Rotor Quest
Build, Fly, Explore

STEM in a Bag is a project of
Tulsa Regional STEM Alliance

This activity aligns with the following Oklahoma Academic Standards:
- 3.PS2.1, 3.PS2.2, 4.PS3.1, 4.PS3.4, 5.PS2.1, 7.PS3.5, 8.PS2.2, 8.PS2.4, G.35.ETS1.2, G35.ETS1.3, MS.ETS1.2, MS.ETS1.3

1 🚀 ENGAGE

Did you know that in the 15th Century (over 500 years ago) long before airplanes, cars and even trains, **Leonardo DaVinci** sketched many mechanical designs which included one called the **Aerial Screw?** The Aerial Screw resembled today's helicopters. As an artist and sculptor, DaVinci was a curious and observant person. One of the many things he observed was birds. He noticed every aspect of them and their flight.

He understood the concepts of flight like gravity and the center of lifting pressure on a bird's wing. These ideas of human mechanical flight were first documented by DaVinci and were later developed in more depth by inventors like the Wright Brothers and others!



2 📝 SUPPLIES

- Safety Glasses
- Propeller
- Wooden Stick
- Rubber Band
- Card Stock with Helicopter Cut-Outs
- Paper Clips
- Tape

USE CAUTION: When testing your helicopter, make sure you are outside and wearing eye projection. Safety glasses have been included in your kit.

3 🔍 EXPLORE

You are going to be an aerospace engineer and build your own helicopter!
1st: Fit the propeller onto one end of the wooden popsicle stick.
2nd: Open up the paper clip to a 45-degree angle (V shape) and securely tape the longer half of the paper clip to the stick (opposite side of the propeller).
3rd: Attach the rubber band to the hook of the propeller and the paper clip.
4th: Cut out the paper helicopter shape and attach it to the stick with a loop of tape. Make sure the paper doesn't touch the propeller.
5th: Firmly hold the end of the stick with the paper clip. Face the propeller toward you and turn the propellers clockwise to wind up the rubber band, creating potential energy. Wind it until the rubber band starts to coil on itself.
6th: Release the blades first, then release the bottom of the stick in a one-two sequence.

4 🧠 EXPLAIN

A helicopter uses rotating wings to fly. The blades can spin at very high speeds; when the rotors spin, the helicopter pushes the air down beneath the rotors to lift off! Its wings are in the shape of an **airfoil,** just like the wings of an airplane. This shape that is curved on top and flat on the bottom helps with allowing the air to push the plane or helicopter upwards. The top curved part creates low air pressure, and the flat bottom part has higher air pressure, and this phenomenon creates **LIFT**. It's called **Bernoulli's Principle.**

A helicopter and airplane both have the same forces acting upon them:
WEIGHT (the force of the weight of the helicopter & crew is pulled down by gravity),
THRUST (the force produced by the rotation of the helicopter's blades. Its direction can be forward, rearward, sideward or vertical ,
DRAG (the forces that try to stop the helicopter from moving through the air) and
LIFT (the upward force keeping the helicopter in the air)

✈️ ELABORATE

5

Try changing the sizes of the paper cutouts. What happens if you make it smaller or larger? Did it fly as high? Add some paper clips to the paper cut-out. What do you notice or wonder about the changes?

How are helicopters different from airplanes? Helicopters are more flexible! Planes can fly higher and faster, but helicopters can take off and land from almost anywhere. They don't need long runways to fly. Helicopters can also pause in mid-flight. That is why they're used in military and civilian medical & rescue operations.

Are there helicopters on other planets? YES! On February 18, 2021, **Ingenuity** landed on Mars. It caught a ride on the Mars rover Perseverance. It was the first ever controlled flight on another planet. Ingenuity completed 72 flights in under 3 years. It flew for the last time on Jan. 18, 2024.

🔬 EVALUATE

6

The next time you see a Maple Tree Seed, look carefully at its design. What does it look like? The natural wing design of the seed allows the tree seeds to be **dispersed** or spread over a wide area by the wind because they are **aerodynamic**. The long, thin winged/blade of the seed allows the seed to travel far away from its parent tree for better growing conditions. The scientific name of Maple tree seeds is **samaras,** but they are often called whirlybirds or helicopter seeds. The seeds have something else in common with helicopters besides their nickname. Both Maple tree seeds and helicopters use autorotation. **Autorotation is an upward flow of air**. Normally, helicopters push air down with the spinning torque of their blades to create lift. But if it has engine failure, the helicopter allows the blades to spin in a controlled glide to land safely. Without the engine spinning the blades, it experiences an upward flow of air to create lift like a Maple tree seed.

📚 MORE

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WATCH THE SMITHSONIAN'S STEM IN 30 VIDEO: *SPINNING WINGS*

Read about it:

- ***Helicopters*** by Meg Greve
- ***The Science of Flight: The Air-Amazing Truth About Planes and Helicopters*** by Ian Graham
- ***The Science and Technology of Leonardo Da Vinci*** by Elizabeth Pagel-Hogan

🥼 STEM HERO

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Dustin Stone, from Coweta, OK, is the pilot for **Osage SkyNews 6**. He began his career at KOTV as a videotape and master control operator.

In 2004, after his mother was in a serious car accident in Tulsa, a helicopter flew him from western Oklahoma to be by her side—his first ever helicopter ride. The experience, both terrifying and awe-inspiring, sparked his passion for flying. He pursued flight school, became a camera operator in the news helicopter, and after years of dedication and perseverance, Dustin became the pilot for Osage SkyNews 6 in 2018.

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