All batteries have one thing in common: they run for a while, need recharging and require an eventual replacement as the capacity fades. Battery replacement comes often before retiring the host. The idea of an uninterrupted energy source is still a pipedream.

The website is continuously being upgraded and much of the information comes from the best-seller*Batteries in a Portable World: A Handbook on Rechargeable Batteries for Non-engineers*. The book will soon be in its fourth edition.

**Recognize the strength of the battery and learn how to live with its weakness.**

Nature offers many ways to produce power. Most result through combustion, mechanical movement and photosynthesis, as in a solar cell. Electrical energy generation of the battery develops by an electrochemical reaction between two metals of different affinities. When exposed to acids, a voltage develops between the metals as part of ion transfer; closing the circuit induces a current. In 1800, inventor [Alessandro Volta](http://batteryuniversity.com/learn/article/when_was_the_battery_invented)discovered that the voltage potential became stronger the farther apart the affinity numbers moved.

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| Energy is the product of power and time, measured in watt-hours (Wh); power is the flow of energy at any one time, measured in watts. |

A battery is rated in ampere-hours (Ah). This specifies how much charge a pack can hold. Like fluid in a container, the energy can be dispensed slowly over a long period of time or rapidly in a short time. The amount of liquid a container holds is analogous to the energy in a battery; how quickly the liquid is dispensed is analogous to power.  
  
The physical dimensions are specified by volume in liters (l) and kilograms (kg). Adding dimension and weight provides specific energy in Wh/kg, power density in W/l and specific power in W/kg. Most batteries are rated in Wh/kg, revealing how much energy a given weight can generate. Wh/l denotes watt-hours per liter.

A battery has two separate pathways; one is the electric circuit through which electrons flow, feeding the load, and the other is the path where ions move between the electrodes though the separator that acts as an insulator for electrons. Ions are atoms that have lost or gained electrons and have become electrically charged. The separator electrically isolates the electrodes but allows the movement of ions.

**Anode and Cathode**

The electrode of a battery that releases electrons during discharge is called the *anode*; the electrode that absorbs the electrons is the *cathode*.  
  
The battery anode is always negative and the cathode is positive. This seems to violate the convention as the anode is the terminal into which current flows. A vacuum tube, diode or a battery on charge follows this convention; however, taking power away from a battery on discharge turns the anode into negative. Since the battery is an electric storage device providing energy, the designation does not change between charging and discharging. The battery anode is always *negative*.

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| **http://www.batteryuniversity.com/_img/content/battery.png** |
| **Battery symbol** The cathode of a battery is positive; the anode is negative. |

## Electrolyte and Separator

Ion flow is made possible with an activator called the electrolyte. In a flooded battery system, the electrolyte moves freely between the inserted electrodes; in a sealed cell, the electrolyte is normally added to the separator in a moistened form. The separator segregates the anode from the cathode, forming an isolator for electrons but allowing ions to pass through. (See [BU-306: Separator](http://batteryuniversity.com/learn/article/bu_306_battery_separators) and [BU-307: Electrolyte](http://batteryuniversity.com/learn/article/bu_307_electrolyte))

## Capacity

Capacity represents specific energy in ampere-hours (Ah). Ah is the discharge current a battery can deliver over time. You can install a battery with a higher Ah than specified and get a longer runtime; you can also use a slightly smaller pack and expect a shorter runtime. Chargers have some tolerance as to Ah rating (with same voltage and chemistry); a larger battery will simply take longer to charge than a smaller pack, but the Ah discrepancy should not exceed 25 percent. European starter batteries are marked in Ah; North America uses Reserve Capacity (RC). RC reflects the discharge time in minutes at a 25A discharge. (See[BU-904: How to Measure Capacity](http://batteryuniversity.com/learn/article/how_to_measure_capacity).)