

Electrochemistry

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Overview of Electrochemistry

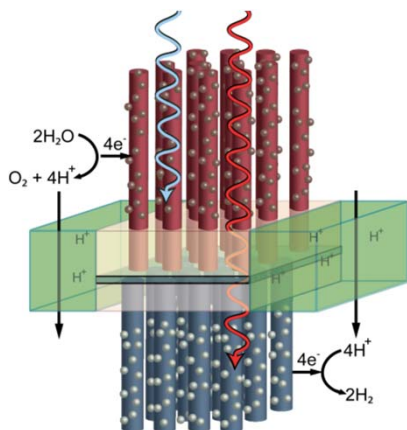
Electrochemistry simply requires

- * power supply
- * two electrodes
- * electrolyte
- * reactants (in most cases)

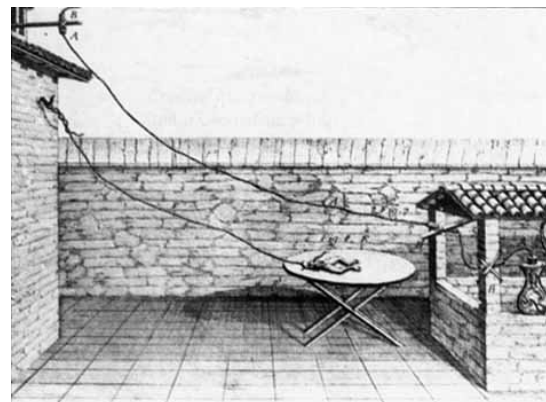
e.g. two pieces of metal, battery, sea water

** Most of the images in this presentation were taken from Wikipedia*

Caltech Solar Science

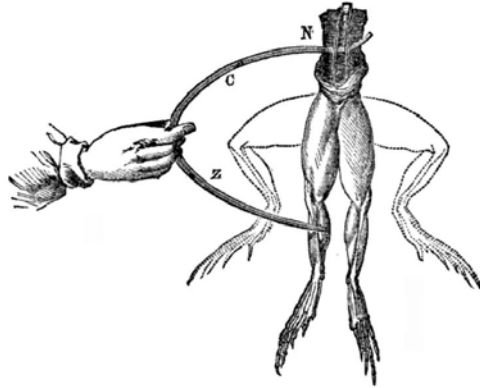


The First Electrochemist



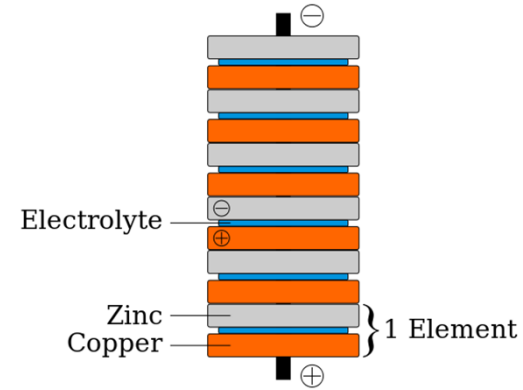
Luigi Galvani (physician & anatomist) (1791)

The First Electrochemist



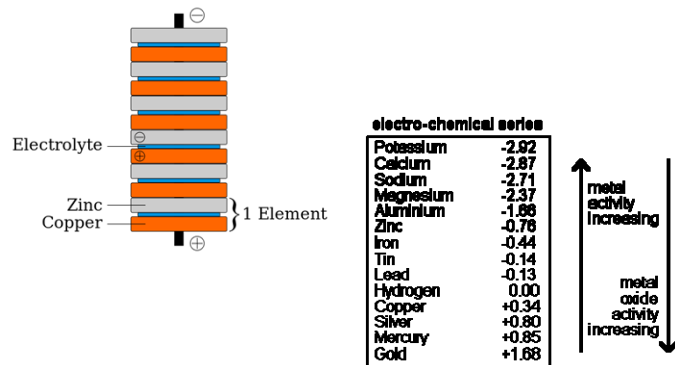
Luigi Galvani (physician & anatomist) (1791)

The 1.5th Electrochemist

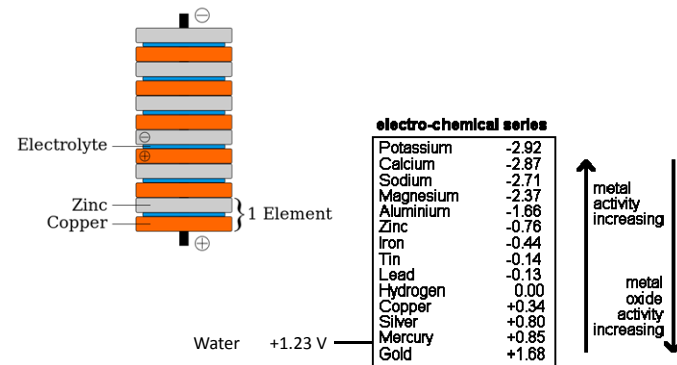


Alessandro Volta (physicist) (1799)

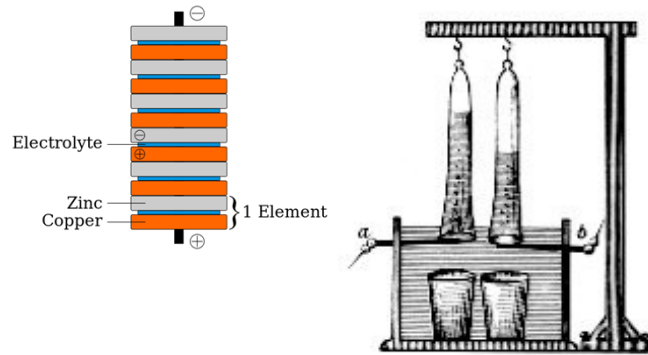
The Electrochemical Series



The Electrochemical Series



The 2nd Electrochemist



Anthony Carlisle (surgeon) & William Nicholson (chemist) (1800)

The 2nd Electrochemist



Anthony Carlisle (surgeon) & William Nicholson (chemist) (1800)

SEAL Activity



Electrochemistry

Physics

- Current: rate of a reaction
- Voltage: energy of a reaction

Chemistry

- Electron-Transfer $A + B \rightarrow C$
- Ion Transport ions moving

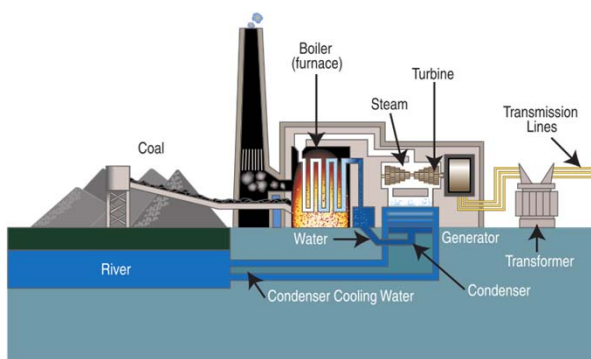
Physics



Physics



Coal-fired power plant

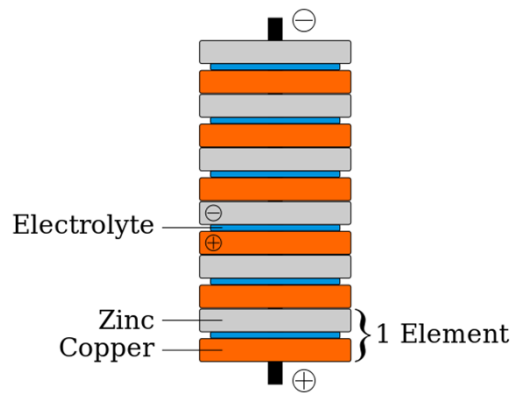


Source of current and voltage is nasty, harmful chemicals!

Physics



This is like your outlet



Batteries 101

electro-chemical series	
Potassium	2.92
Calcium	-2.87
Sodium	-2.71
Magnesium	-2.37
Aluminium	-1.66
Zinc	-0.76
Iron	-0.44
Tin	-0.14
Lead	-0.13
Hydrogen	0.00
Copper	+0.34
Silver	+0.80
Mercury	+0.85
Gold	+1.68

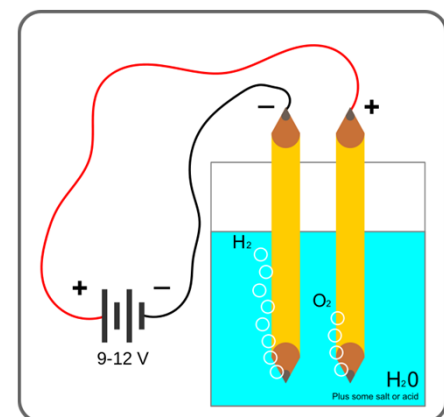
↑ metal activity increasing

↓ metal oxide activity increasing

What is the battery doing here?

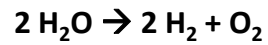
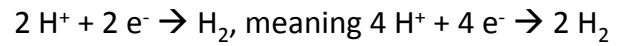
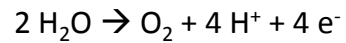
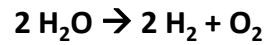
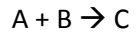


Water Electrolysis

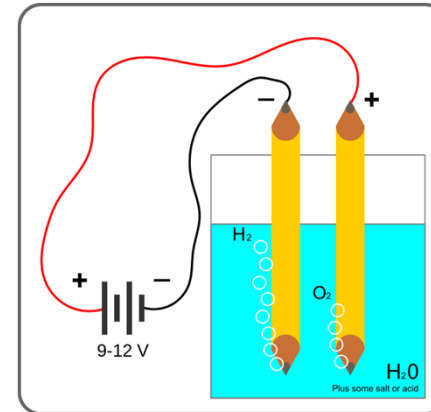


Chemistry

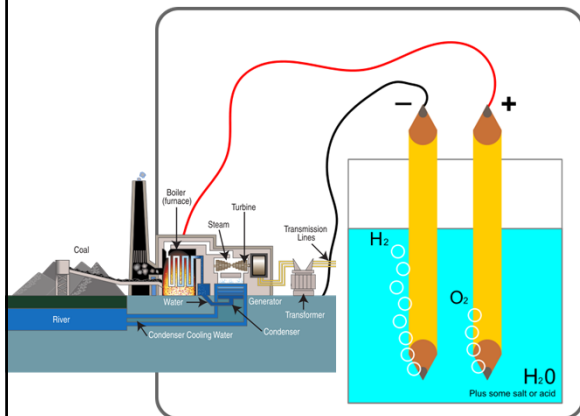
Electron Transfer



A subtlety: completing the circuit



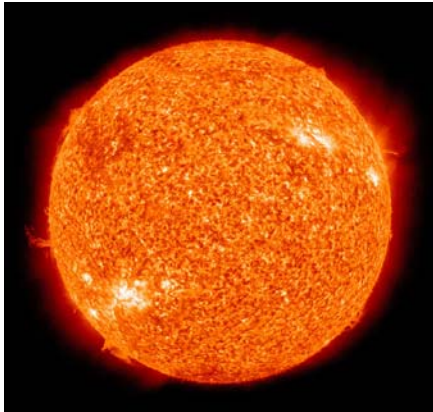
Making H₂ makes pollution!



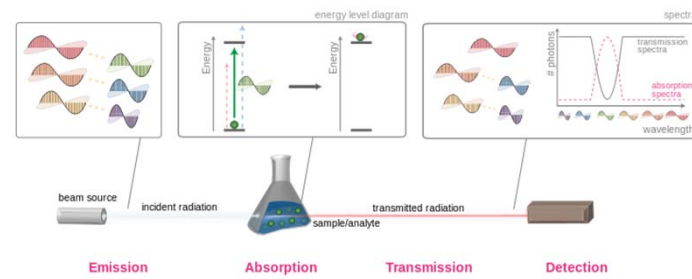
What is a free source of energy?



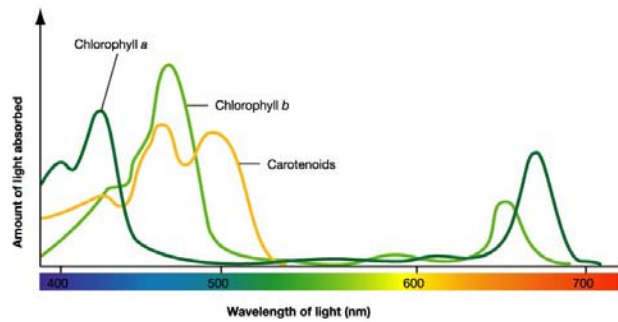
Nuclear chemistry !



What did Dr. Mueller teach you?



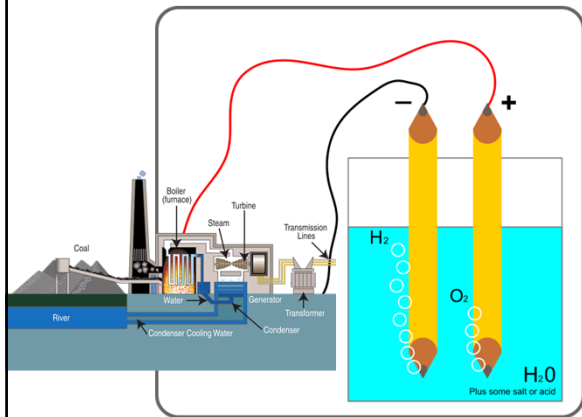
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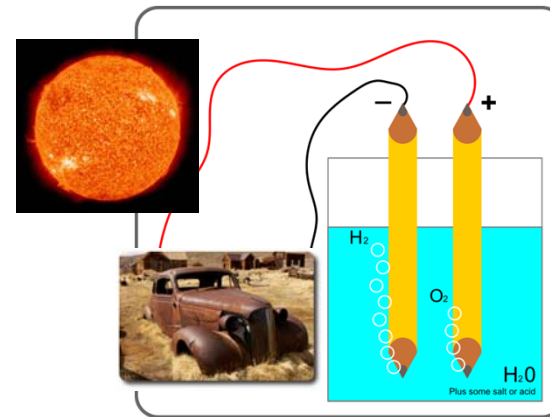
What compound is this?



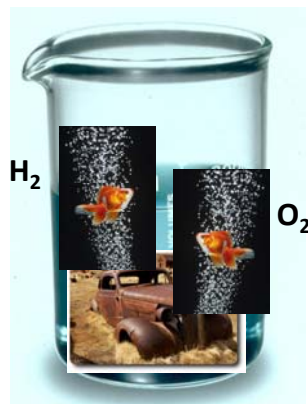
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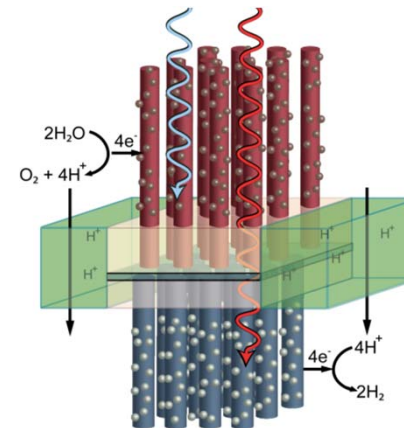
“Renewable” energy can make H₂

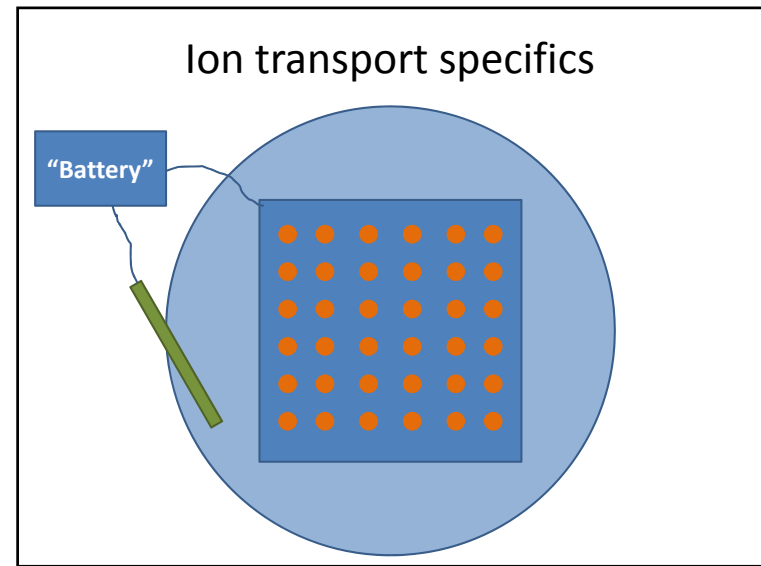
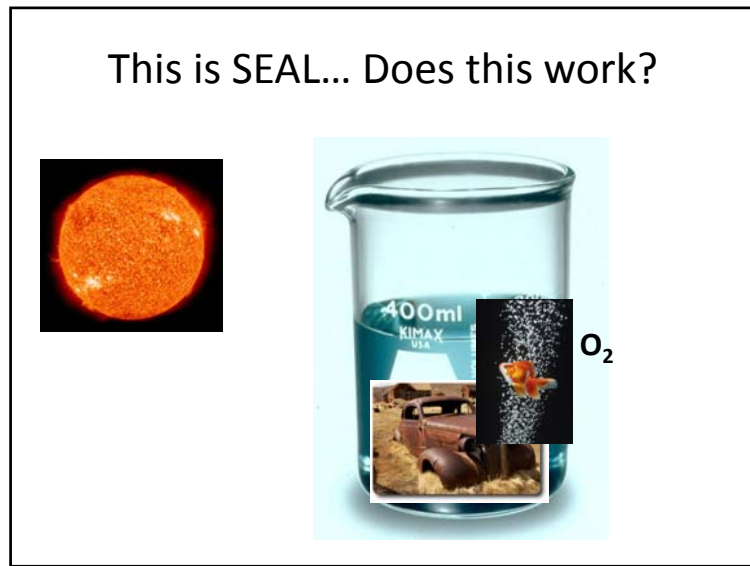
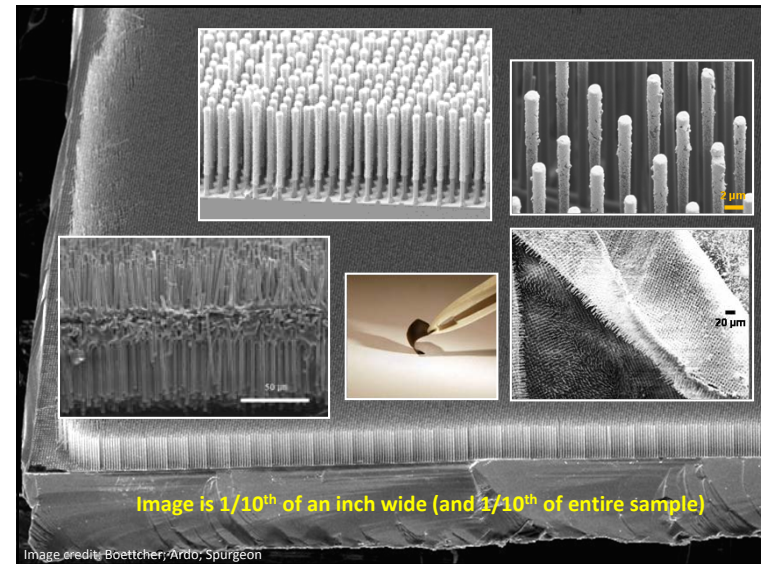
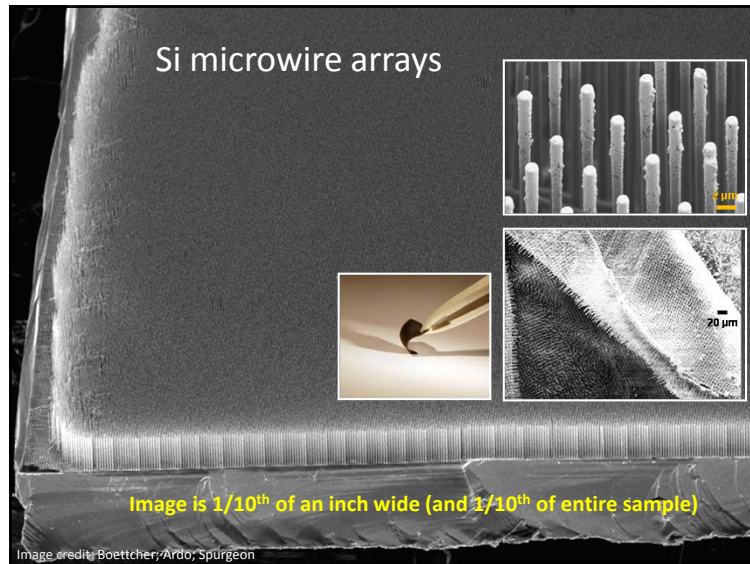


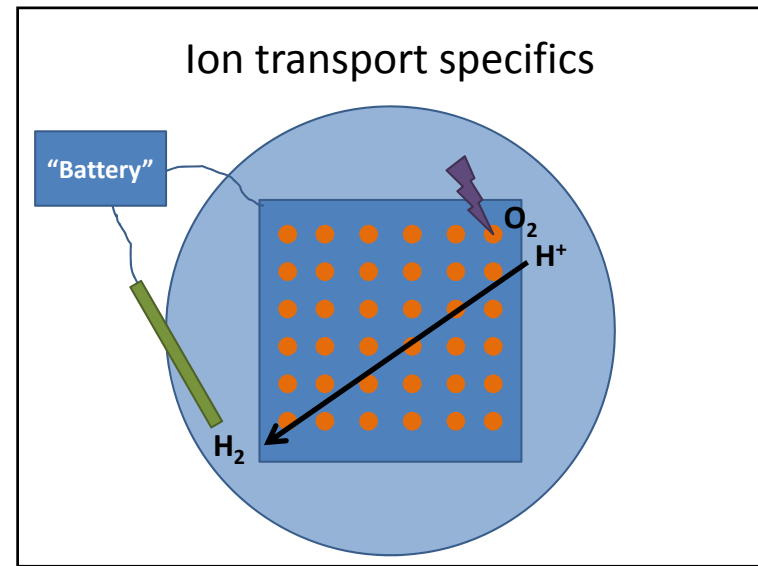
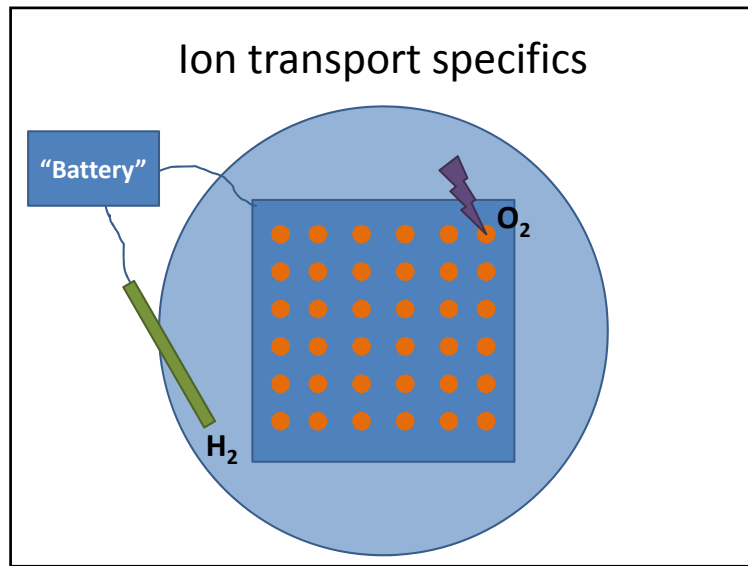
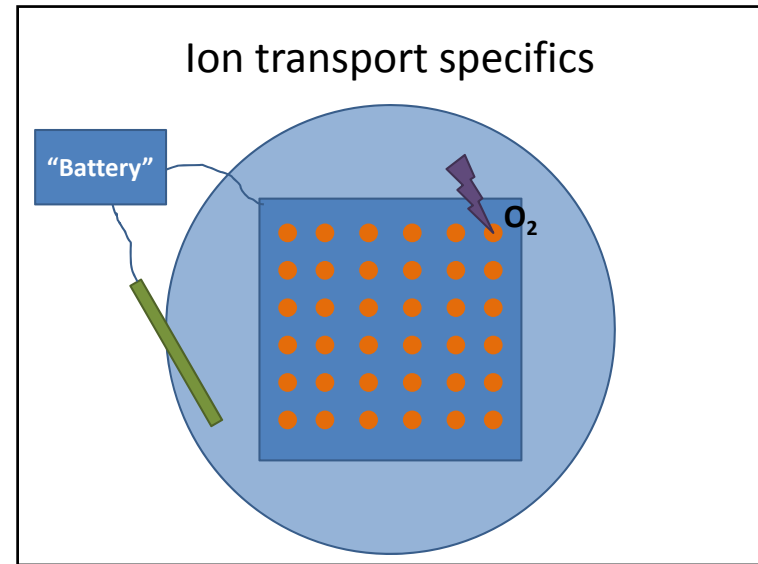
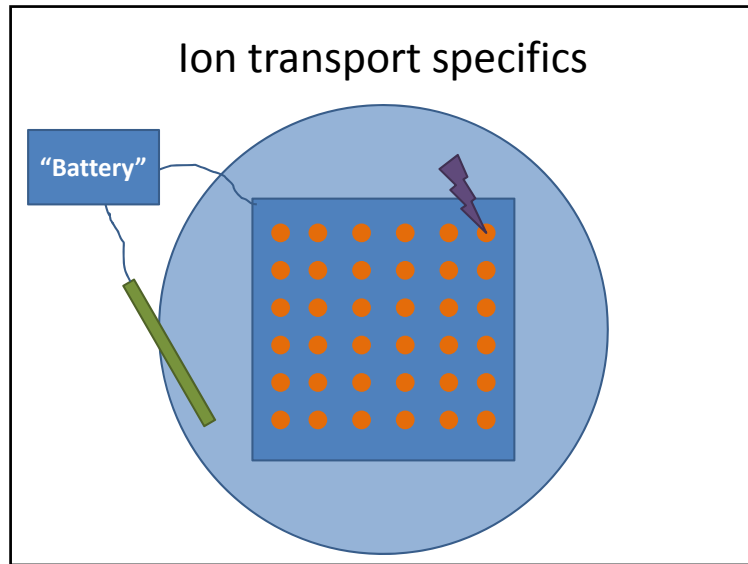
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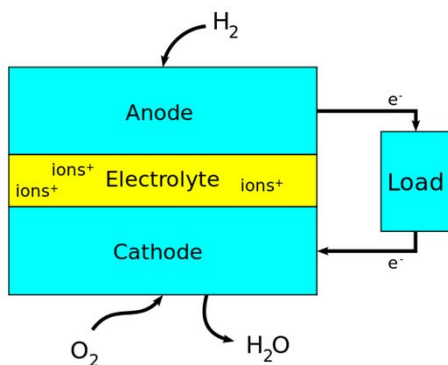
Caltech Solar Science





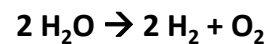
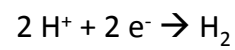
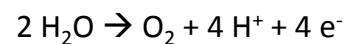
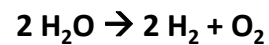
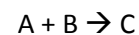


Fuel Cell to use the H₂



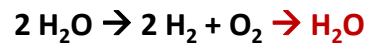
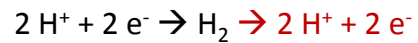
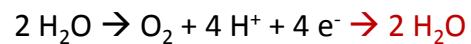
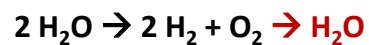
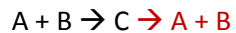
Water Splitting Chemistry

Electron Transfer

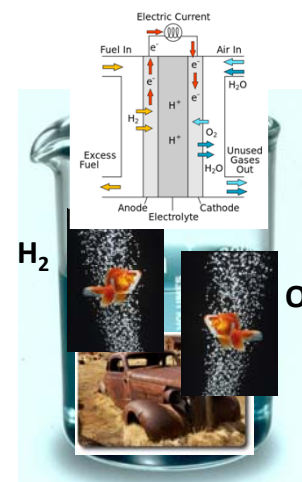
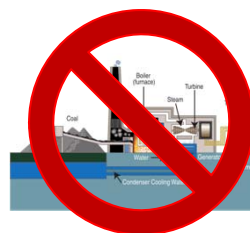


+ Fuel Cell Chemistry

Electron Transfer



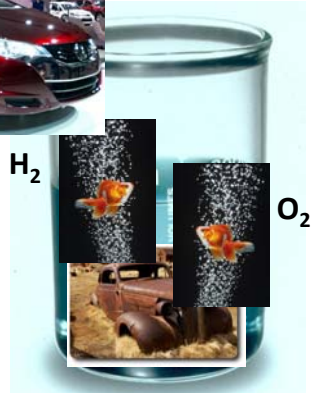
Making clean electricity



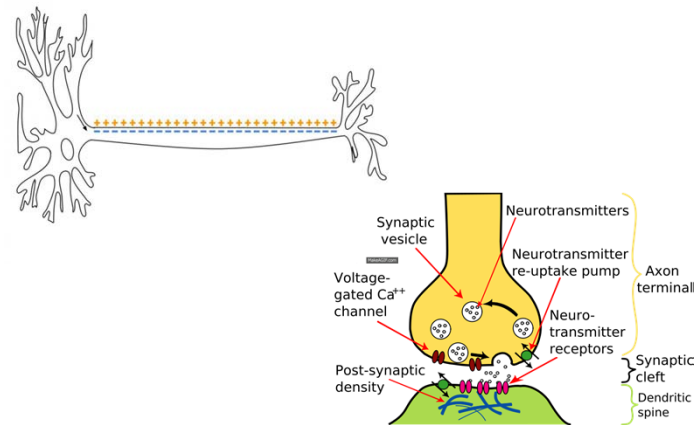
Use H₂ day and night



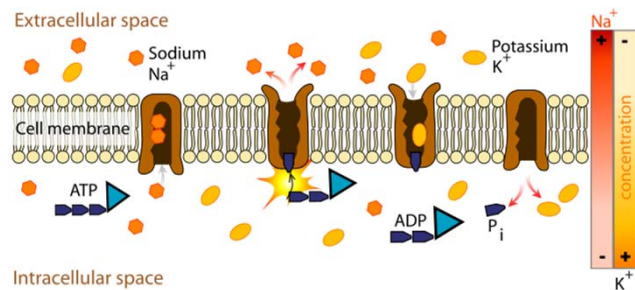
Honda 2008 FCX Clarity
\$600/month lease



Coming full circle... Signal Transduction



Coming full circle... Signal Transduction



Conclusions

- EChem requires a power supply, two electrodes, an electrolyte, and usually reactants
- Current is electrons moving back and forth (not creating electrons)
- We must complete the circuit for these to work
- Fossil fuels currently charge our batteries
- EChem is Nature, Electrolysis, Batteries, Fuel Cells