

Better batteries activity sheet

39 Ways to Save the Planet

Battery power

A battery stores chemical energy and converts it to electrical energy. Since the Italian physicist Alessandro Volta stacked alternate discs of copper and zinc to create the world's first battery in 1800, they have proved indispensable to modern day life. This resource has been created to accompany the BBC Radio 4 series 39 Ways to Save the Planet. Listen to the episode [Better batteries](#) to understand more.

Can you imagine a world without batteries? All electronic equipment (toys, watches, remotes, laptops, mobiles, torches etc.) would need to be tethered by a wire to a power supply. Remember, once upon a time, even home landlines were all hard-wired to telephone wall sockets for transmission!

A dry cell battery is the most common type of battery used today. It converts stored chemical energy into electrical energy. Internally there are 3 sections to a battery: an **anode (-)**, **cathode (+)**, and the electrolyte, consisting of zinc, graphite, and ammonium chloride paste. A chemical reaction within the battery causes a build-up of electrons in the **negative terminal** anode, creating an electrical imbalance between the anode and the **positive terminal** cathode. The electrolyte prevents the extra electrons rearranging directly into cathode. When a 'conductive path' is created, **the flow of electrons** travels to the cathode — providing power to any appliance along the way in the closed circuit.



Figure 1 batteries have enhanced product mobility but also pose a recycling challenge © John Cameron

1. Using the introductory description of a battery, particularly the 5 words in **bold**, correctly label the arrows in the dry cell battery (Figure 1).

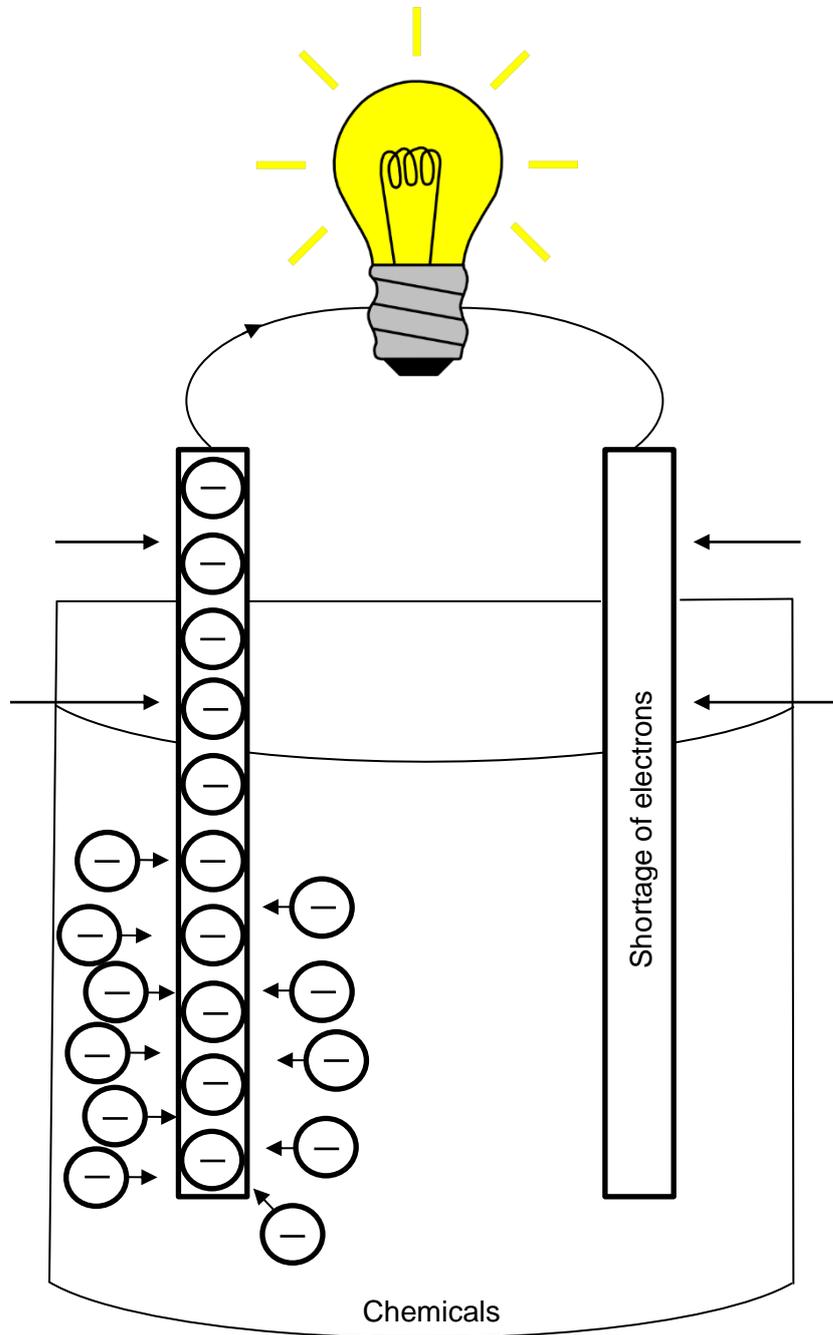


Figure 1 a battery based on © [dummies](#) and [cleanpng](#) light bulb

Better batteries

Batteries are an incredibly important source of power. They are found in most electrical devices and provide the initial power needed to start engines, for example. Batteries also often act as an important backup source of electricity in telecommunications and public transport — and they will become a critical component in the fight against climate change as governments, companies and individuals go through the energy transition to a low-carbon world i.e., by adopting electric vehicles (EVs).

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Better batteries allow things to become electronic, and as the technology improves storage times will increase.

2. Many car manufacturers have brought their production cycle forwards to 2025 for electric vehicles (most originally identified 2030 in their plans). What is the concern about batteries in the UK?

EV batteries have seen a recent surge in demand. In October 2021 Envision announced plans to expand the UK's only gigafactory (a very large manufacturing facility) in Sunderland. Zhang Lei, the chief executive of the Chinese company Envision, said the facility's annual capacity would eventually increase from its current output of 1.7GWh to 38GWh per year, enabling the site to produce thousands more EVs per year. However, the Faraday Institution (which is backed by the UK government) has calculated that the country will ultimately require annual battery output of about 140GWh a year by 2040 if it is to sustain a car industry of similar size after the transition away from internal combustion engines and fossil fuels.



Figure 2 a rechargeable battery for the electric Kumpan 54 Iconic (a scooter) © Kumpan Electric Unsplash

The key concern regarding batteries is environmental impact. New lithium-ion rechargeable batteries can create a huge amount of damage to the landscape, both in production (mining lithium, nickel, and cobalt) and when they reach end-of-life, as car battery recycling is still in its infancy.

3. When will the first wave of EV batteries come to their 'end-of-life' and need recycling?

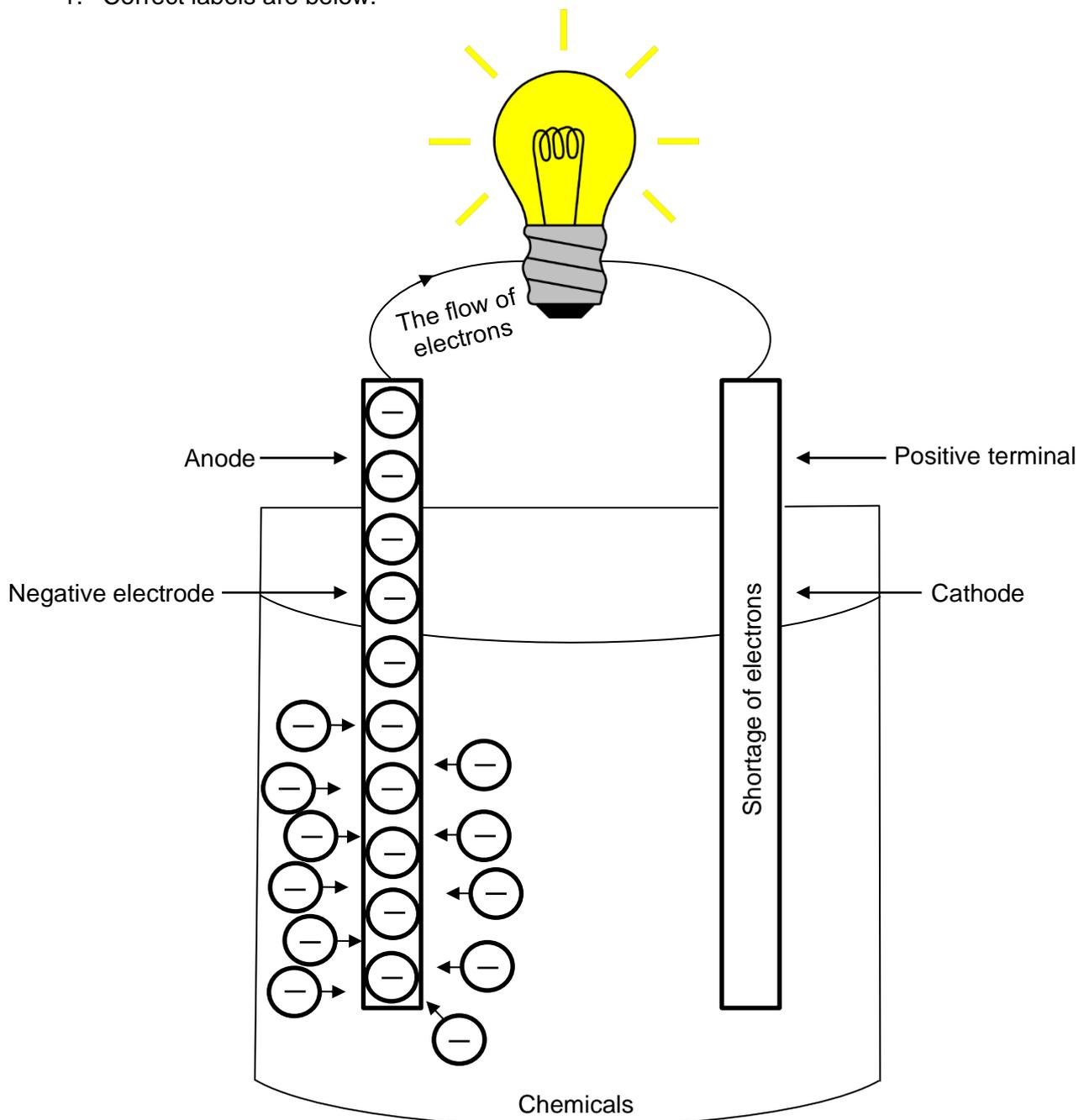
Further reading

- Phys org [The history and development of batteries](#)
- Dummies [How Batteries Work](#)

- FT [UK's first 'gigafactory' set for huge expansion](#) by Envision
- [UK battery 'gigafactory' plans huge expansion as electric car demand soars](#), The Guardian
- Autocar [Bentley boss: make UK a "safe haven" for battery production](#)
- The Guardian [Blow to UK battery industry hopes as Johnson Matthey halts research](#), as it is lagging too far behind rivals already making batteries at scale
- In-depth teaching resource [2021: The year of the electric car](#)

Answers

1. Correct labels are below.



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2. There is not enough domestic production in the UK to meet the recent seismic shift in the adoption of electric vehicles. As a consequence of sudden consumer demand there is a pressing need to build up the manufacturing capability across all of the suppliers in the UK battery supply chain. Professor John Goodenough is credited as developing the world's first commercial lithium-ion rechargeable battery (whilst at the University of Oxford) in the 1980s, but the UK failed to commercial it (whilst Japan did).
 3. 2027 or 2028. Low-carbon content will be needed, as well as localised recycling facilities which do not require shipping around the world at the 'end-of-life' stage.

Suggested questions for Better batteries

- a. At the UK industrialisation centre what do scientists hope to achieve in battery research?
- b. At the moment, which two countries have the highest number of 'big battery manufacturers'?
- c. What is the emission level for carbon dioxide from cars and buses?

An RGS-IBG expert

Go to [What our experts say](#) to hear further analysis from Society Fellow Dr Carlos Fernandez from Robert Gordon University.

