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| **Stop it!** |
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| Developing a parachute-type system to slow a landing spacecraft |
| **Subject(s):** Design and Technology, Engineering, Mathematics**Approx time:** 60-90 minutes |  | **Key words / Topics:** * aeronautical engineering
* drag
* payload
* prototyping
* future of flight
* parachute
* spacecraft
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| **Stay safe** Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for:• ensuring that any equipment used for this activity is in good working condition• behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠ |
| **Suggested Learning Outcomes**  |  |  |
| * To understand how parachutes work to slow landing aircraft and spacecraft
* To be able to develop and test a prototype of a parachute system that would help to slow a landing spacecraft
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| **Introduction** |  |  |
| This is one of a series of resources designed to allow learners to use the theme of the future of flight to develop their knowledge and skills in Design & Technology, Engineering and Mathematics. This resource focusses on developing a prototype of a parachute type system that would help to slow a landing spacecraft and allow it to land safely.When spacecraft and jet aircraft land on the ground they are travelling very fast. Can you develop a method of reducing their speed so they can stop safely? |
| **Purpose of this activity**In this activity learners will make use of the theme of the future of flight to develop a parachute type system that will help a spacecraft to land and stop safely. They will be able to make some design decisions contributing to the performance of their solution. They will then test their prototype to see how well it works.This activity could be used as a main lesson activity to teach about developing and prototyping skills within an aviation theme. It could also be used as part of a wider scheme of learning to teach about aeronautical engineering concepts within Engineering, or about career opportunities within the aviation engineering sector. |
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| **Activity** |  | **Teacher notes** |
| **Introduction, context and brief (10 minutes)**Teacher to introduce and discuss the context and design brief shown in the presentation. Teacher to explain what is meant by drag and how parachutes work to increase this.**Prototyping their solution (30-40 minutes)**Learners to use appropriate materials to make a prototype. The presentation gives steps that can be followed as a starting point with some design options, but these could be altered depending upon the design decisions taken by individual learners (slides 6-10):* Step 1 - Decide what shape to make the parachute. Draw the shape on the fabric. Cut out the shape from the fabric.
* Step 2 - Decide how many strings are wanted. E.g. eight. Fold the circle in half and half again to mark out four points. Fold again to find the points in between. Mark each point with a clear dot. Make each dot 6 mm in from the edge.
* Step 3 - Cut string lengths that are at least as long as the shape is wide.
* Step 4 - Sew a string to each dot. Knot the strings securely, leaving as long a bit as possible on one end.
* Step 5 - Gather the strings together and tie a knot. Leave enough string to tie the payload on the bottom.

**Testing the prototype (10-20 minutes)**Learners to attach their payload to the big knot.They should then hold their parachute from a high spot and let it go, timing how long it takes to reach the ground.**Plenary (10 minutes)**Discuss with learners:* How well did your parachute work?
* How could it be modified to slow a spacecraft when landing?
 |  | **Introduction and brief**For further context, the teacher may wish to use the space shuttle as an example – when in service this used to land at about 220 miles per hour (354 kph).Parachutes have a very large surface area but pack away really small – this makes them ideal for spacecraft where space is limited.**Producing a prototype**A 36 cm pizza tray could be drawn around to create a circular parachute shape. The string length could be 40 cm for a 36.5 cm circle.Take care when using scissors and sewing needles/equipment.**Testing**A small lump of play dough weighing around 30 g could be used for the payload.If the school is in a building with stairways and balconies, the test could involve dropping the parachute from a suitable balcony.Always take care when working from heights. Teacher must ensure appropriate risk assessments are followed.**Plenary**Questions could include how well did the parachute slow the fall? Did the materials used work well? Did it avoid tearing or other damage on landing?  |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Pre-cut parachute materials in simple shapes and pre-cut strings to size.
 |  | * Make prototypes using different shapes of parachute.
* Use different weights and shapes of payload/spacecraft to slow.
* Perform calculations to ensure the area of the parachute is kept the same when changing its shape.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Pencils
* A3 or A4 paper
* Thin fabric e.g. rip stop nylon
* Thin string or thread
* Marker pens
* Weights or pieces of clay
* Scales
* Scissors
* Sewing needles
* Rulers
* Somewhere high to safely drop the parachutes when testing
 |  |  Presentation – Stop it! |
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| **Additional websites** |
| * **Encyclopedia Britannica - Leonardo da Vinci’s parachute:** Encyclopedia article about the parachute invented by Leonardo Da Vinci – could be used as part of a starter activity. <https://www.britannica.com/topic/Leonardo-da-Vincis-parachute-1704849>
* **NASA – Mars exploration:** Description of the parachute system used by the Mars rovers. <https://mars.nasa.gov/mer/mission/spacecraft/entry-descent-and-landing-configuration/parachute/>
* **Wikipedia – Splashdown:** <https://en.wikipedia.org/wiki/Splashdown>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * Research and discuss the history of parachutes.
* Analyse Leonardo Da Vinci’s design for a parachute and other existing designs.
 | **Plenary*** Evaluate the and prototypes produced against the requirements of the brief.
* Self/peer assess the prototypes produced.
* Competition to see who has the best parachute design.
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| **The Engineering Context** film |
| * The future of flight is a great context to explore the opportunities that working in the aeronautical engineering industry presents! For example, designing, making and maintaining aircraft and spacecraft, and all their different parts.
* Understanding how key concepts of flight work, such as drag, is essential for aeronautical engineers to be able to complete their roles safely and effectively.
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| **Curriculum links** |
| **England: National Curriculum**Design & Technology * KS3 1b, 2b

Mathematics * KS3 use a calculator and other technologies to calculate results accurately and then interpret them appropriately.

**Scotland: Curriculum for Excellence**Technologies* I can apply a range of graphic techniques and standards when producing images using sketching, drawing and software
* TCH 3-11a
 | **Northern Ireland Curriculum**Technology & Design* KS3 demonstrate understanding that the design process may contain some or all of the following: − design opportunity; − research; − brief; − specification; − idea generation and development; − manufacture; and − testing and evaluation.

**Wales: National Curriculum** Design and Technology* KS3 explore, develop and communicate design ideas in a range of ways, including annotation, drawings and CAD, e.g. clip art libraries, internet resources, scanners, digital cameras.
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| **Assessment opportunities** |
| * Informal teacher assessment of completed worksheets and designs.
* Self/peer assessment of designs produced.
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