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| **Balance the Broomstick** |
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| Using maths to balance a lever supporting different loads |
| **Subject(s):** Mathematics,Science, Design & Technology, Engineering**Approx timings:** 50-70 minutes |  | **Key words / Topics:** * Halloween
* balancing
* levers
* mass
* pivots
* units of measurement
* weight
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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 understand how a simple lever works.
* To understand how to balance a lever with different masses.
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| **Introduction** |  |  |
| This is one of a series of resources that are designed to allow learners to use the theme of Halloween to develop their knowledge and understanding in Mathematics, Science, Design & Technology and Engineering. This resource focusses on learners working out whether creatures and objects with different masses will successfully balance a lever, in this case the witch’s broomstick. |
| **Purpose of this activity**In this activity learners will make use of the theme of Halloween to learn how a simple lever works and how it can be balanced. They will work through a series of examples to see whether different animals sat at each end of the broomstick will balance it or not. They will then find as many ways of balancing the broomstick as possible, using a given set of creatures, animals and objects with different masses.This activity could be used as a main lesson activity to teach about simple levers and how they work, or to introduce the concept of levers, mass and balancing. It could also be used as part of wider scheme of learning focussed on simple mechanical systems and/or the use of mathematics in context. |
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| **Activities** |  | **Teacher notes** |
| **Introduction (10 minutes)**Teacher to introduce the aim of the activity and the Halloween theme.**The witch and her broomstick (20-30 minutes)**Teacher to use presentation slide 3 to introduce the witch and her broomstick, and the concept of a simple lever. Teacher to explain that the broomstick is the lever, and the witch is the pivot.Teacher to talk through example 1, shown on presentation slide 4, with learners. Ask them if they think the broomstick will be balanced in this situation. Teacher to then use presentation slide 5 to show the answer (the broomstick is not balanced) and discuss how it could be balanced. Learners to work through and write down their answers for examples 2-4 (presentation slides 6-11) one at a time, with the teacher showing the appropriate slides and discussing the responses once each is completed.**Balancing the broomstick (20-30 minutes)**Teacher to give learners the option of using each of the creatures, animals and object shown on presentation slide 12 to balance the broomstick. Learners to find as many different ways as they can of balancing the broomstick with the different loads - they can use each as many times as they like. |  | **Introduction and simple levers**A simplified version of a broomstick is presented here which assumes that the broomstick is balanced with the brush present at the back. This is to the reduce the complexity of working out whether the different masses balance it out. Because the witch is the pivot, her mass can be ignored for the purpose of this activity. Also, ignore the mass of the sticks on the back of the broomstick (assume this is 0 kg) and take the back end of the lever to be as shown on presentation slide 3.**The witch and her broomstick*** Example 1 -the broomstick is not balanced - it will tip backwards. The broomstick could be balanced by adding another cat with a mass of 3 kg on the front end of the broomstick.
* Example 2 - the broomstick is not balanced - it will tip forwards. The broomstick could be balanced by having two cats sat on top of each other at the back end of the broomstick, or one dog instead of the cat.
* Example 3 - there is a 6 kg mass at each end of the broomstick, so therefore it is balanced.
* Example 4 - the broomstick is not balanced - it will tip forwards. The broomstick could be balanced by having two dogs or four cats sat on top of each other, or one dragon, on the back end of the broomstick.

**Balancing the broomstick**Learners could draw or write down their responses on paper or in their exercise books.For weaker learners the teacher could print out sets of card broomsticks and the objects available, so that learners can complete by sorting visually.This could be made into a competition to see who can find the most ways of balancing the broomstick in a set time, e.g. 20 minutes. |

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| **Differentiation** |  | **Teacher notes** |
| **Basic** |  | **Extension** |
| * Use a physical example of a simple balancing lever to aid understanding.
* Simplify the examples so just the cat and dog are considered.
* Print out sets of card broomsticks and the objects available for the final balancing task so that learners can complete by sorting visually.
 |  | * Investigate the effect of moving animals up and down the broomstick - for example with two 3 kg cats, what would happen if they moved different distances from the witch (pivot point).
* Introduce the mass of the brush on a broomstick into the problem. What effect might this have?
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Pens and pencils
* Paper or exercise books
 |  | icon-ppt Primary Presentation – Balance the Broomstick |
| **Additional websites** |  |  |
| * **History.com – Halloween:** <https://www.history.com/topics/halloween/history-of-halloween>
* **BBC teach - KS2 Science: Levers and their mechanisms:** <https://www.bbc.co.uk/teach/class-clips-video/articles/zr3d239>
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| **Supporting starter and plenary ideas** |  |  |
| **Starters** (Options) * Discuss the theme of Halloween and how it links into this activity.
* Ask learners to write down two things they already know about balancing levers and two things they would like to know about the topic.
 | **Plenary*** Self/peer assessment of responses to each example problem.
* Quickfire quiz to assess knowledge gained and the meaning of key terms (pivot, lever, mass etc).
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| **The Engineering Context**  |
| * Engineers need to be able to understand and apply mechanical principles so they can use them when solving problems. For example, how levers work and how they can be used in the design of different mechanical systems.
* Engineers need to understand basic mathematical concepts, such as how units of measurement are used, and how these principles are applied in context.
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| **Curriculum links**  |
| **England: National Curriculum**Design & Technology KS1* explore and use mechanisms [for example, levers, sliders, wheels and axles], in their products

Science KS2* recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect

Mathematics KS1* mass/weight [for example, heavy/light, heavier than, lighter than]
 | **Northern Ireland Curriculum**The World Around us KS2* the causes and effect of energy, forces and movement
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| **Scotland: Curriculum for Excellence**Sciences* SCN 1-07a

Numeracy and mathematics* MNU 2-11a, MNU 2-11b
* MTH 2-12a
 | **Wales: National Curriculum** Primary – Science and Technology* Forces and energy provide a foundation for understanding our universe.
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| **Assessment opportunities** |
| * Formal teacher assessment of completed problems.
* Self/peer assessment of completed problems.
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