

# Rubber Band Helicopter

Beginner - Intermediate

## Project Goal

Students design and build helicopters that can fly at least 8 feet in the air.

## Design Variables

Shape, size, and placement of paper, number of rubber bands, craft stick length

## Key Concepts

Lift occurs when an object pushes against the air (or other gas/fluid), typically causing the object to rise upward or slow its descent.

Drag occurs when air (or other gas/fluid) pushes back against a moving object and slows it down.

## Prep

- Bend paperclips
- Cut cardstock into quarters

## Materials

### Basic Example

- 1 craft stick
- 1 propeller
- ¼ cardstock
- 1 paperclip
- 2 short r-band
- tape

### Advanced Idea

#### Experimental Aircraft

- 2 straw
- 2 skewer
- 2 pipe cleaner
- 1 long r. band
- hot glue (1 per 4 students)

## Troubleshooting

<i>If the Helicopter is...</i>	<i>Then...</i>
Falling or barely hovering	<ul style="list-style-type: none"><li>• There is not enough energy stored in the rubber band</li><li>• Use two rubber bands</li></ul>
Spinning rapidly but not generating lift	The paper cutout is not generating drag (the paper is too small)
Flying in a random direction	Remember to say 'Tic-Toc' as the propeller and craft stick are respectively released
Making a buzzing noise	Check if the propeller or rubber band is hitting the paper
Hitting the ceiling	Launch the helicopter lower to the ground

## **Introduce the project and demonstrate a successful flight (1 min)**

### **Explain how it works (3 min)**

- ▶ Energy is stored in the rubber bands by turning the propeller.
- ▶ When released, the energy from the rubber band turns the propeller, which generates lift.
- ▶ The untwisting rubber band also spins the main body of the helicopter; the rubber band unwinds from both ends simultaneously. Energy spent in this way is wasted because it does not generate lift.
- ▶ Define drag. Attaching a paper cutout creates horizontal (side-to-side) drag, but not lateral (up-and-down) drag.
  - Think of it like this: Have the students wave their hand and feel the air passing around it. You can't see it, but you can feel the air pushing back against your hand. That same air is also pushing against the paper when the helicopter turns.
- ▶ This makes it more difficult to turn the main body of the helicopter, thus diverting energy to the propeller. At the same time, it does not slow the helicopter's ascent.

### **Explain and demonstrate how to fly the helicopter (2 min)**

- 1 Face the top of the propeller toward you and turn clockwise until the rubber band becomes significantly more difficult to wind (50-80 rotations).
  - You can also look at the rubber band as it gets twisted. Once the entire rubber band begins coiled around itself three times then it has enough energy (try winding the helicopter and watch the rubber band).
- 2 Hold the propeller with one hand and pinch the bottom of the craft stick with the other.
- 3 Face the propeller up or away from you.
- 4 Let go of the propeller and craft stick as you say the words 'Tic-Toc,' respectively.
- 5 Recap: Wind it up a lot, face away, hold propeller and craft stick, release while saying Tic-Toc.

### **Show students how to build the Basic Example (4 min)**

- ▶ Show step-by-step how to build a helicopter.
- ▶ Use a create shape other than the helicopter-shaped cutout. Be very clear that students can try any paper shape that they believe will create enough drag.

### **Support redesigning (1 min)**

- ▶ Tell students that they should try at least three different paper shapes and sizes. Some shapes and sizes work better than others.
- ▶ Tell students that the craft stick can be lengthened.