curious minds
Discover STEM

Classroom Resource

Investigating Falling Things: Paper Helicopters

Taighde Éireann
Research Ireland

Investigation

Investigating Falling Things: Paper Helicopters

Class Level - All

Curriculum Links

Strand:	Energy and Forces; Living Things
Strand Unit:	Forces
Curriculum Objectives:	Investigate how forces act on objects; Explore how objects may be moved; Investigate falling objects; Explore how some moving objects may be slowed down; Become aware that objects have weight because of the pull of gravity; Become aware of some of the basic life processes in animals and plants; Understand some ways in which plants reproduce
Skills Development:	Questioning; observing; predicting; investigating and experimenting; analysing: recording and communicating
New words / vocabulary:	Air resistance; rotor
Focail nua:	Héileacaptar (helicopter); rótar (rotor)
Cross curricular links:	Maths: lines, angles, area, perimeter, measures, data, averages, ratios, tables and graphs. History of flight
Equipment / materials	• Helicopter templates photocopied • Assorted types of paper • Paperclips • Pencils and Rulers • Scissors

Engage

Prompt questions/wondering:

- Why do things fall? What force is acting on a falling object?
- How could we slow down a falling object?
- Can you name some things that fly? Are these man-made or natural things?
- How do aeroplanes fly?
- How do birds fly?
- How do helicopters fly?

Background information:

Falling objects are pulled down by the force of gravity. When an object falls through the air, the air pushes up on the object creating a force in the opposite direction. This force is known as air resistance. Air resistance is a form of friction. If we want to slow down a falling object, we need to increase the force of the air pushing up on it. We can do this by increasing the surface area of the object so there is more surface for the air to push against. The helicopter has two rotors. The air pushes on the two rotors separately causing the helicopter to spin. Our paper helicopters do not actually fly but the air pushing up on the rotors will allow the helicopter to spin and to fall more slowly.

Real-world application

A real helicopter has an engine which causes the rotor blades to spin. The faster the blades spin, the more they push down on the air below them and the more the air pushes back. Once the blades are spinning fast enough there is enough force to lift the helicopter into the air. A helicopter also has a tail rotor which helps with direction. The pilot can control the movement of the helicopter and go up, down or sideways by adjusting the tilt and the speed of the rotors.

When trees produce seeds they need these seeds to be dispersed as far away from the parent tree as possible to grow new trees. Some are dispersed by birds or animals, some by water and some by wind. The seeds of the Sycamore tree or other varieties of Maple are sometimes called keys and are also often known as Helicopters because their shape causes them to spin in the air like the blades of a helicopter. Air resistance causes them to fall slowly so that gusts of wind can then carry them further away from the parent tree.

The seeds of the Ash tree are similar in size and shape. Birch trees and Willow trees also use the wind for seed dispersal but the Birch seeds are very tiny, and the Willow seeds are small and fluffy. Willow seeds are dispersed in spring and early summer

Exploring

Try dropping different objects from a height and observe how they fall. A flat piece of paper and a scrunched up piece of paper have the same mass but different shape. Will they both fall at the same rate and why? The flat sheet of paper has a greater surface area so the force of the air acting upwards will allow it to slow down more.

We want to design the best paper helicopter so discuss with the class what we mean by the best. Is it the one that spins the most or the one that takes the longest time to reach the ground? From this, the class can decide on their first starter question.

Investigate

Testable question

Does the size of the helicopter affect the speed of fall?

Or

Does the size of the helicopter affect the number of spins

Prediction

Ask the learners to predict which helicopter will have the slowest fall.

Conducting The Investigation

Use the templates to print out the large and small helicopters onto paper. Assemble them as shown in the diagram.

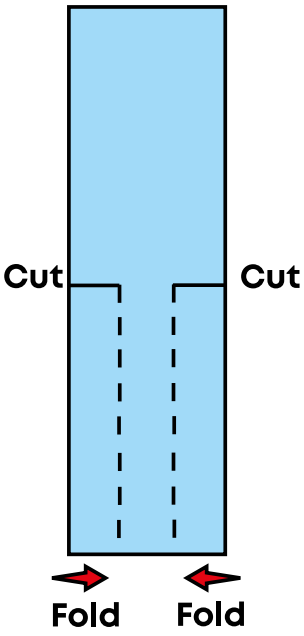
Drop each helicopter from a height and observe what happens.

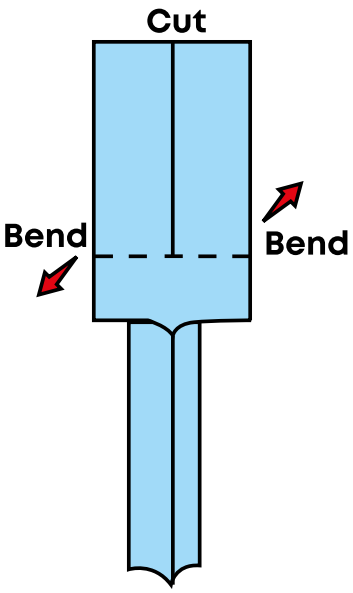
- How long does it take for the helicopter to reach the ground?
- Which direction does the helicopter spin? (clockwise of anticlockwise?)

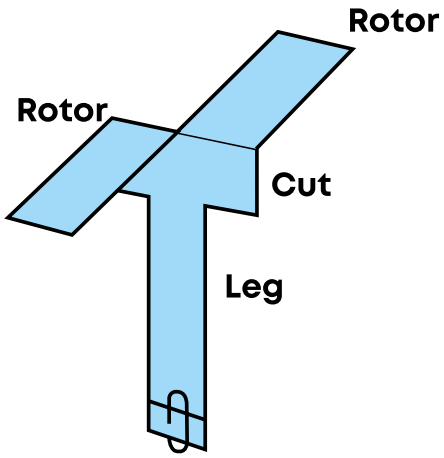
Encourage the learners to come up with other starter questions that they can investigate. They could try reversing the bend of the blades to change the direction of spin. They might draw their own versions of the template and vary the length of the rotor blades, the thickness of paper or the number of paper clips attached to the helicopter. For each new question, they investigate, the learners should think about how they will make it a fair test i.e. changing only one variable at a time and keeping everything else constant such as the height of the drop.

Examples of questions might include:

- Does the direction of the blades affect the direction of spin?
- Does the length of the rotor blades affect the speed of fall?
- Does the mass of the helicopter (more paperclips added or thicker paper) affect the number of rotations?







Sharing data/results

Learners should record their new starter questions before carrying out their investigations. They might make a table with each of their questions, their predictions and the results. They could make a video of their investigations and the results of each one. Videos could be slowed down to make it easier to determine the number of spins and the speed of fall.

Various graphs could be drawn e.g.

- Length of rotor blades v number of spins (width of helicopter, height of drop and number of paper clips kept constant)
- Surface area of the blades v time taken to reach the ground (width of helicopter, height of drop and number of paper clips kept constant)
- Number of paper clips v number of spins (size of helicopter and type of paper kept constant
- Length of stem v time taken to reach the ground (size of blades, width of helicopter and height of drop kept constant)

Especially for older classes, the helicopters can be used for a variety of practical maths activities to include:

- Identifying shapes, lines and angles in the template
- Calculating the surface area of the blades and perimeter of the helicopter (estimate and measure)
- Calculating averages by repeating each investigation a number of times
- Ratios: Using the template in the book or their own designs, learners might make two helicopters with their blades in the ratio for example 3:1 (graph paper might be useful here)
- Data collection: for each different starter question, data can be gathered and learners can choose how to represent it in graphs or tables. Can they come to any conclusions based on their data? e.g. do longer blades spin faster? What other questions can they answer with their data
- Helicopter problems based on journey time, speed and distance

Take the Next Step

Adapt for home

This is a very simple investigation that can easily be replicated at home without any adaptation.

Follow-up challenge/project/citizen science link:

- Investigating Autumn Trees and Seed Dispersal
- Investigate seeds from a number of trees in Autumn
- Which trees do you think use wind as a method of seed dispersal? (look at the shape of the seeds)
- Drop seeds from a height or throw them in the air
- What variables affect how far from the parent tree the seeds will travel? (wind speed and direction, position of the seeds on the tree)
- Would it be possible to carry out a fair test investigation using sycamore seeds? (Possibly too many variables in nature)

Research the history of helicopters including Leonardo Da Vinci's design that was never built.

Use the templates to make paper helicopter