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| **Calculate energy use at home** |
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| Calculating the energy used by different electrical appliances and devices within the home |
| **Subject(s):** Design and Technology, Engineering**Approx time:** 40-70 minutes |  | **Key words / Topics:** * current
* efficiency
* electricity
* electrical energy
* kilowatt hours
* national grid
* power
* voltage
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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 calculate the power consumption of different appliances using P = I V
* To be able to calculate the energy consumption of different appliances
* To be able to show calculated data as part of a table
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| **Introduction** |  |  |
| This is one of a series of resources developed in association with the National Grid ESO, to allow learners to develop their knowledge and skills in Design & Technology and Engineering. This resource focusses on calculating the energy usage of different appliances and considering how this could be reduced. National Grid ESO ensure that Great Britain has the essential energy it needs by ensuring supply meets demand every second of every day. |
| **Purpose of this activity**In this activity learners will calculate the energy usage of different electrical appliances. They will first calculate the power consumption using P = I V, then use the results of these calculations to work out how much energy each uses in kilowatt hours (kWh).This activity could be used as a main lesson activity to teach about electrical power and energy, and how each are calculated. It could also be used as part of a wider scheme of learning focussing on electricity and the National Grid or as an exercise to use mathematical skills in a practical context.  |
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| **Activity** |  | **Teacher notes** |
| **Introduction (10 minutes)**Teacher to explain the task to learners and explain that they are going to calculate how much energy different appliances in the home use.Learners to list all the electrical appliances they use at home and at school. **Mains electricity (5-10 minutes)** Teacher to explain what is meant by mains electricity and how it is transported to our homes. Teacher to explain that in the UK mains electricity is 230 V AC and what this means in terms of safety.**Calculating power (10-20 minutes)**Using slide 6 of the presentation, teacher to explain how power is calculated using P = I V and why we need to do this before calculating energy usage.Learners to complete Task 1 on the worksheet by calculating the power used by each of the electrical appliances shown on slide 7. Teacher to share the answers on slide 8 once this is completed.**Energy used (10-20 minutes)**Teacher to use slide 9 to explain how energy usage is calculated in kilowatt hours (kWh), by multiplying the power in kW by the number of hours in use.Learners to complete Task 2 on the worksheet by calculating the power used by each of the electrical appliances. Teacher to share the answers on slide 11 once this is completed.**Review (5-10 minutes)**Teacher to discuss the outcomes with learners and ask questions about what they have learnt.* What do their answers mean?
* Are they surprised by any of these results?
* How could they reduce their own energy usage?
 |  | **Introduction**Learners could present their responses as a list or a spider chart. Slide 4 of the presentation could be used as a follow up to the starter to discuss the different types of power sources often used within homes.**Mains electricity**Explain that mains electricity in the UK and Europe is at 230 V (both were brought in line from their respective 240 V and 220 V in 2009), which can be very dangerous if live wires are touched. It is different some countries, e.g. 120 V in the USA. This means that devices designed for one country’s mains power supply will not always work in a different country.**Calculating power (task 1)**Calculators will be needed.Recap that current is measured in amps (A) and that kilo is x 1000, if necessary. Power needs to be calculated before the energy used by different devices, as energy is power x time. Useful supporting link - <https://electronicsclub.info/power.htm> The appliances given could be exchanged for others as required. Information about current draw can usually be found on a sticker on the appliance itself, or approximate values can be found online.When using P = I x V with alternating current (AC) devices, the power found is an instantaneous value, i.e. the value at a particular instant. This is fine for the purpose of these calculations, and doesn't need any further explanation to learners at this stage.Explain that for the next stage we need the values to be in kW.**Calculating energy usage (task 2)**Calculators will be needed.Usage times are approximate for a day’s use of each appliance and can changed as required by the teacher. |
| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Complete the power calculations in advance so learners only need to multiply by the hours used to work out the energy consumption of each appliance.
* Provide partially completed examples of the calculations.
 |  | * Find other appliances at home or at school where the power requirements can be easily identified. Work out how much power each appliance uses every day and explain how to their reduce usage.
* Design a poster to convince people to turn unused appliances off to save energy.
* Write a short blog post about electrical energy consumption and how this can be reduced.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Writing implements (pens or pencils)
* Calculators
 |  |  Presentation – Calculate energy use at homeicon-pdf Worksheet - Calculate energy use at home |
| **Additional websites** |  |  |
| * **National Grid website:** Homepage for the National Grid with lots of information about the network. <https://www.nationalgrid.co.uk/>
* **National Grid map:** A map showing the different transmission lines across the UK. <https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/network-route-maps>
* **National Grid Education resources:** <https://www.nationalgrid.com/national-grid-ventures/education-hub>, <https://www.nationalgrid.com/document/136696/download>, <https://www.nationalgrid.com/document/136736/download>
* **Electronics Club – Power and energy:** Explanation of the different formulae used the calculate electrical power and energy. <https://electronicsclub.info/power.htm>
* **Ofgem - Electricity use explained:** Regulator website for the electrical power industry explaining how energy consumption is worked out. <https://www.ofgem.gov.uk/information-consumers/energy-advice-households/average-gas-and-electricity-use-explained#:~:text=Energy%20usage%20is%20calculated%20in,1%20kWh%20in%2026%20hours>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * List electrical appliances used at home and at school.
* Discuss the problems caused by using too much electrical energy.
* Complete National Grid teaching activities: <https://www.nationalgrid.com/document/136696/download>, <https://www.nationalgrid.com/document/136736/download>
 | **Plenary*** Discuss the meaning of the results calculated.
* Discuss the benefits of reducing electrical energy consumption.
* Self/peer assess the completed calculations.
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| **The Engineering Context**  |
| * Engineers have a moral and ethical responsibility to ensure that their work is sustainable and that they do not negatively impact the environment. This includes reducing energy consumption wherever possible. As such, it is important that all engineers understand how products and systems are powered and how much energy they use.
* Power engineering is a very important field which focusses on how energy is generated, transmitted and used by homes and businesses. There are lots of well-paid and rewarding careers available in this area.
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| **Curriculum links** |
| **England: National Curriculum**Design & Technology * KS3 4c

**GCSE D&T**AQA D&T* 3.1.1, 3.1.2

Edexcel D&T* 1.1.3c, 1.3

Eduqas D&T* Core: 1, 3

OCR D&T* 3.2

**Mathematics*** KS3 – use standard units

**England: GCSE Engineering*** 3.1.3, 3.3.2
 | **Northern Ireland Curriculum**Technology & Design* Developing pupils as contributors to the economy and the environment
* Identify product needs and pursue sustainable harmonious design solutions in a local outdoor/indoor context
* Education for sustainable development.
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| **Scotland: Curriculum for Excellence**Technologies* TCH 3-05a

Mathematics* MNU 2-11b
 | **Wales: National Curriculum** Design and Technology* KS3 Systems and controls: 16

Science and Engineering* Design thinking and engineering offer technical and creative ways to meet society’s needs and wants.
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| **Assessment opportunities** |
| * Formal teacher assessment of completed tables and calculations for power and energy usage.
* Self/peer assessment of completed tables and calculations for power and energy usage.
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