

IT'S CRUNCH TIME!



HOW CAN A CRUNCHIE BAR HELP US LEARN ABOUT BATTERY RECYCLING?



To understand:

1. The different ways we can recycle batteries
2. The differences between these battery recycling methods
3. The advantages and disadvantages of these techniques

THINGS YOU WILL NEED

Adult supervision needed!



To start with... A QUIZ! (ANSWERS AT THE END)

1. Circle the items that contain a battery.



Microwave



TV Remote



Mobile Phone

2. What is a rechargeable battery? Do any of the items above contain a rechargeable battery?
3. How many batteries are thrown away in the UK every year? Circle the answer

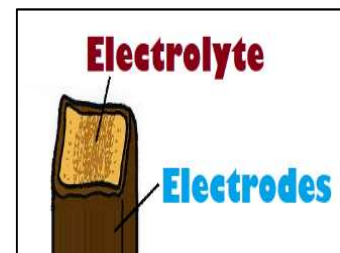
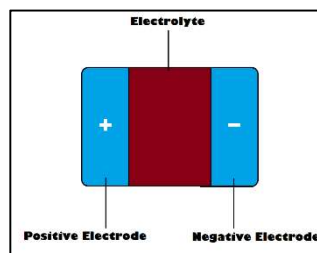
600 million

600

60,000

As you found out in the quiz, **MANY** batteries are thrown away each year. These batteries contain lots of valuable **MATERIALS** that we want to reuse, therefore it's very important to recycle them! **RECYCLING** is hugely important to ensure we don't damage our natural environment.

Batteries have three main parts, a positive electrode, an electrolyte, and a negative electrode. In our experiment, the chocolate represents the 2 electrodes and the honeycomb is the electrolyte. When we recycle, we want to separate these parts.



THE EXPERIMENT brought to you by scientists Beatrice Browning and Rosie Madge



METHOD 1 - Melting batteries (pyrometallurgy)

Firstly, the batteries (your Crunchie bar) are crushed up to make them easier to dissolve.

1. Take 1 Crunchie bar and smash it up into small pieces with the rolling pin.
2. Add half of the pieces of Crunchie into your microwave-safe bowl, and the other half to a cup.

Pyrometallurgy: The shredded battery is heated in order to melt. The melted mixture can then be mixed with other materials to make new batteries

3. Firstly, focussing on melting, heat the Crunchie pieces in the microwave until they are fully melted, stirring every 30 seconds. **Take care as it will get very hot!**
4. With help from an adult, pour the melted chocolate mixture into your ice cube tray and leave to set in the fridge.

TIME TO THINK



How easy was it to melt together the crushed Crunchie?

Does the chocolate from the ice cube tray look the same as your original chocolate bar?

METHOD 2 - Dissolving batteries (hydrometallurgy)

Firstly, the batteries (your Crunchie bar) are crushed up to make them easier to dissolve.

1. Take 1 Crunchie bar and smash it up into small pieces with the rolling pin.

This crushed battery material is then added to a special solution to separate parts of the battery.

2. Fill your cup with warm water, add the crushed crunchie bar and stir with your spoon. Keep stirring until all your honeycomb is dissolved.

TIME TO THINK



What happened to the honeycomb and the chocolate when they were stirred in warm water?

Is there any way to get the honeycomb and chocolate back out of the water again?

METHOD 3 - Separating battery components

Scientists are working on this method at the moment, as we want to avoid crushing up batteries as much as possible!

1. Take your whole Crunchie bar, and using the knife, try to separate all of the chocolate from the honeycomb so that they are completely separate. **Take care when cutting with a knife!**

TIME TO THINK



Can you think of any other ways to completely separate the chocolate and the crunchie?

What are the advantages/disadvantages of this method?

What have we learnt?

Method 1: Pyrometallurgy

Melting the batteries is not always that easy.

The material you recover is of lower quality than your original battery material (as you can see from your melted crunchie in your ice cube tray!)

Method 2: Hydrometallurgy

Dissolving the batteries is not always that easy.

Different parts of the battery will dissolve more easily than others (as you can see from the different ways that the chocolate and honeycomb dissolve!)

Method 3: Separating battery components

If separated successfully using the method where you break apart the battery (closed-loop recycling), the honeycomb and chocolate pieces can easily be "reused".

As you will have found, however, there is quite a lot of difficulty in getting all the components completely separate without any contamination. Scientists from the Faraday Institution are trying really hard to find ways to do this!

Find out more about batteries with Professor Saiful Islam who even entered the Guinness World Record books' during his [Fully Charged](#) Royal Institution Christmas Lecture!



Send us pictures of your experiments!



@B_Browning_
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Watch this video about [Dana Thompson's](#) work on battery recycling with the [Faraday Institution](#).



Watch [Lizzie Driscoll's](#) video to learn more about the how the Li-ion battery functions!
[The Lithium Shuffle Project](#)

For more battery related experiments check out the ['Faraday Fully Charged Battery Box'](#) available from the [Curiosity Box](#)

QUIZ ANSWERS: 1 - TV remote and mobile phone, 2 - A battery you can keep reusing, by charging it up when the battery dies. The mobile phone, 3 - 600 million