Create your own little whirlybird!

Materials

- Paper coffee cup with lid
- Six 6-inch wooden skewers
- Fishing line
- Scissors
- Crazy glue
- Pencil
- Utility knife
- Wire
- Wire cutter
- Plastic cup
- Marker
- Needle
- Thread
- Finish nail
- Perler bead
- Needle nose pliers
- Foam board
- Hot glue
- Rubber bands
- Screw eye, or use wire

Additional Resources

- You-Tube demonstration,
<https://www.youtube.com/watch?v=IQdRyFkZMLo>

Procedure

- 1) Pierce 4 wooden skewers into the bottom edge of the cup so that they are equidistant apart.
- 2) Draw the blunt ends of the skewers together to form a pyramid.
- 3) Tie the skewers together at the top with fishing line
- 4) Spread a bead of glue over the fishing line to bind the fishing line to the skewers.
- 5) When the glue has set, carefully pull out the skewer pyramid and set aside.
- 6) Keeping the cup upside down, find the center point on the base of the cup. Cut out a $\frac{1}{2}$ -inch square with a utility knife.
- 7) Cut a 4-inch length of wire. Pierce the wire through the top of the skewer assembly.
- 8) Slide the wire back and forth to open the gap.
- 9) Cut the base off the plastic cup so that you have a curled flap of plastic.
- 10) Cut 2 strips that are each two inches long from the top to the bottom of the cup.
- 11) Trim each strip so it is in the shape of an elliptical propeller. The propeller will be more round on the end and will taper to flat edges where the propellers will connect.
- 12) Cut the point end of a skewer off, leaving a 3-inch-long segment.
- 13) Use the utility knife to cut a $1\frac{1}{4}$ -inch slit in each end of the stick.
- 14) Slide each propeller in the slit so the curved edges curl up.
- 15) Secure in place by sewing loops around the stick and through the propellers.
- 16) Coat the thread, holes, and seams with thin layers of glue.

- 17) Carefully use the finish nail to drill a small hole in the center of the propeller stick.
- 18) Insert a 4-inch length of wire through the hole, bending the tip of the wire around the propeller shaft.
- 19) Wrap the joint tightly in fishing line and coat with a thin layer of glue.
- 20) Slide a Perler bead up on the shaft to the underside of the propeller blades.
- 21) Slide the shaft back through the skewer assembly. Check to make sure the wire spins freely.
- 22) Use the pliers to carefully shape the end of the wire into a sharp, open eye hook.
- 23) Place the skewer assembly back in the cup and rotate the propellers. Check to make sure the hook eye does not catch the skewers when rotating. Adjust the hook eye as necessary.
- 24) Coat all the skewer joints in the cup with glue to hold them securely in place.
- 25) With the final skewer, pierce a hole that goes from one side to the other on the edge of the plastic lid.
- 26) Cut off the ends of the skewer and set the lid aside.
- 27) Cut two foam-board wings 6 inches in length and 2 inches wide in the center. The shape of the wings should be elliptical with one flat edge and the other rounded. Use one wing as a template for the second.
- 28) Hot-glue the large wings on either side of the cup so that they are $\frac{3}{4}$ inches below edge of the cup and below two of the skewers.
- 29) Put three rubber bands together to form one thick unit. Link this unit to three more rubber bands clustered together. Keep adding a cluster of rubber bands until the overall length is correct. You should end up with a link of rubber bands that will be tight when spanning the distance between the base of the cup and the hook in the skewer assembly.

- 30) Slide the lid skewer back. Link the bottom cluster of rubber bands through the skewer. Then slide the skewer back in place.
- 31) Bend a small piece of wire into a hook to fish the band loop through the cup and up the hole. Link the end of the rubber bands to the screw eye. Secure the lid to the cup.
- 32) Wind the propeller so the rubber band begins to twist.
- 33) Take your helicopter outside, wind it up, and let it go.
- 34) How high could you get the helicopter to fly?

My Results

Explanation

The helicopter needs thrust to lift off the ground. In this model, the rubber bands wind up, creating elastic potential energy. When the propellers are released, the energy transfers to kinetic energy, and the propellers spin. The curved shape of the propeller blades, which came from the shape of the cup, produces lift. The curve allows the air to move faster over the wing. The faster movement of air over the wing causes fewer air particle collisions than the number of collisions happening under the blades, so the helicopter is pushed up. You can watch the wings rotating in the opposite direction as the rubber bands are unwinding against the lid of the cup. When the rubber bands unwind, the helicopter will fall back down to the ground.

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