



Battery Technology

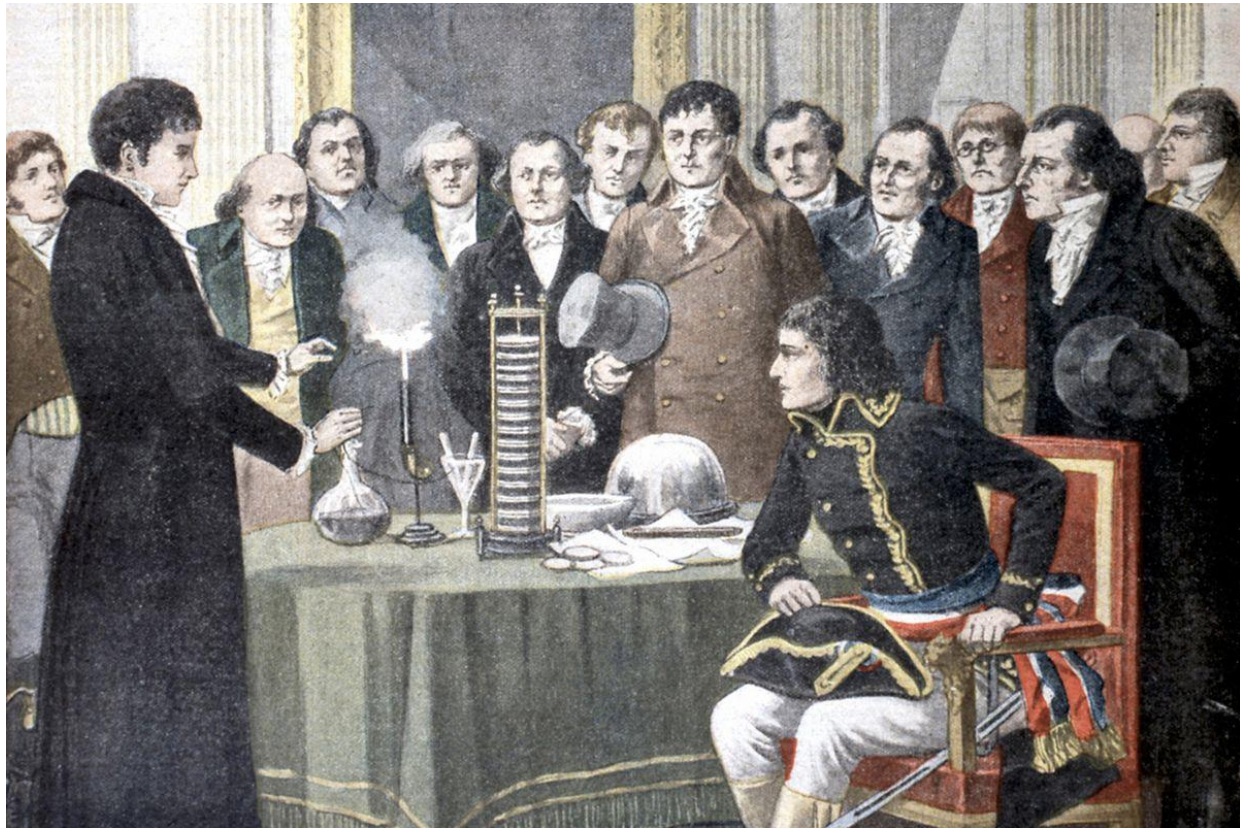
TCPC Tech Topics - May 2020

First a Little History...

The term Battery predates the electrochemical device we now think of as a battery. Benjamin Franklin coined the term as it related to a linked group of Leyden Jars. When they all discharged together he said it reminded him of a battery of cannon all firing at the same time.

The electrochemical cell was invented by Alessandro Volta around 1799. He stacked many cells together in what became known as a “Voltaic Pile”. The next slide is a classic image of Volta demonstrating the “pile” for Napoleon.





[Volta and Napoleon from vox.com](http://vox.com)

Terminology

Primary Reaction - this is the chemical reaction that occurs when a battery is discharging.

Secondary Reaction - this is the chemical reaction that takes place to reversed the primary reaction and “recharge” the battery.

Primary Cell - a battery designed to only be used once. (ex. Alkaline battery)

Secondary Cell - a rechargeable battery



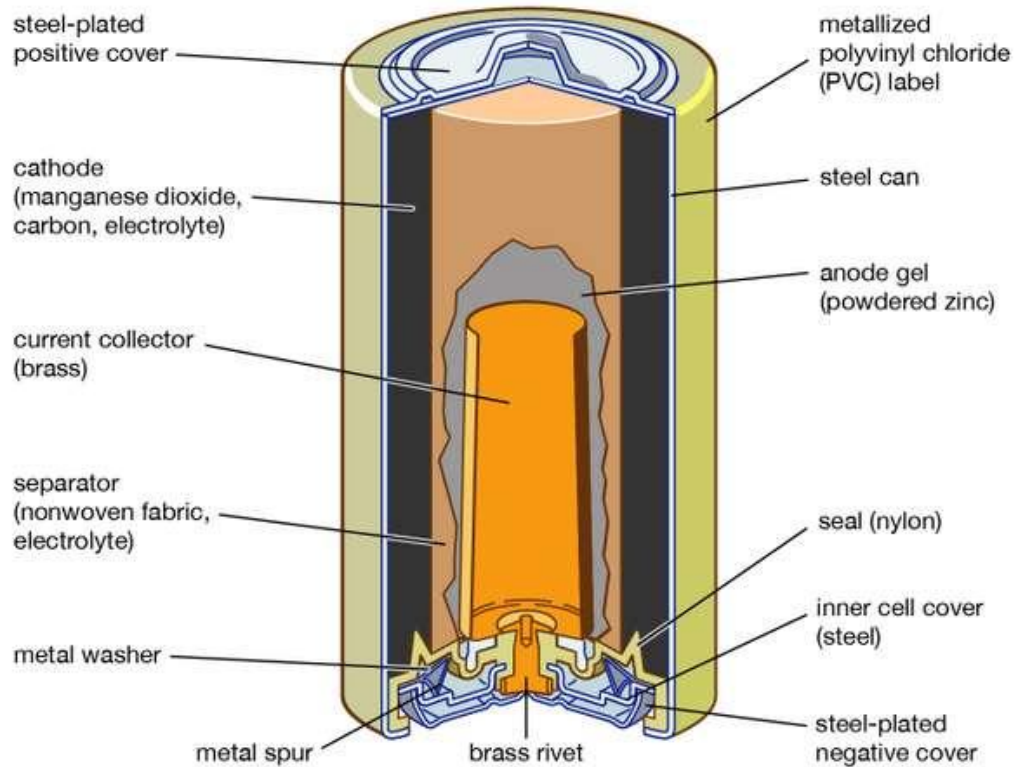
Common Primary Batteries/Cells

Alkaline Batteries/Cells - High Capacity disposable batteries/cells.

Heavy Duty Batteries/Cells - Cheap cells lower capacity than alkaline. [Sometimes referred to as a Leclanche cell or a Zinc Chloride Cell]

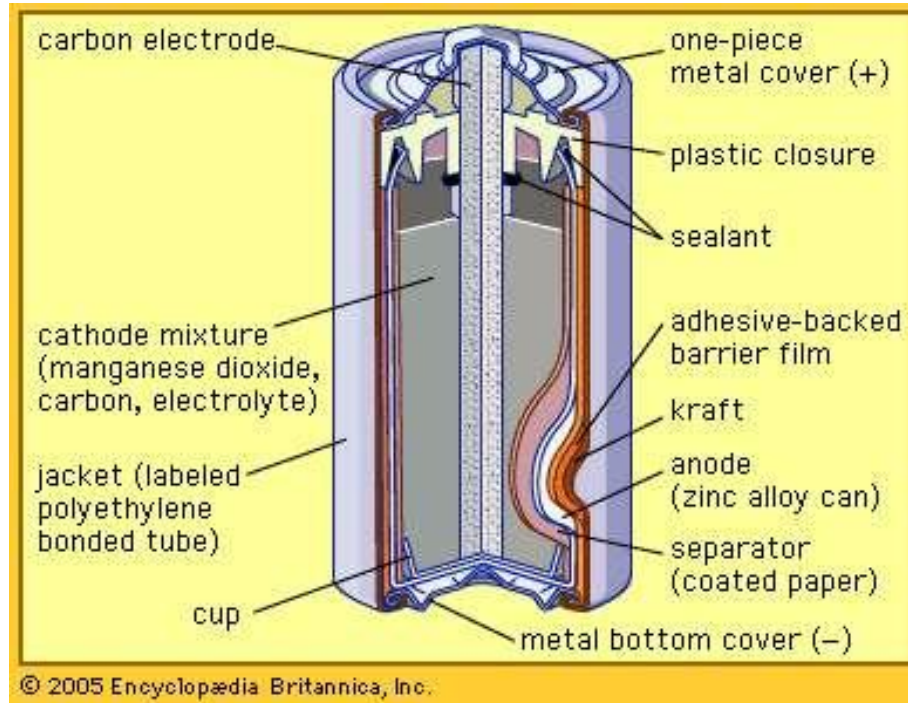
Lithium Metal Batteries/Cells - Extra long life in low drain situations. [Ex. Energizer Ultimate Lithium]. Danger exists of overheating and explosion.





© Encyclopædia Britannica, Inc.

<https://cdn.britannica.com/s:700x500/91/24091-050-4D2203B3/Cutaway-view-dioxide-power-cell.jpg>



<https://cdn.britannica.com/s:700x500/90/24090-004-EC128E8C/version-battery-cell-Leclanche-electrolyte.jpg>

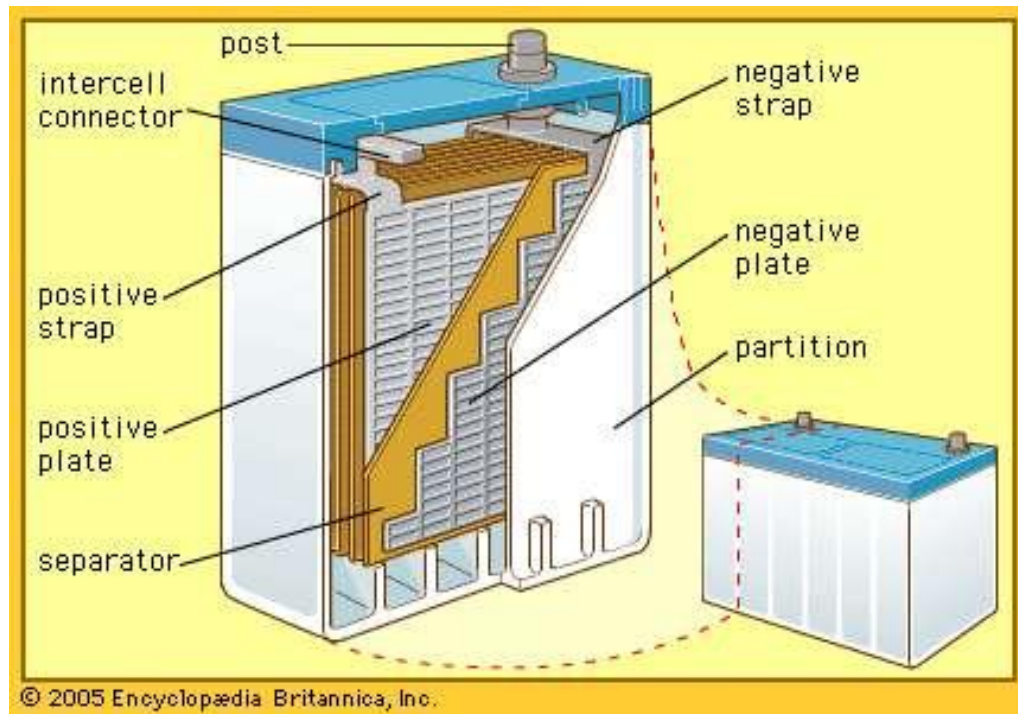
Common Secondary Cells

Lead-Acid Battery: Efficient rechargeable battery best if weight is not a factor.

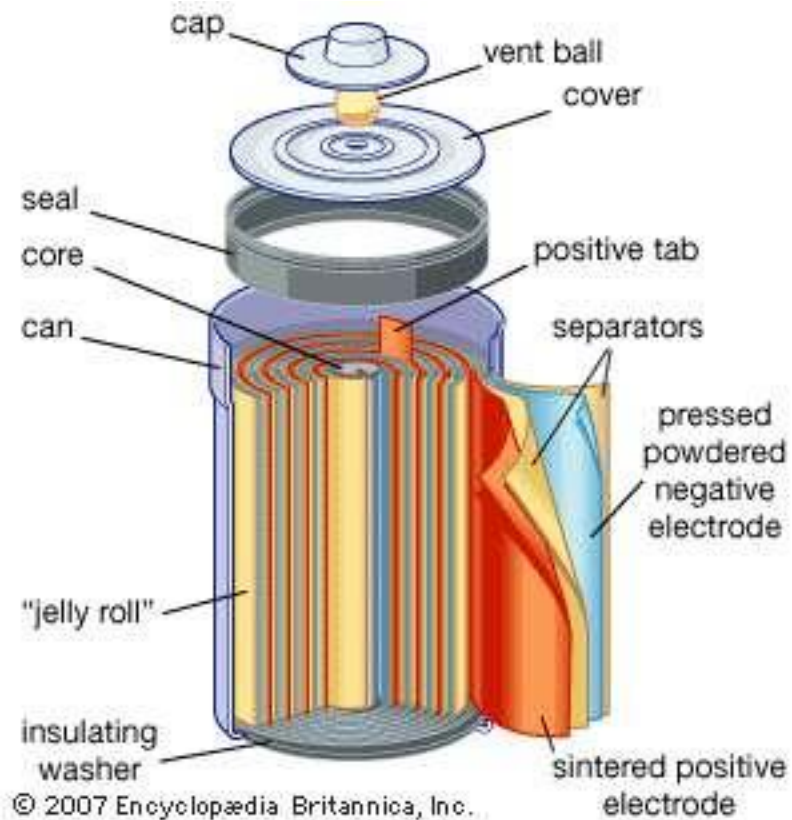
NiMH (Nickel Metal Hydride) - Common Rechargeable with higher energy density than previous NiCd without the toxic metals.

Lithium Ion - High energy density, comes in a variety of types based on Cathode material, some of which are hazardous. Used in most portable electronics and many electric vehicles.





<https://cdn.britannica.com/s:700x500/93/24093-004-D0F7DA04/Construction-storage-battery-lead-acid-charge.jpg>




<https://cdn.britannica.com/s:700x500/17/54317-004-45BBCD9E/Nickel--cadmium-cell-construction-jelly-roll-battery.jpg>

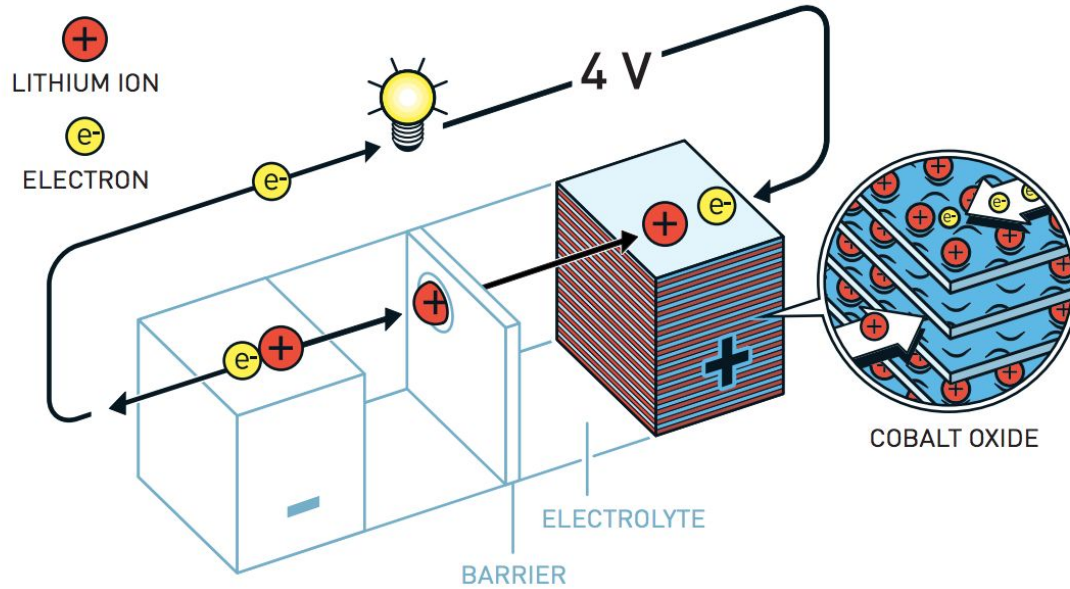
More about Li-ion batteries

Since Li-ion batteries are what most of us have in our devices a little more information might be useful:

- Only use a charger rated for the device you are charging
- Overpowering the charging ratings can cause fire and/or explosion
- Be aware of the operational and charging temperature limits
- Li-ion batteries are hazardous waste

The developers of the Li-ion battery technology received the 2019 Nobel Prize for Chemistry.





©Johan Jarnestad/The Royal Swedish Academy of Sciences

<https://www.designnews.com/sites/default/files/Design%20News/Goodenough%20Battery%20design.png>

Rechargeable Household Batteries

Almost all rechargeable household batteries (AA, AAA, C, D, 9V) are NiMH chemistry. Some information from ReviewGeek's page on rechargeable AA batteries:

- Batteries will self-discharge over time
- Each design is rated for a certain number of recharge cycles
- The listed voltage for an NiMH cell is 1.2 volt as opposed to 1.5 volt for alkaline cells.



Sidebar: Fuel Cells

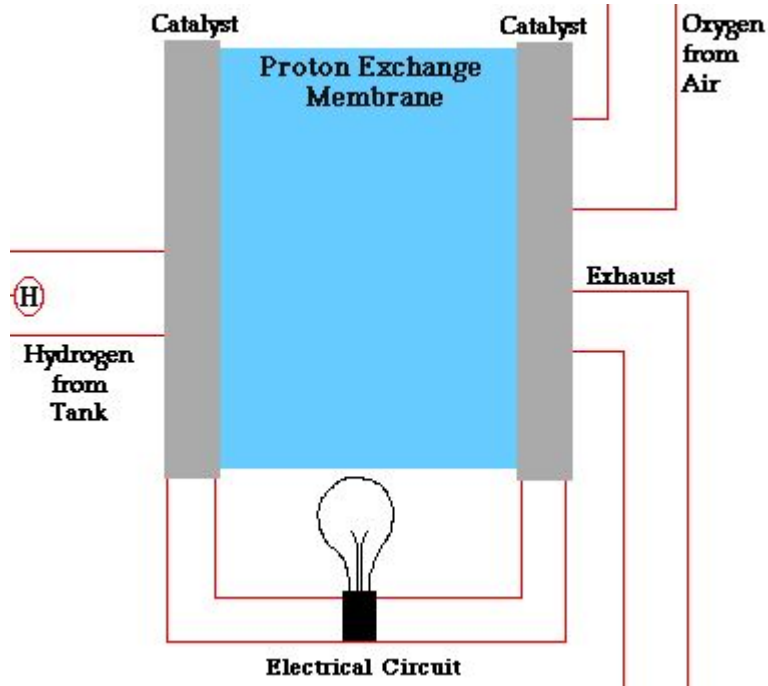
Four minute video on fuel cells from DOE at:

<https://www.energy.gov/eere/videos/energy-101-fuel-cell-technology>

- The Hydrogen fuel cell creates electricity by “borrowing” electrons from the hydrogen
- Eventually the electrons and the hydrogen ions combine with oxygen from the air to create water.
- Fuel cells can be stacked to create generators.



From the Smithsonian Institution



Graphic by Marc Marshall, Schatz
Energy Research Center



From DOE Success Stories website

<https://www.energy.gov/eere/success-stories/articles/eer-e-success-story-fuel-cell-generators-prove-they-can-save-energy-and>

The story on the linked page is about using fuel cell generators to power refrigeration units on inter island barges in Hawaii. Image is from the article.

