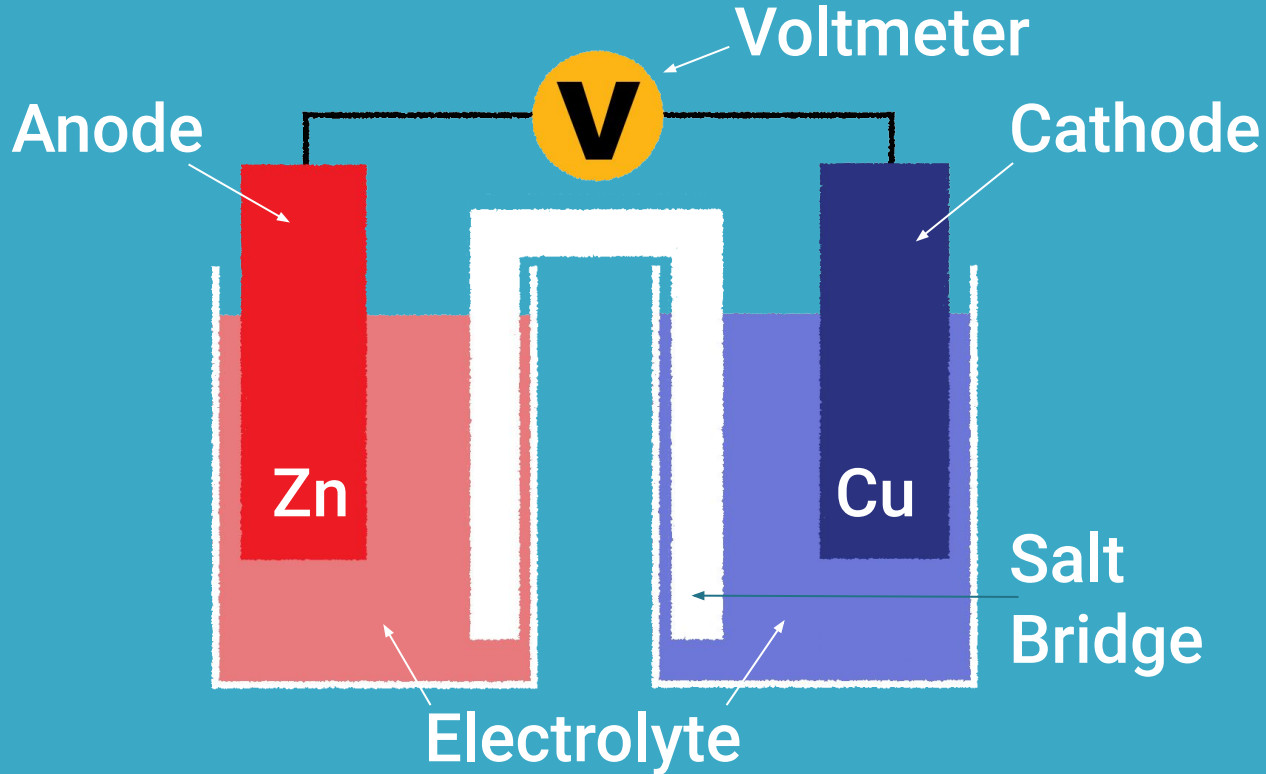
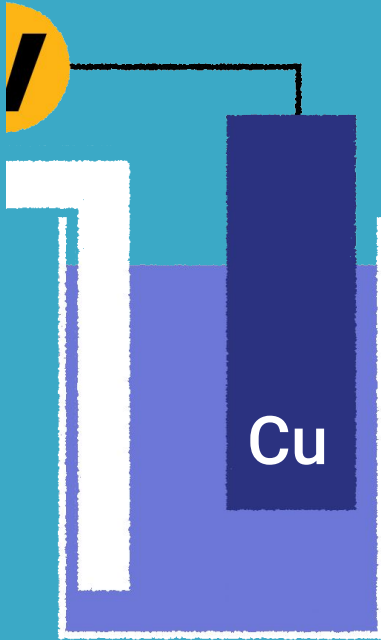


Build a Battery Classroom Game - Electric Car Edition

Chemical Cell



Cathode



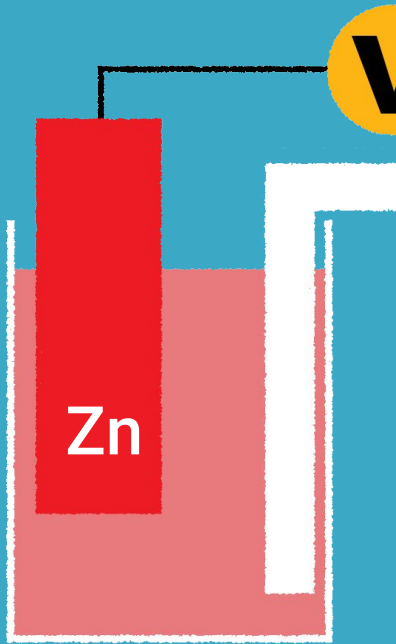
At the Cathode, reduction occurs.

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

Half Equation:



Anode



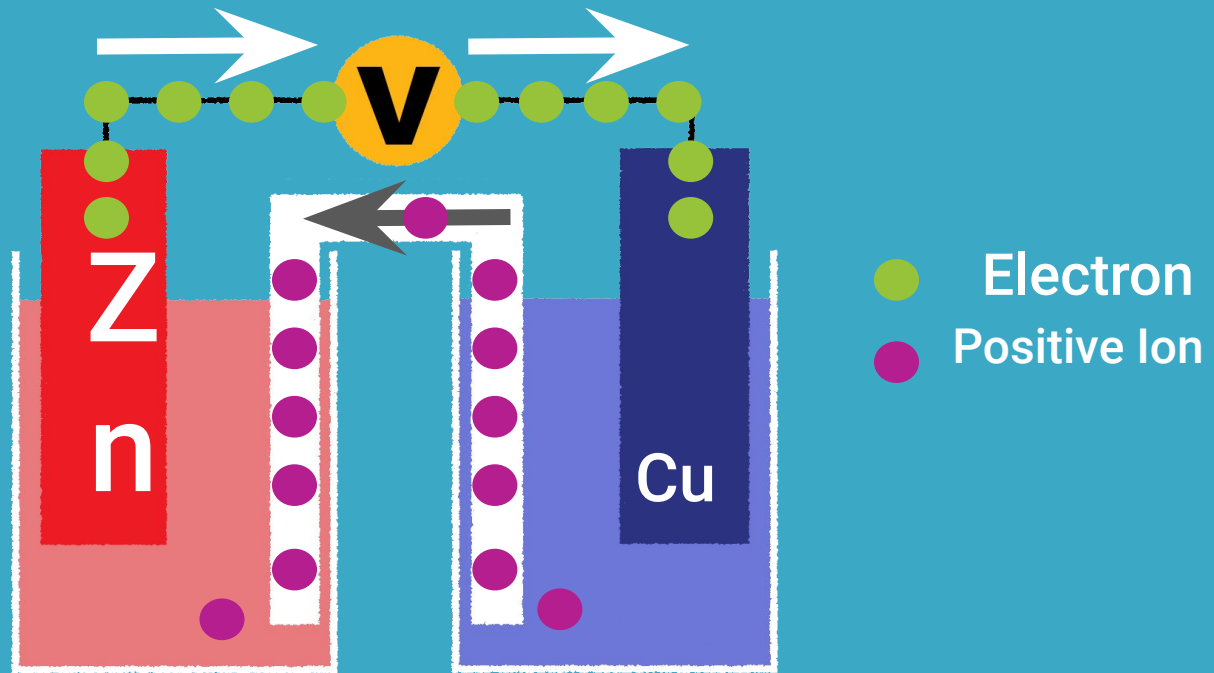
At the Anode, oxidation occurs.

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

Half Equation:



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:

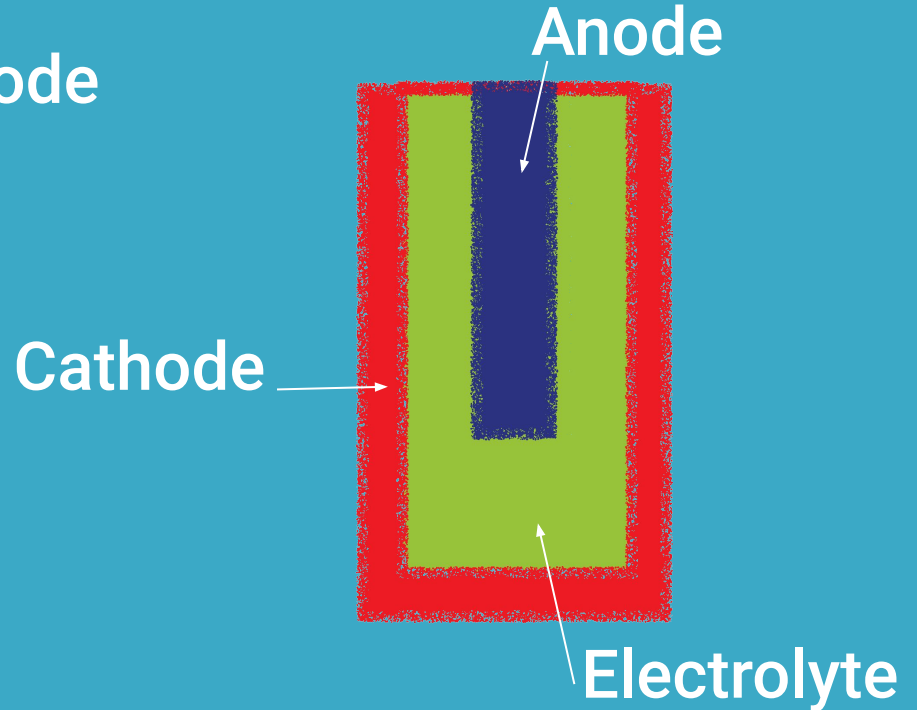
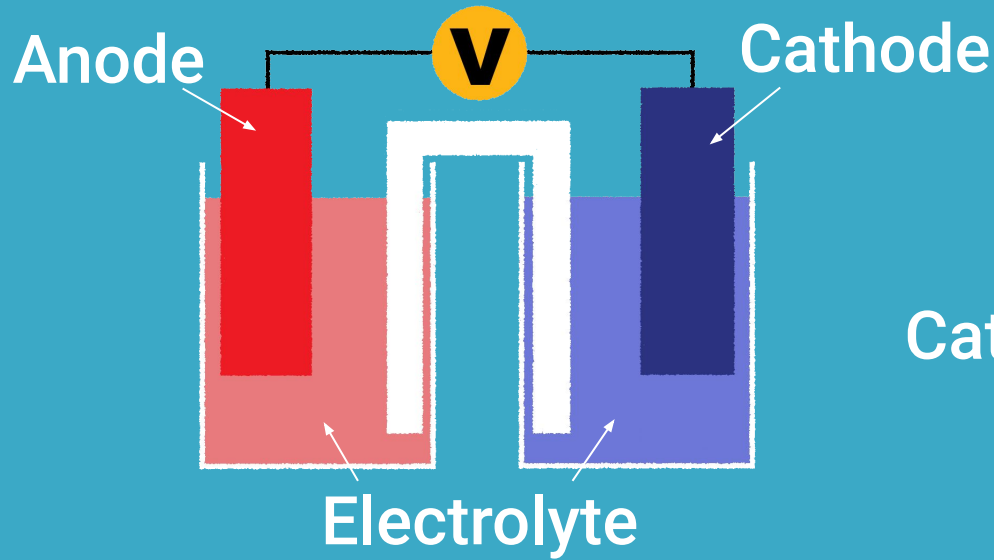


At the Anode, oxidation occurs.

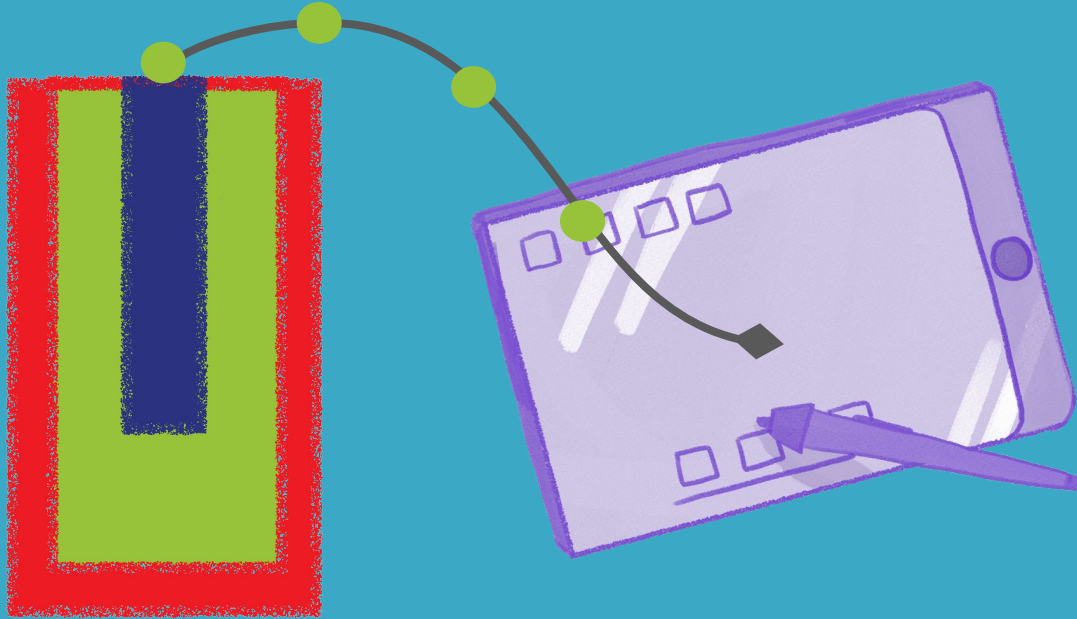
Half Equation:



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.

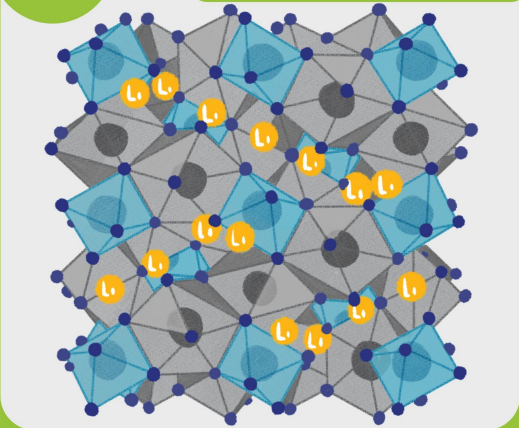
The game uses cards to represent the different parts of the battery that you will build.

Example of a Cathode Card

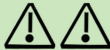



Example of an Electrolyte Card

E LLZO - Lithium Solid State Electrolyte

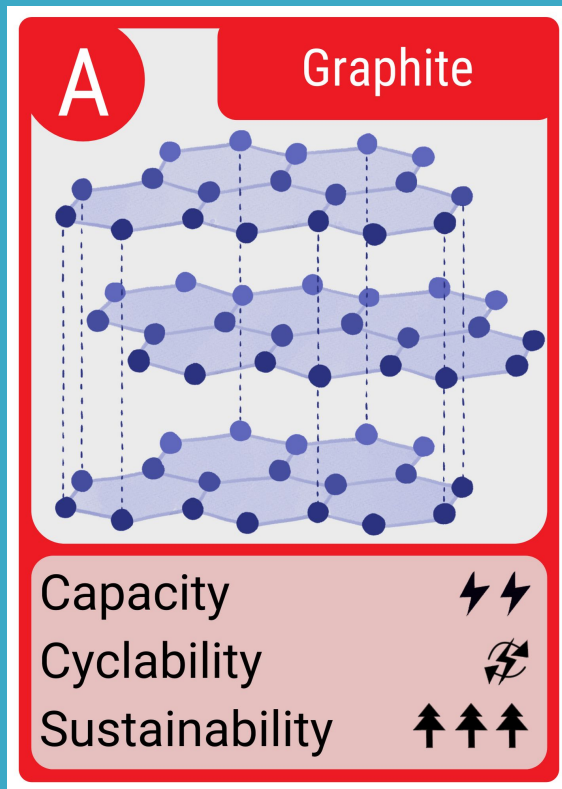


Only pair with Cathodes containing Lithium

Safety 

Cost 

Example of an Anode Card



Example of a Bonus Card

B Hydrothermal

H_2O

CATHODE MATERIAL

Li Na Mn

Li Na Mn

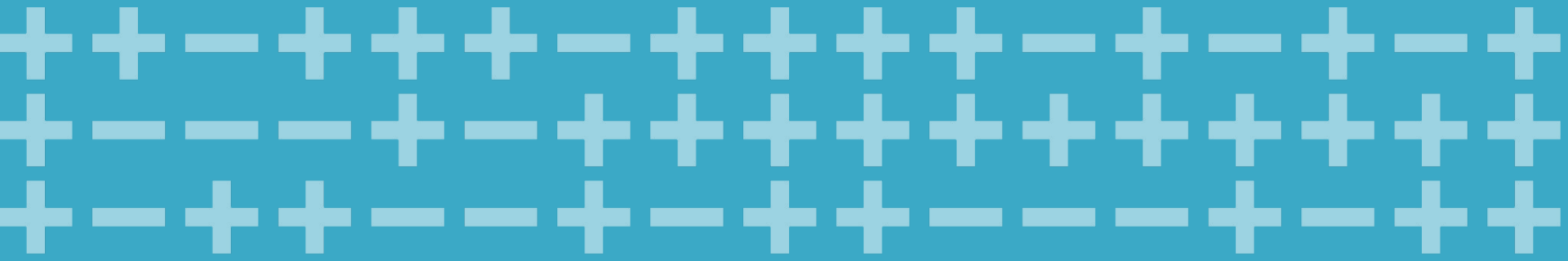
Li Na Mn

LOW TEMPERATURE

Materials are manufactured using water, as a solvent, at low temperatures. Sometimes, pressure is used to create interesting particle morphology.

Sustainability ↑↑

**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. Batteries 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 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 fit for the application

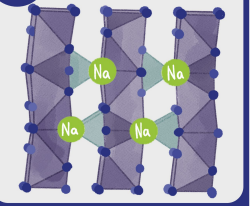
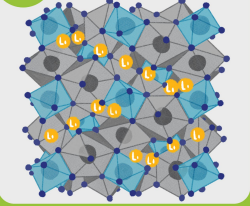
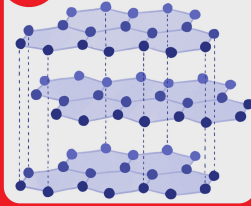
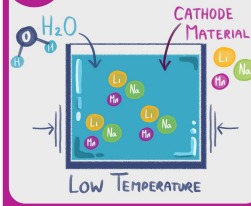


Rules for Making a Battery

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.

<p>C NaFePO</p>  <p>Sustainability ↑↑↑ Safety ⚠️⚠️ Cost - ££</p>	<p>E LLZO - Lithium Solid State Electrolyte</p>  <p>Only pair with Cathodes containing Lithium Safety ⚠️⚠️ Cost ££</p>	<p>A Graphite</p>  <p>Capacity ⚡⚡ Cyclability ⚡ Sustainability ↑↑↑</p>	<p>B Hydrothermal</p>  <p>Materials are manufactured using water, as a solvent, at low temperatures. Sometimes, pressure is used to create interesting particle morphology.</p> <p>Sustainability ↑↑</p>
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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 meet to 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

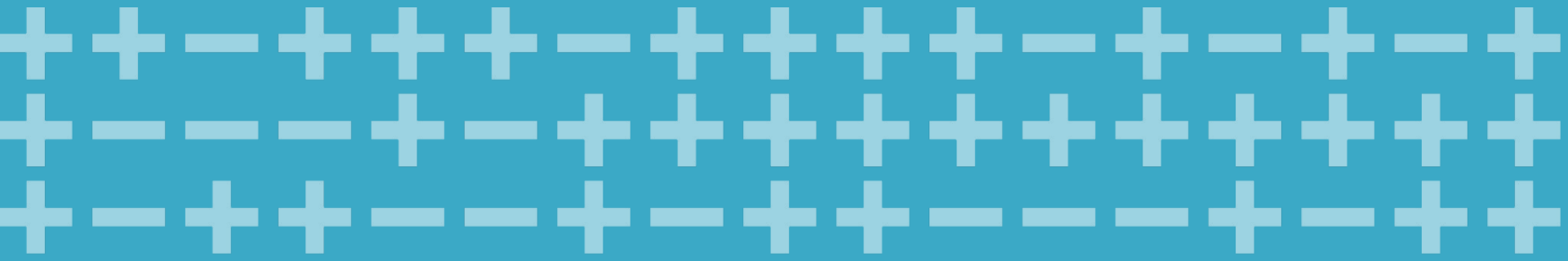
Race Car

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.

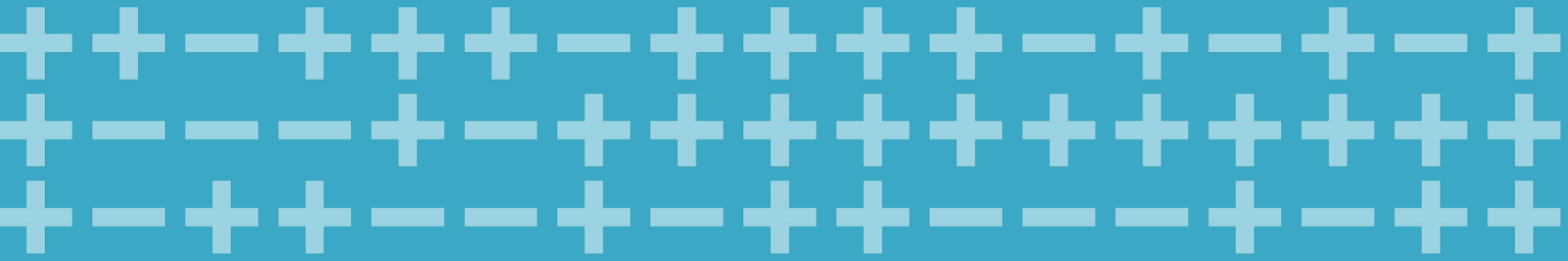
Round 4- Lucky Dip

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.

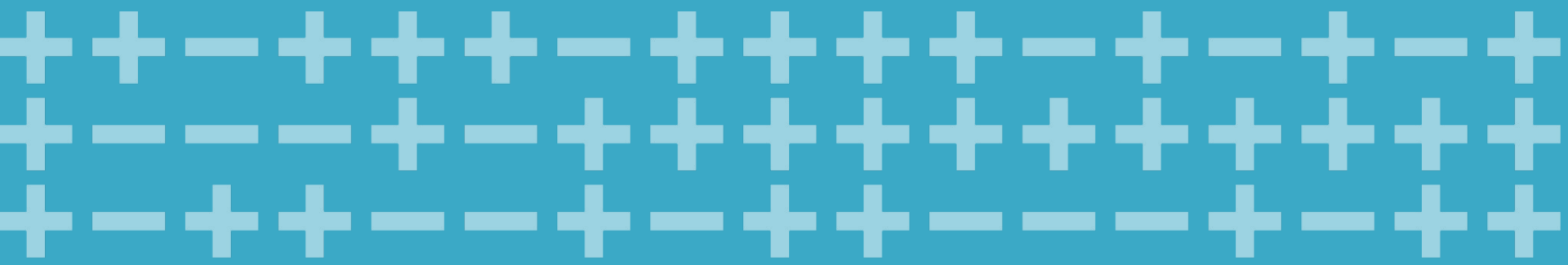
Time to Design your Electric Car to Present to the Others



Things to Consider when Designing your Electric Car

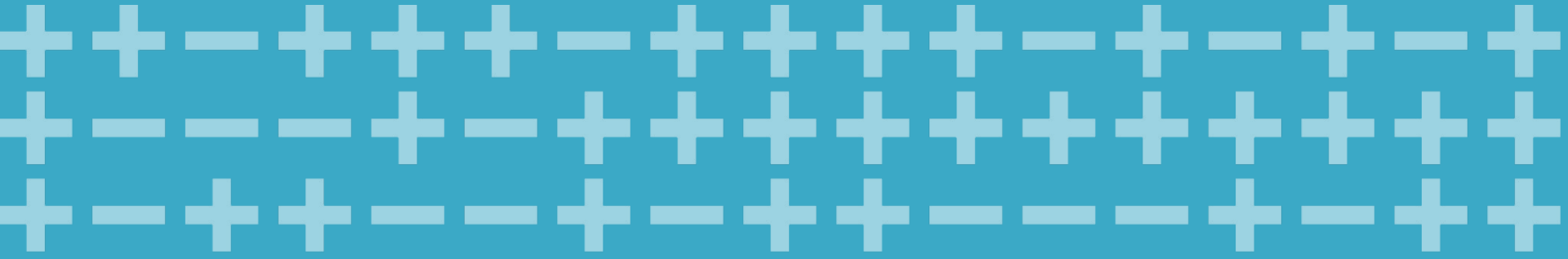
- Who will be using your car
- Internal features (radio, seat heating, phone compatibility)
 - Number of doors and Seats
 - External Car Design

Examples of Electric Cars for Inspiration

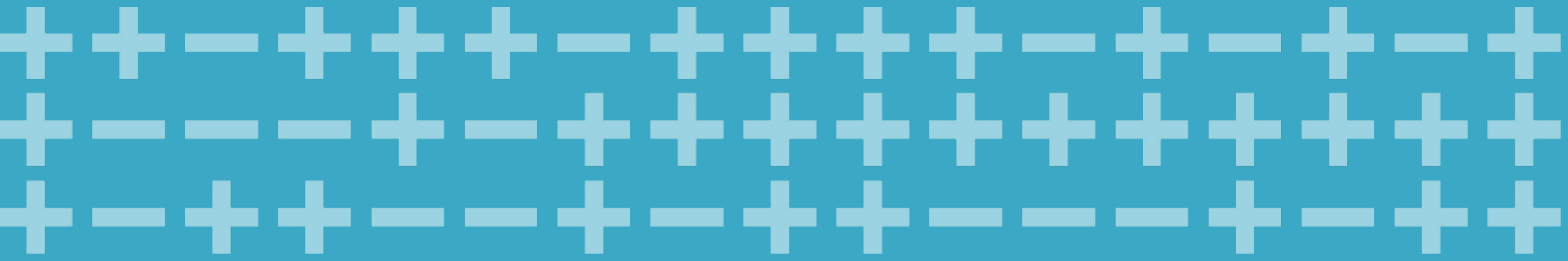




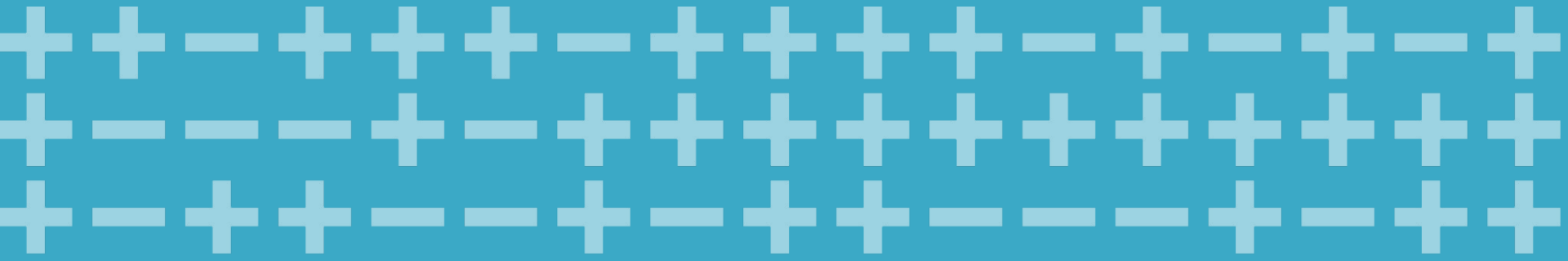
Time to Design the Electric Cars



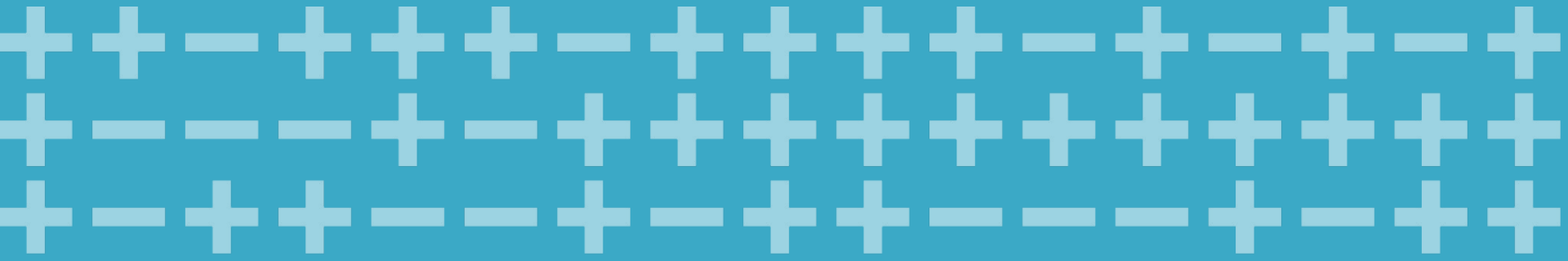
Time to Plan your Presentation



Time to Present the Electric Cars and The Batteries inside them



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



For more information on The Faraday
Institution: <https://faraday.ac.uk/>

For more information on FutureCat
research group: <https://futurecat.ac.uk/>



THE FARADAY
INSTITUTION

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NEXT GENERATION LI-ION CATHODE MATERIALS