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| **Build a popsicle stick catapult** |
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| Learning about levers by making a catapult |
| **Subject(s):** Design & Technology, Engineering**Approx. time:** 50-70 minutes |  | **Key words / Topics:** * Catapult
* Craft sticks
* Elastic bands
* Levers
* Structures
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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 be able to describe the three classes of lever
* To be able to make a structure
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| **Introduction** |  |  |
| The word ‘engineer’ was originally used to describe people responsible for building siege weapons in ancient times. When laying siege to towns and castles, it was common practice for skilled specialists to build catapults in an attempt to break down defences and demoralise the defenders. One particular type of catapult was the ‘onager’ – this was named after a type of wild donkey that was well-known for having a vicious kick. The specialists who constructed this were purportedly called ‘onager-neers’ which eventually became ‘engineers’.Most catapult designs are based upon the principles of levers. This resource introduces the concept of levers, the three classes of levers and examples of typical applications.This is one of a set of resources designed to allow learners to use Easter themes to develop their knowledge and skills in Design & Technology, Mathematics and Science. This resource involves making a simple catapult which works as a lever to propel a chocolate or mini egg. |
| **Purpose of this activity**In this activity learners will develop understanding of levers and build a simple catapult from craft sticks. This could be used as an engaging one-off main lesson activity to introduce levers. |
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| **Activity** |  | **Teacher notes** |
| **Introduction (15-20 minutes)**Teacher to explain that learners are going to make a catapult to fire mini eggs (or chocolates), based on the principles of levers. Teacher to use the presentation to introduce the classes of levers.**Making the catapults (25-30 minutes)**Teacher to demonstrate the steps shown in the presentation and listed below:* Step 1 – Make the fulcrum. Using elastic bands at each end, attach 4 (or 5) craft sticks together. Wrap the elastic bands around as many times as necessary to hold it securely
* Step 2 – Make the thrower. Using two elastic bands, attach the spoon to one end of a craft stick. Using one elastic band, attach a second craft stick to the underside of the other end of the first stick.
* Step 3 – Assemble the parts together. Wedge the block between the two craft sticks of the thrower. Wrap an elastic band about the point where it touches the craft sticks to hold it in place.
* Step 4 – Testing: Using one hand, hold down the catapult at the end. Place the chocolate mini egg in the spoon. Pull the spoon back – then release and launch the egg!

Learners to complete each step for themselves. The teacher presentation could be left on the whiteboard as a supporting guide as they do this.**Discussing the results of the activity (10-15 minutes)**Learners to compete to see whose catapult fires the mini egg the furthest. Teacher to ask what changes could be made to the design to make it more effective. |  | Thin strips of wood could be used instead of craft sticks. Small, narrow elastic bands are easier to use than thicker, larger elastic bands. Step 1 – the number of craft sticks in the fulcrum will change the angle of the throwing arm (which may change the distance of the throw) but the fulcrum point should be similar.Step 2 – ideally the back of the spoon should be flush to the craft stick, with only the scooped part protruding. The elastic bands should be separated as far as possible.Step 3 – in the presentation, the elastic band attaching the two sections was wrapped firstly around one side of the fulcrum, then the thrower, then the other end of the fulcrum.Step 4 - when testing the catapults, it is necessary to hold down the base, as the catapult can otherwise move substantially during use.Pictures of previous pupil designs are included in the presentation for reference, with close-up views of selected important features.  |
| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * An example could be provided for learners to copy.

 |  | * Learners could experiment with how the length of the throwing arm and the distance this is pulled back influence the length of the throw. They could plot their results as graphs.
* Learners could make an alternative design similar to an onager, using pencils (or similar), as shown in the presentation or listed in the additional websites. Note the way that the elastic bands are used to attach the throwing arm to the structure.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| Craft sticks (at least 7 per learner)Small elastic bands (at least 7 per learner, plus spares)A teaspoon (metal or plastic)Chocolate mini eggs (or similar)**For the extension activity:**Pencils (or similar, such as dowel rods)Elastic bands |  |  Build a popsicle stick catapult presentation |
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| **Additional websites** |  |  |
| * BBC bitesize videos explaining how levers work <https://www.bbc.co.uk/bitesize/clips/zrp6n39> and moments, levers and gears <https://www.bbc.co.uk/bitesize/guides/ztjpb82/revision/1>.
* Institute of Physics ideas for teaching approaches to introduce levers <https://spark.iop.org/collections/levers-teaching-approaches>
* Introduction to levers, with alternative examples of applications for each class <https://technologystudent.com/forcmom/lever1.htm>
* Alternative catapult design made from dowel rod held together by elastic bands <https://frugalfun4boys.com/2013/06/06/how-to-build-a-catapult-out-of-dowel-rods-and-rubber-bands/>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * How do levers work BBC Bitsesize video <https://www.bbc.co.uk/bitesize/clips/zrp6n39>
* Moments, levers and gears BBC bitesize video <https://www.bbc.co.uk/bitesize/guides/ztjpb82/revision/1>
 | **Extension** (Options)* Learners could experiment with how the length of the throwing arm and the distance this is pulled back influence the length of the throw. They could plot their results as graphs.
* Learners could make an alternative catapult design similar to an onager, as shown in the presentation or listed in the additional websites.

 **Plenary*** Testing and questions and answers about how the catapults could have been improved
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| **The Engineering Context** film |
| Levers are one of the simplest machines and are used in many applications. These include pliers, scissors, brake pedals and wheels and axles. The principles of levers are also used in many applications when designing sports equipment, such as cricket bats, golf clubs and hockey sticks. |

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| **Curriculum links**  |
| **England: National Curriculum**Design & Technology Key Stage 3Technical knowledge* understand and use the properties of materials and the performance of structural elements to achieve functioning solutions
* understand how more advanced mechanical systems used in their products enable changes in movement and force

Science Key Stage 3Motion and forcesForces* forces as pushes or pulls, arising from the interaction between two objects
* change depending on direction of force and its size
 | **Northern Ireland Curriculum**Science Key Stage 3Developing pupils’ Knowledge, Understanding and SkillsForces and energyForces and energy transfer |
| **Scotland: Curriculum for Excellence**Craft, Design, Engineering and GraphicsApplication of Engineering* TCH 3-12a.
 | **Wales: National Curriculum** Design and Technology Key Stage 3Making* 3. be creative in finding alternative ways of making if the first attempt is not achievable

Resistant materials and textiles* 13. understand that loads can cause material failures in structures by bending, twisting and stretching

Science Key Stage 3How things work4. the forces in devices and their relationship to work done and power |
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| **Assessment opportunities** |
| * Formal assessment of the completed catapult structures.
* Informal assessment of pupil responses on how to improve the designs.
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