UCL

Expand

Technologies and the Physical World

Before we get going

Any questions?

This session and the next

- Due to the nature of the project and topic, it is important to front load the information

- This means, you can expect less new content to learn as each session progresses, and more time to work and collaborate on your individual posters

Reminder

The poster must be your own individual work set on a topic of your choosing.

Despite this, sharing ideas, research documents for valuable information etc. is welcomed and is encouraged.

Just make sure you are the one doing the work, as otherwise you are not actively developing these valuable skills for the next steps in your education.

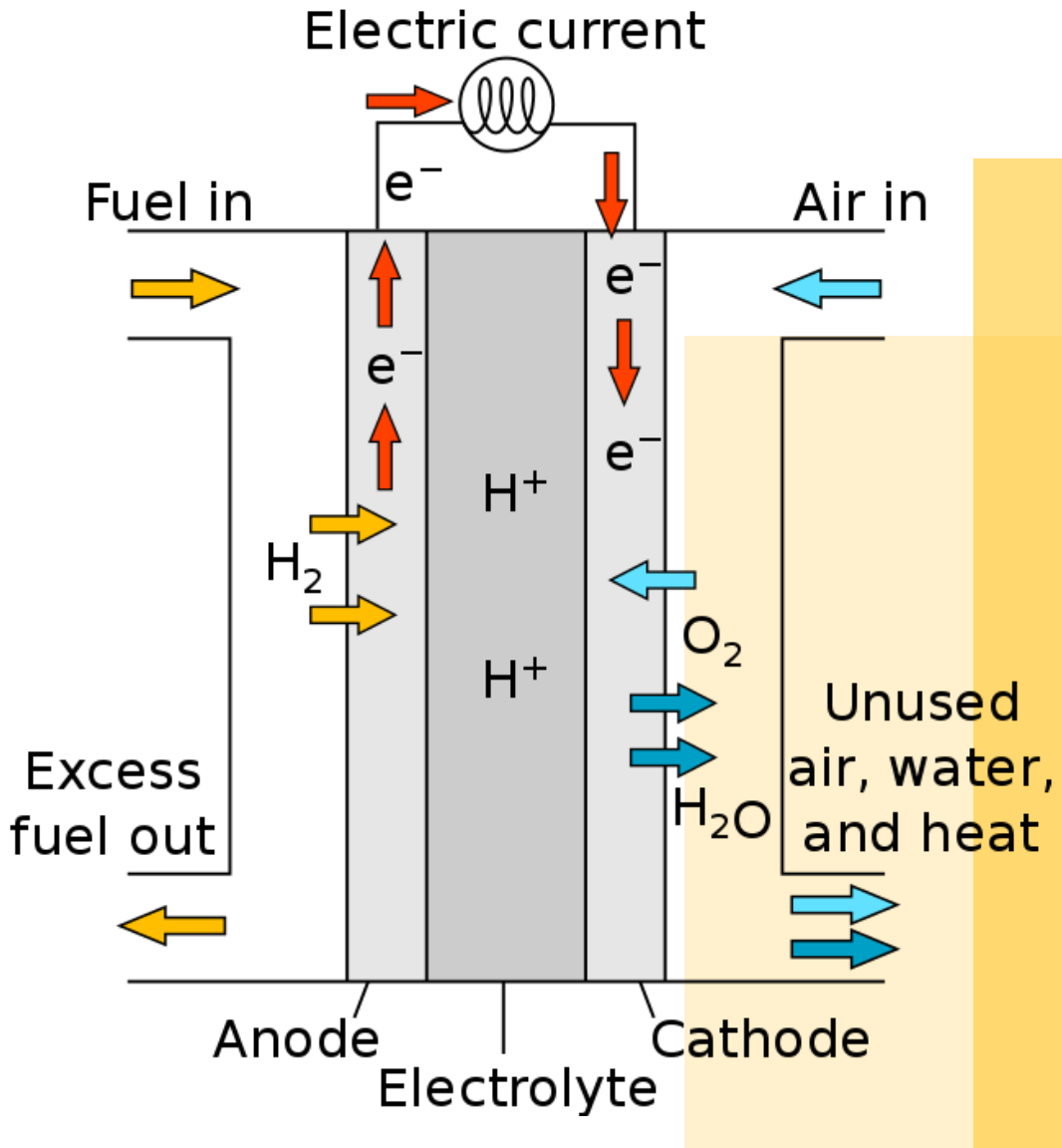
Our aims for today

- An in-depth analysis of the science and engineering of fuel cells

- Critically think about the advantages of different types of fuel cells e.g PEMFC, SOFC

How fuel cells operate

We'll start by annotating some key points of interest in the fuel cell



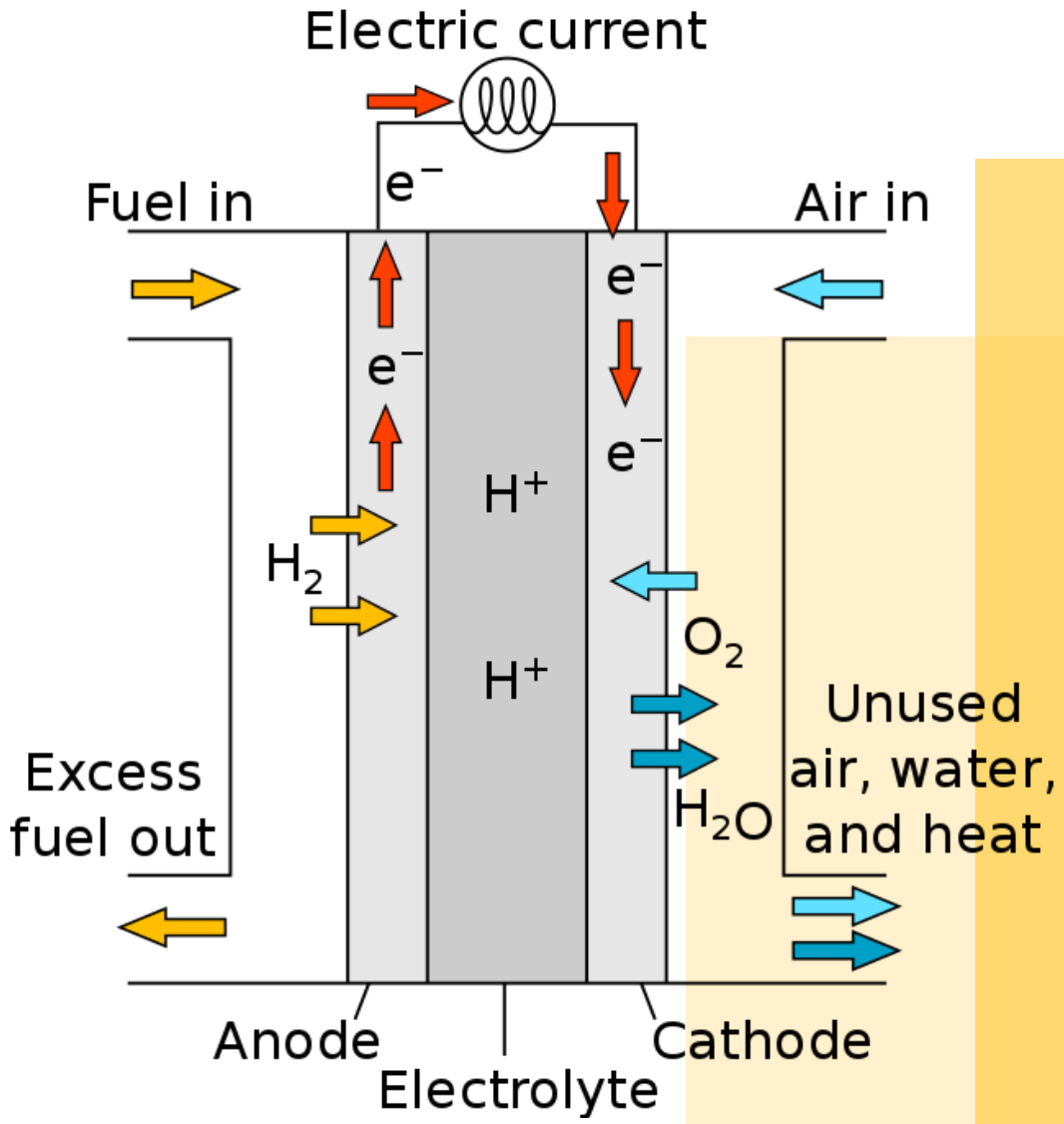
How fuel cells operate

The cell can simply be broken down to:

1. Electrodes
2. Electrolyte
3. Current Collector

Key elements we'll be ignoring for now are

1. **Flow fields**
2. **Gas Diffusion Layers**

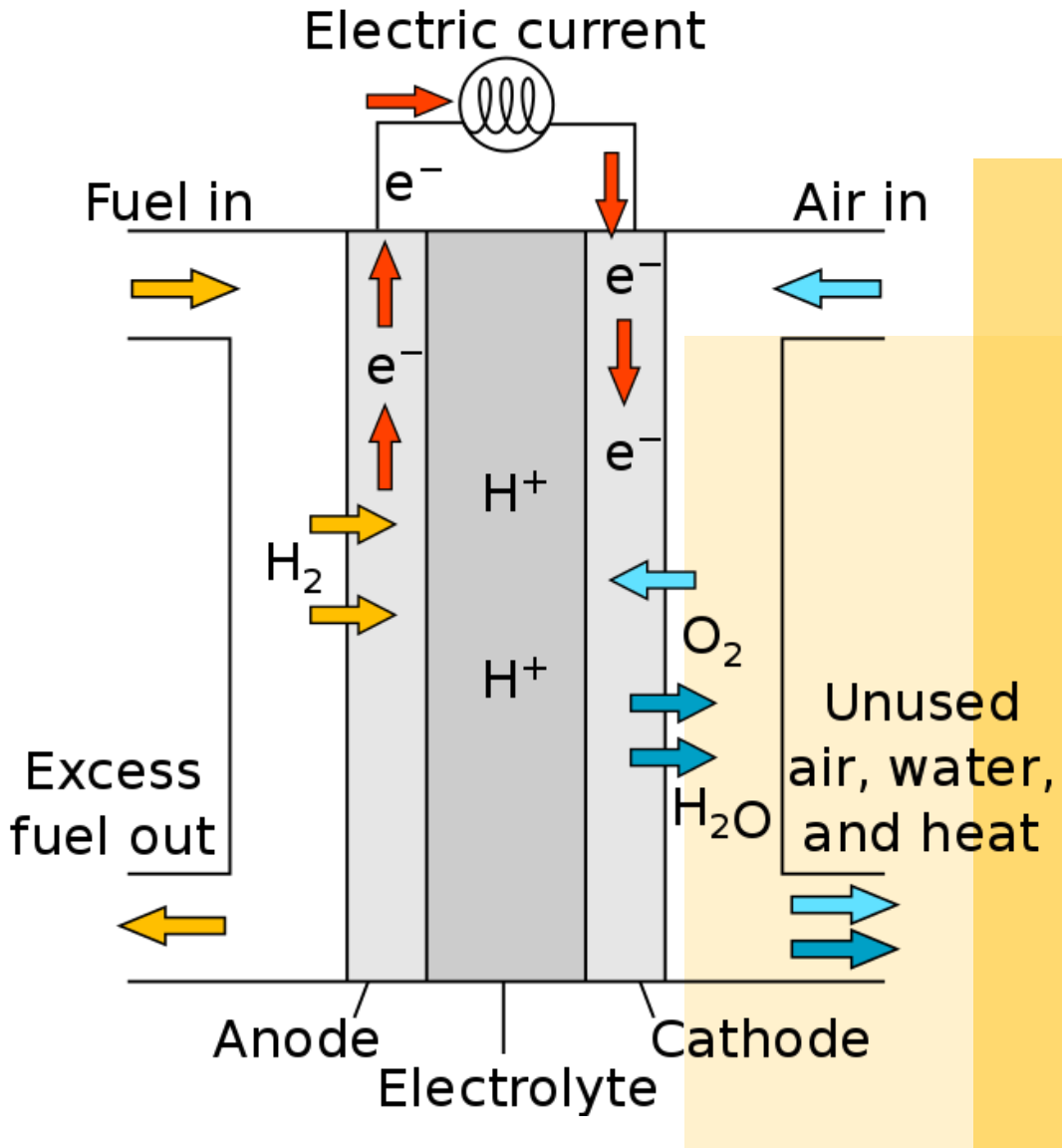


How fuel cells operate

1. The electrodes (anode and cathode) are where the chemical reactions of oxidation and reduction take place.

$$2H_2 \longrightarrow 4H^+ + 4e^-$$

$$O_2 + 4e^- \longrightarrow 2O^{2-}$$



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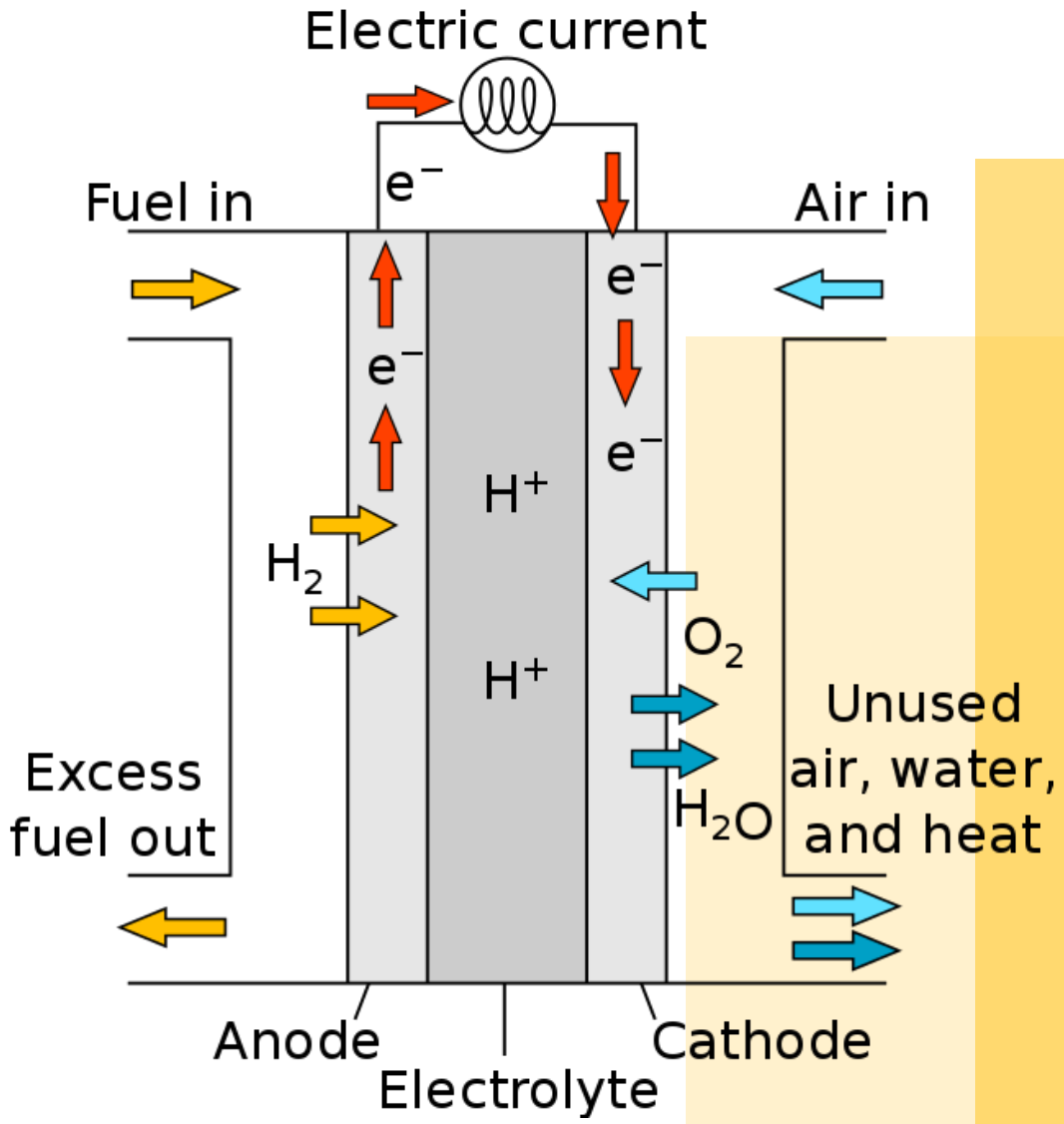

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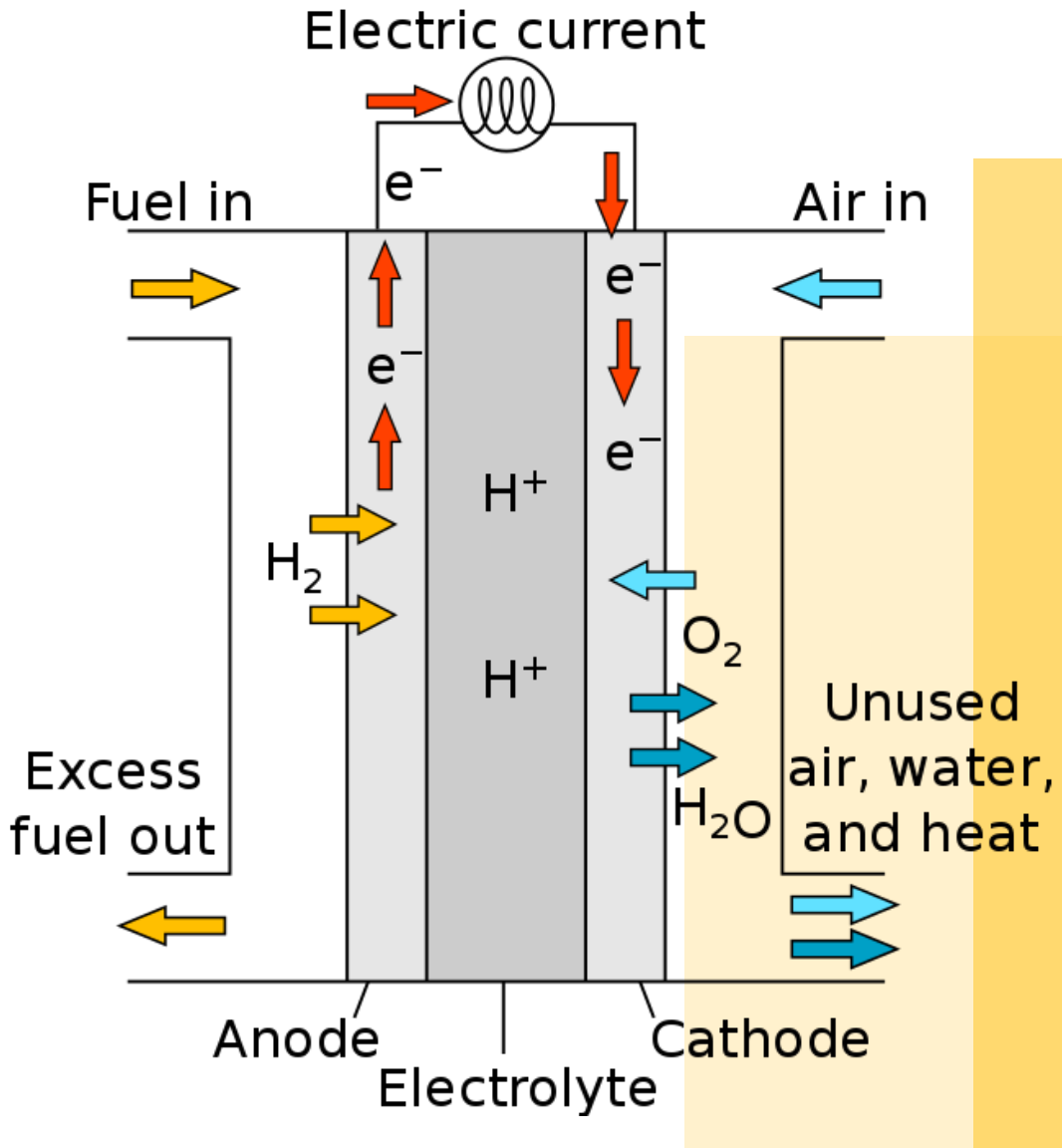

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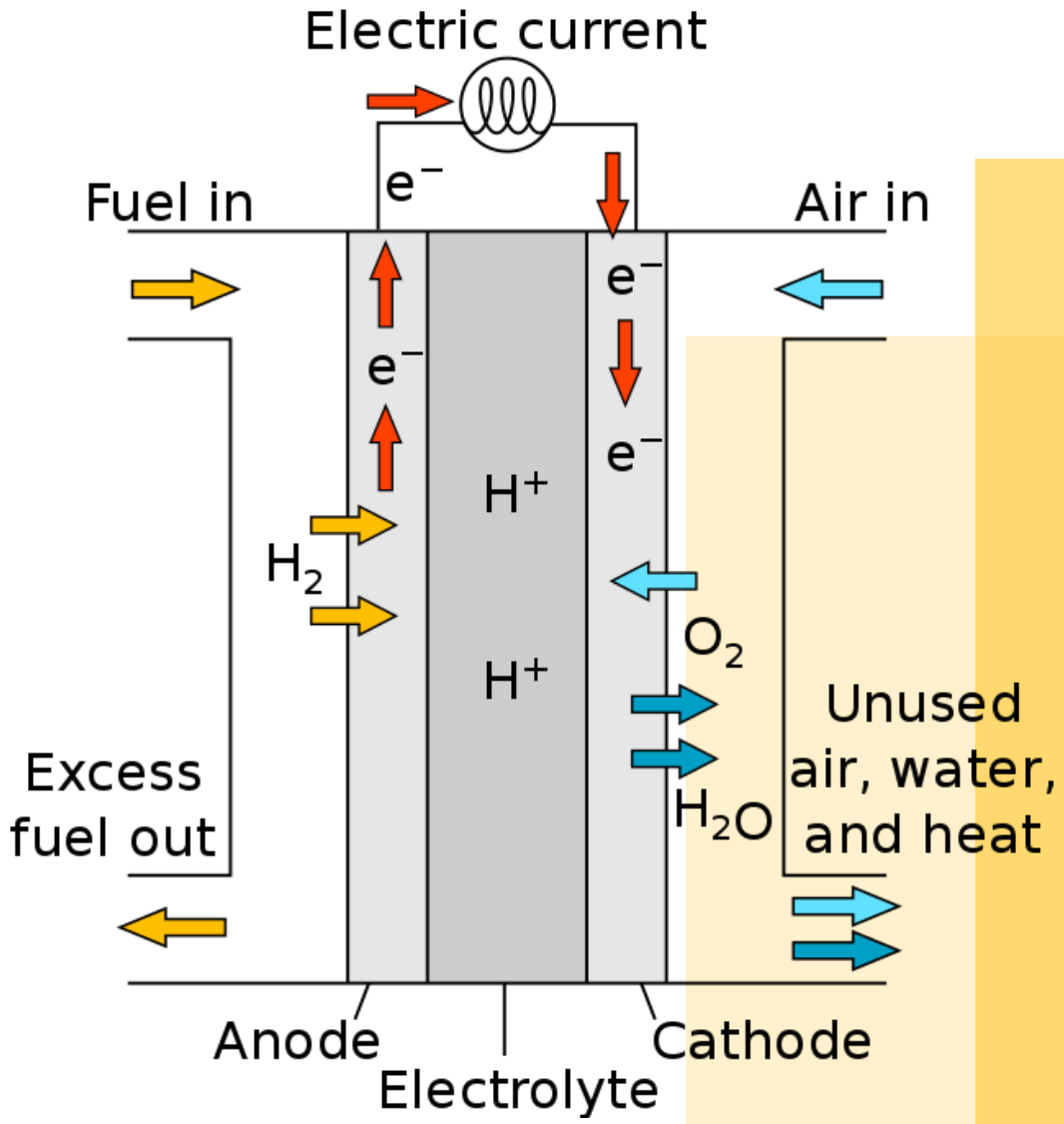
$$2H_2 + O_2 \longrightarrow 2H_2O$$



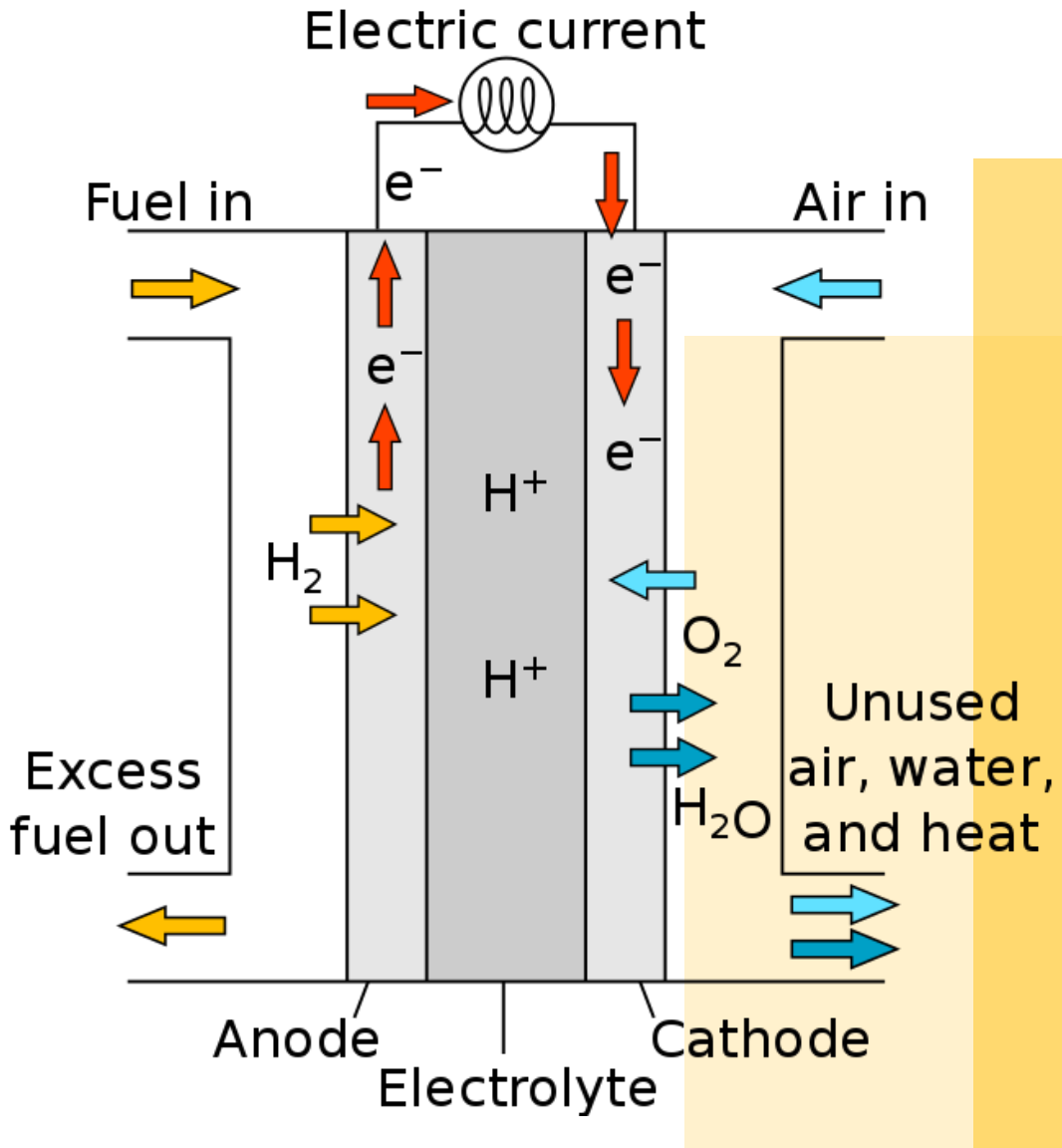
How fuel cells operate

3. The current collectors are simply the parts of the fuel cell that collects the power generated from the chemical process.

   Thinking back to the reaction:

   $2H_2 \longrightarrow 4H^+ + 4e^-$

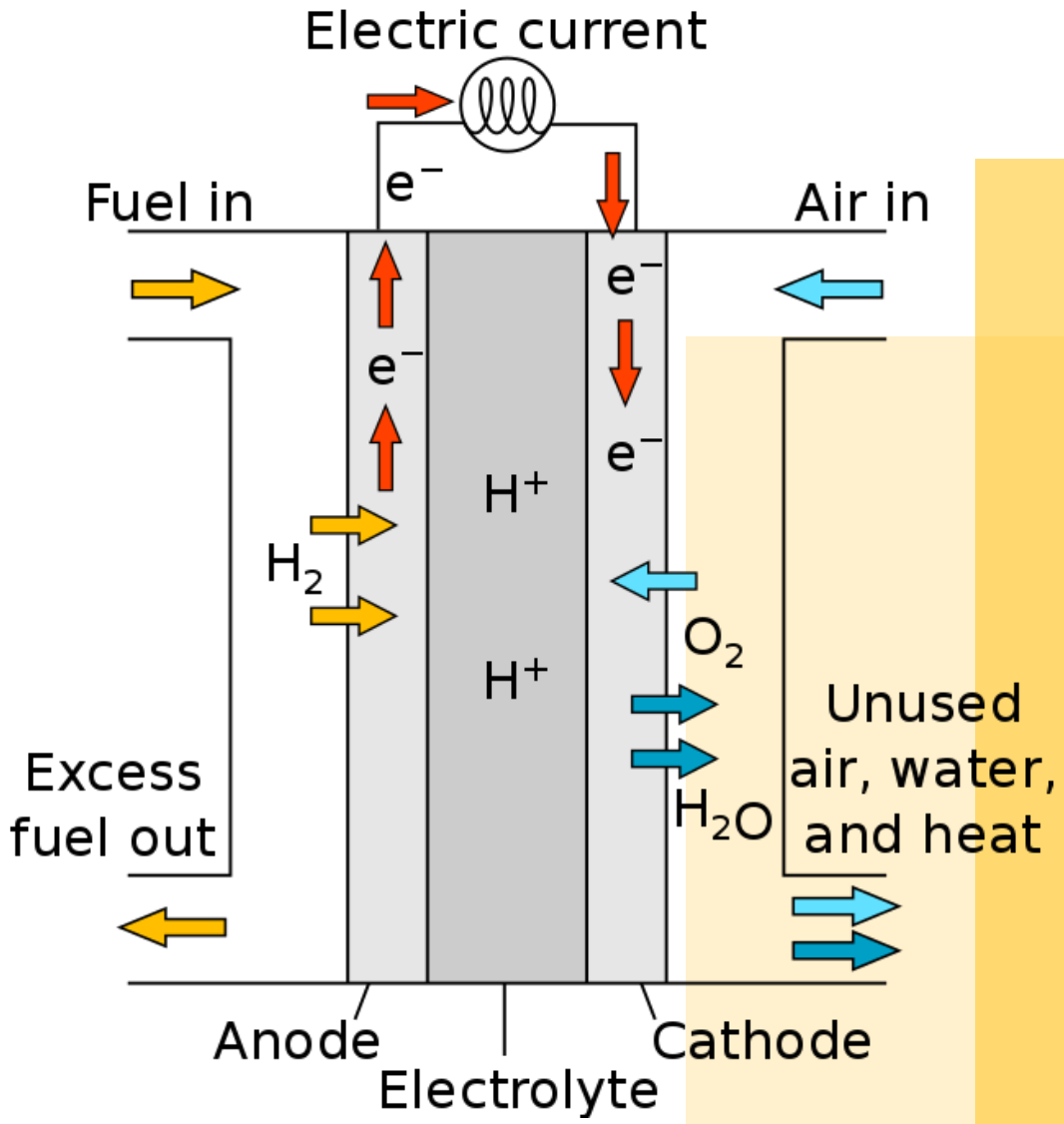
   The electrons flow to the other side of the cell through an external circuit.



How fuel cells operate

2. The electrolyte is a medium to allow ions to cross from one side of the cell to another.

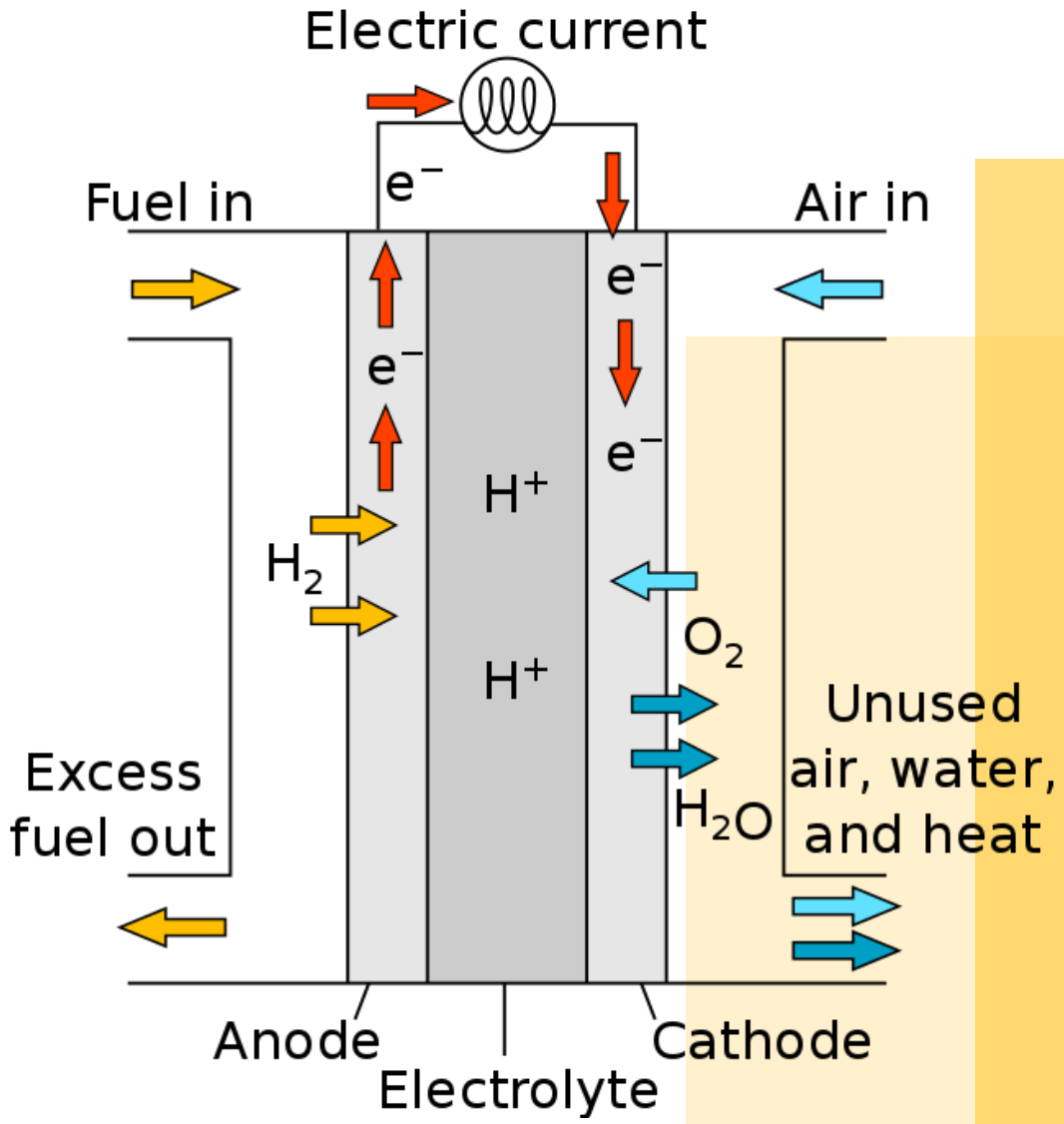
   In this case, the electrolyte allows the crossing of protons (H^+) which then combine with oxygen ions (O^{2-}) to form water.



How fuel cells operate

2. Different types of fuel cells will use different types of electrolytes.

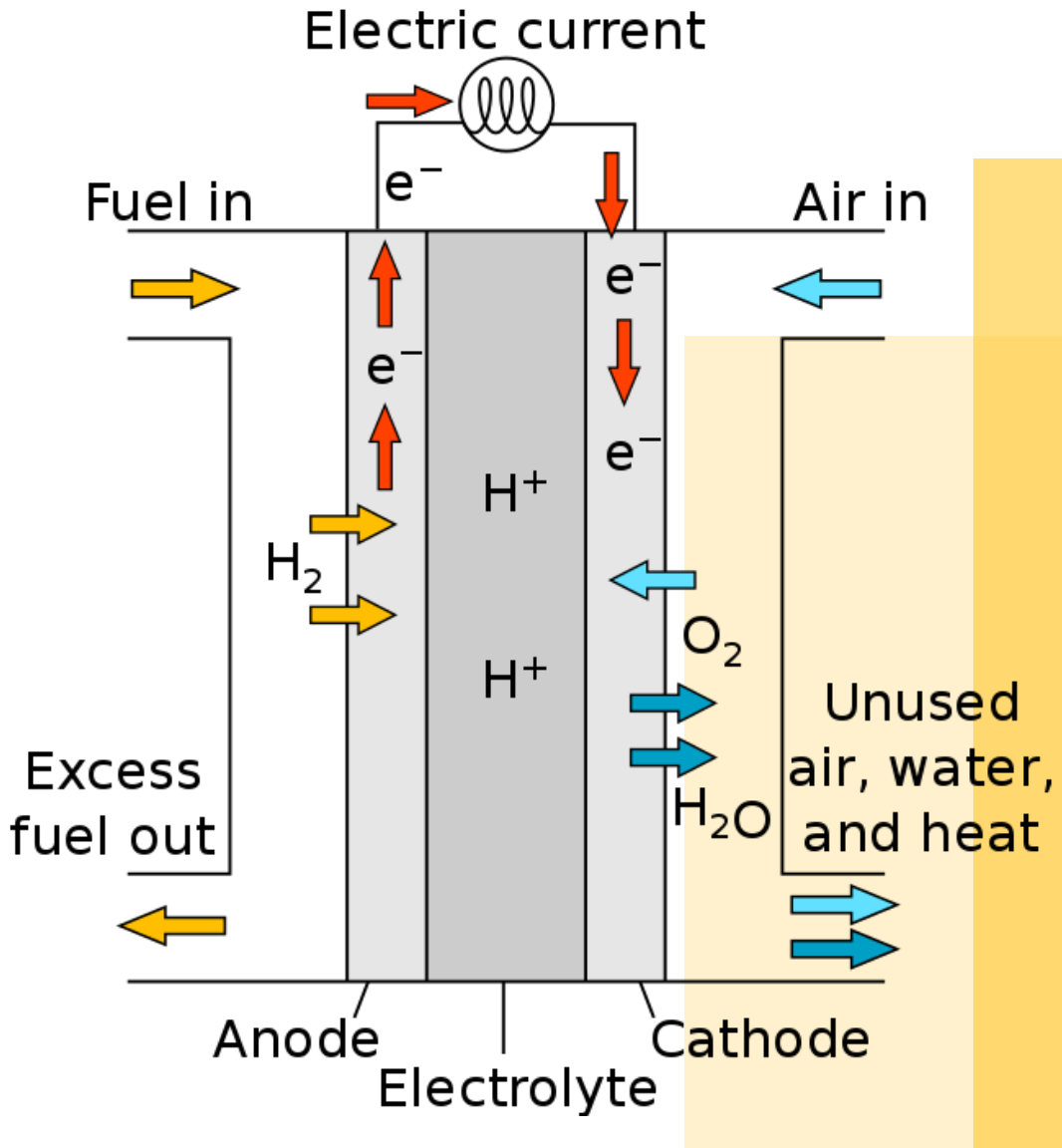
   These are studied independently in hopes of finding appropriate solutions for various fuel cell applications.



How fuel cells operate

2. Important properties to consider are:

- Operating temperatures
- Ionic conductivity
- Size of stack



Your turn

Task 1:

Each group is assigned a type of fuel cell to research.

Once in your breakout rooms, find out your group number and access the relevant document on the SharePoint.

Discussion

Task 1:

1. Firstly, why are there different types of fuel cells being developed? Should investments not be focused on developing a single type that works well?
   Think about both sides to this argument.

Discussion

Task 1:

2. What kind of electrolyser does this fuel cell use? What makes it different from the other types?

Discussion

Task 1:

3. The operating temperatures (the temperature the cell needs to reach before it is working optimally) of each type of cell will vary.
   What are the operating temperatures of this cell and why must this be something important to consider when deciding on which type of fuel cell to use?

Discussion

Task 1:

4. The range of power outputs will also vary.
   Why is it sometimes easy to overcome a problem in which a single cell of a certain type only has a small power output?

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Breaktime

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Critical Thinking

- Our task before the break involved the need to think critically about a problem or solution.

- This will be an active expectation of every person going to university.

Critical Thinking

- Take a moment to remember other times you have had to critically think
- This can be a time where you were stuck and were able to devise a solution yourself, or even to think “I know a person who will know the answer”
- Critical thinking is not only for the big questions and problems.

Time to collaborate

- You are now given time to work on your poster.
- You will be placed in breakout rooms in order to discuss some ideas.
- If you have not yet had a chance to think about what your poster will focus on, now is a great chance to get started!

Time to collaborate

- In your breakout rooms,

1. Summarise what you have learned so far. Which topics and main focuses have been discussed?

2. Of those, which do you find most interesting or has the most things you believe you could research and discuss?

Note: The next session's content is on characterisation and diagnostics when faced with problems in fuel cells. **That will be the last piece of new content.**

Finishing up

Have you?

1. **Decided on what will be in your poster.**
2. **Shared your thoughts with others?**
3. **Filled in the google form with your brief summary?**

Any questions?

Next steps

Before our next session…

- Review the information you have been presented today and get involved in your own research!
- Get started with the poster!

What's coming up?

Drop-in sessions are run on the following evenings from 6pm – 7pm.

Monday 4th March

Monday 11th March

Monday 18th March

Monday 25th March

Your next subject session will be on the 6th of March from 6pm – 7:30pm.

Any questions?

If you need any support, or have any further questions, please don't hesitate to send the UCL Expand Team an email at wp.post16@ucl.ac.uk or drop us a text on **07857630033.**