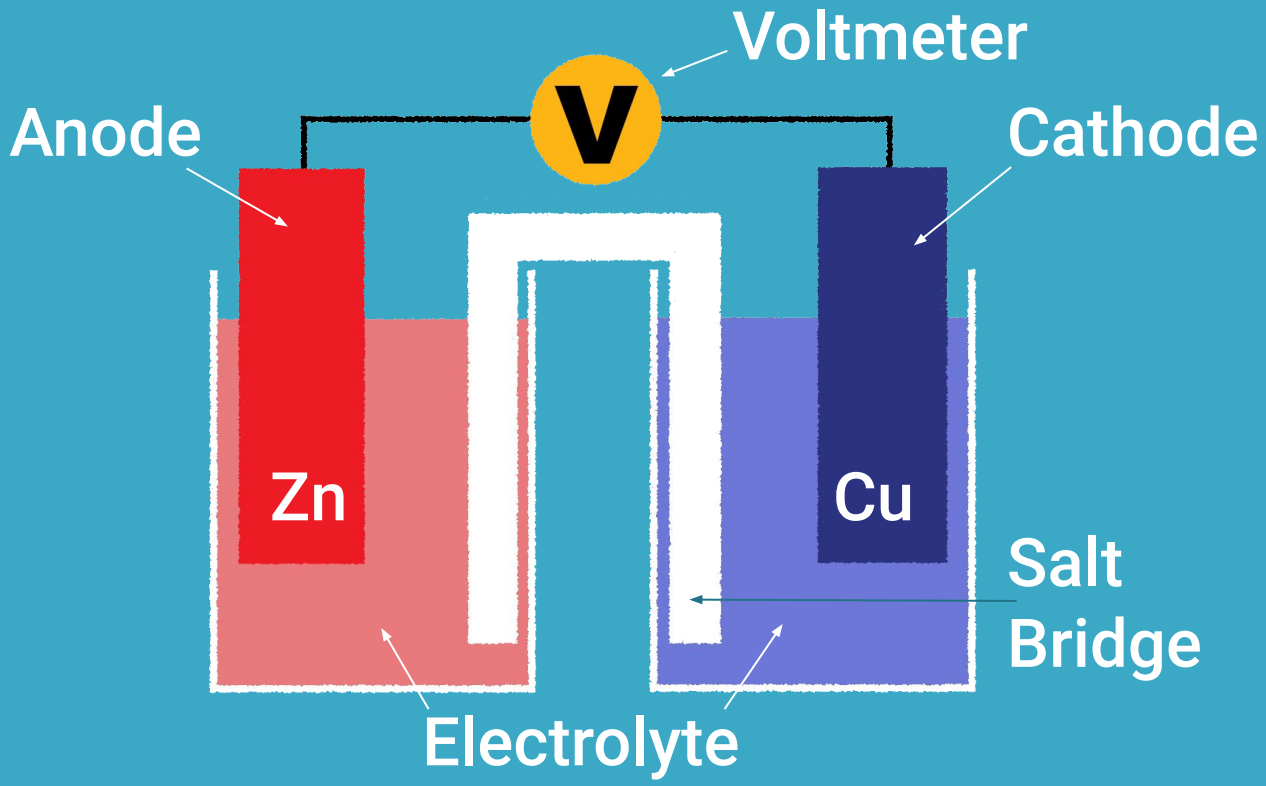
Build a Battery Classroom Game - Electric Car Edition

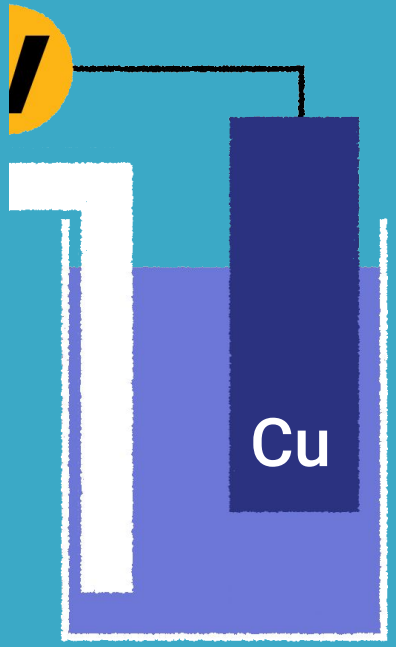
THE FARADAY INSTITUTION FutureCat

NEXT GENERATION LI-ION CATHODE MATERIALS

Chemical Cell



Cathode



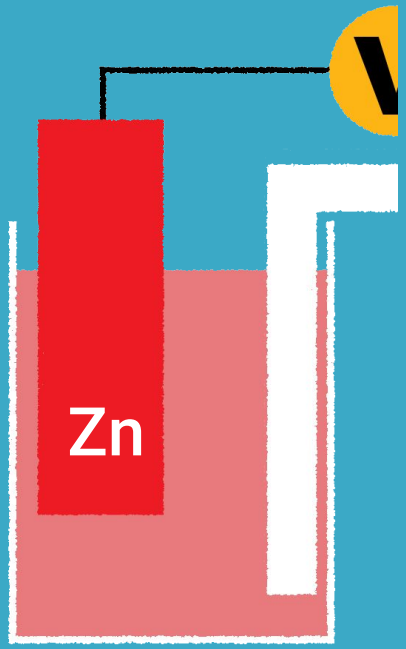
At the Cathode, reduction occurs.

Reduction is the process of an ion gaining electrons to form a neutral atom.

Half Equation:

$$Cu^{+}_{(aq)} + e^{-} \rightarrow Cu_{(s)}$$

Anode



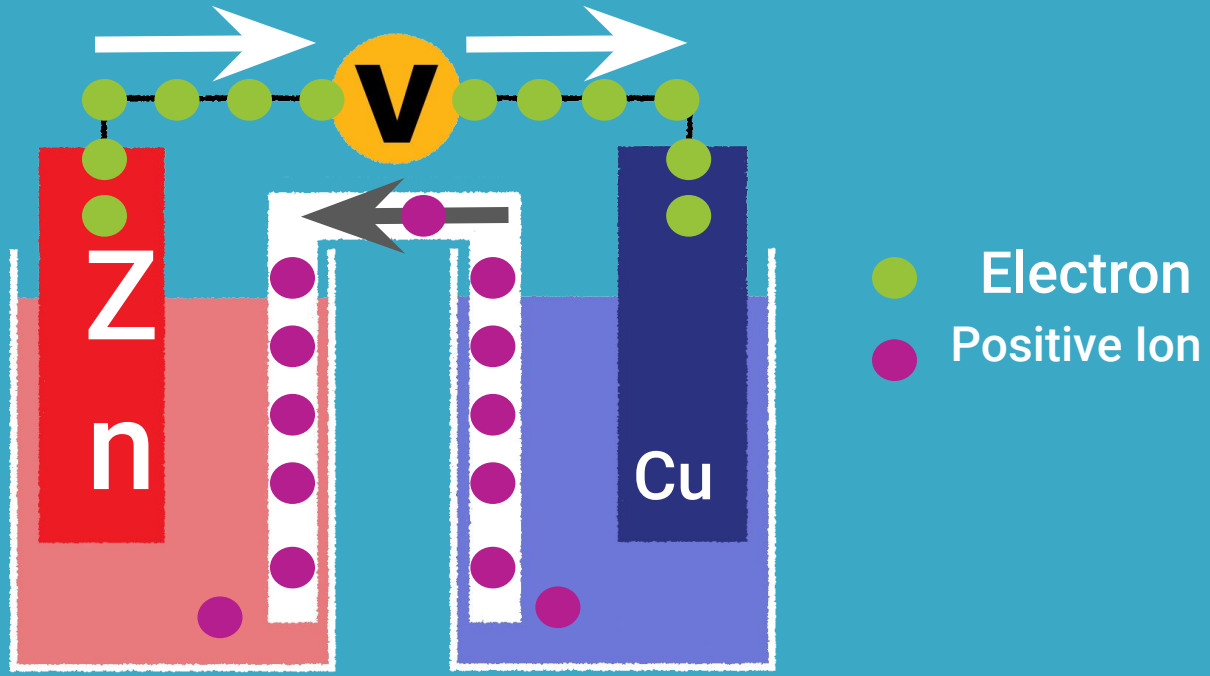
At the Anode, oxidation occurs.

Oxidation is the process of an atom losing electrons, to form a negatively charged ion.

Half Equation:

$$Zn_{(s)} \rightarrow Zn^{+}_{(aq)} + e^{-}$$

A Redox Reaction Occurs



A Redox Reaction is when an Oxidation and Reduction occurs at the same time.

At the Cathode, reduction occurs.

Half Equation:

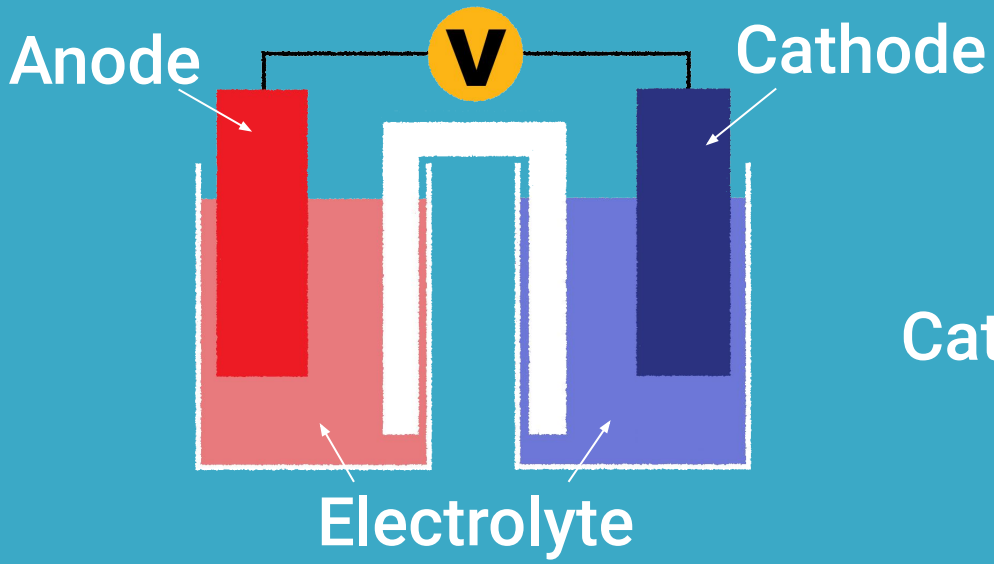
$$Cu^{+}_{(aq)} + e^{-} \rightarrow Cu_{(s)}$$

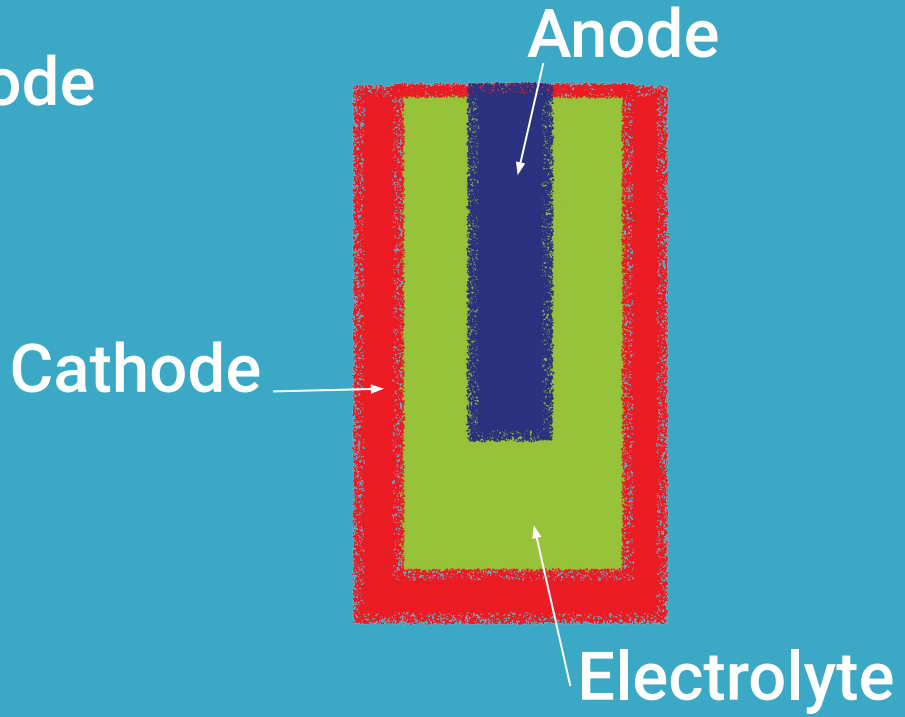
At the Anode, oxidation occurs.

Half Equation:

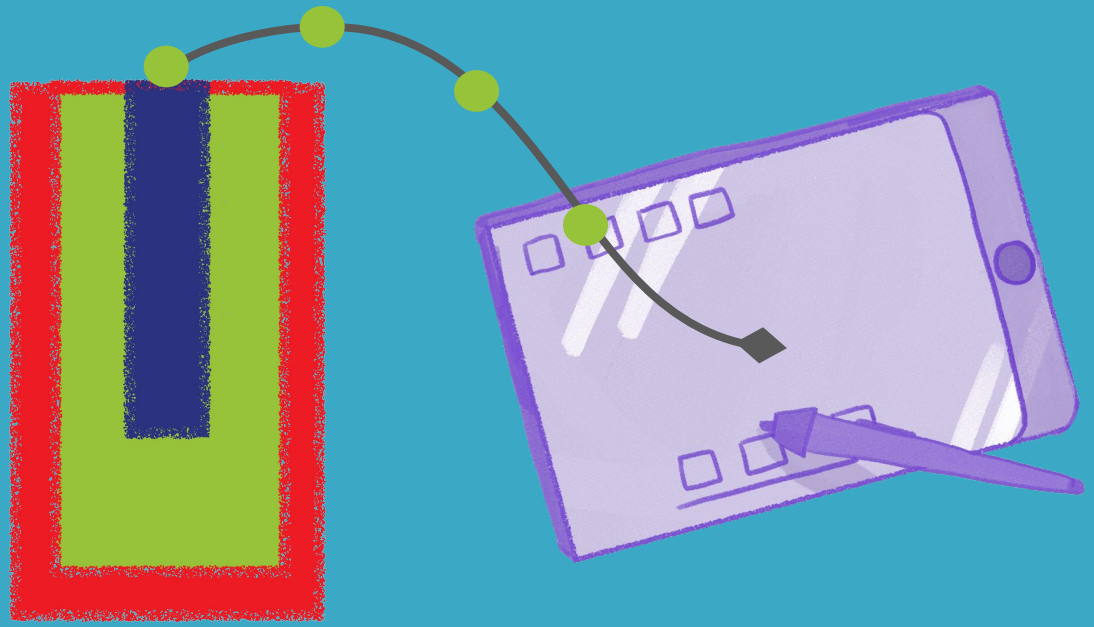
$$Zn_{(s)} \rightarrow Zn^{+}_{(aq)} + e^{-}$$

A Battery is a Chemical Cell





The Flow of Electrons from the battery's anode while discharging powers the Tablet

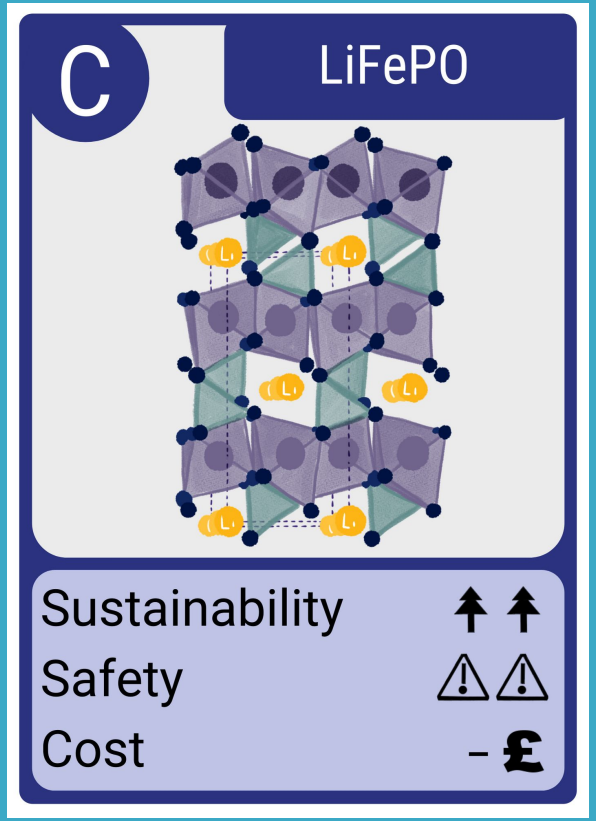


Build a Battery Classroom Game

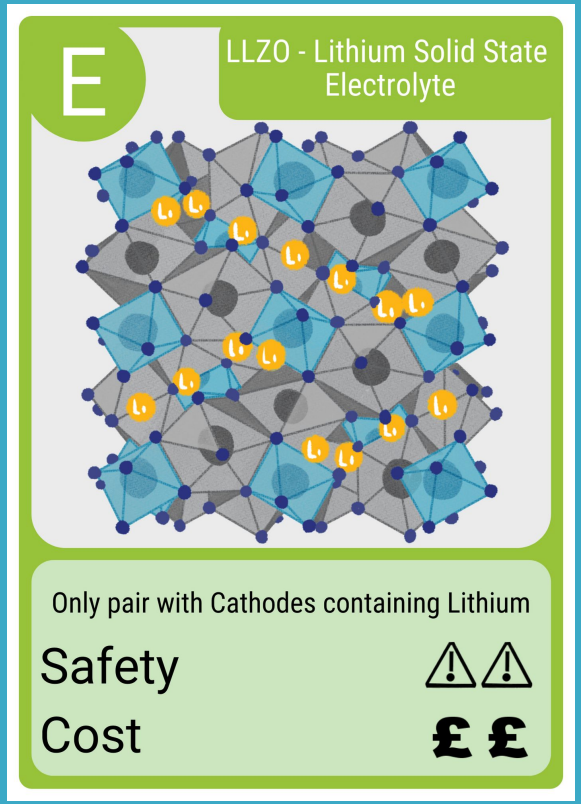
Batteries can be made in many different ways, leading to the batteries having different properties. Some batteries are more sustainable or more safe than others.

The game uses cards to represent the different parts of the battery that you will build.

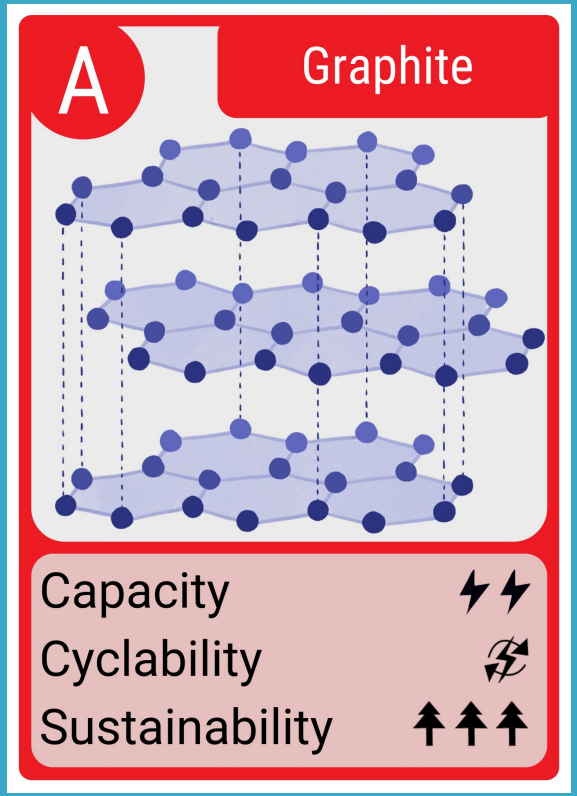
Example of a Cathode Card



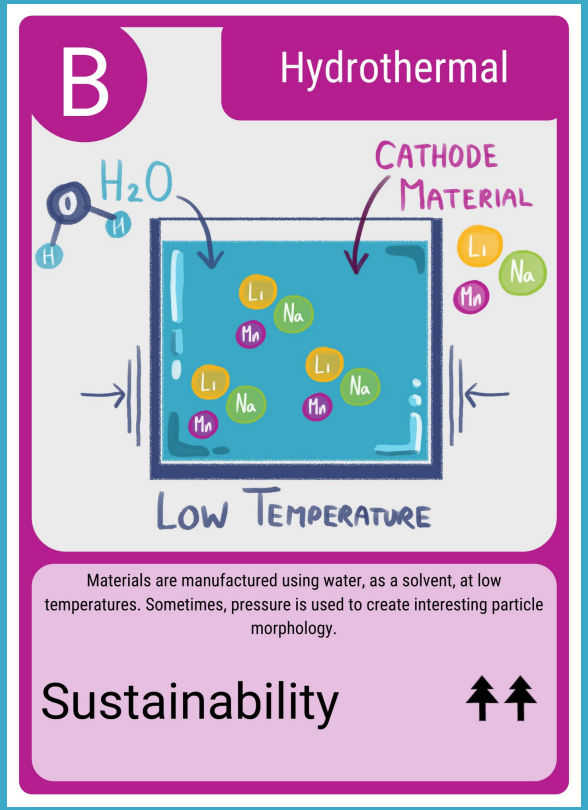
Example of an Electrolyte Card



Example of an Anode Card



Example of a Bonus Card



What are the Battery Characteristics on the playing cards?

Capacity

This characteristic is based on the materials theoretical capacity.

Theoretical capacity is a prediction made by scientists. It predicts the maximum amount of energy the material could produce if everything went perfectly.

For cathode materials, this is often calculated using computer programs.

There is also an experimental capacity, found through testing the material.

This is similar to theoretical yield compared to experimental yield of chemical reactions.

Cyclability

This is about the number of times the battery can complete a charge and discharge cycle.

The charge/discharge cycle is not perfect, so over time ions in the battery do not complete the whole cycle. This reduces the capacity of the battery, since less ions are transferring energy.

This is called battery degradation. Scientists want to improve battery's lifetime by reducing battery degradation.

Safety

Battery safety is very important. Battery are used in many everyday applications, in our houses, pockets and in our cars.

A battery explosion is dangerous and can be difficult to fix.

Therefore, it is important batteries are safe to protect us.

Sustainability

There is a large drive to make batteries more sustainable.

Sustainability is important for protecting our resources and planet. Currently, most commercial batteries use Lithium and Cobalt, that have concerns about abundance and unethical mining.

Cost

This is a simple one, it is the cost of the materials.

However, there are many hidden factors affecting the cost:

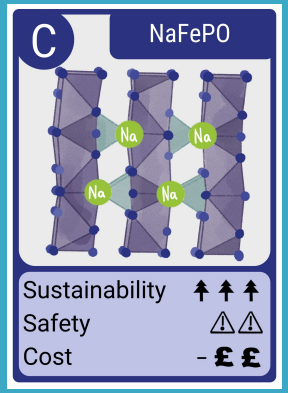
- The Abundance of the material
- Mining or Extracting the Material
- The processing and manufacture of the material so it is fit for the application

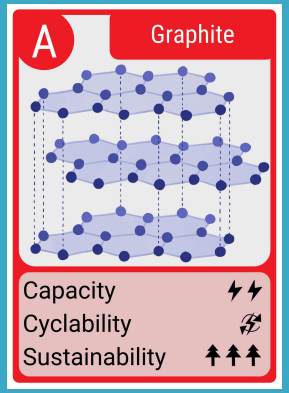
Rules for Making a Battery

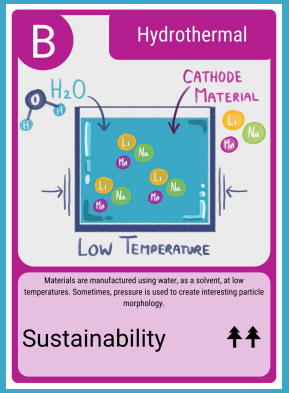
To make a battery you must have: 1 Cathode card, 1 Electrolyte card and 1 Anode card.

These are all key points of a battery and it cannot be considered complete if you are missing one.

There is the option to include 1 Bonus card to your battery to improve it.







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Electric Cars

In 2030, the sale of new petrol and diesel cars will be banned in the UK. This is to help the UK reach the Net Zero carbon emission goals. These are designed to battle climate change.

Electric cars don't emit carbon dioxide when they are moving, so are a green alternative to petrol and diesel cars. Also, electric cars can be charged with electricity from renewable sources such as wind, solar and wave.

There are different types of Electric Cars for Different Applications

Small Car

Family Sized Car

Luxury Car

Race Car

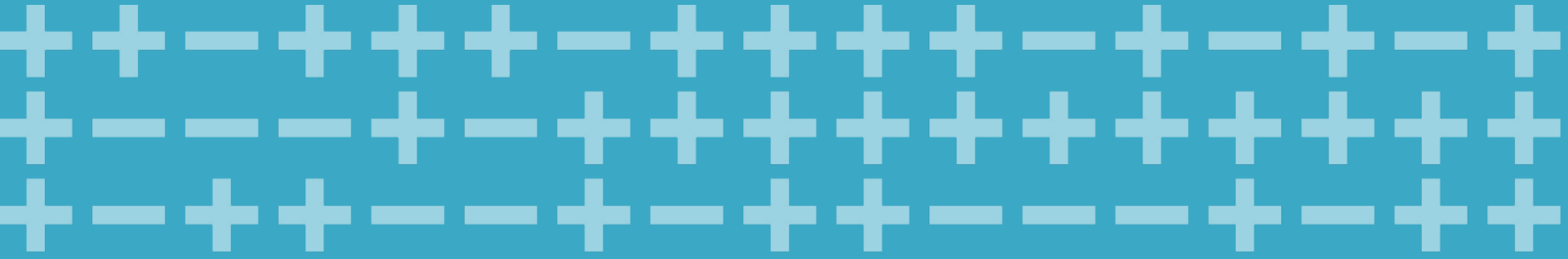
Different cars will have different priorities for their batteries.

Challenge- Create a Battery for a Type of Car and present to the others

As a Group - Select a type of Electric Car to make

Eco Car
Race Car
Luxury Car
Small Car
Family Car

TIME TO BUILD BATTERIES!



Round 1- Rotation

A type of Card is selected (cathode, electrolyte anode or bonus) and each team has to give one of their card of that type to the group on their left.

Round 2- Selection

Each group nominates one person to swap cards with another group.

The cards swapped must be the same type of card, so at the end of the round, each team has the same distribution of cards.

This is done with the group on the right.

For example, group 1 nominates Ann and she goes to group 2 and selects one of their cathode cards and swaps it with a group 1 card.

No hiding your cards!

Round 3- Trading

Groups have an opportunity to trade cards.

Any type of card can be traded for another, but groups should remember they still need 1 Cathode, 1 Electrolyte and 1 Anode to build their battery and win.

A group member is nominated to address the class. They state the card they want to trade (ie. electrolyte card with ++ safety) and the card they want to receive (ie anode with one + or more for sustainability).

No one is forced to trade, but each group is given an opportunity to.

Round 4- Lucky Dip

This is similar to the card game “Cheat”.

A group can say to the class they have a certain card and they want to swap. This does not have to be true.

Another group can decide to swap with them.

Time to Design your Electric Car to Present to the Others

Things to Consider when Designing your Electric Car

- Who will be using your car
- Internal features (radio, seat heating, phone compatibility)
- Number of doors and Seats
- External Car Design

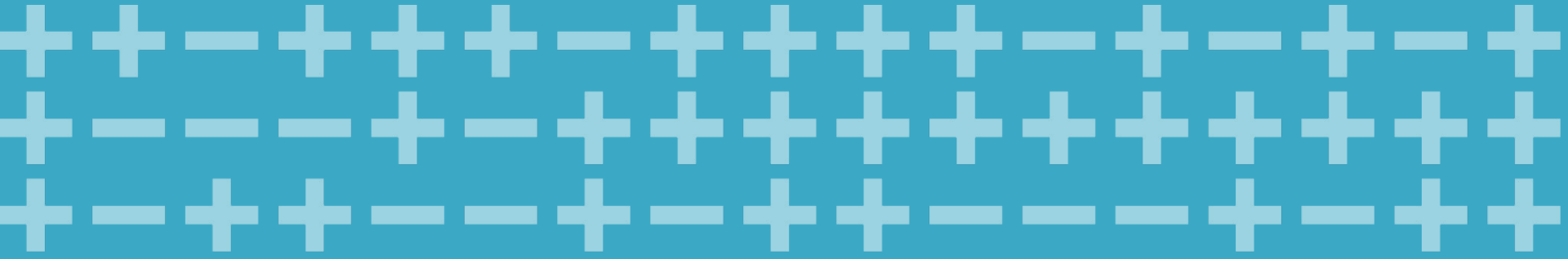
Examples of Electric Cars for Inspiration


293 MBC

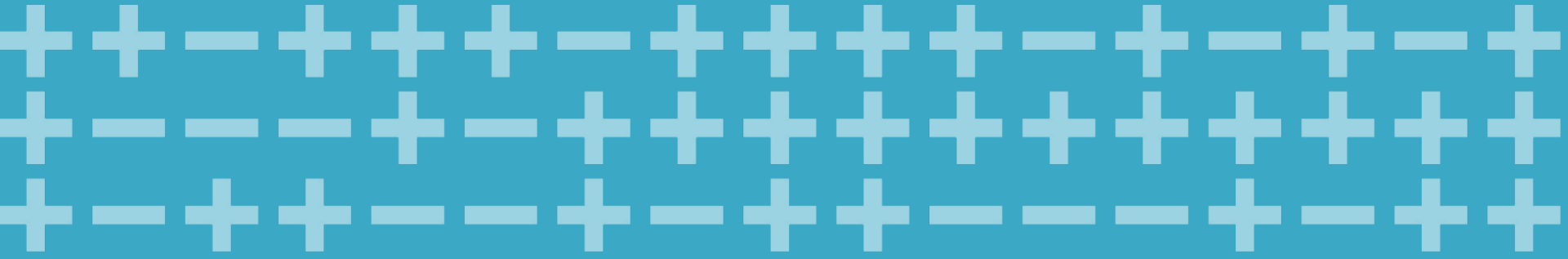

K ME 937E


EI UPP

Time to Design the Electric Cars

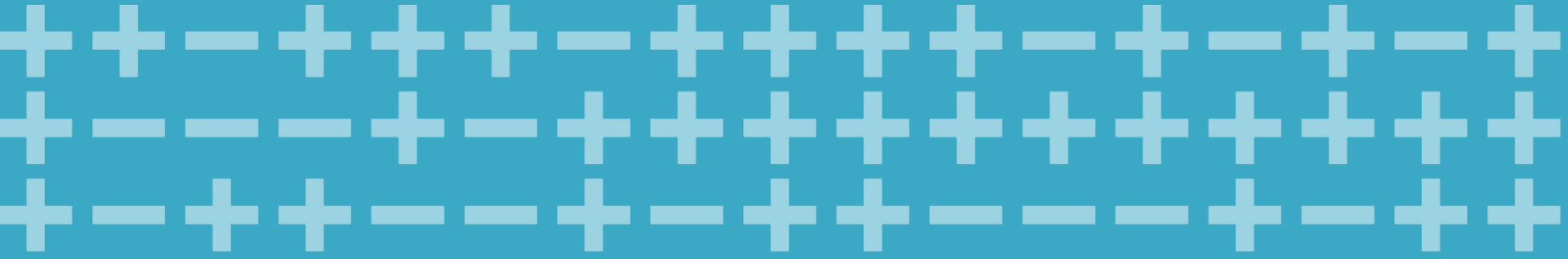


Time to Plan your Presentation



Time to Present the Electric Cars and The Batteries inside them

Well Done for Completing the Electric Car and Build a Battery Challenge!



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