
ELECTRICITY

Goals

Explain the flow of electrons in terms of

- alternating and direct current.
- the relationship among voltage, resistance and current.
- simple series and parallel circuits.

Explain static electricity in terms of

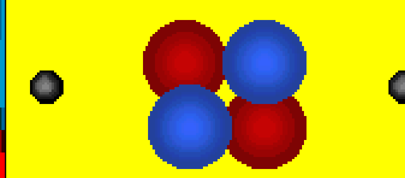
- friction
- induction
- conduction

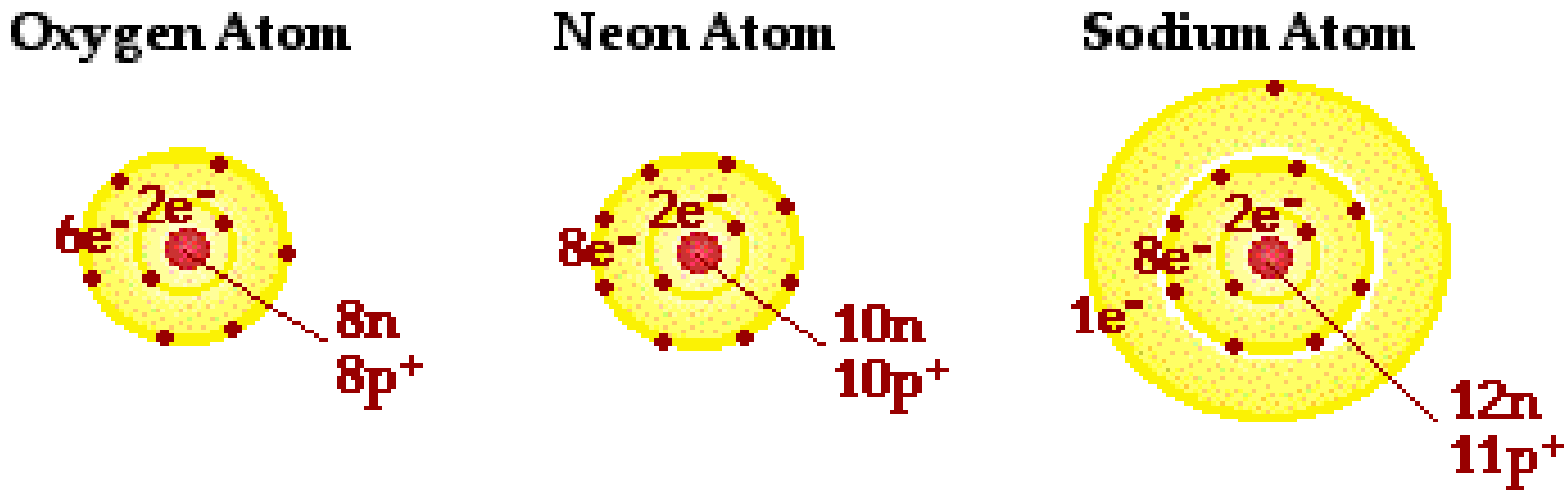
Construct simple circuits

Properties of Electric Charge

Atomic Structure: Composed of three main particles:

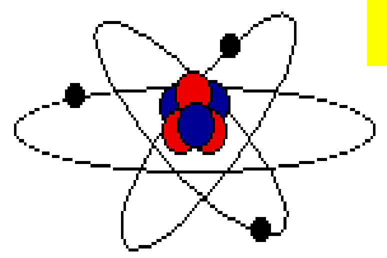
1. Proton
2. Neutron
3. Electron





Atoms are composed of protons and neutrons located in the nucleus and electrons which are positioned in the surrounding regions of space known as electron shells.

Things to Remember:



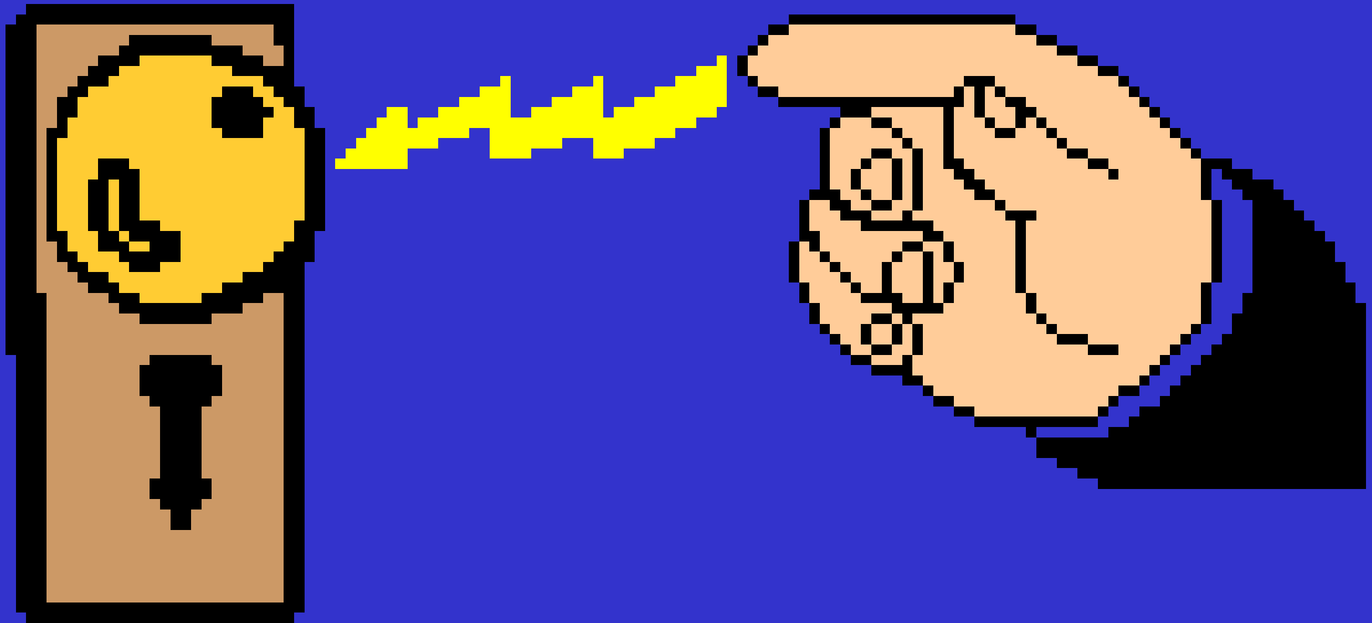
- **Everything is made of atoms.**
- **Electrons can move from one atom to another atom.**

Static Electricity

- The temporary building up of charge on an object.
- Some atoms hold e- more tightly than others.
- Ex. Your shoes

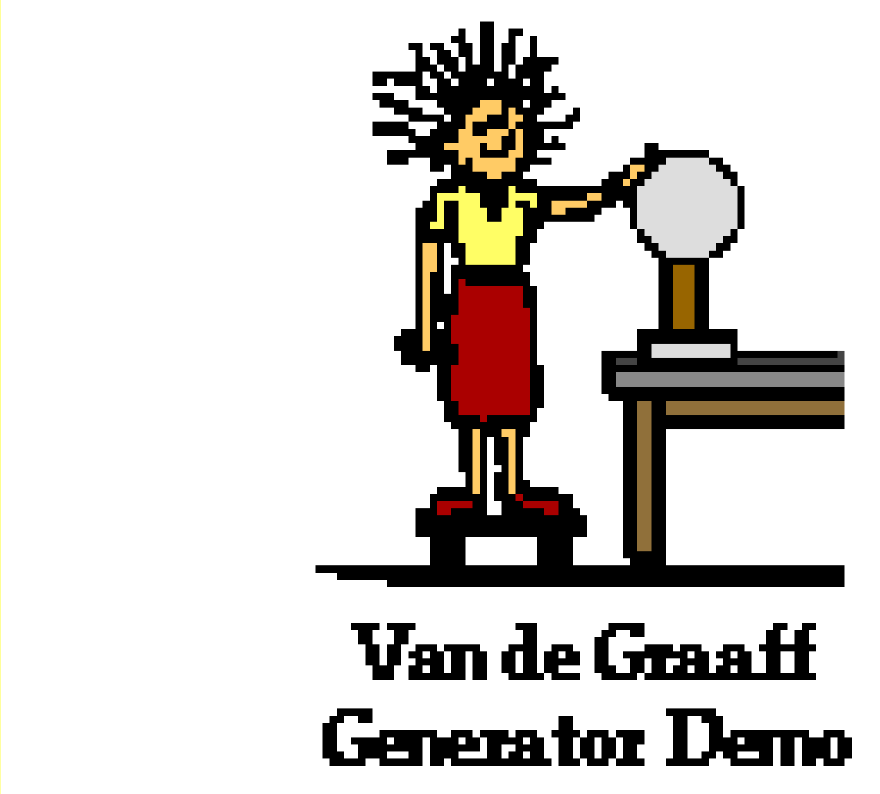
  and Carpet

If you walk across a carpet, electrons move from the rug to you (because of friction). Now you have extra electrons. Touch a door knob and ZAP! The electrons move from you to the knob. You get a shock.



STATIC ELECTRICITY IS ACTUALLY AN *imbalance* IN THE AMOUNTS OF POSITIVE AND NEGATIVE CHARGES IN THE RFACE OF AN OBJE

American physicist Robert Jemison Van de Graff invented the Van de Graff generator in 1931

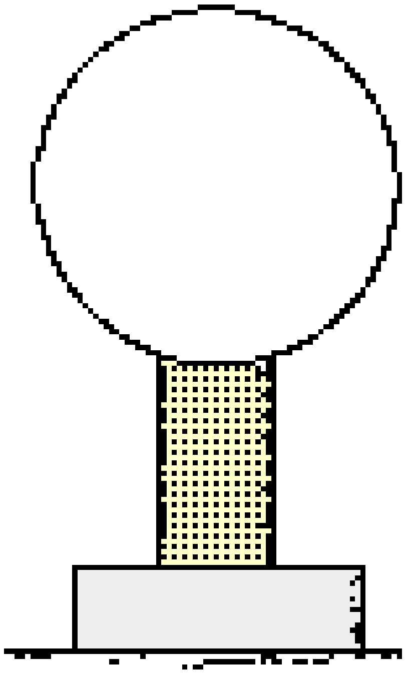


Three ways to induce a charge in an object

1. Friction
2. Induction
3. Conduction (Contact)

Charging by Induction

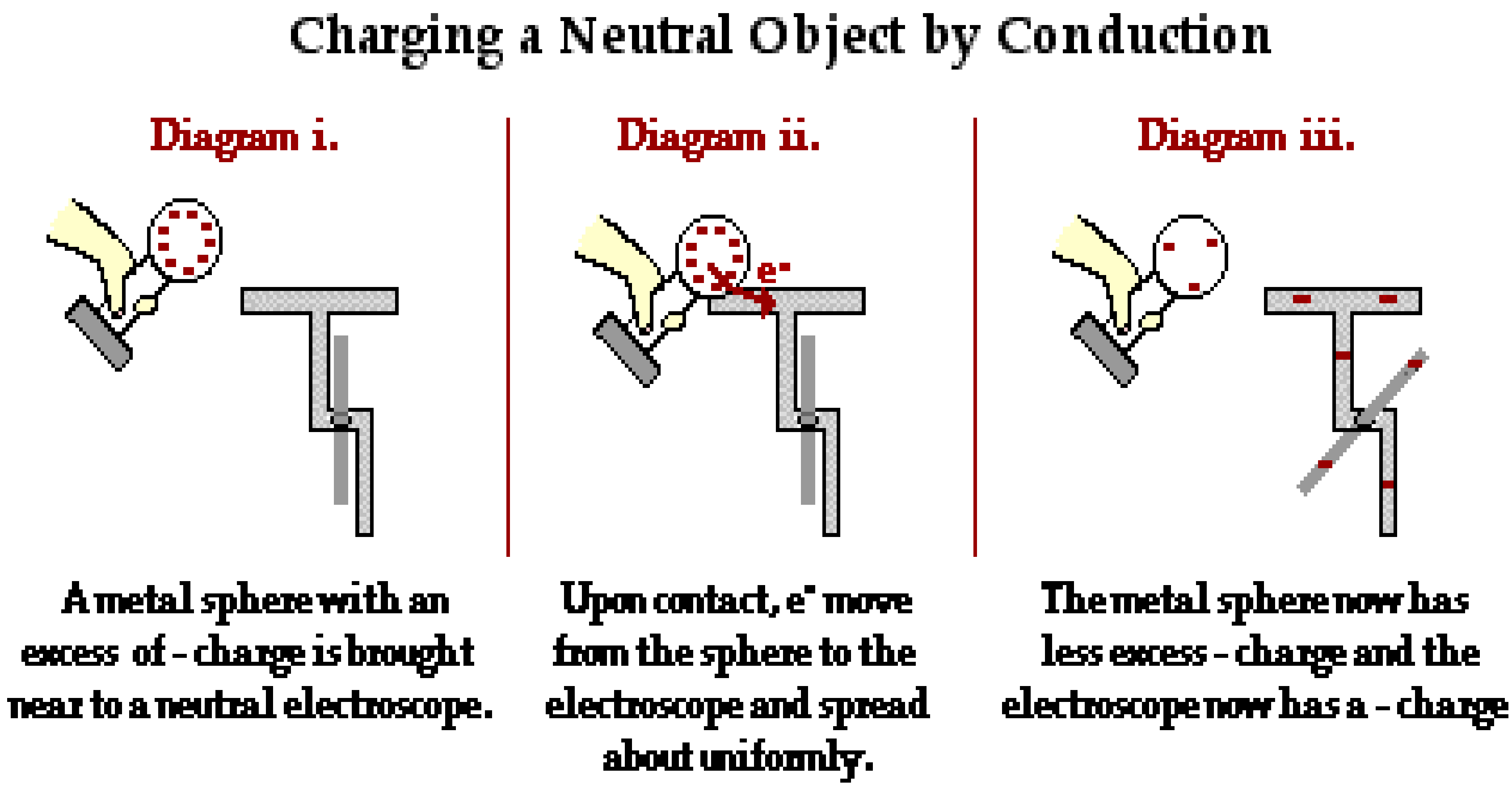
Involves the charging of one object by another without direct contact.



A negatively charged object is brought near to a neutral, conducting sphere. Electrons in the sphere are forced from the left side of the sphere to the right side.

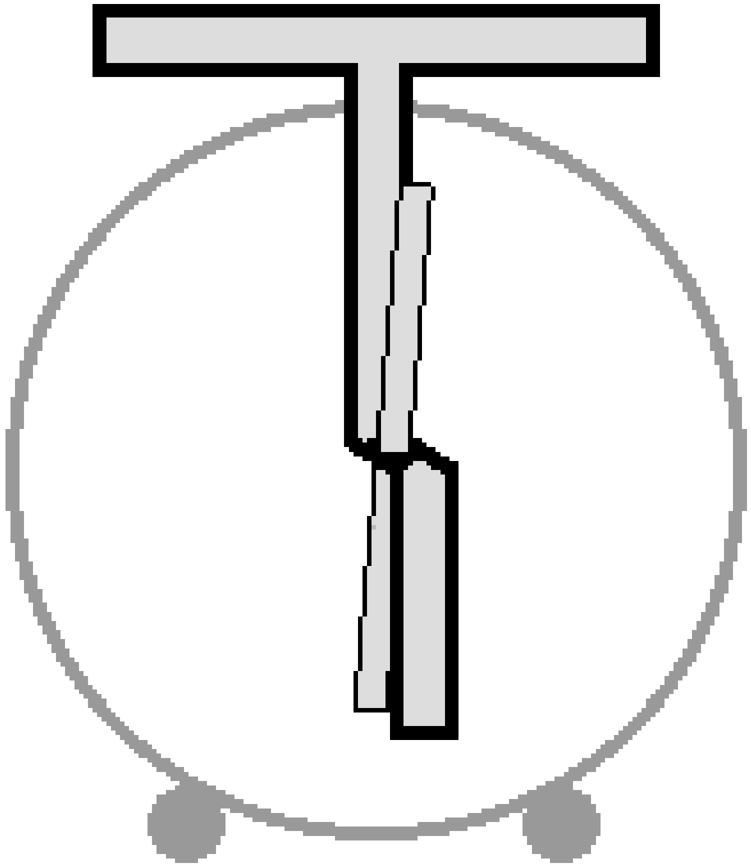
Charging by Conduction

involves the **direct contact** of a charged object to a neutral object.



Detecting an Electric Charge

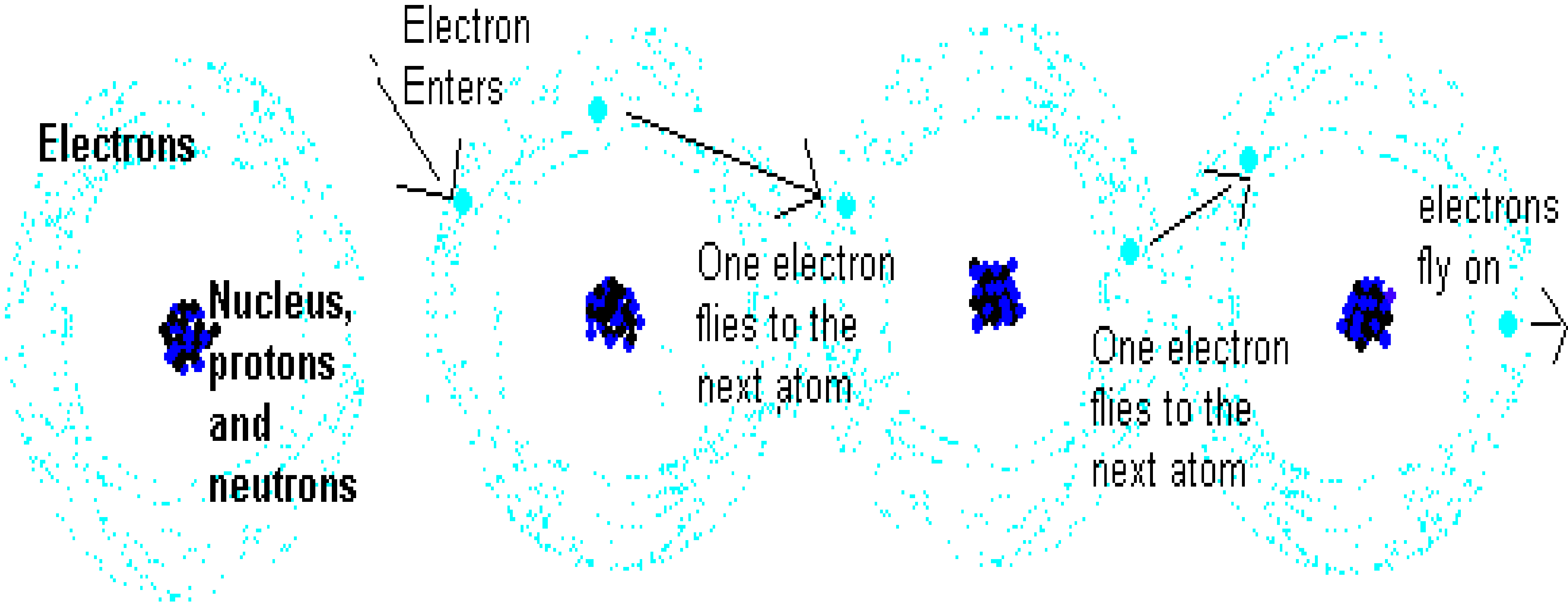
An uncharged Electroscope	A charged electroscope.



The electroscope is neutral as evidenced by the needle in a relaxed position.

Electric Current

The constant flow of electrons.



An Atom

Flow of Electricity

Transfer of Electric Charge

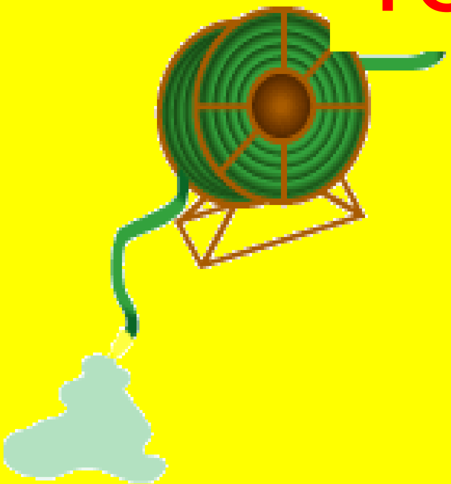
Clip

Has to do with the molecular structure of the material

Conductors : Gold, Silver, Copper, Iron, Lead, Salt Water.

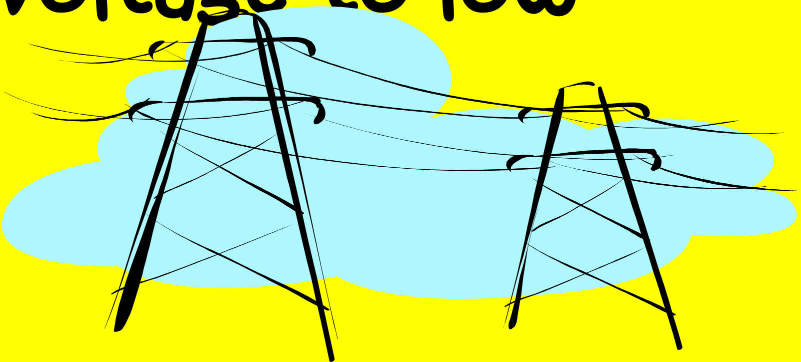
Insulators : Plastics, Glass, Dry Air, Wood.

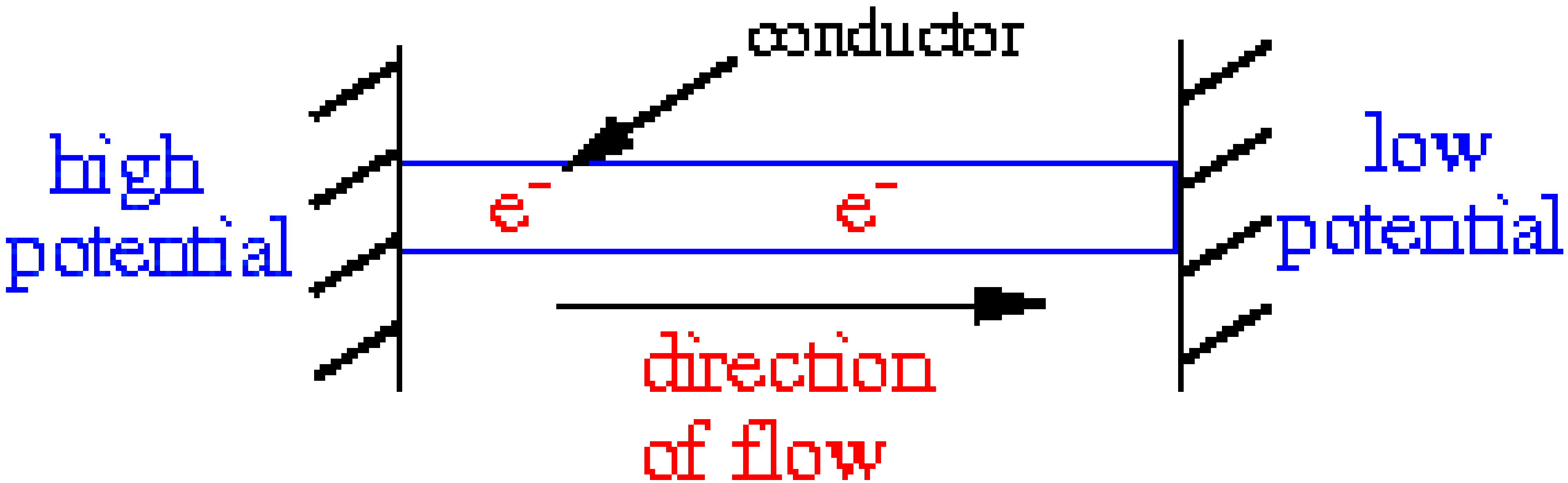
Voltage



For electrons to flow there must be a potential difference between to places.

- This is called voltage, which is the "Push" that causes electrons to flow.
- It's electrical "Pressure".
- Charges flow from high voltage to low voltage.
- Measured in Volts (V).

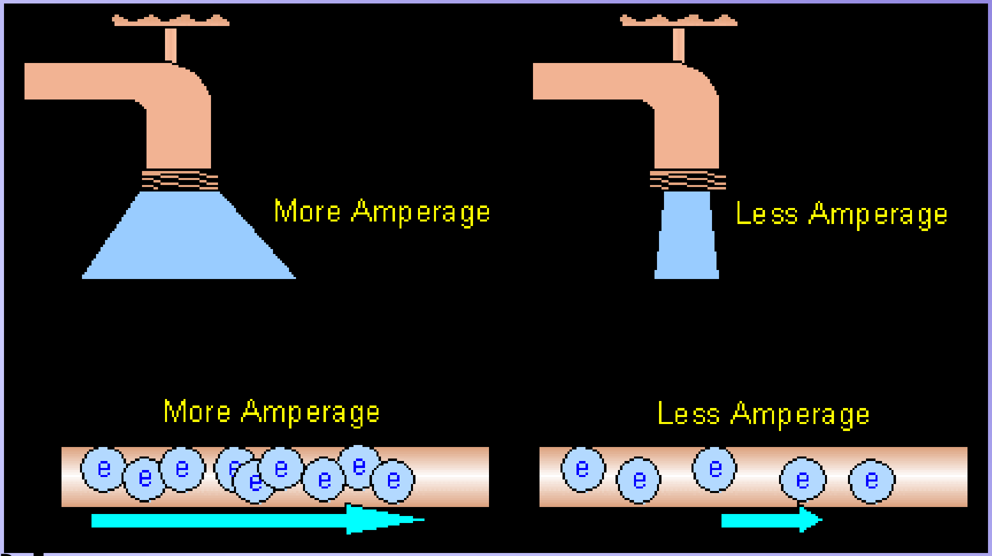




conductor
high potential
low potential
e⁻
e⁻
direction of flow

CURRENT

The measure of **<u>how many electrons</u>** per second are flowing through the wire is the amperage (A).

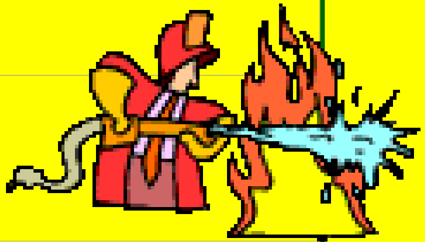


Electrical current

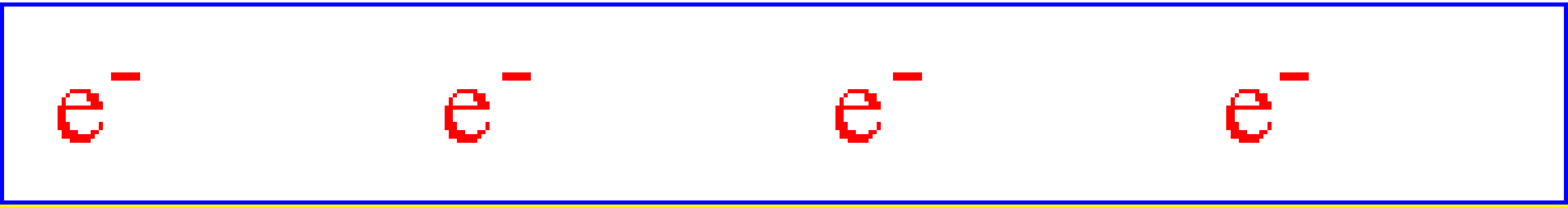
The # of e^- is called current (unit = Ampere or Amp.)

Electrical current is like the amount or volume of water flowing through the hose.

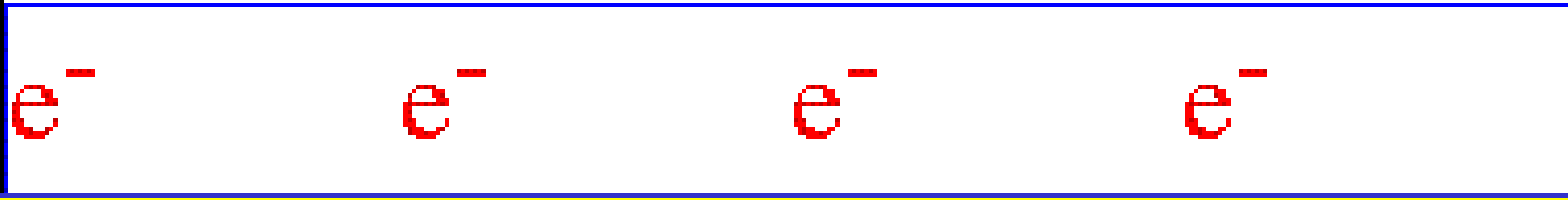
Water in a Hose	DC in a Wire	Electrical Units
pressure	potential (V)	Volts
volume	current (I)	Amps
friction	resistance (R)	Ohms



Alternating Current (ac)



Direct Current (dc)



Resistance

- The tendency for a material to oppose the flow of electrons.
- Different material have different amounts of resistance to the flow of electrons.
- The unit of resistance is ohm.

Resistance

Ex: gold, silver, and copper have low resistance, which means that current can flow easily through these materials.
Glass, plastics, and wood have very high resistance, which means that current cannot pass through these materials easily.

Resistance in Wires

- Thick wire Vs. Thin Wire

Thin wires provide more resistance than do thick wires

Resistance also depends on temperature, usually increasing as the temperature increases resistance

Resistance in wires produces a loss of energy (usually in the form of heat), so materials with no resistance produce no energy loss when currents pass through them.

OHM'S LAW

In a material, the current (I) is directly proportional to the voltage (V) and inversely proportional to the resistance.

$$I = \frac{V}{R}$$

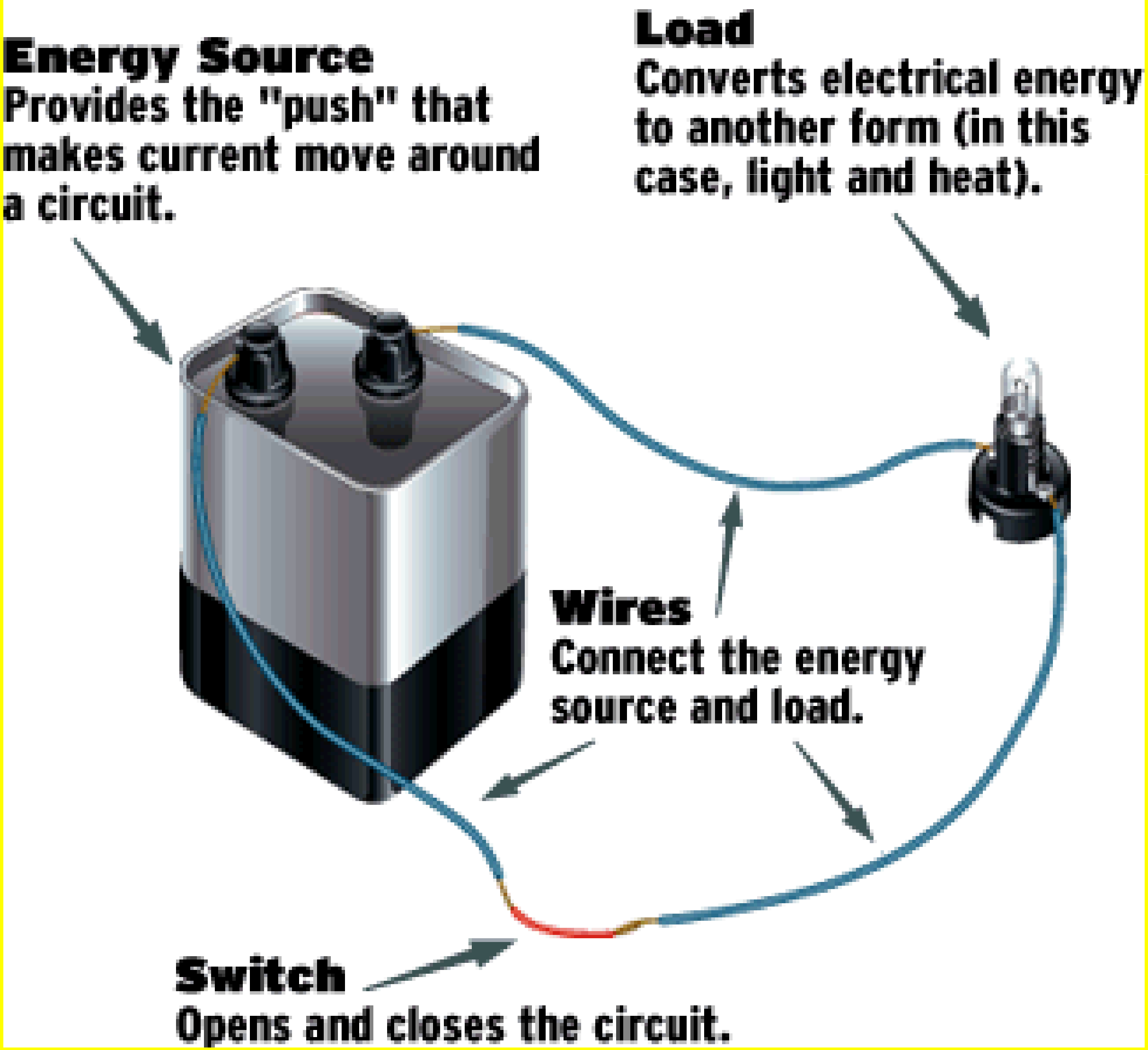
OR

$$V = IR$$

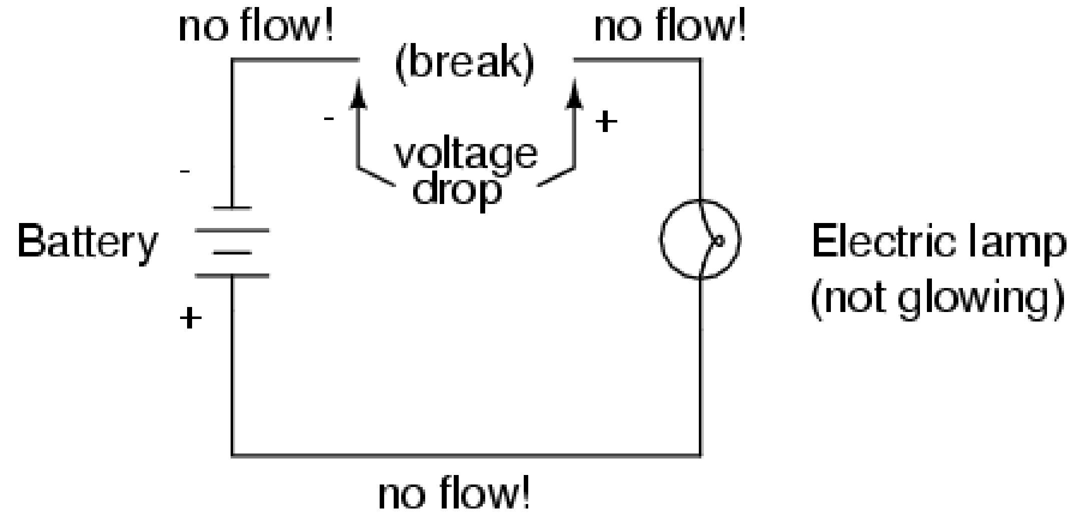
Electric Circuits

A PATHWAY FOR ELECTRONS TO FLOW.

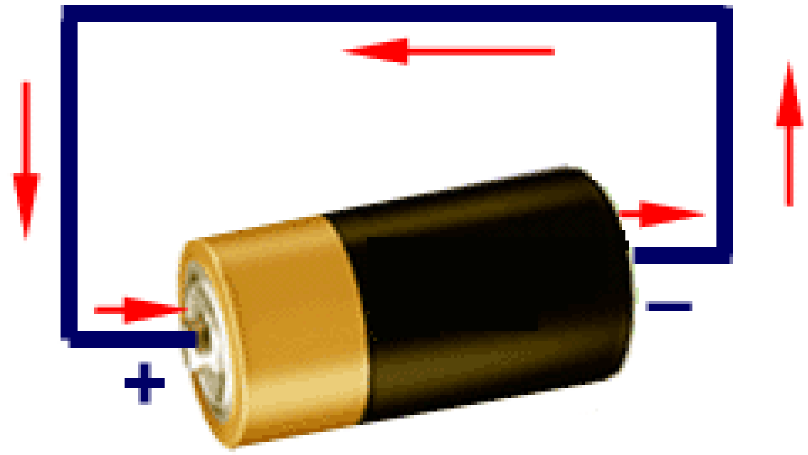
Four Parts of the Circuit



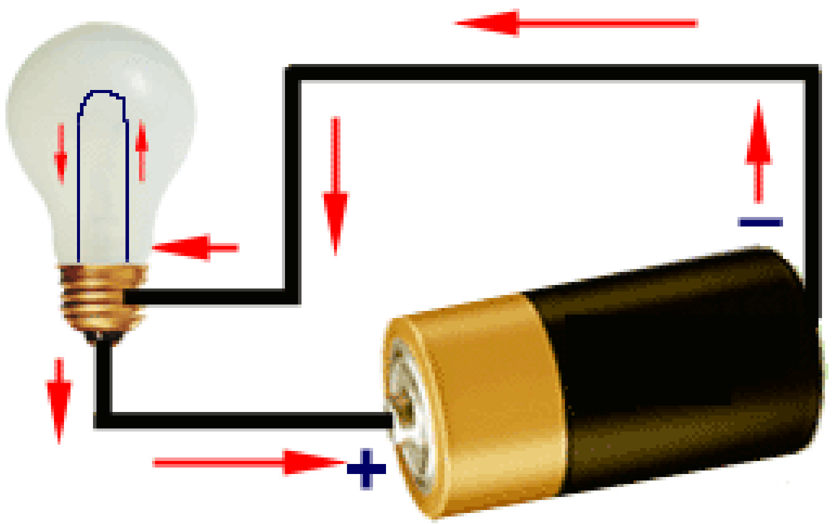
Open Circuits



Closed Circuits



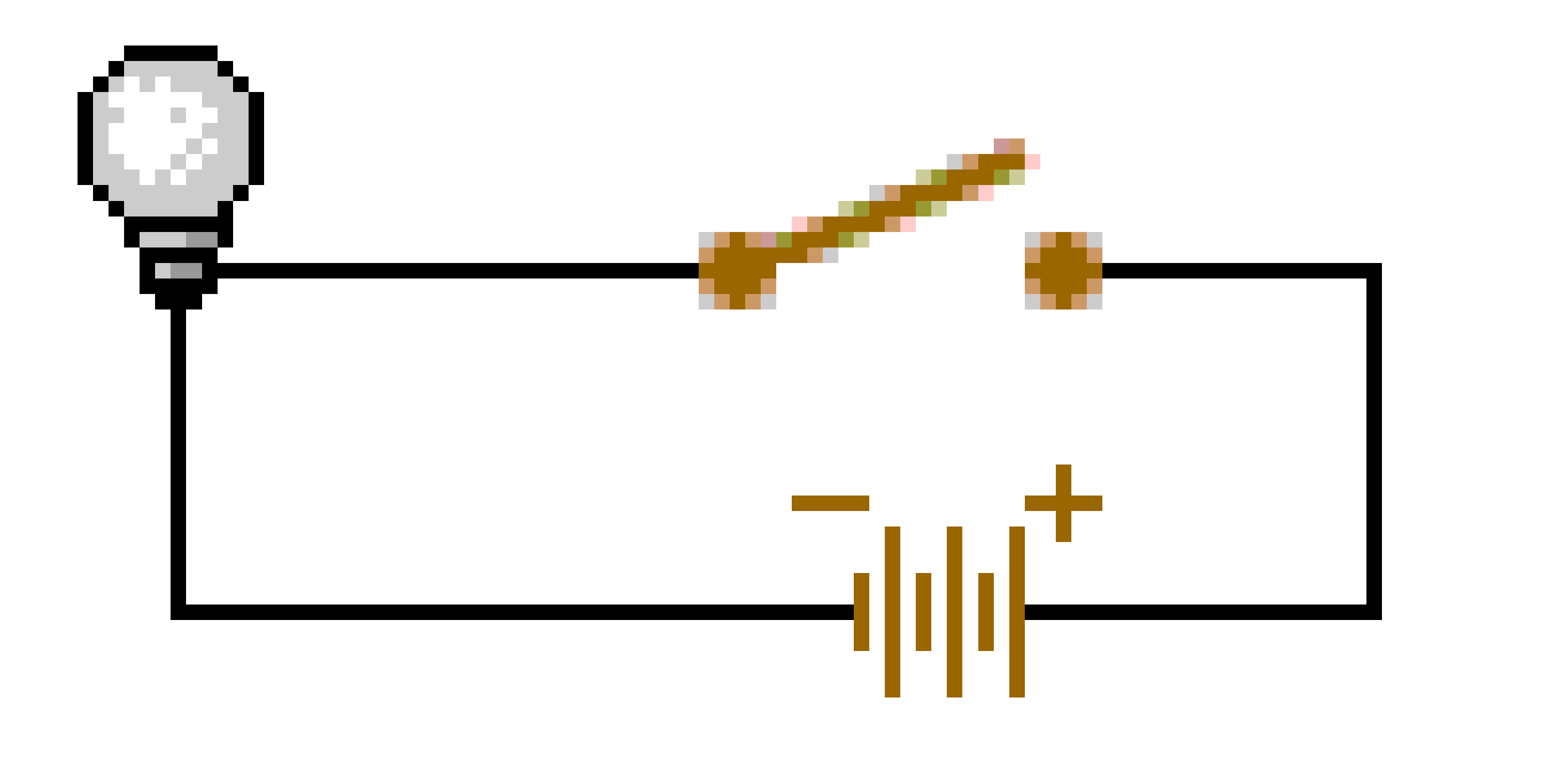
A simple circuit



Simple circuit with light

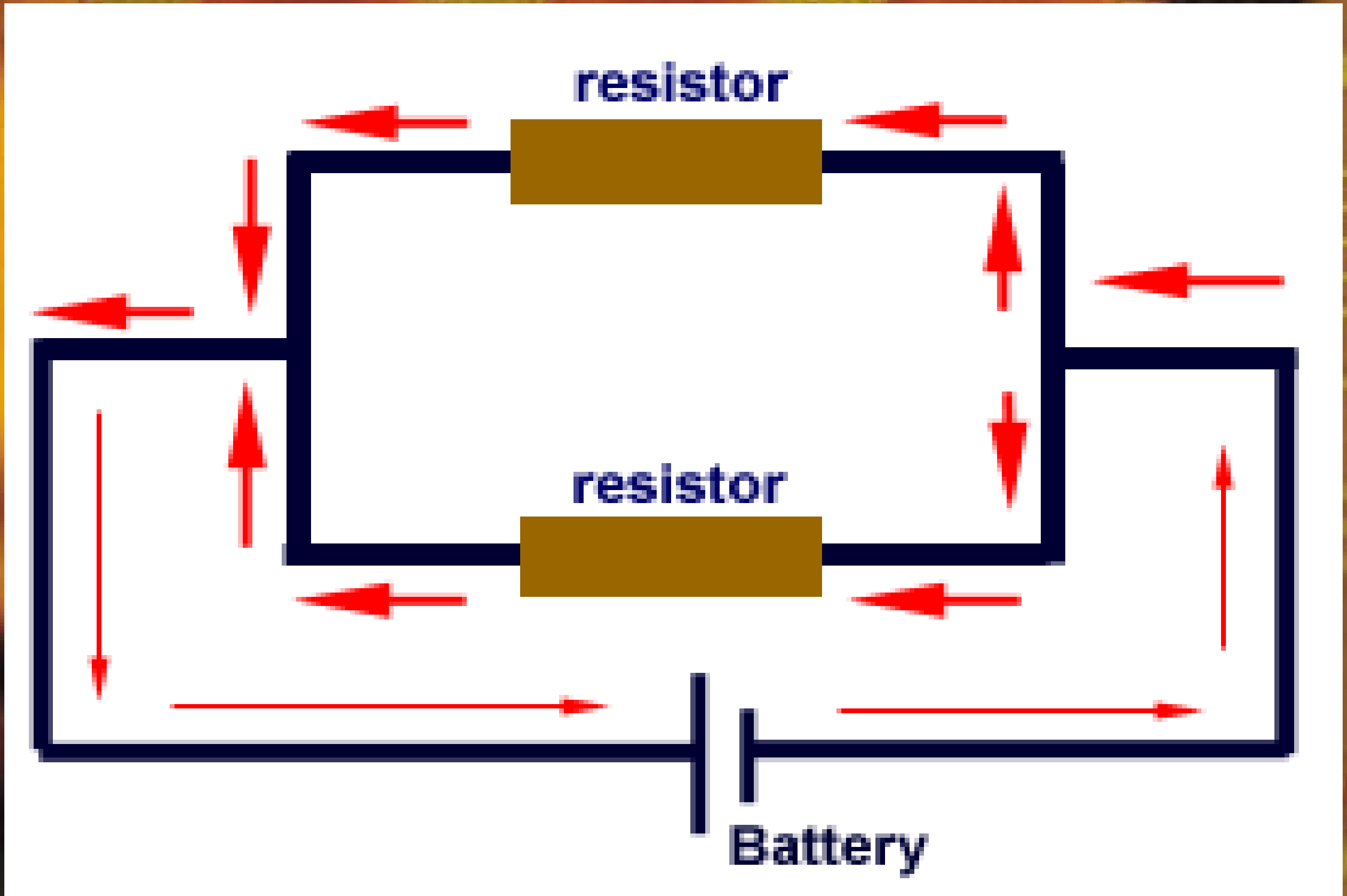
Series Circuit

The current has only one path to follow.



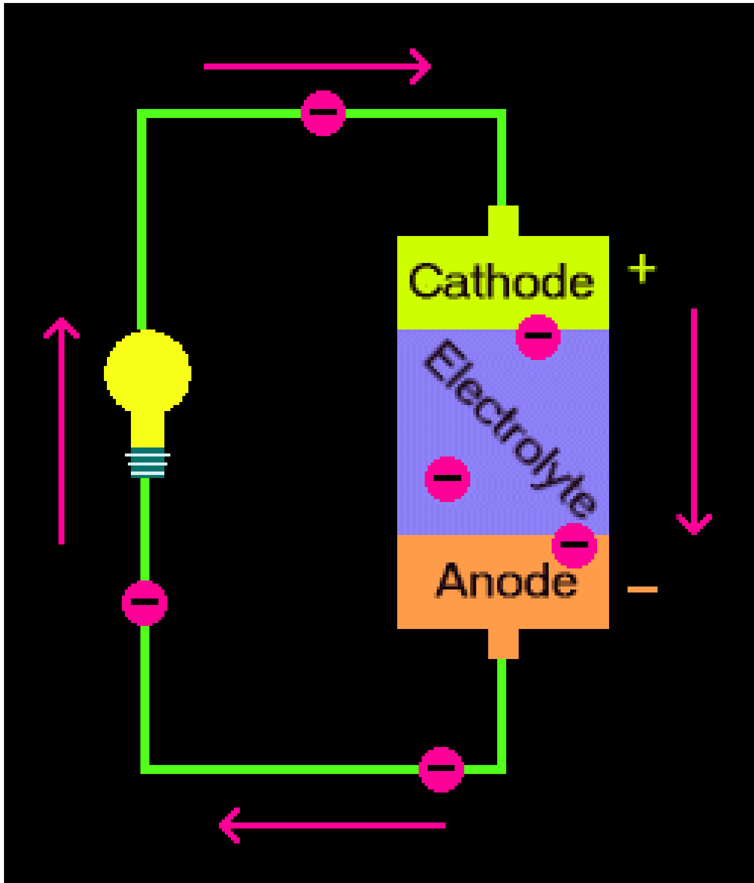
Parallel Circuits

Two or more branches for the current to flow.



How do batteries work?

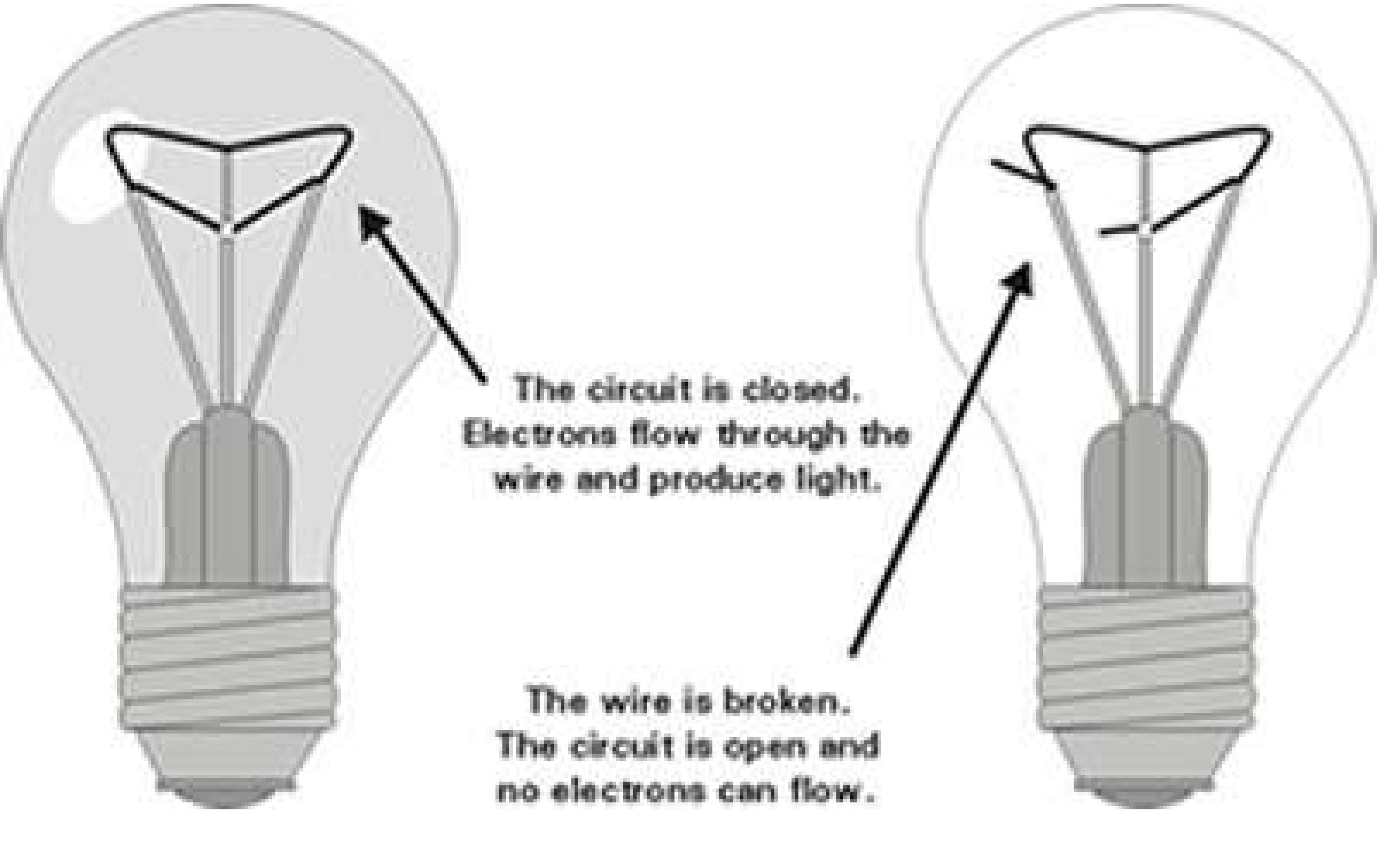
Batteries have three parts, an *anode* (-), a *cathode* (+), and the *electrolyte*. The cathode and anode (the positive and negative sides at either end of a traditional battery) are hooked up to an electrical circuit.

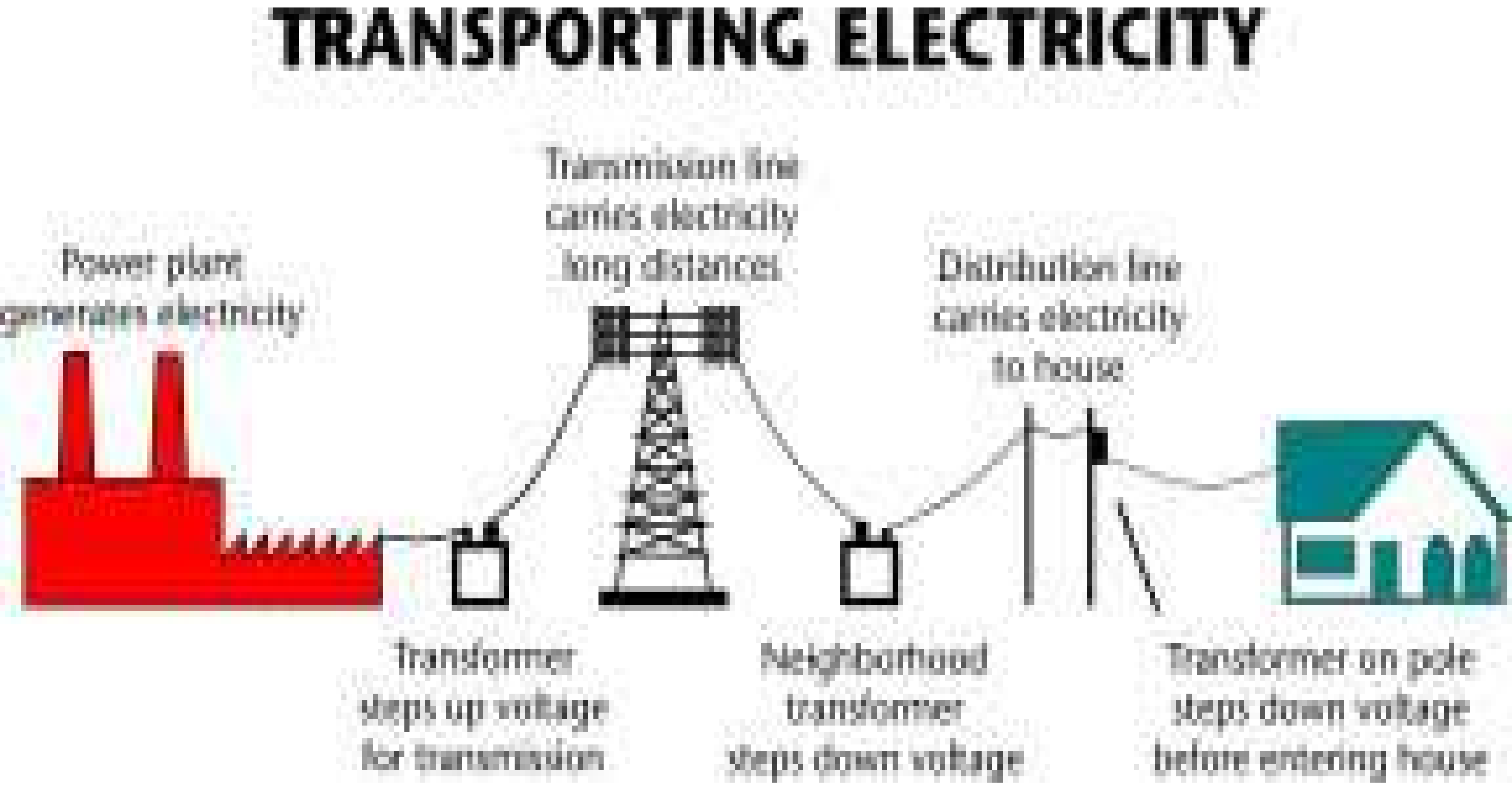


The chemical reactions in the battery causes a build up of electrons at the anode. This results in an electrical difference between the anode and the cathode. You can think of this difference as an unstable build-up of the electrons. The electrons wants to rearrange themselves to get rid of this difference. But they do this in a certain way. Electrons repel each other and try to go to a place with fewer electrons.

Review Series and Parallel Circuits clip

How a Lightbulb Works




TRANSPORTING ELECTRICITY
Transmission line carries electricity long distances
Power plant generates electricity
Distribution line carries electricity to house
Transformer steps up voltage for transmission
Neighborhood transformer steps down voltage
Transformer on pole steps down voltage before entering house

$$P = IV$$

Electric Power

- The rate at which electrical energy is transferred by an electric circuit.
- The SI unit of power is the watt
- Joule's Law $P = IV$

What is a kilowatt hour?

- How long you run an appliance.
  - How much energy is used?
- Energy used = Power (kW) x Time (hrs)
- $E = P \times t$
- To find cost:
- Ex: *10¢ per kilowatt hour*
    - *E x $*

- 105 V are used to power an appliance that needs 15.0 amps. What is the power used?
  - 1575 W =1.575kW
- How much energy is used when this appliance is used for 30.0 days- 24hrs a day?
  - 1134 kW -hr
- If the power company charges 8¢/Kw-h, what is the cost of the energy above.
  - $90.72