Tomorrow's Engineers

Clever Copters

Fantastic fuselages

For details of all routes into engineering go to www.tomorrowsengineers.org.uk

Organisers Notes

Clever Copters

Tomorrow's Engineers

What do you need to know?

Organiser's notes

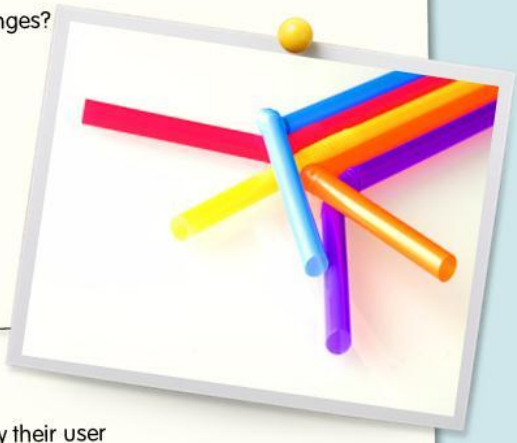
This activity will help students to understand the principles of propulsion, friction and stabilisation, and will give them an appreciation of how weak materials may be reinforced in certain combinations.

Guidance

- Read through the instructions and familiarise yourself with the procedure
- Do a test run yourself so your know how to help others make their own
- Use the discussion topics below to introduce, summarise and provide context to the activity
- Make sure that students have had sufficient time to read and understand the directions

Discussion topics

- What makes a bundle of spaghetti strong when a single strand is brittle and weak?
- What combinations of materials are both strong and light?
- How could materials be used to reinforce one another?
- Why use a glass bead (or other rounded spacer) between the washer and the propeller?
- Why attach the curled card to the fuselage?
- Why is safety so important? How will this change as transport changes?



Curriculum links

KS3 SC 3.1	(Energy, electricity and forces)
KS4	Forces and motion
KS3 SC 2.2 a, b	(Critical understanding of evidence)
KS3 SC 1.1	(Scientific thinking)
KS3 SC 1.2	(Application and implication of science)
KS3 SC 2.1	(Practical enquiry)
KS3 Ma 2.3 a-e	(Interpret and evaluate)
KS3 D&T 1.1b	(Apply knowledge to design products)

Get Involved

More engineering challenges...

If you have enjoyed this challenge and you if you have some K'NEX try their user group Helicopter Challenge

Further reading and resources...

Find out what it is like to be a graduate engineer at Agusta Westland (video case study)
Find out about future aerospace engineering challenges (future challenges and careers)

Tomorrow's Engineers

An aeronautical engineer is part of our travel crew. Do the Whose Crew Are You? quiz to find out which crew you're in!

Find out more about careers in engineering

Tomorrow's Engineers provides engineering careers materials for young people aged 11-14, and other resources for teachers.

For more information visit the Tomorrow's Engineers website.

For lots more hands-on science and engineering activities visit the National Science & Engineering Week website.

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Student Section

Clever Copters

Tomorrow's Engineers

Are you ready for an engineering challenge?

Clever Copters

You work for a roll cage development facility, designing and building helicopter safety frameworks. In order to make these, factories make prototypes using materials that act in a similar way.

Your task

...is to design and build a model self-propelled, unpiloted helicopter that's strong but still light enough to fly – using materials that at first glance may not seem suited to aeronautical engineering purposes but can be used in prototypes. For example, you can use spaghetti which is strong and light like carbon nanotubes, and acts in a similar way.

Get involved

Materials engineers are always looking for ways to replace the component parts of a machine with materials that are lighter, stronger, easier to maintain, more plentiful or cheaper (or a combination of these factors). Where aerial vehicles are concerned, the lighter a material is, the better – the more something weighs the more fuel it needs to keep it in the air, and fuel costs money.

One huge breakthrough was the development of carbon fibre in the 1950s and 1960s which, when combined with lightweight polymers, led to a material that was light and strong. The next such leap forward in materials science is likely to be the use of carbon nanotubes – tiny tubes of graphite – to reinforce polymers, which produces a material even stronger than carbon fibre. Beyond that are 'smart materials' – substances that react to external forces and change their behaviour accordingly.

Designers are increasingly looking at ways to remove the pilot from the aircraft in the future, more and more aircraft are likely to be unpiloted, either flown by pilots from the ground or controlled by setting waypoints. These craft are designed to conduct missions that are "dull, dirty and dangerous" which would be undesirable or impossible for a human pilot – such as conducting 24-hour surveillance, monitoring contaminated areas or transporting supplies through a war zone.

Find out how you can become an engineer

If you have enjoyed this activity and would like to find out more about careers in engineering Tomorrow's Engineers can help…

To learn more visit the Tomorrow's Engineers website

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Further Resources

Clever Copters

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Get engineering...

Activity Materials List

A selection of fuselage materials (such as spaghetti, coffee stirrers, cardboard tube, drinking straws)
A propeller
Two small corks (or one cut in half)
A washer
Two paperclips
A small glass bead
Sticky tape or masking tape
Rubber bands


Propeller cork


Tension cork


Clever Copter!

Instructions

First assemble the tension cork:
Make a hole through the middle of the corks, this needs to be big enough for a paper clip to move freely. Unfold one of the paperclips, leaving a J-shaped hook at one end, and thread it through the cork. Fix the end of the paper clip to the end of the cork. This is your tension cork.
Tie elastic bands together end to end until you have a single band that can be gently pulled taut to a length of around 30 cm (two will probably be sufficient). Loop this band onto the J-shaped hook on the tension cork.

Next construct the fuselage:
Select from the fuselage materials available to create a firm, hollow framework around the cork.
Thread the elastic band through the framework and fix the tension cork to the end of the cylinder.

Assemble the propeller cork:
Now you need to make your propeller cork: As before, unfold the paperclip leaving a J-shaped hook at one end, make a hole through the cork, and thread the paperclip through the hole.
Slide a washer over the straight end, and then a glass bead, then affix the propeller.
Hook the elastic band over the J-shaped hook in the propeller cork, and attach the cork to the fuselage.

Finally, add a stabiliser fin:
Roll a piece of card into a cylinder, then tape it to the fuselage. You are now ready to conduct your first flight, just wind the propeller and set your pilotless helicopter soaring into the air.

Tips

- Remember, keeping the weight down is important (when was the last time you saw a fat sparrow? Exactly).
- Which material (or combinations of materials) provides the most strength for the least weight?
- Try the helicopter without the curled card attached to the fuselage; what happens? Why do you think this is?
- Try the helicopter without the spacer bead; what happens? Why do you think this is?

Follow on activities

The only job of an aircraft is to carry a payload in the air – commercial aircraft carry passengers, fighter aircraft carry munitions, and surveillance aircraft carry cameras, radars and other detection systems.

- What is the maximum weight of payload that your helicopter can transport?
- Are any trade-offs required in terms of strength or propulsion power when carrying additional weight? Do you need to compromise the design in any way – use lighter materials, or a stronger elastic band?