

**EMF**

A battery is a source of potential difference (voltage)

This voltage is also known as EMF or Electromotive Force ( $\mathcal{E}$ )

Despite the name this is a potential not a force.

The EMF is the potential if nothing is connected to the battery, as soon as current flows, the potential difference across the terminals is always less than EMF

This is due to internal resistance

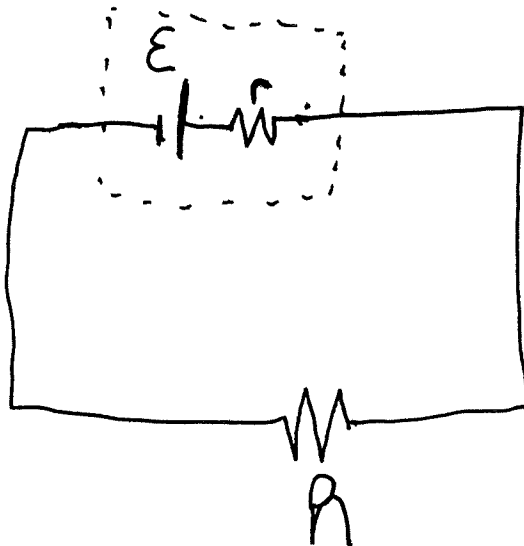
$$V_{\text{term}} = \mathcal{E} - Ir$$

$V_{\text{term}}$  is the voltage across the battery's terminals

$r$  is the internal resistance

$I$  is the current

Create a diagram showing a circuit with the external resistance  $R$ , internal resistance  $r$ , and EMF  $\mathcal{E}$



When a battery goes dead it is because the internal resistance builds up until the voltage drop across the internal resistance is equal to the EMF.

EXAMPLE: A 12.0 V battery has an internal resistance of  $0.220\Omega$ . What is the terminal voltage of the battery when a current of 3.00 A flows through the battery?

$$V_{\text{term}} = \mathcal{E} - Ir$$

$$= 12.0\text{V} - 3.00\text{A} \times 0.220\Omega$$

$$= 11.34\text{V}$$

$$\approx 11.3\text{V}$$