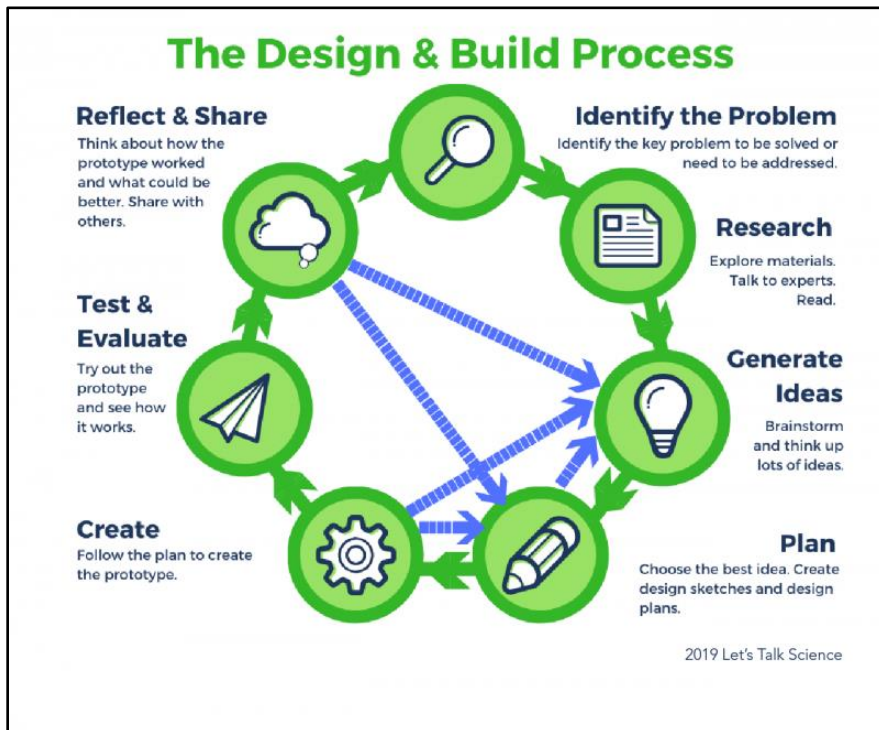


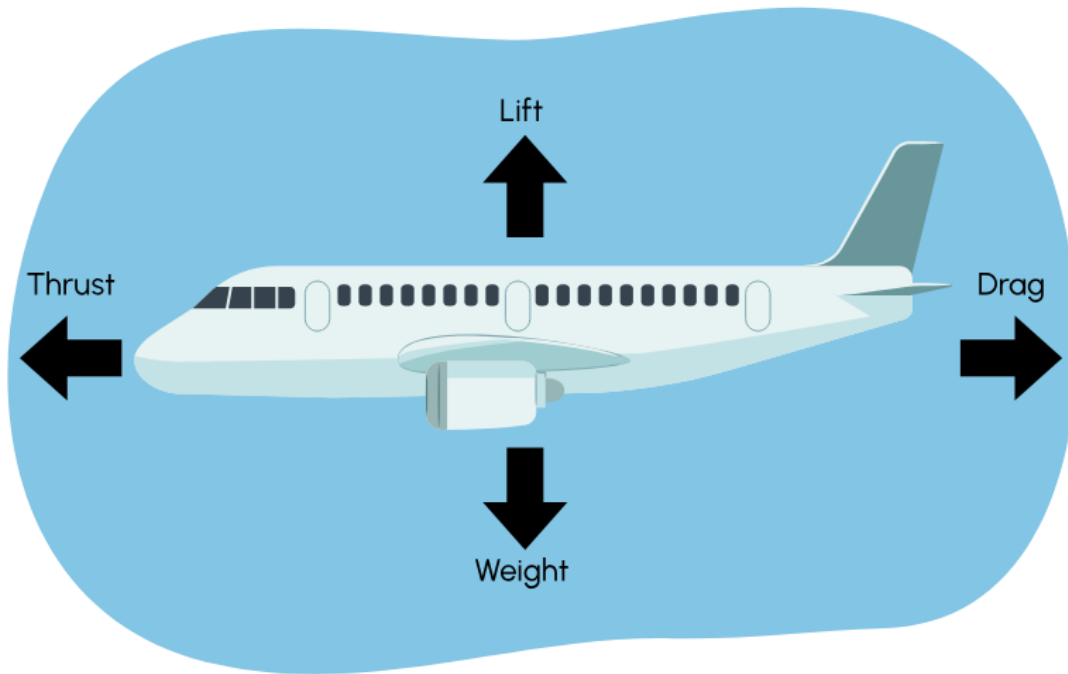
STEMterprise Stage 2: Grade 6 Flight Challenges



YOUR MISSION is to improve pizza delivery and allow people to enjoy your delicious pizza anywhere in Canada.

Use the Engineering Design Process to learn about simple machines and food chains.

Go to the challenge your teacher has instructed you to complete.



Flight

Challenge 1: Pizza Delivery Parachute

Scenario: Your pizza business wants to deliver pizzas to remote locations, where planes can't land, by dropping them with parachutes! They need a new, improved parachute system that ensures the pizza lands safely and accurately in a designated "delivery zone."

The Challenge: Design, build, and test a parachute system that can safely lower a small "pizza box" (e.g., a small weighted container) from a height, aiming for a specific target landing zone, while controlling its descent rate.

Design Constraints:

- The parachute must safely carry a "pizza box" (e.g., a small container with a few coins for weight).
- The goal is to have the pizza land *within* a designated target area (e.g., a hula hoop, a marked square).
- The pizza should descend at a controlled rate (not too fast, not too slow).

- Materials are limited (e.g., plastic bags, string, tape, paper clips, cardboard). Teachers can choose the materials available in addition to this list.

Your Task:

1. **Problem:** Understand the need for a safe, accurate, and controlled pizza drop.
2. **Research:** Brainstorm different parachute shapes and sizes. How does air resistance (drag) affect a falling object? How does the size and shape of a parachute create lift/drag to slow descent?
3. **Plan:** Sketch your parachute design. Consider the canopy shape, string length, and attachment points for the pizza box.
4. **Create:** Construct your parachute system.
5. **Test & Evaluate:** Conduct multiple "pizza drops" from a consistent height (e.g., from a chair, a table, or a second-floor railing) into your target zone. Measure how close it lands to the center and record its descent time.
6. **Reflect:** Analyze your results. How did the shape or size of your parachute affect its descent rate and accuracy? What adjustments could you make to improve its performance (e.g., increase drag, reduce weight, adjust string length)? Explain how your design manages the forces of drag and weight.

Success Criteria:

- The "pizza box" lands safely without damage.
- The parachute system lands within the target zone a majority of the time.
- Your team can explain how their design utilizes the force of drag to control the descent and overcome the force of weight.

You can use the box below to brainstorm and design.

A large, empty rectangular box with a thin black border, intended for students to use for brainstorming and designing their parachute system.



Flight Challenge 2:

Pizza Delivery Paper Airplane

Your pizza business wants to grow and deliver pizza across Canada. You will need the best airplane to make those deliveries. When engineers design a new airplane, they have to look at the design of each part of the airplane to make sure it's ideally suited to the task the plane is meant to accomplish. Your paper airplane needs to fly as far as possible. If an airplane is heavy, imbalances, can't fly far, or needs to land frequently, it will be more expensive in fuel costs and that will cut into your pizza profits!

Materials:

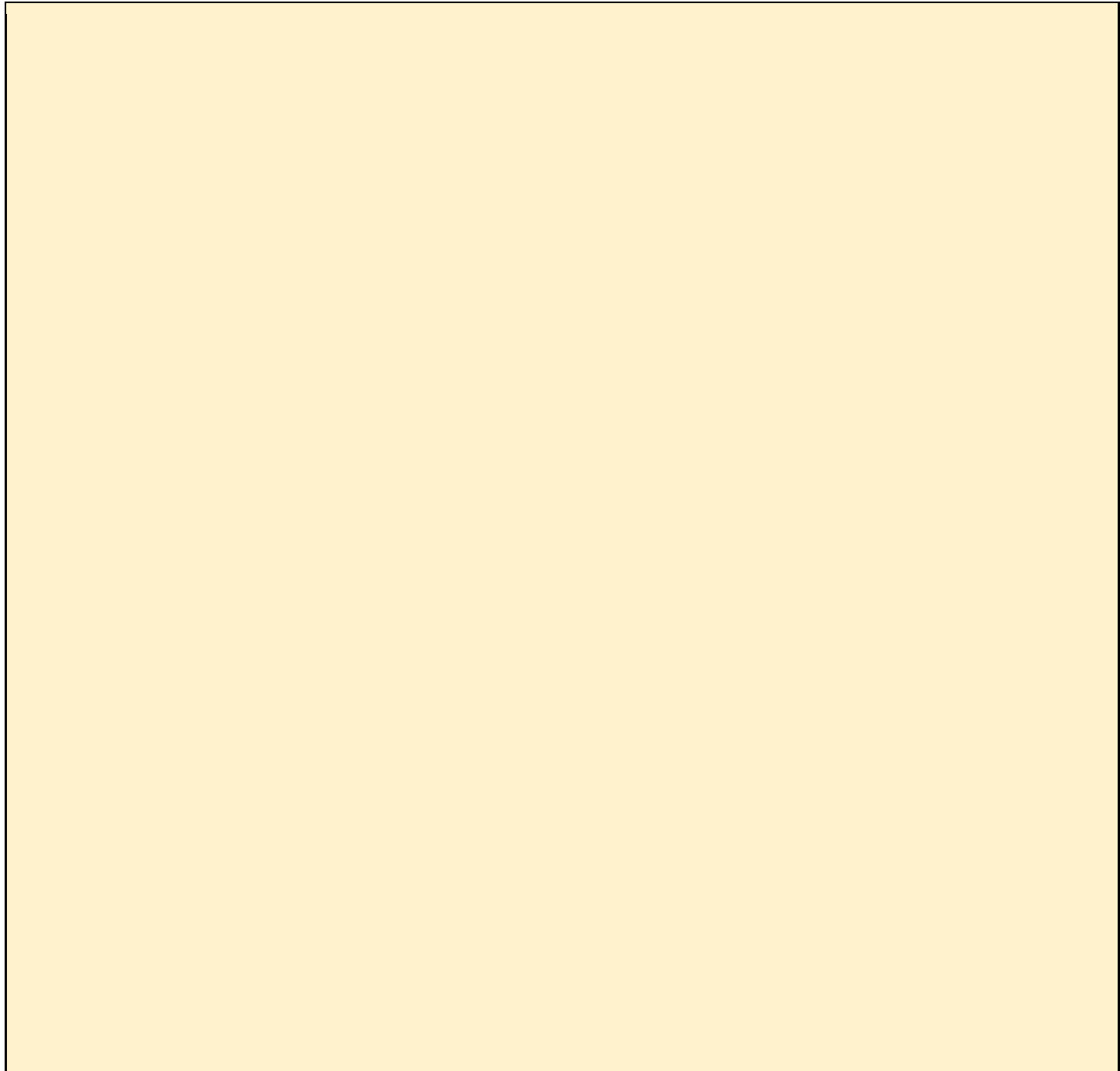
- Lots of sheets of paper
- Scissors
- Rulers (to smooth down edges and potentially mark lines to be folded)
- Tape (just in case, to help hold something together or fix a rip)

1. **Research:** Use paper airplane designs from the [FoldnFly](#) website or choose from this list of pdf's.
 - [Airplane Design: Sea Glider](#) (pdf)
 - [Airplane Design: King Bee](#) (pdf)
 - [Airplane Design: Staple Easy](#) (pdf)
 - [Airplane Design: LTS Paper Instructions](#) (pdf)
 - [Airplane Design: Jet Fighter](#) (pdf)
 - [Airplane Design: Tailed Plane](#) (pdf)
 - [Airplane Design: Basic Dart](#) (pdf)
 - [Airplane Design: Lock Bottom](#) (pdf)
 - [Airplane Design: Royal Wind](#) (pdf)
 - [Airplane Design: Star Flight](#) (pdf)
2. **Ideas:** Think about why your paper airplane design choices are best for the goal of flying far.
3. **Plan:** Choose your top three airplane designs and note the reasons why you think they will be successful flyers.
4. **Create:** Build more than one plane. Remember to fold the creases really well, using a ruler or your thumb to firmly press along the folds.
5. **Test and Evaluate:** Create a testing zone in the classroom or hallway. Students, individually or in groups of two or three, will take turns throwing their paper airplanes to test them.
 - Let's look at the forces of flight when you fly your paper airplane.
 - i. Pick up one of your airplanes. What forces are acting on it?
 - ii. Throw the airplane and watch it fly. Is there a force when you throw it?
 - iii. If your airplane had an engine, would that force continue?
 - iv. The airplane slows down. Why?
 - v. So there is another force – what is it called?
 - Let your paper airplane drop on the floor.
 - i. Does the airplane hit the floor as rapidly?
 - ii. What force affects it when you drop the paper airplane?

Reflect and Share:

How can you change these forces of weight, thrust, drag, and lift to make it easier to fly?

You can use the box below to make notes, brainstorm, and design.



Flight Challenge 3:

Pizza Delivery Drone

Scenario: Your pizza business wants to launch a new, fast, and reliable pizza delivery service using drones! They need your Grade 6 engineering team to design, build, and test a prototype for their new "Pizza Delivery Drone" that can safely transport a mini-pizza to a target.

The Challenge: Design and build a model drone structure (it doesn't need to actually fly with

motors, focus on the structural design) that can securely carry a small, weighted "pizza box" (e.g., a small cardboard cube or a block) and is aerodynamic enough to be "flown" (e.g., glided or launched by hand/catapult) while maintaining stability.

Design Constraints:

- The drone must securely hold a "pizza box" (e.g., a 5x5x2 cm weighted block).
- The drone must be designed to be stable during "flight" (e.g., not tumble uncontrollably).
- Materials are limited (e.g., cardboard, straws, tape, paper, pipe cleaners, small weights).
- The design should consider principles of lift, drag, thrust (simulated by launch), and weight.

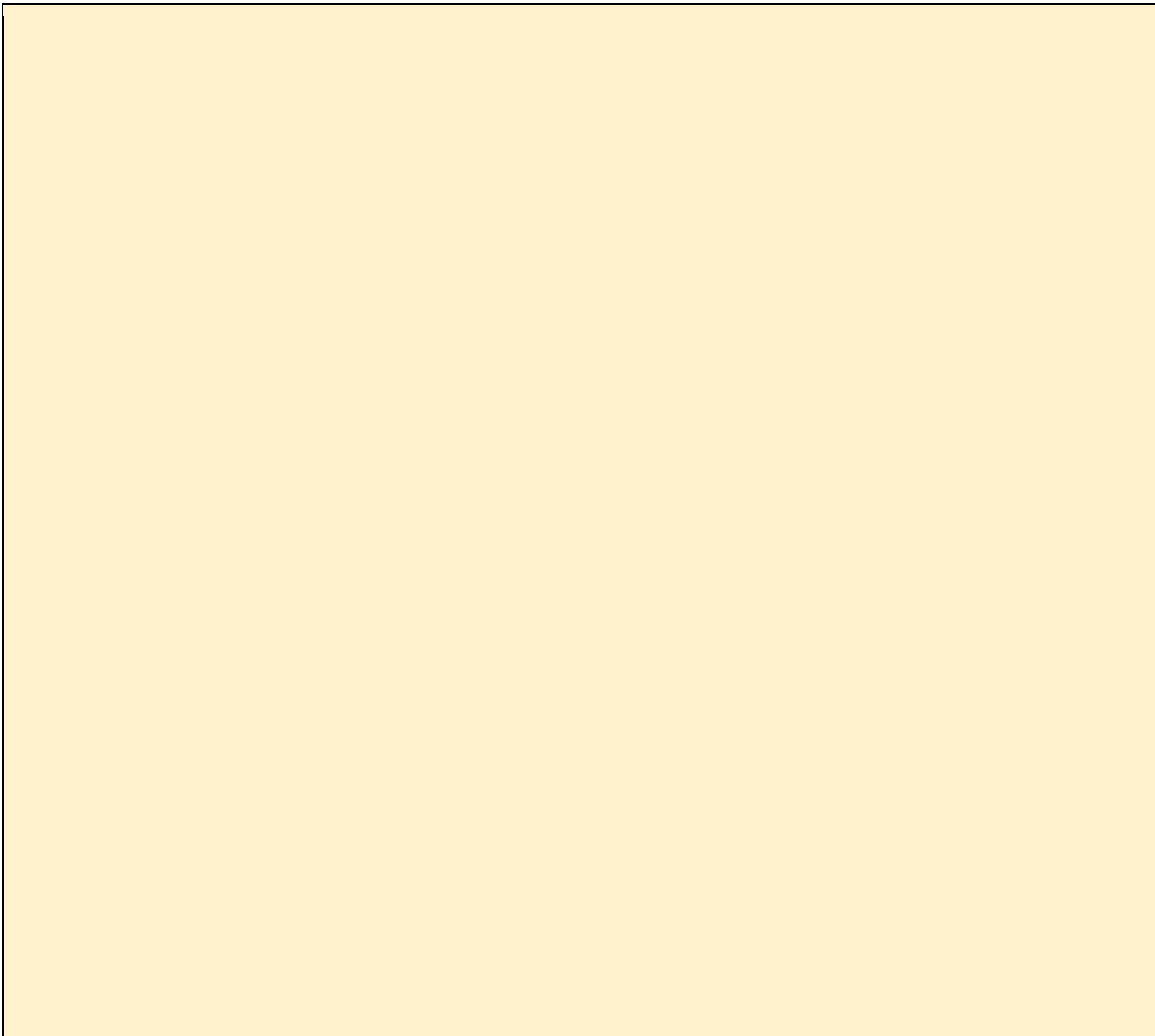
Your Task:

1. **Problem:** Create safe and stable pizza delivery by drone.
2. **Research:** Brainstorm different drone shapes and structures. How do real drones create lift and stability? What forces act on them? (Discuss lift, drag, weight, and thrust).
3. **Plan:** Sketch your drone design. Label its parts and explain how it will carry the pizza and be stable during flight.
4. **Create:** Construct your drone prototype using the provided materials.
5. **Test & Evaluate:** Test your drone's ability to carry the pizza and maintain stability during a simulated "delivery" (e.g., a gentle toss or slide down a ramp).
6. **Reflect:** What worked well? What didn't? How could you redesign it to reduce drag or improve stability? How do your design choices relate to the forces of flight?

Success Criteria:

- The drone prototype successfully holds the "pizza box."
 - The drone demonstrates reasonable stability during its simulated flight.
 - Your team can explain how their design addresses the forces of flight.
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You can use the box below to brainstorm and design.



Flight Challenge 4:

Delivery Drone Rotor Improvement

Your pizza business wants to start a delivery service. You decide that you want to use quadcopter drones to deliver the packages. Drones, also known as unmanned aerial vehicles (UAVs), would be a great choice because they can go into places other aircraft can't. The problem is that most quadcopter drones cannot carry heavy loads. To carry heavy loads, they need lots of **lift**. Lift comes from a drone's rotor blades.

Your challenge is to improve the design of a model rotor system so that it can stay in the air the longest.

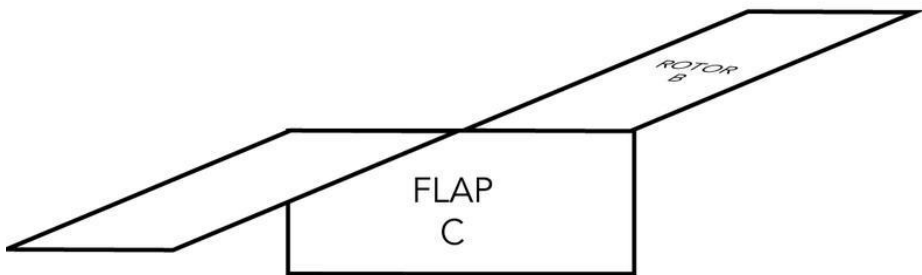
Materials:

For this activity, you will need at least:

• Boxboard (like from a cereal box) or cardstock • Scissors • Tape • Ruler • Pencil	• Something cylindrical to make a shaft for the rotor (e.g. straw, pencil, skewer, tightly rolled up paper, etc.) • Timer • Rotor template (see the diagram below)
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1. Start by making the basic rotor.

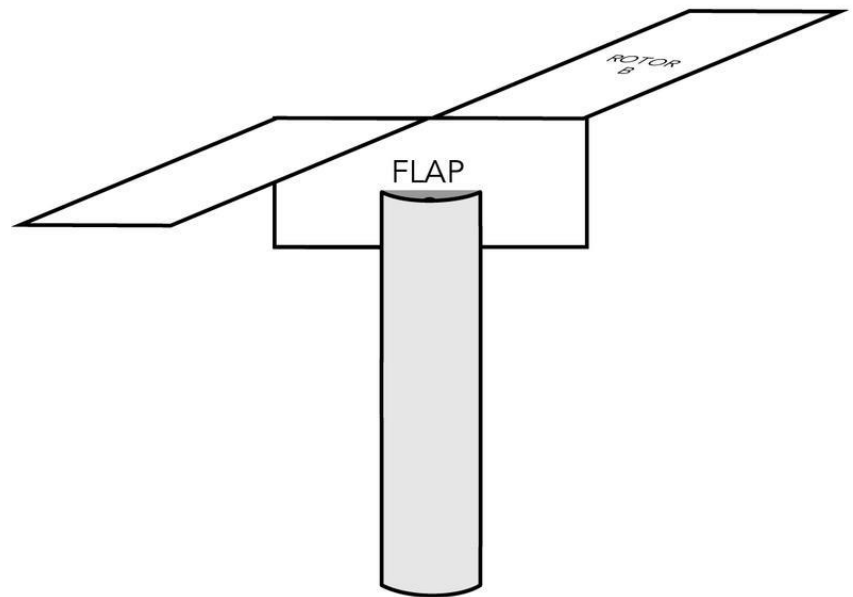
- Using a pencil and ruler, draw a copy of the rotor template onto the boxboard or cardboard.
- Cut along the solid lines and fold along the dashed lines.
- Fold rotor blade A perpendicular to flap C.
- Fold rotor blade B the opposite direction, perpendicular to flap C.



Rotor Step 1 (©2024 Let's Talk Science)

2. Attach the handle.

- If you're using something for a handle that can be cut, cut a 2-cm slit lengthwise on one end of the handle. Slip flap C into the slit and tape onto the handle.
- If you're using something solid for a handle that can't be cut, tape one end of your handle in the centre of flap C.



Rotor Step 2

(©2024 Let's Talk Science).

3. To make your model fly, put the handle between the palms of your hands with the rotor facing up. Roll the handle quickly in one direction and then let go. It should fly up and away from you. Have someone time how long the rotor is in the air.
4. **Generate Ideas** - What are some ways that you can modify the model so it could stay in the air longer? Write down any ideas you can think of.

You could think about:

- The size of the rotor and blades
 - The shape of the rotor blades
 - The material used to make the rotor
 - The size of the handle
 - The material used to make the handle
5. **Create** - Make **ONE** change to your model.
 6. **Test & Evaluate** - Test it at least **three times**. Observe how the change affected the flight. Was the model able to stay in the air longer?
 7. Continue making **one change at a time** and testing your model until you're satisfied with the results.

