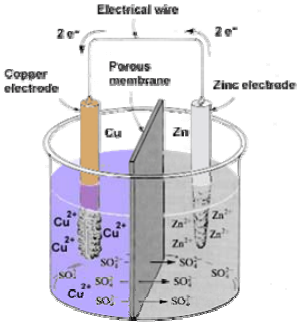
Topic 5 - Portable Power

Electrochemical Cells

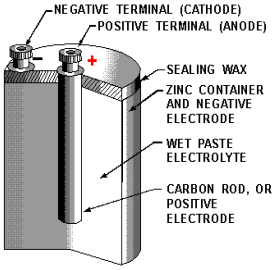
Two metal *electrodes* are surrounded by an *electrolyte*. These cells supply a steady current. The chemical reaction in a cell releases free electrons, which travel from the negative terminal of the cell, through the device, which uses the electricity, and back to the positive terminal of the cell. The chemical reactions within the cell determine the potential difference (voltage) that the cell can create. Several cells connected in series produces a higher voltage, and is commonly referred to as a battery, which is a sealed case with only two terminals.

A *primary cell* is one in which the reactions will not continue after the reactants are used up.

Wet cells use a liquid electrolyte. Wet cells are 'wet', because the electrolyte is a liquid (usually an acid). Each electrode (zinc and copper) reacts differently in the electrolyte. The acidic electrolyte eats away the zinc electrode, leaving behind electrons that give it a negative charge. The copper electrode is positive, but it is not eaten away. Electrons travel from the negative terminal (attached to the zinc electrode) through the device and on to the positive terminal (attached to the copper electrode).



Dry cells –the electricity-producing cells, referred to as 'batteries', are called dry cells, because the chemicals used in them are a paste. The dry cell is made up of two different metals, called electrodes in an electrolyte. An electrolyte is a paste or liquid that conducts electricity because it contains chemicals that form ions. An ion is an atom or group of atoms that has become electrically charged through the loss or gain of electrons from one atom to another. The electrolyte reacts with the electrodes, making one electrode positive and the other negative. These electrodes are connected to the terminals.



A *secondary cell* uses chemical reactions, which can be reversed. These are referred to as rechargeable batteries.

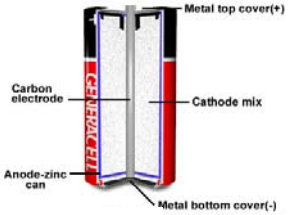
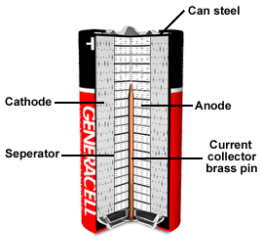
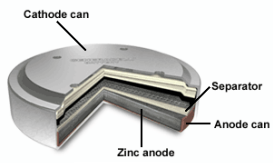
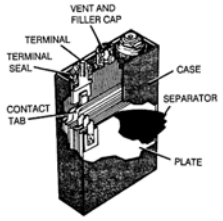
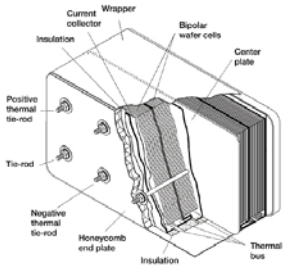
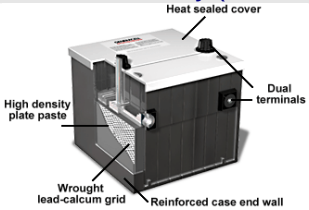
Rechargeable cells use an external electrical source to rejuvenate the cell. The reversed flow of electrons restores the reactants in the cell. The most common reactions that are efficient enough to be used for these types of cells are Nickel Oxide and Cadmium (Ni-Cad). The reactants are restored, but the electrodes will eventually wear out over time.

The tiny cells in a pacemaker can last from 5-12 years

Fuel Cells

Fuel cells combine hydrogen and oxygen without combustion. Electricity, heat and pure water are the only by-products of the fuel cell's reaction. They are 50-85% efficient.
World leader in fuel cell technology is a Canadian company Ballard Power Systems, in Burnaby, B.C. http://www.ballard.com/

Types of ‘dry’ cells

Name	Diagram	Uses	Pros and Cons
Primary Dry Cells			
zinc-carbon		Flashlights, portable stereos, CD players, walkmans	Not efficient at low temperatures
alkaline		Flashlights, portable stereos, CD players, walkmans	Last longer than zinc carbon, but more expensive
zinc-air		Calculators, hearing aids, watches	Highest energy per unit mass, but discharge rapidly
Secondary (rechargeable) Dry Cells			
nickel-cadmium		Electric shavers, laptops, power tools, portable TV’s	Rechargeable hundreds of times
nickel-metal hydride		Cameras, laptops, cell phones, hand tools, toys	Less toxic than NiCad – 40% more energy density than NiCad, rechargeable, no memory effect, lose charge when stored
Secondary (rechargeable) Wet Cell			
lead acid		Cars, motorbikes, snowmobiles, golf carts	Dependable, but heavy and has a corrosive liquid