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How Batteries Fail WAYNE SASLOW, Texas A&M University — Batteries are series and/or parallel sets of individual voltaic cells, each characterized by an emf (electromotive force) and an internal resistance. A voltaic cell, with two electrodes separated by ion-containing electrolyte, supports chemical reactions at each electrode-electrolyte interface, involving ions in the electrolyte and both atoms and electrons in the electrode. The chemical reactions drive an electric current, and are responsible for the cell emf (electromotive force). Moreover, ions in the electrolyte are largely responsible for the electrolyte conductance, which determines the internal resistance. As the cell discharges, the ion density decreases, causing a rate of decrease of the conductance proportional to the current. A simple model that treats the ion density as always uniform can explain numerous aspects of the discharge curves (current vs time or current vs total discharge), including the precipitous fall in current when the internal resistance becomes comparable to the load resistance.

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