Current Electricity

Continuous flow of electric charges

Did You Know?

The voltage across a muscle cell in your body is about 70 millivolts. A millivolt (mV) is one thousandth of a volt.

AC and DC

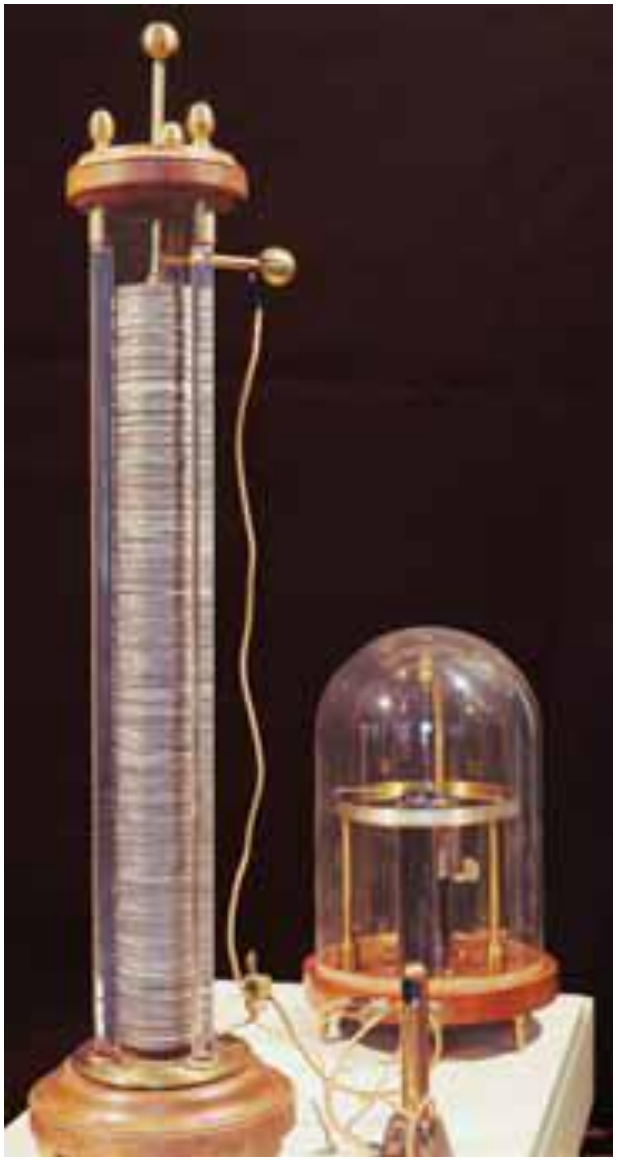
- DC
  - Direct Current
  - Electrons flow in one direction
  - e.g. battery
- AC
  - Alternating Current
  - Electrons flow changes direction
  - e.g. wall outlet (120Volts, 60 Hertz or vibrations per second)

In 1799, Volta invented a “voltaic pile” battery, alternating zinc and copper disks separated by pieces of fabric

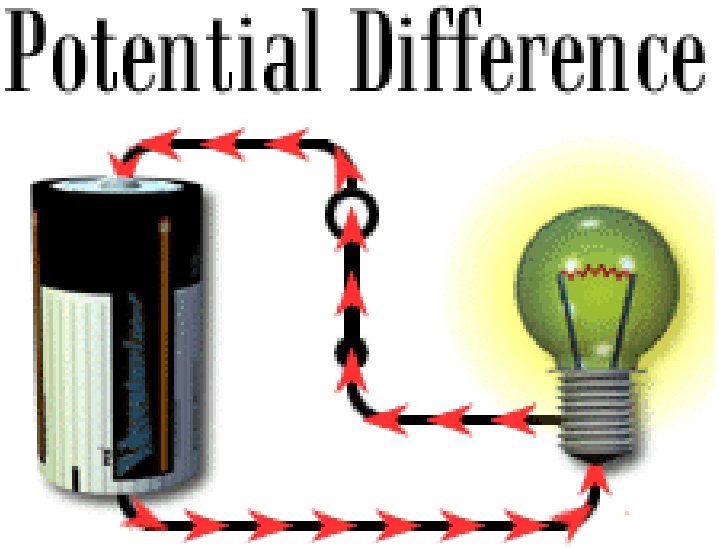
soaked in salt water.

Alessandro Volta

(1745–1827)



Electric Potential Energy

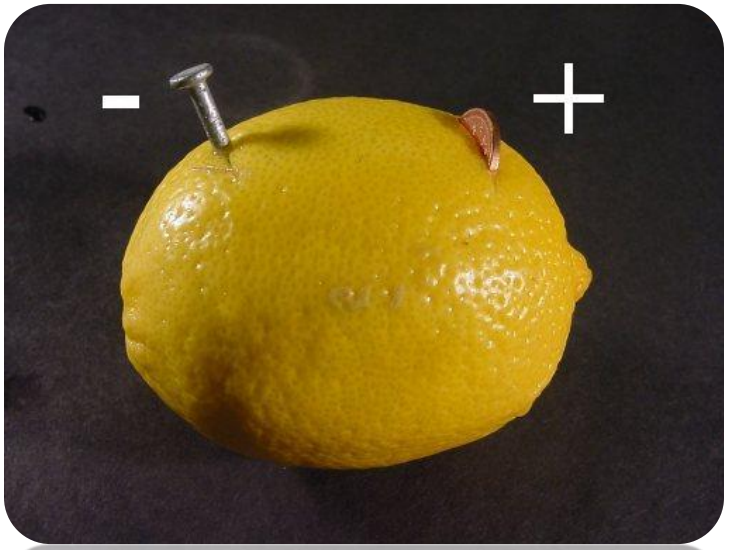


- stored energy from separating + and – charges

or from pushing like charges together.

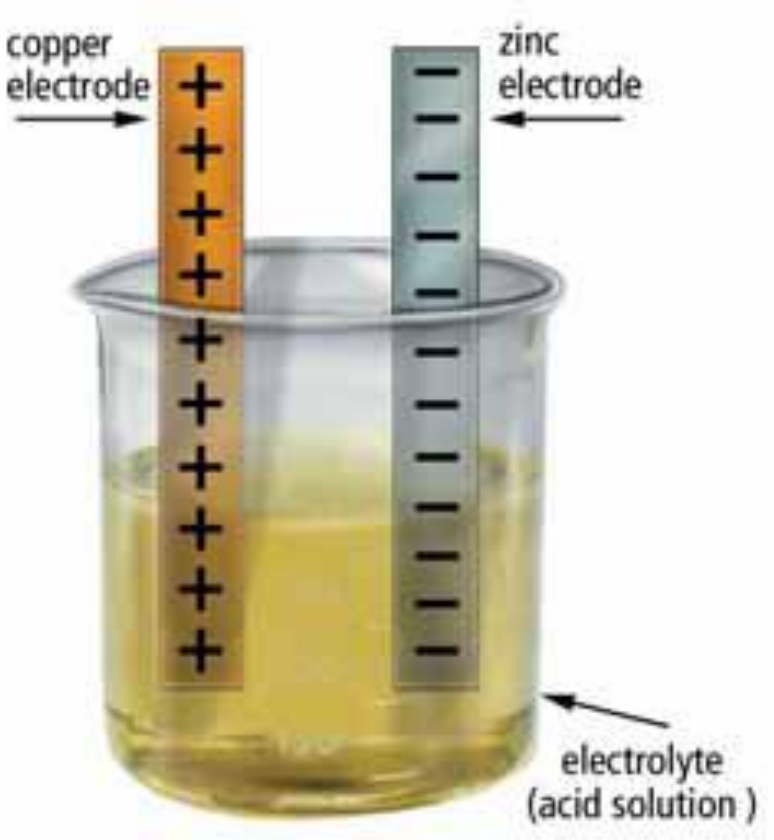
- Current will flow if:
- 1) a difference in electrical potential energy can be maintained
- 2) a complete pathway exists for charges to follow

A chemical cell

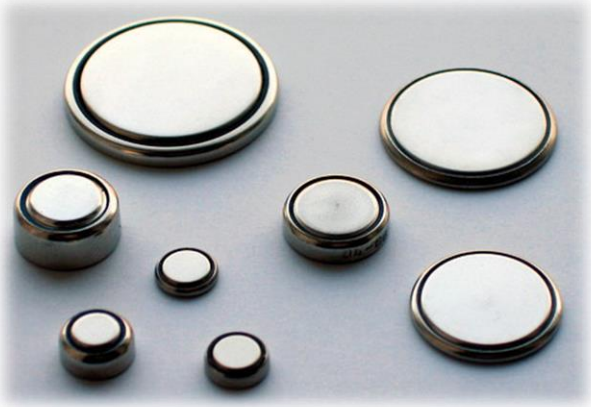


- 2 electrical connections (terminals) made of two different metals in a conducting solution
- chemical reactions create a source of electrons at one point and consume electrons at another
- “Dry Cells” - liquid conductor is replaced by a conducting paste (e.g. D - cell, AA - cell)

An electrochemical cell requires two different electrodes (usually metals) and an electrolyte.

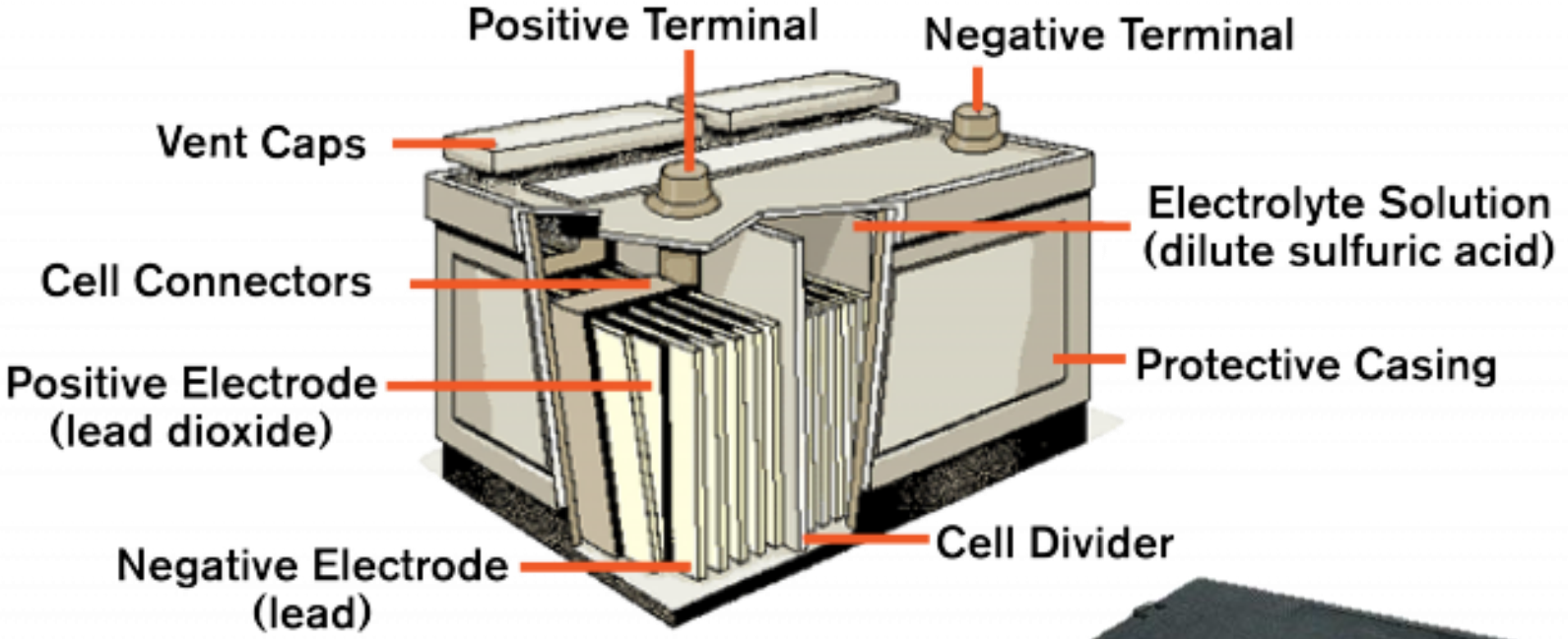


Different Types of Dry Cells



Battery

- term is usually used incorrectly in everyday speech
- consists of 2 or more cells connected together
- e.g. car battery, group of AA or other cells connected together


Positive Terminal
Negative Terminal
Vent Caps
Electrolyte Solution
(dilute sulfuric acid)
Cell Connectors
Protective Casing
Positive Electrode
(lead dioxide)
Cell Divider
Negative Electrode
(lead)

Car Battery

What is a conductor?

- a material that allows free electron movement
- Examples:
  - Aluminum
  - Gold
  - Copper
  - Most Metals

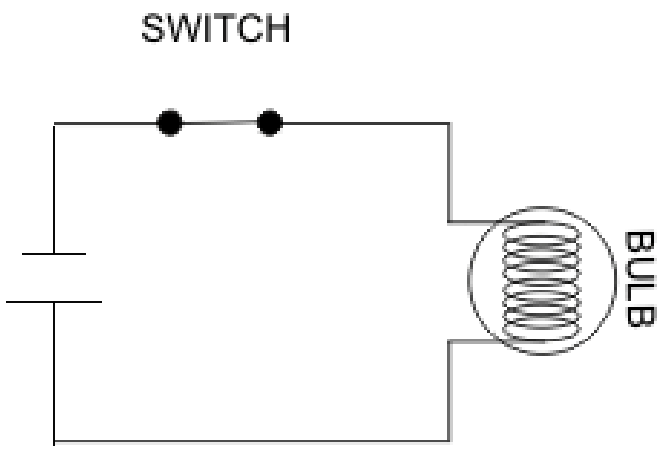
Circuits

- A circuit is a closed path that electrons move through.

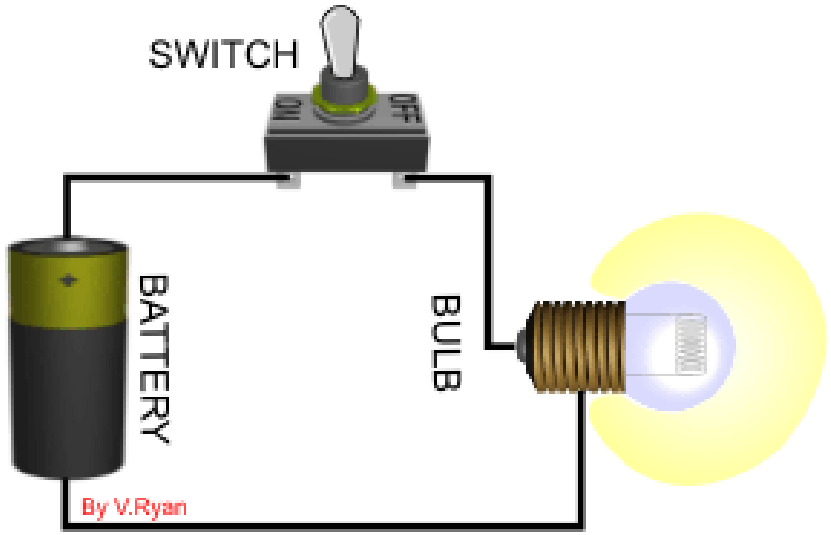
In circuits there are:

- Batteries as the energy source which provide the energy to push electric charges. This movement is called a current.
- A resistor represents loads which convert electrical energy to other forms like light, heat, motion and sound.
- Resistors all resist the movement of charge through the circuit.
- A switch is used to control the circuit.

CIRCUIT DIAGRAM



PICTORIAL CIRCUIT DIAGRAM



Units

- Electrical Charges are measured in Coulombs

$$1\,\text{coulomb of charge} = 6.24\times10^{18}\,\text{charges}$$

Voltage

- A measure of the electrical potential energy of the charges
- measured in Volts

$$1\,\text{Volt} = \frac{1\,\text{Joule of energy}}{1\,\text{Coulomb of charge}}$$

Current - a measure of the rate of flow of electrons

$$1\,\text{Ampere (or Amp)} = \frac{1\,\text{Coulomb of charge}}{\text{second}}$$

"Conventional Current": flow of charges from + to -

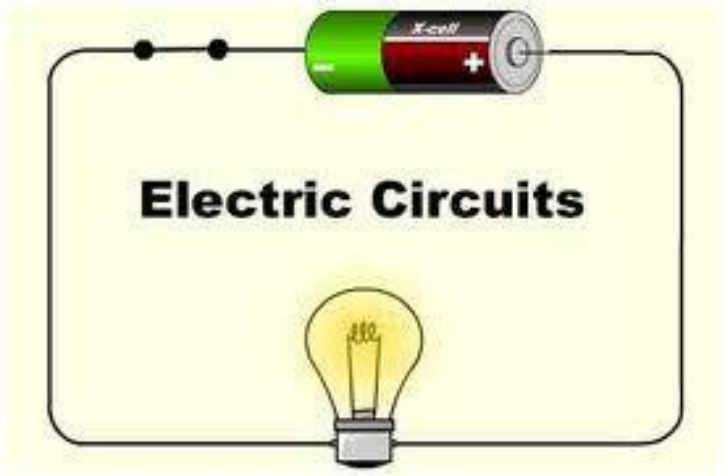
(decided before it was known that electrons moved, not protons)

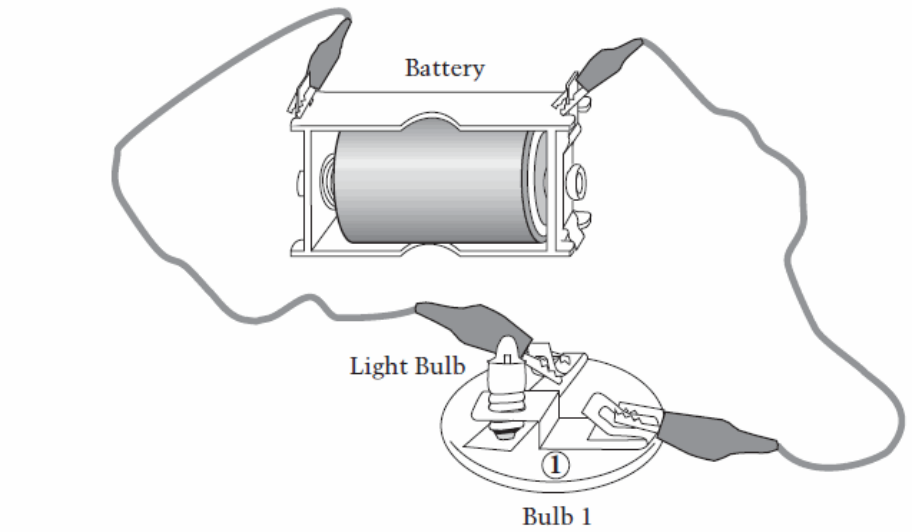
- Actual flow of charges (electrons) is from - to +

Continue lesson next day
Complete Booklet 8.1

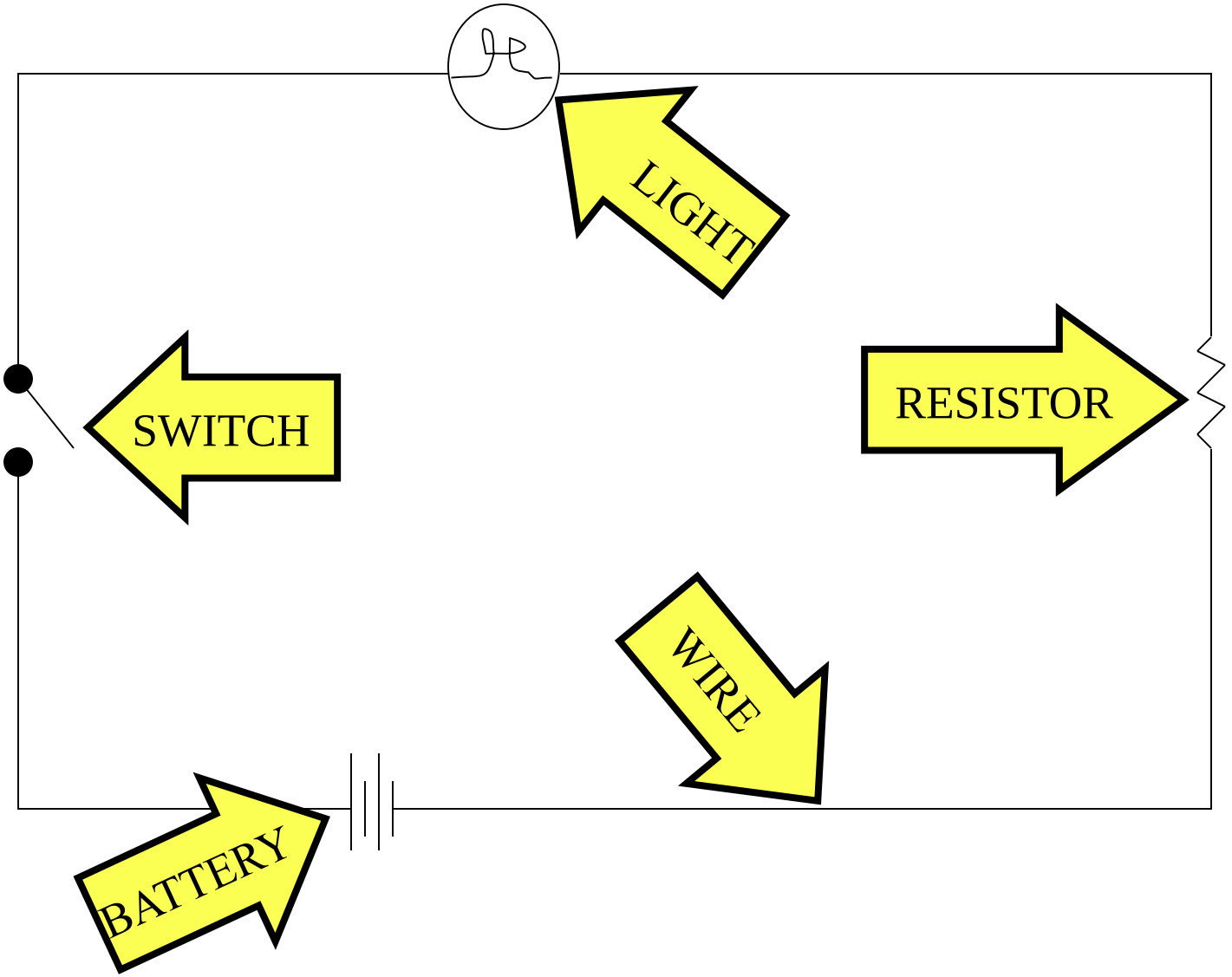
ELECTRIC CIRCUITS

- A complete conducting pathway for current from the source and back again
- Two different types of circuits depending on the number of pathways for the electrons



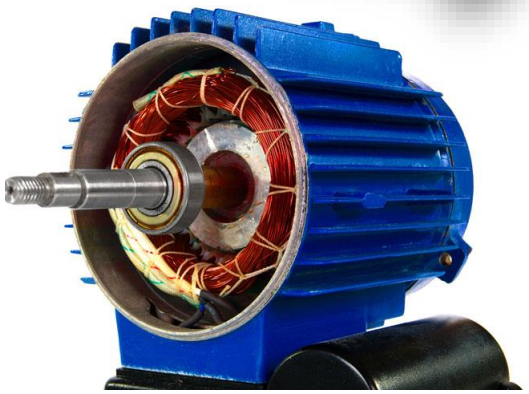


A Simple Circuit



Load

There must be a device, called a load, which converts electrical energy into other forms of energy such as light or sound. Light bulbs, speakers, heaters, and motors are examples of loads.



Resistance

- a measure of how difficult it is for current to flow through a conductor
- measured in Ohms (Ω)

Resistor

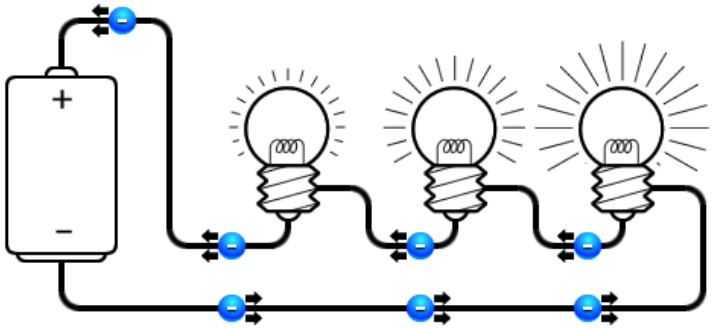
- devices that "resist" flow of electricity
- turns electricity into heat and light (e.g. light bulb filament, heating element, toaster wires)

Rheostat

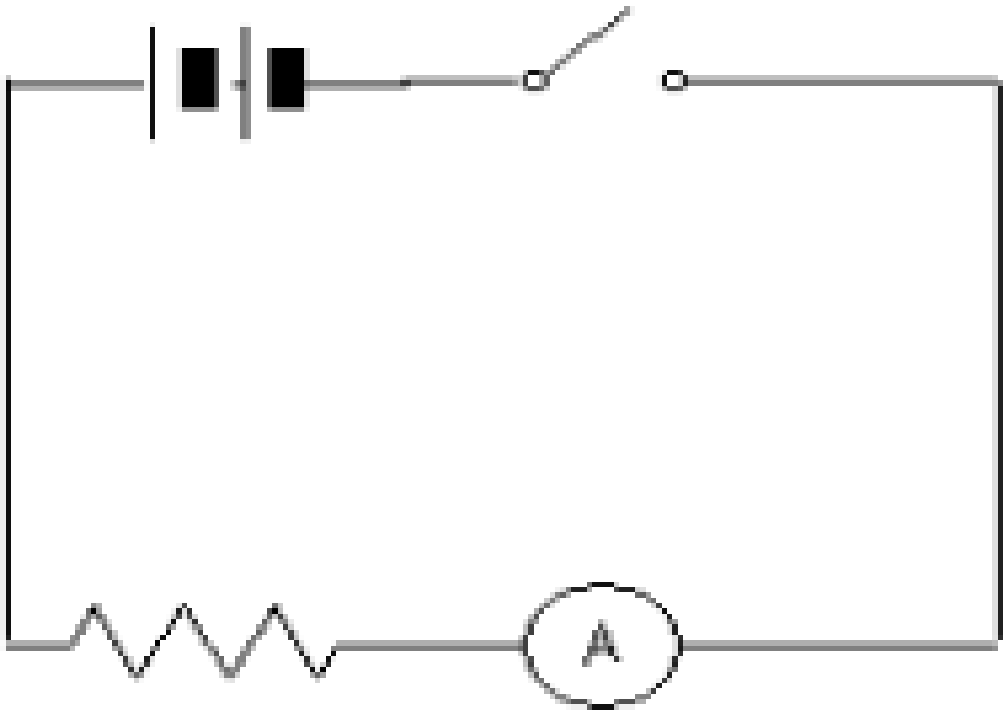
- variable resistor
- Changes the amount of electricity that flows
- e.g. volume control, dimmer switch, temperature control

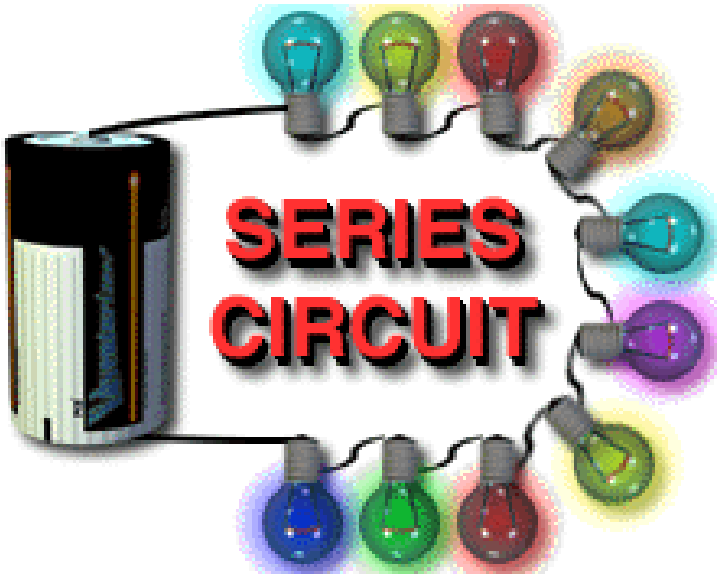
SERIES CIRCUIT

- A single pathway through all parts of the circuit
- voltages add together,
- current stays constant.



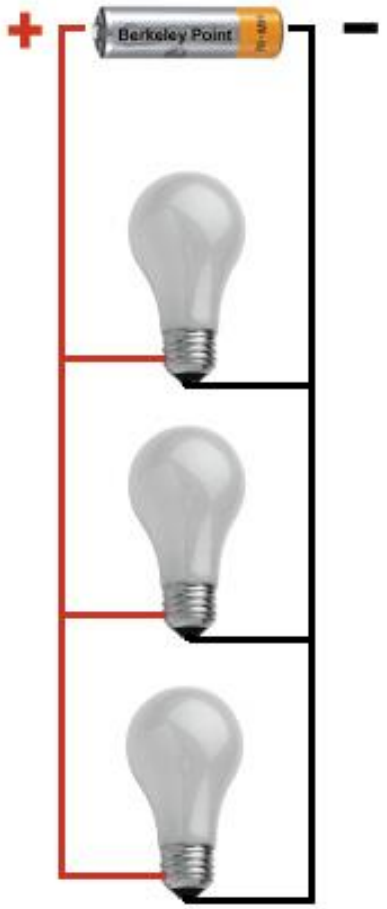
Series Circuit



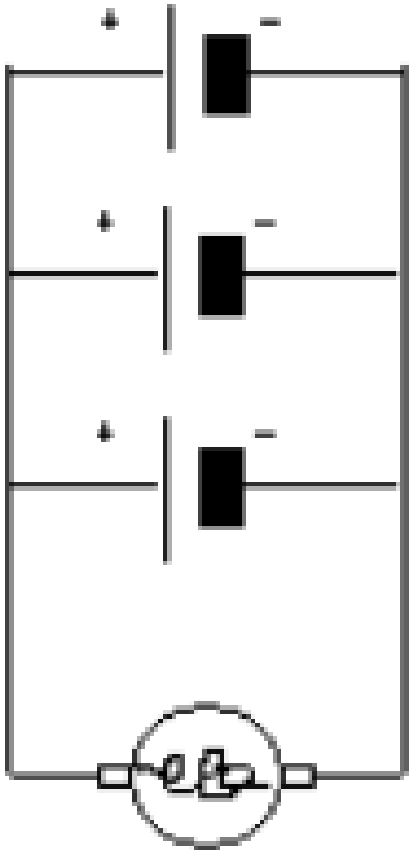


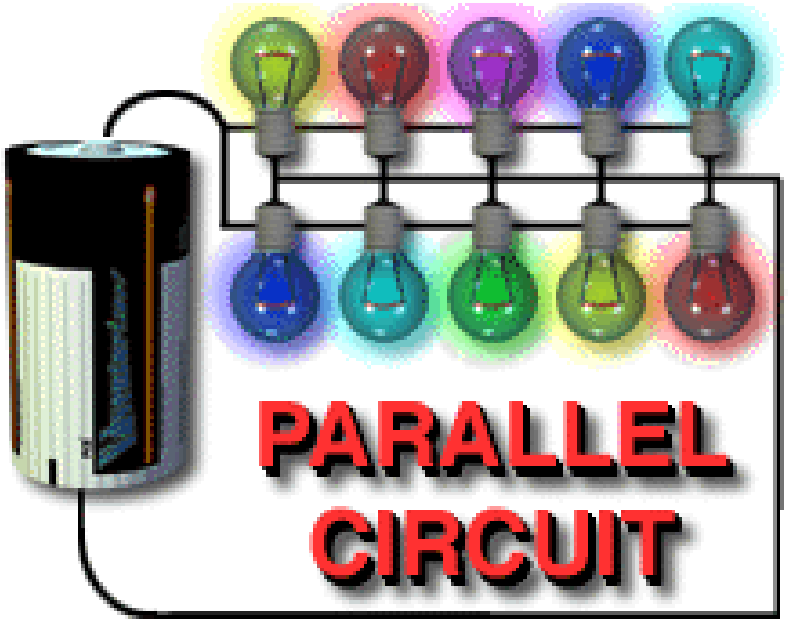
PARALLEL CIRCUIT

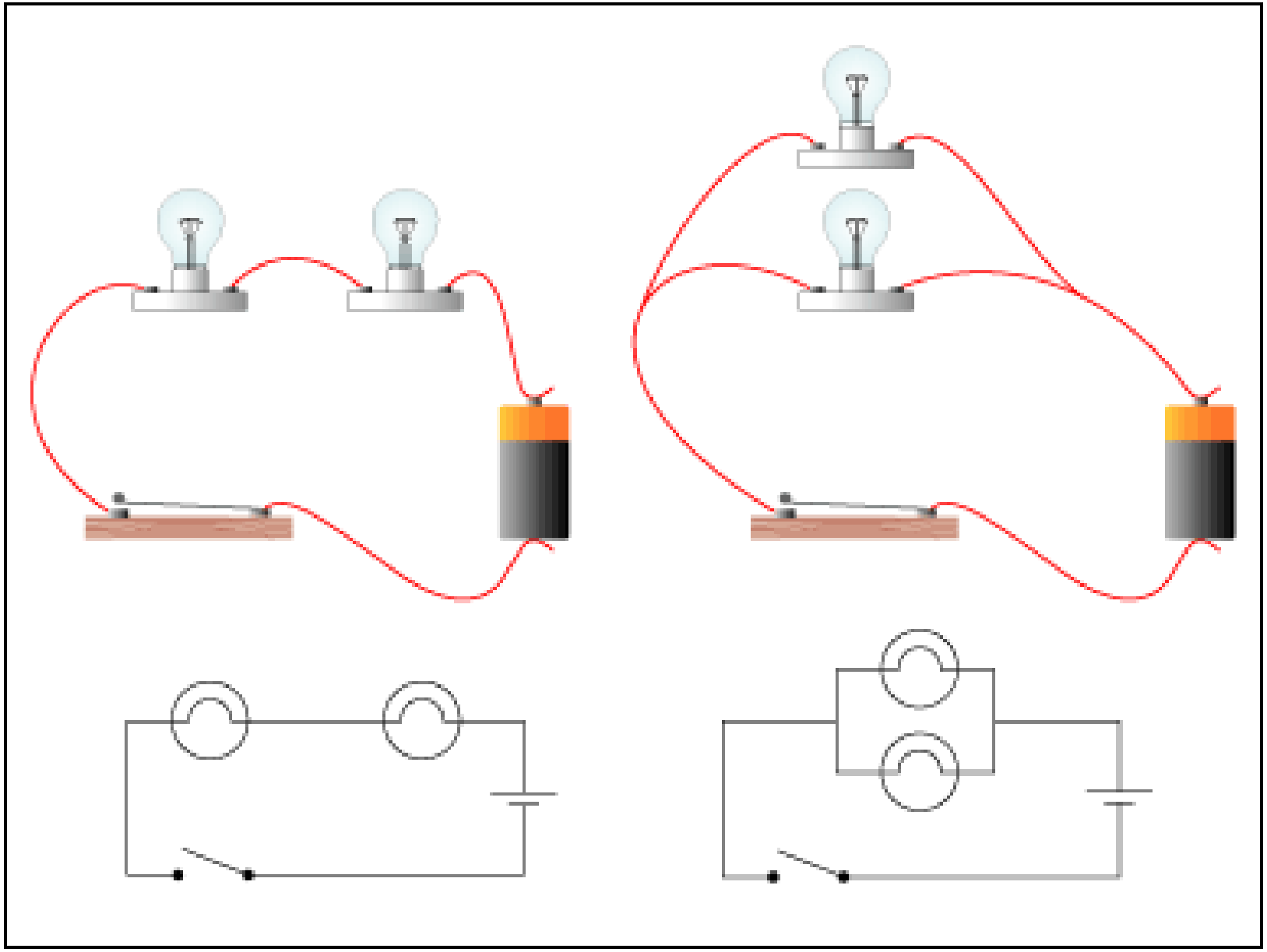
- A branched pathway - more than one path for electrons
- voltage stays constant,
- currents add together.



Parallel Circuit







Continue lesson next day
Complete booklet 8.2

Current, Voltage, Resistance

- Current
  - a measure of the flow of electrons
  - measures in Amperes (A)
- Voltage
  - a measure of the potential energy per charge
  - measures in Volts (V)
- Resistance
  - a measure of the opposition to electron flow
  - measured in Ohms (Ω)

Units of Measure

- Charge
  - Measure in Coulombs (C)
  - Charge of one electron = 1.602×10^{-19} Coulombs
- Current
  - 1 Ampere = 1 Coulomb/second
- Voltage
  - 1 Volt = 1 Joule/Coulomb
- Resistance
  - 1 Ohm = 1 Volt/Ampere