



# Lots and Lots of Lightbulbs: A Teacher's guide

*By The Cambridge Centre for Gallium Nitride Outreach Team*

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## Introduction

The “Lots and Lots of Lightbulbs” video workshop was originally recorded for the 2021 Cambridge Festival, as an activity that could be done from home during the global pandemic. However, with a little adaptability it can be used, in whole or in part, as a workshop for classes in schools or for homeschooling. It is broadly intended for use with Keystage 1 classes, but may also be suitable for younger children in Keystage 2.

The overall aim of the workshop is to introduce children to the idea that various lightbulbs have different energy efficiencies, and to help them think about how energy is used or wasted in their homes and wider environment. There is an emphasis on light emitting diode (LED) bulbs as an energy efficient light source. The workshop is divided into 6 videos with a short activity at the end of each, creating a workshop lasting around an hour, including just under 40 minutes of video content, or the videos can be used separately as standalone inputs into other teaching. Each video is explained briefly below.

## Section 1: Introduction

This short introductory video explains the format of the workshop and a bit about how lightbulbs work, and how this relates to the generation and use of electricity. The first activity, at the end of the video, asks children to count up how many lightbulbs they have in their house. For use of the video workshop in a school classroom, you might like to ask the children to fill in the pre-workshop worksheet at home before using the videos. This is available as a printable for [download](#) and the first question asks them to count up how many lightbulbs they have in their house. Alternatively, you could go on a bulb hunt around the school, counting up lightbulbs!

## Section 2: What do light bulbs need to work?

This video shows that light bulbs need a source of electricity to work and asks children to think about where electricity comes from. It includes a demonstration of how electricity can be generated using a hand-cranked generator, where a handle is manually turned to rotate a magnet in a coil. The video ends by asking children to discuss how the electricity that they use might be generated, and includes a final image with some helpful hints as to possible answers to that question. This might be an opportunity for class discussion on this topic.

## Section 3: Where does electricity come from?

This video discusses how electricity is generated. It starts with a discussion of how fuel can be burnt and used to generate electricity. It discusses steam generators in power stations, and includes a demonstration of a Stirling engine, where the heat from a burning candle is used to generate electricity and light an LED bulb. We talk about some of the disadvantages of burning fuel to generate electricity in terms of producing carbon dioxide and the consequences for global warming.

We then introduce a solar cell, and use that to light an LED, as an example of a more sustainable way to generate electricity. As a precursor to the next video, the task at the end of this video then asks the children to look for different kinds of light bulbs in their homes. In the classroom, this can be addressed by either using the pre-workshop worksheet, which also addresses this question. Alternatively, children could look for different types of lightbulbs in their school, or teachers could provide examples for them to look at.

#### **Section 4: How much electricity do light bulbs use?**

This video explains three different types of light bulbs – the traditional filament bulb, compact fluorescent bulb, and LED bulb. It includes two demonstrations to show that LED bulbs use less energy than other bulbs, one using a hand-cranked generator and one using a power meter. The experiment with the power meter provides an opportunity for children to read two digit numbers off a display and to practice their understanding of place value. To do this, a teacher might like to pause the video before the demonstrator reads the number off the display, or the video could be played with the sound off for this segment. The activity at the end of the video asks children to decide which bulb uses the most electricity and which the least by looking at the relevant data in a table.

#### **Section 5: Where does the wasted energy go?**

Having concluded that some bulbs use more energy than others, we talk about the fact that the extra energy is wasted – i.e. not turned into light. We use two different demonstrations which show that the wasted energy is lost as heat: a convection spinner which turns using the hot air rising from a hot bulb, and an infra-red camera which shows the heat lost from the bulbs. The last part of this video asks about other devices which waste energy and hence give off heat and suggests touching a phone or laptop charger to feel how hot it gets. This activity can be done in the classroom if a suitable device is available.

#### **Section 6: Investigate wasted energy yourself!**

In the final section, we introduce a hands-on activity which allows the children to make their own convection spinner, and demonstrate how to make it. Convection spinner printouts are available to [download](#). To make a spinner, the children will also need a piece of sewing thread, a pair of scissors, a needle and some colouring pens or pencils. Most children in this age-group will need help adding the thread to their spinner, so teachers may wish to prepare for this aspect in advance. The spinners once made can be used to detect rising heat from lamps, radiators or other sources. They should not be held over naked flames as this is a fire hazard. If students do make spinners and photos or videos are sent to [gan-schools@msm.cam.ac.uk](mailto:gan-schools@msm.cam.ac.uk), we will display them on our website or social media channels.

#### **Live interaction**

If you are running the full workshop from the videos and would also like to hold a Question and Answer session via zoom or skype, please email at us at [gan-schools@msm.cam.ac.uk](mailto:gan-schools@msm.cam.ac.uk) and we will try and organise for one of the scientists who was involved in the making of this video to speak with your class.

**Contact us:**  [gan-schools@msm.cam.ac.uk](mailto:gan-schools@msm.cam.ac.uk)

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