

Battery

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The usage of "battery" to describe a group electrical devices dates to [Benjamin Franklin](#), who in 1748 described multiple [Leyden jars](#) by analogy to a [battery of cannon](#) (Benjamin Franklin borrowed the term "battery" from the military, which refers to weapons functioning together). [Alessandro Volta](#) described the first electrochemical battery, the [voltaic pile](#) in 1800. This was a stack of copper and zinc plates, separated by brine soaked paper disks, that could produce a steady current for a considerable length of time. Volta did not appreciate that the voltage was due to chemical reactions. He thought that his cells were an inexhaustible source of energy and that the associated corrosion effects at the electrodes were a mere nuisance, rather than an unavoidable consequence of their operation, as [Michael Faraday](#) showed in 1834.

Although early batteries were of great value for experimental purposes, in practice their voltages fluctuated and they could not provide a large current for a sustained period. The Daniell cell, invented in 1836 by British chemist John Frederic Daniell, was the first practical source of electricity, becoming an industry standard and seeing widespread adoption as a power source for electrical telegraph networks. It consisted of a copper pot filled with a copper sulfate solution, in which was immersed an unglazed earthenware container filled with sulfuric acid and a zinc electrode

Batteries convert chemical energy directly to electrical energy. A battery consists of some number of voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the negative electrode, the electrode to which anions (negatively charged ions) migrate; the other half-cell includes electrolyte and the positive electrode to which [cations](#) (positively charged ions) migrate. Redox reactions power the battery. Cations are reduced (electrons are added) at the cathode during charging, while anions are oxidized (electrons are removed) at the anode during discharge. The electrodes do not touch each other, but are electrically connected by the electrolyte. Some cells use different electrolytes for each half-cell. A separator allows ions to flow between half-cells, but prevents mixing of the electrolytes.

Primary batteries, or primary cells, can produce current immediately on assembly. These are most commonly used in portable devices that have low current drain, are used only intermittently, or are used well away from an alternative power source, such as in alarm and communication circuits where other electric power is only intermittently available. Disposable primary cells

cannot be reliably recharged, since the chemical reactions are not easily reversible and active materials may not return to their original forms. Battery manufacturers recommend against attempting to recharge primary cells.

Secondary batteries, also known as *secondary cells*, or *rechargeable batteries*, must be charged before first use; they are usually assembled with active materials in the discharged state. Rechargeable batteries are (re)charged by applying electric current, which reverses the chemical reactions that occur during discharge/use. Devices to supply the appropriate current are called chargers.

Molten salt batteries are primary or secondary batteries that use a molten salt as electrolyte. They operate at high temperatures and must be well insulated to retain heat.

A reserve battery can be stored unassembled (unactivated and supplying no power) for a long period (perhaps years). When the battery is needed, then it is assembled (e.g., by adding electrolyte); once assembled, the battery is charged and ready to work. For example, a battery for an electronic artillery [fuze](#) might be activated by the impact of firing a gun: The acceleration breaks a capsule of electrolyte that activates the battery and powers the fuze's circuits. Reserve batteries are usually designed for a short service life (seconds or minutes) after long storage (years). A water-activated battery for oceanographic instruments or military applications becomes activated on immersion in water.

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