60 minutes

Slow It Down

Posted April 1, 2021
Due by April 30, 2021

Design an aircraft that falls as slowly as possible before landing on a target.

DISCOVER ENGINEERING

Introduction

Air resistance, also known as drag, can be a friend or foe. When designing jets and fast cars, engineers work to overcome drag, but when designing parachutes or hot air balloons, they use it to slow descent in order to land gently in a specific location.

In this activity, students will design an aircraft that uses drag to land as slowly as possible onto a target.

PREPARATION

- Choose a place where students can drop their aircrafts from at least six feet of height.
- Mark a target area on the floor. A reasonable target is a circle of 36" diameter, or adjust as preferred to make it more or less challenging.
- Have a stopwatch ready for timing the drops.

Instructions

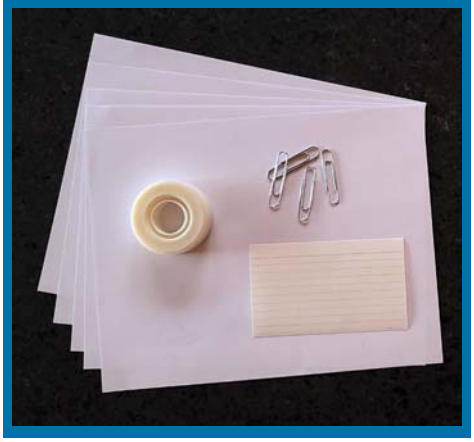
DEFINE THE PROBLEM

1. Share the challenge with students: Design a paper aircraft that stays airborne for as long as possible when dropped from above a target area.
2. Give students the specs:
   - Must be dropped from a height of six feet (or more, depending on your situation), directly above the target area
   - Must land within the target area
   - Can only use the materials provided

Materials

PER TEAM:

- ☐ 5 sheets of paper (8.5 x 11 inch)
- ☐ transparent adhesive tape
- ☐ 1 index card (3 x 5 inch)
- ☐ 4 paper clips
- ☐ scissors
- ☐ sketching materials



3 Get your students thinking about different shapes and how they might slow down the paper's descent or speed it up. Ask:

- Which shapes are designed to fall as quickly as possible? These are the ones to rule out.
- What do objects that fall gently and relatively slowly have in common, in terms of shape, weight, and materials?
- What does a falling object's motion say about how it is catching air? Hint: Consider a spinning maple seed or a swaying feather.

Guiding Questions ?

How might you fold your paper to slow its fall? How do the locations of the paper folds make a difference?

Does your aircraft drop more slowly or quickly if it is designed to spin?

How can you use paper clips to stabilize the falling aircraft's pathway into the target?

BRAINSTORM SOLUTIONS

4 Divide students into small teams. Distribute the materials. Tell them to plan and/or sketch ideas to help determine their best design, and test some ideas by having one student stand on a chair to drop the aircraft.

Note: The materials for this activity allow for a wide range of possible solutions—such as a parachute, whirlybird, or leaf—and each of these solutions won't necessarily use the full complement of materials.

5 Tell teams to build the best design of their aircrafts. Assure them that after they test their designs, they can change and improve them to take longer to fall or land more accurately.

6 During testing, time each fall and note how close to the target each aircraft falls.

EVALUATE AND REDESIGN

7 Once everyone has had a chance to test their design, hold a discussion. What were the characteristics of the aircrafts that stayed aloft the longest? Why did some aircrafts fall on or near the target, whereas others did not?

8 Tell students to gather another set of materials and try again. Encourage them to incorporate ideas from other teams whose aircrafts stayed aloft longer or landed more accurately.

SCIENCE AND ENGINEERING CONNECTIONS

- Air may be invisible to us, but it is made of molecules that get pushed out of the way as objects move through it. The faster the object, the more the air resists because more molecules of air are being pushed out of the way. This air resistance is known as drag. Scientists and engineers design objects to maximize or minimize drag, depending on the speed they are aiming for.

- Parachutes work against gravity, which otherwise quickly pulls a person in freefall to Earth. The air caught inside the parachute pushes up against it, creating a force opposite to that of gravity. This drag force, or air resistance, slows the descent to create a safe landing. The larger the parachute, the more air resistance, and the longer it takes to reach the ground.

- Maple seeds, known as samaras, have long wings that balance the weight of the seed. The wings get wider farther away from the seed. When a seed falls from a tree and starts spinning, the air moving over the wide end of the wing moves faster than the air closer to the seed, giving it the lift needed to stay aloft. Scientists have recently discovered that the seeds also create a vortex right above them as they twirl, which further helps keep them airborne. Engineers are using this information to create tiny flying machines that can be used to explore the atmospheres of planets.

- The height at which something falls influences the method that works best to land gently and with precision. Shorter plants, like dandelions, need plumed seeds to fly steadily on the breeze, away from the parent plant. Tall plants, such as trees, use winged seeds because their height offers stability to the seeds' flight. Bristles are also an effective mechanism for carrying seeds safely down to Earth from a tall tree.