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| **How to make a potato battery** |
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| Making a potato powered light  |
| **Subject(s):** Design & Technology, Engineering**Approx time:** 60 - 90 minutes |  | **Key words / Topics:** * batteries
* electrical circuits
* light emitting diodes (LEDs)
* energy generation
* renewable energy
* sustainability
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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: ⚠ |
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| **Suggested Learning Outcomes**  |  |  |
| * To be able to create a battery using potatoes, which is able to light up an LED.
* To understand how a battery functions.
* To understand what is meant by, and the need for, renewable energy.
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| **Introduction** |  |  |
| This is one of a set of resources designed to allow learners to use seasonal themes to support the delivery of key topics within design & technology, maths and science. This resource is based on National Earth Day.As the global warming becomes more and more of problem across the world, it is becoming increasingly important to find ways of generating electricity that are more sustainable and environmentally friendly. Could potatoes be the answer?! |
| **Purpose of this activity**In this activity learners will use the theme of National Earth Day to design and make a potato battery that can provide enough energy to light an LED. This activity could be used as a main lesson activity to teach about the benefits of renewable energy sources and the importance of finding alternatives to fossil fuels. It could also be used as part of a wider scheme of learning focussing on energy generation and/or sustainability issues within design and technology and engineering. |
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| **Activity** |  | **Teacher notes** |
| **Introduction (15-20 minutes)**Teacher to explain that learners are going to produce a battery which can power an LED, using potatoes.Teacher to introduce and hand out resources required for the task to learners.**Which of these will power an LED? (5-10 minutes)**Use the teacher presentation teacher (slide 2) to show different examples of fruit and ask learners which could be used to power an LED. Discuss and show answers on the following slide.**Making the potato powered circuit (40-60 minutes)**Teacher to demonstrate the steps shown in the presentation and listed below:* Step 1 - Place the coins and nails into each potato as shown.
* Step 2 - Attach a RED clip to the coin in potato 1. Attach other RED clip to the nail in the potato 2.
* Step 3 - Connect the coin from potato 2 to the nail in potato 3 with a RED clip.
* Step 4 - Connect a RED clip to the coin in potato 3. Connect a BLACK clip to the nail in potato 1 to the coin in potato 4. Connect a BLACK clip to the nail in potato 4.
* Step 5 - Connect the free BLACK clip from potato 4 to the short leg on the LED. Connect the free RED clip to the longer leg on the LED.
* Step 6 - The complete circuit will cause the LED to emit light.

Learners to complete each step for themselves. The teacher presentation could be left on the whiteboard as a supporting guide as they do this.**Plenary (5 minutes)**Class discussion of possible applications of potato power, such as a renewable power supply for different products. |  | This activity could be completed as individuals, in pairs or in small groups, depending on resources and equipment available.**Which of these will power an LED?** To make a battery from organic material all you need is two metals - an anode, which is the negative electrode, such as zinc, and a cathode, the positively charged electrode, such as copper. The acid inside the potato forms a chemical reaction with the zinc and copper, and when the electrons flow from one material to another, this releases energy.**Equipment and resources**The coins must be copper, e.g. 1p or 2p. Nails must be zinc coated.**Making the potato powered circuit**For step 1 there needs to be adequate coin/nail above the surface of the potato to attach the crocodile clips to.Do not let the coins and nails touch each other on each potato. It can help insertion to use a knife to make slits in the potato first, under appropriate supervision.In step 2 onwards the potatoes are labelled for ease of following the instructions. Ask learners: what is the difference between the red and black cables? Why does it matter which way around they are connected? In step 3, tie a knot in the crocodile cables if they are too long, as this prevents them looking messy and getting tangled. Physically number the potatoes if students are struggling with the concept, using a marker pen.In step 5, make sure the correct clips are on the correct legs of the LED (red to long leg, black to short leg). If they are connected the wrong way around the LED will not light. Make sure that the crocodile clips do not touch each other. |
| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Get learners to physically number each potato with a marker pen – this will make connecting them together easier.
* Cut slits in the potatoes with a knife to enable ease of inserting the coin and nail.
 |  | * Experiment with a combination of fruit, potatoes and other vegetables to see which combinations work. Are any better than others?
* Use a multimeter to measure the exact voltages produced by each potato within the circuit and the circuit as a whole.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| Per learner, pair or small group:* 4 Potatoes
* 3 Red crocodile clips
* 2 Black crocodile clips
* 4 Coins (2p/1p)
* 4 Zinc plated nails
* Light emitting diode (LED)
 |  | icon-ppt How to make a potato battery presentation |
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| **Additional websites** |  |  |
| * **The earth day website:** earthday.org
* **YouTube – Earth Day for kids:** https://www.youtube.com/watch?v=yl3zgcL0Tv8
* **BBC Bitesize – Renewable energy:** Video and revision notes explaining sustainability and the uses, advantages and disadvantages of different renewable energy sources. <https://www.bbc.co.uk/bitesize/guides/zf8ck2p/revision/3>
* **Association for Renewable Energy website:** Website for a not-for-profit organisation that champions the development and use of renewable energy solutions. <https://www.r-e-a.net/>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * Watch the earth day for kids clip on you tube: <https://www.youtube.com/watch?v=yl3zgcL0Tv8> and discuss the purpose of National Earth Day.
* Discuss which types of fruit can be used to power an LED bulb.
* Discuss the advantages and disadvantages of different types of renewable energy sources.
 | **Extension** (Options)* Experiment with a combination of fruit, potatoes and other vegetables to see which combinations work. Are any better than others?
* Use a multimeter to measure the exact voltages produced by each potato within the circuit and the circuit as a whole.

**Plenary*** Discuss possible applications of potato power, such as a renewable power supply for different products.
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| **The Engineering Context** film |
| * Engineers have a social and moral responsibility to consider the effects of the environment when solving design problems.
* The renewable energy sector is one of the biggest growing industries within engineering, so an understanding of ways to produce greener energy is essential for anyone looking to become an electrical or electronic engineer.
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| **Curriculum links** |
| **England: National Curriculum**Design & Technology * KS3 2a, 3d, 4c

**GCSE D&T**AQA D&T* 3.1.1, 3.1.2, 3.1.4, 3.2.3, 3.3.2

Edexcel D&T* 1.1.3, 1.1.7a, 1.2.2d, 1.2.4, 1.3, 1.6.3c, 5.2.3b

Eduqas D&T* Core: 1, 2, 3, 5
* Electronic systems: 1, 2

OCR D&T* 2.1a vi, 2.2a, 3.1a, 3.2, 6.4b i
 | **Northern Ireland Curriculum**Technology & Design* KS3 Developing pupils as contributors to the economy and the environment: Pursue design solutions using environmentally friendly materials and energy sources
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| **England: GCSE Engineering*** 3.1.3, 3.3.2, 3.3.3

**Scotland: Curriculum for Excellence**Technologies* TCH 3-07a, TCH 3-12a
 | **Wales: National Curriculum** Design and Technology* KS3 Skills: Designing 8
* KS3 Skills: Making 1, 2
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| **Assessment opportunities** |
| * Informal teacher assessment of practical skills through observation of learners.
* Formal teacher assessment of the completed potato battery.
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