MEDIUM | 5 – 11 YRS | 1 HR

1. Find out where fossil fuels come from
2. Discover how we can make a simple chemical battery and use it to power an electric candle
3. Explore how batteries work

INNOVATION IN CHEMISTRY

BRILLIANT BATTERIES FOR A FOSSIL-FREE FUTURE

Salters' Institute

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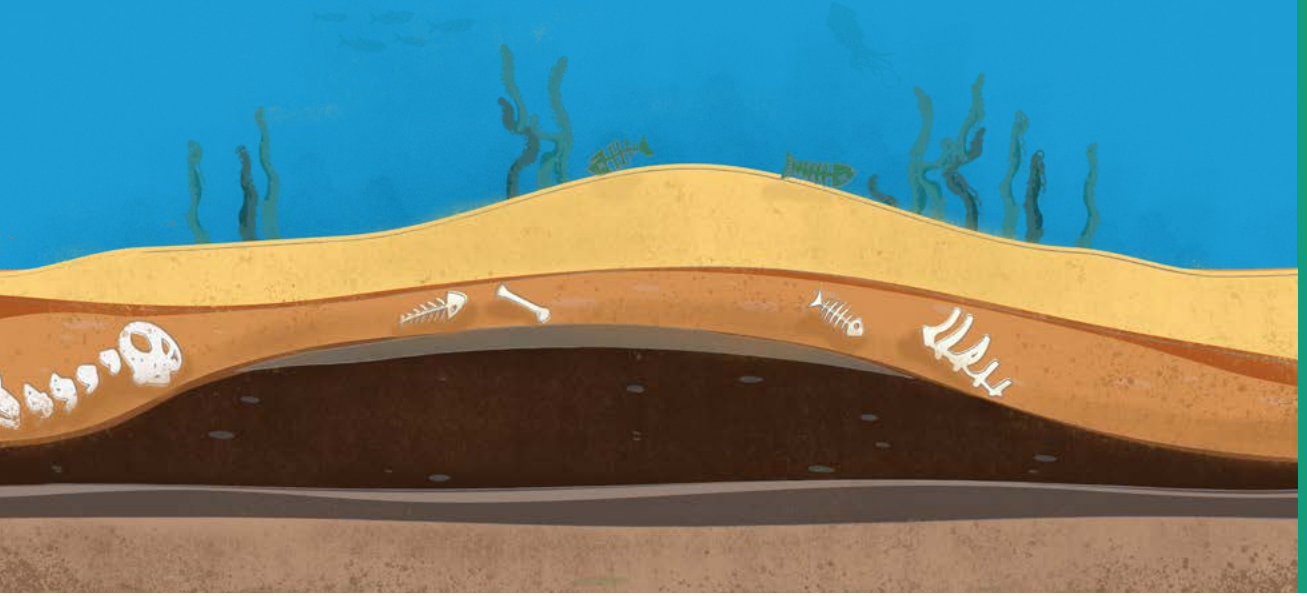
INTRODUCTION

Fossil fuels like oil, gas and coal are made from the dead plants and animals.

The dead plants and animals fall to the bottom of the seabed or swamps and are covered with layers of mud and sand. Over millions of years, they are squashed and eventually they turn into fossil fuels. These fossil fuels can be burned to create power and to power vehicles. This releases gasses that contribute to climate change.

Scientists have invented clever ways of generating electricity from sources that do not release gasses that contribute to climate change such as: solar panels, wind turbines and hydroelectricity schemes. These energy sources are called renewable energies. One of the main challenges with electricity is that it is difficult to store. Batteries allow us to store electricity and use it later.



SAFETY

- Take care with sharp knives
- An adult should cut the lemons before starting
- Any batteries should be removed from the battery candle by an adult before starting and stored in a safe place out of the reach of children

DID YOU KNOW?

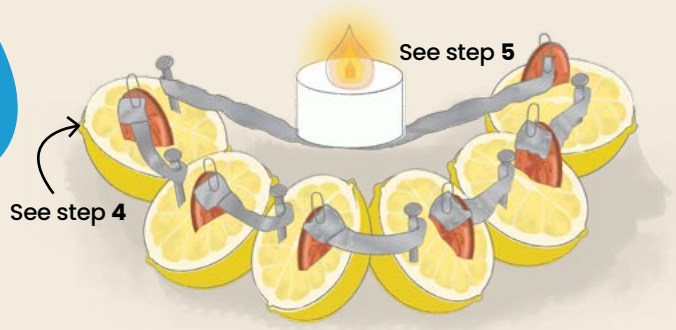
There are many types of battery, but most laptop, pacemaker and mobile phone batteries contain the element lithium. The earth's supply of lithium is very small and will eventually run out. Chemists are currently developing batteries that will use more common elements such as sodium and potassium.

References: Pacemakers: NHS website

Batteries with sodium and potassium: Mohan, I., Raj, A., Shubham, K., Lata, D.B., Mandal, S., Kumar, S. (2022)

Potential of potassium and sodium-ion batteries as the future of energy storage: Recent progress in anodic materials. Journal of Energy Storage v55B 105625 can be viewed at www.sciencedirect.com/science/article/abs/pii/S2352152X22016139

ACTIVITIES



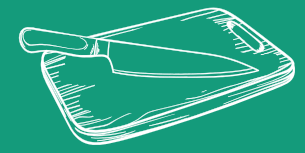
INSTRUCTIONS

1. Soak the 2p coins in vinegar overnight to clean them. Rinse in warm water and dry. Before starting the experiment adults should remove the tealight batteries and cut the lemons in half.
2. Line the six lemon halves up side by side in a straight line. Insert a nail into the left-hand side of each lemon half, until half the length the nail is visible above the surface. Push a 2p coin into the right-hand side of each lemon half until half the coin is visible above the surface of the lemon.
3. Cut out 2 pieces of kitchen foil approximately 40cm x 6cm. Fold each piece lengthways in half and half again to form 40cm long narrow strips, these will be your 'wires'. Cut these into five shorter 10cm lengths and 2 longer 15cm lengths.
4. Starting with the lemon on the far left hand side, use 1 short kitchen foil wire to connect the 2p coin to the nail in the next lemon on the right. The wire can be wrapped around the nail to secure it. Repeat this process so each lemon has a wire connecting its 2p coin with the nail in the lemon to the right of it. Use the paperclips to securely attach the wires to the 2p coins.
5. Using a longer length of kitchen foil wire, attach one end to the nail on the lemon furthest on the left. Attach the other end to the negative (-) terminal of the battery tealight. Take the other longer length of tin foil wire and attach one end to the 2p coin on the lemon half furthest on the right. Attach the other end to the positive (+) terminal of the battery tealight. Use tape to secure the tin foil wires to the correct terminals on the battery tealight.
6. Switch on the battery tealight and look at the bulb in a darkened room. What's happened? Where is the electricity to light up the bulb coming from?

CHALLENGE

What happens if you connect up more lemon halves in the same way? Does the LED bulb get brighter?

YOU WILL NEED



- 3 x large lemons
- Knife and chopping board
- 6 x paperclips
- Kitchen foil
- Ruler
- 1 x battery powered LED tealight (this experiment was tested with tealights powered by AG13 or CR2032 batteries)
- 6 x zinc galvanised nails at least 4cm long (almost all nails that can be purchased in shops are zinc galvanised)
- 6 x 2p coins
- Malt or white vinegar to clean the 2p coins before starting
- Sticky tape
- Scissors

WHAT'S HAPPENING?

By placing two different metals in an acidic liquid like lemon juice, a chemical reaction happens and a very tiny amount of electricity is produced. This is a simple battery.

Electricity can flow through metals. Kitchen foil is made from the metal aluminium. The foil wires carry the electricity to connect the lemon batteries to each other and the tealight bulb and form a circle which means the electricity can flow in one direction. By connecting six of these simple lemon batteries, the electricity produced is added together and is just enough to power the tealight bulb.

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