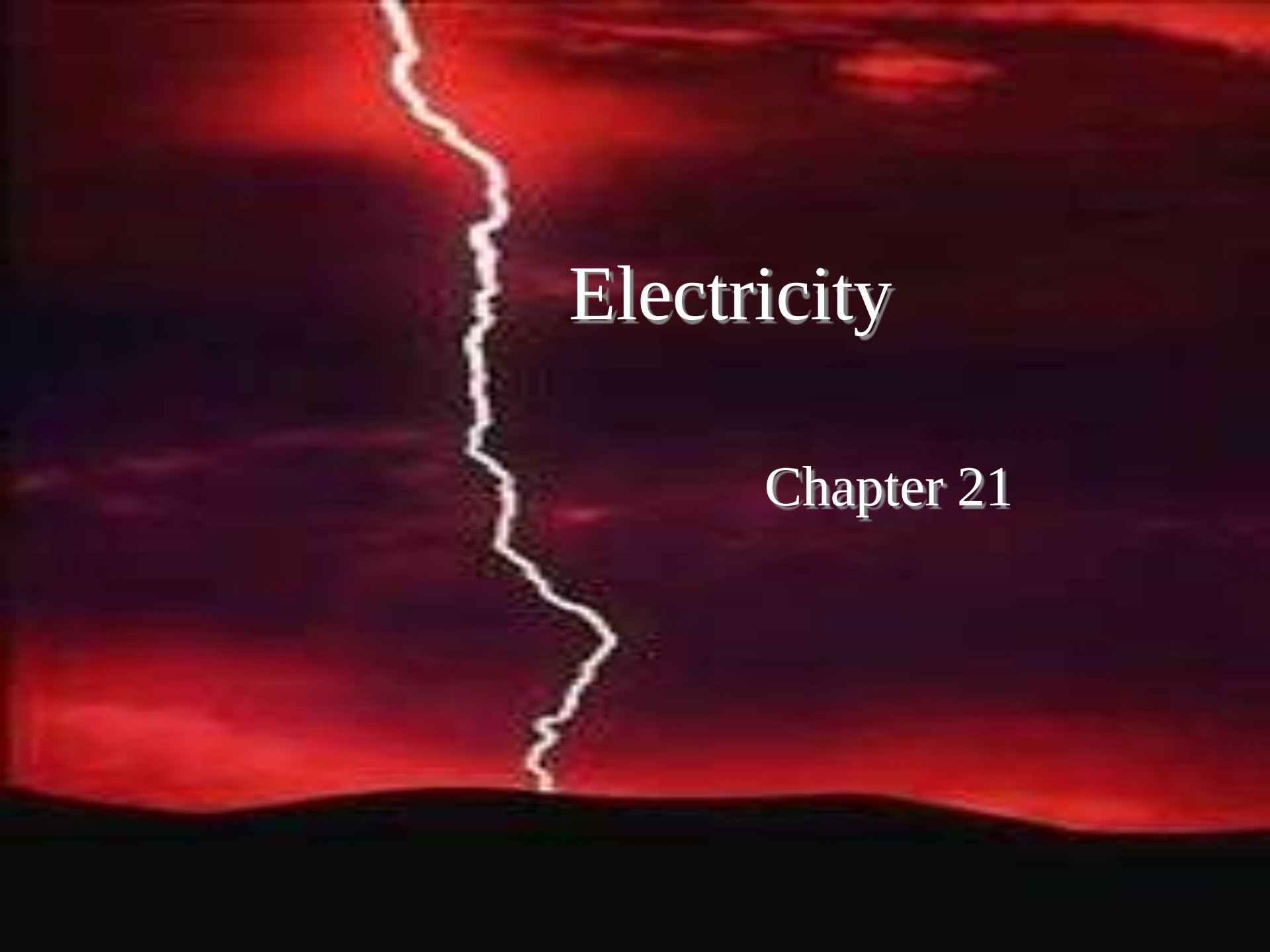


Electricity

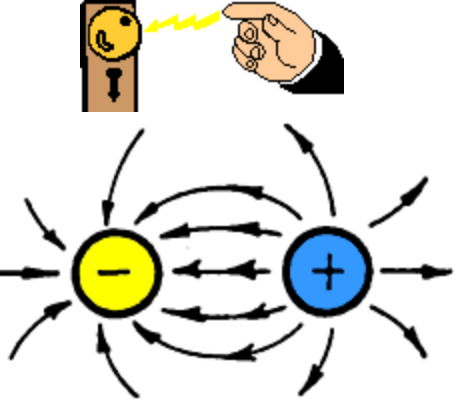
Chapter 21

Electricity

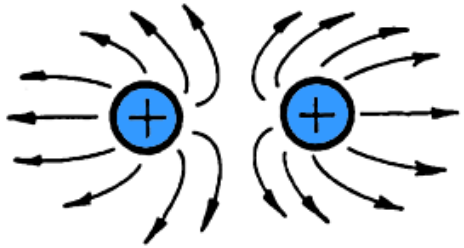
- Charge of proton Positive
- Charge of electron Negative
- Charge of neutron NONE
- Atoms have no charge because the charges of the protons and electrons cancel each other out.
- Atoms become charged by gaining or losing electrons

Electricity

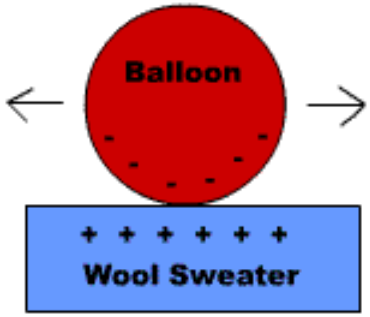
- Why you end up with a static shock after walking across the carpet:
  - Atoms in the carpet hold their electrons more loosely than atoms in your shoes
  - Shoes gain electrons from the carpet, becoming negatively charged
  - Carpet loses electrons & becomes positively charged
  - Shock occurs when electrons are suddenly transferred from one object to another- this appears as a spark



Static Electricity

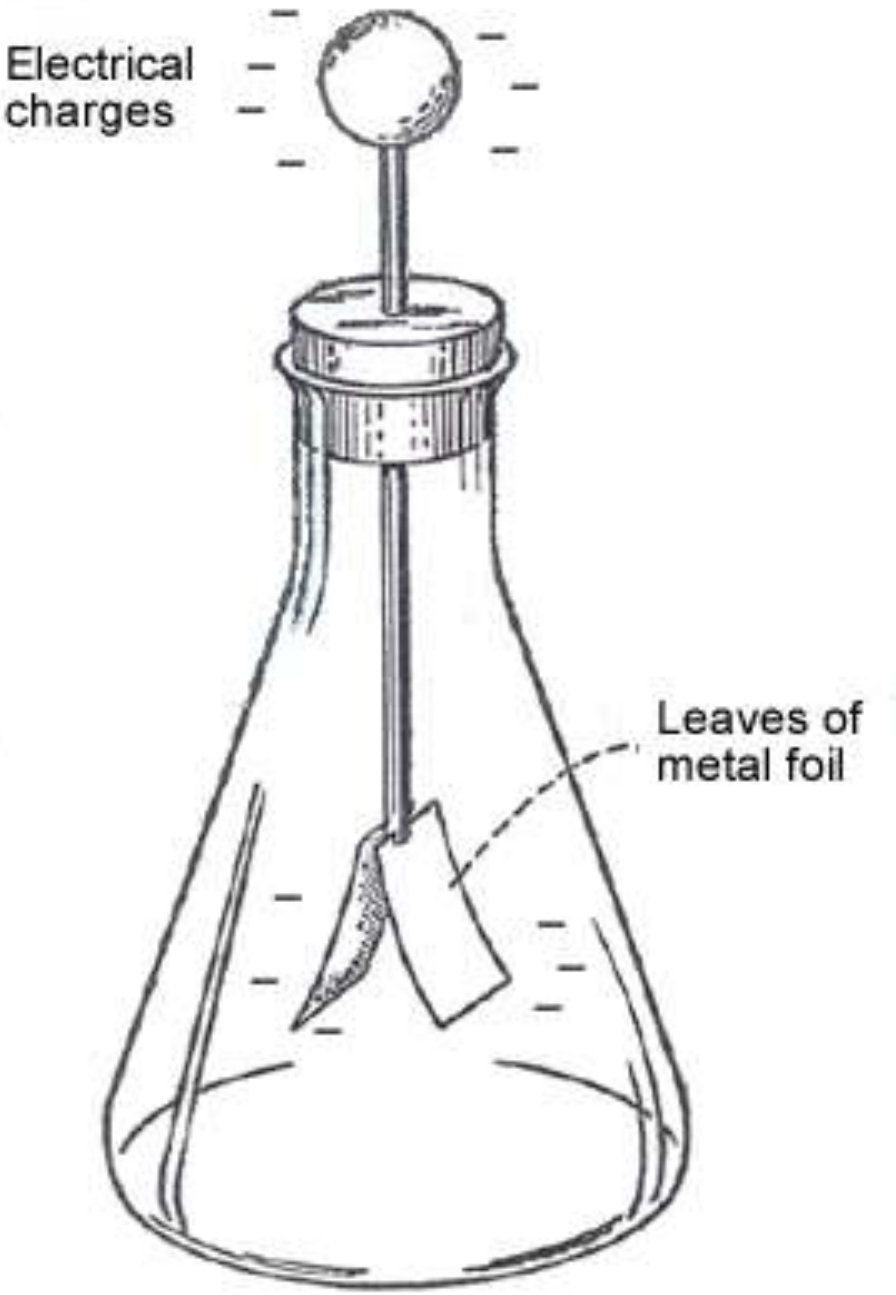


- Static electricity- buildup of excess <u>negative charge</u> on an object
  - Excess ***electrons*** on an object
  - Very short electric discharge
- Law of conservation of charge- charge may be transferred from object to object, but it cannot be <u>created</u> or <u>destroyed</u>



Static electricity is electric charge built up in one place

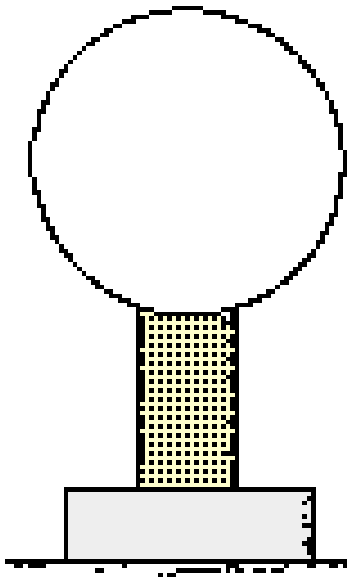
- Any charged object has an electric field around it
- An electric field exerts a force on anything that has an electric charge



Electroscope

- Used to detect static electricity
- Electrons are transferred to the metal ball and down to the foil
- Foil becomes negative and repels

Charging by Induction



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.

Electricity

- **Grounding-** using a conductor to direct an electric charge into the ground
- The presence of electric charges can be detected by an electroscope.

Electricity

- Insulator- a material that doesn't allow electrons to move through it easily
  - Occurs because electrons are held tightly to the atoms in insulating materials – like wood, plastic, glass
- Charging by contact- the process of transferring charge by touching or rubbing two objects together
- Charging by induction- rearrangement of electrons on a neutral object by a nearby charged object

Electricity- movement of electrons

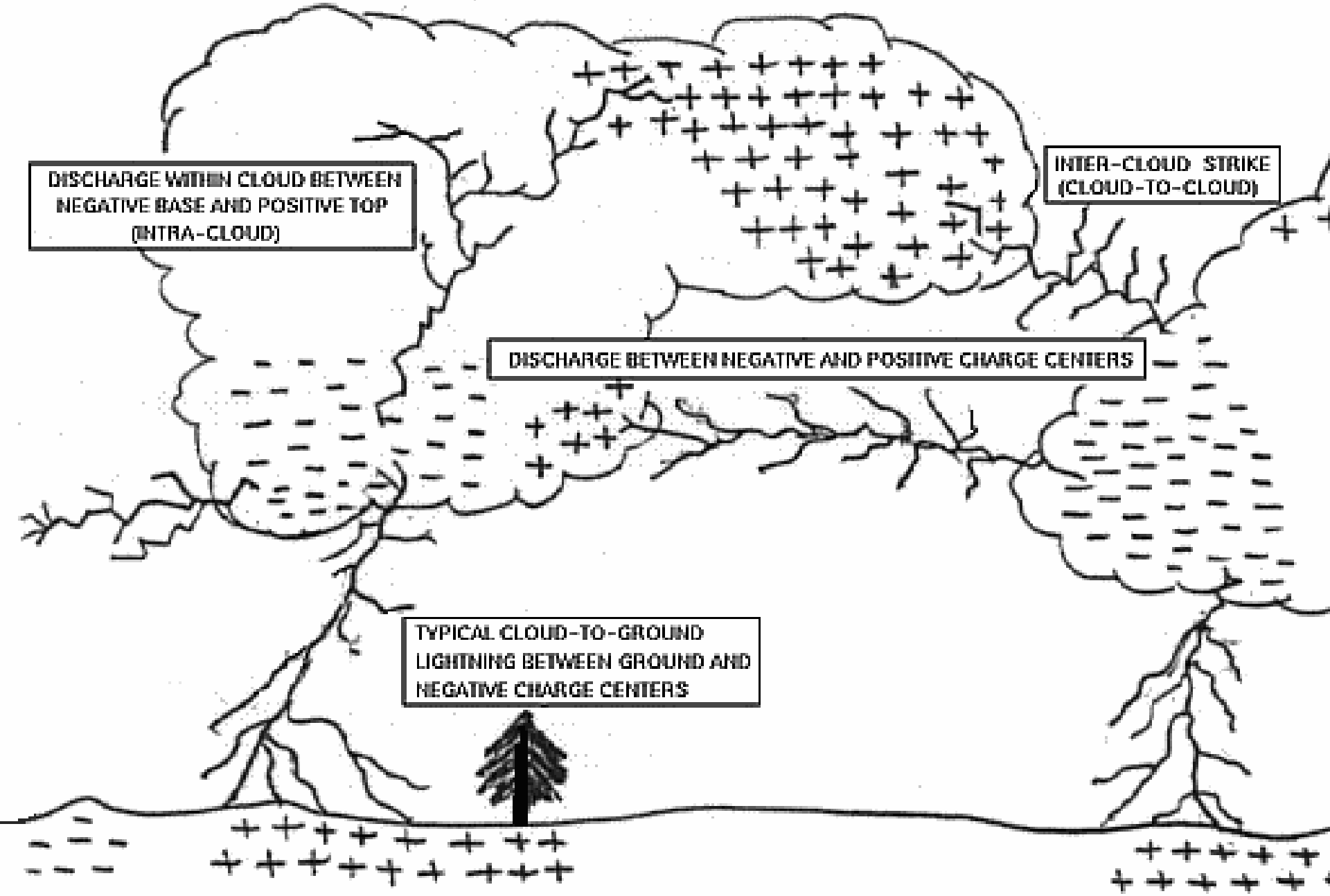
Static Discharge

Human body can not feel less than 2,000 volts of static discharge

Static charge built up by scuffing shoes on a carpet can exceed 20,000 volts?

Static discharge

- is the loss static electricity into something else
- lightening is and enormous electrical discharge
  - the cloud becomes negatively charged because of the redistribution of water
  - The bottom of the cloud will be negative and the top of the cloud will be positive


DISCHARGE WITHIN CLOUD BETWEEN NEGATIVE BASE AND POSITIVE TOP (INTRA-CLOUD)
INTER-CLOUD STRIKE (CLOUD-TO-CLOUD)
DISCHARGE BETWEEN NEGATIVE AND POSITIVE CHARGE CENTERS
TYPICAL CLOUD-TO-GROUND LIGHTNING BETWEEN GROUND AND NEGATIVE CHARGE CENTERS

Lightning

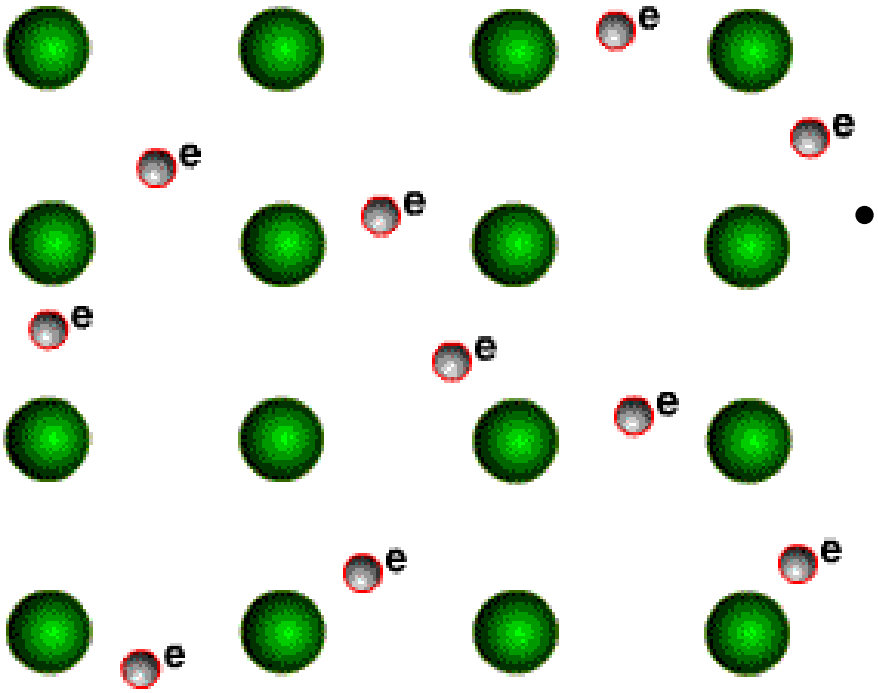
- **kills more than 60 people and**
- **injures more than 400 people a year in the US**
- **one mile every five seconds**
- **about 20,000 C**
- **Voltage of up to 1.2×10^8 volts**
-


Tulsa Ok Sept 1997
(c) 1997 Dave Crowle


g 25 2002 3am
owley www.stormguy.com

Conduction

- is electrons moving
- Conductor is some thing that transfers electrons.
- metals tend to be good conductors



Electricity

- **Charges can act on each other even at a distance because any charge that is placed in an electrric field will be pushed or pulled by the field**
- **Electrons move more easily through conductors, like metals**
  - Metals conduct well because: atoms in metals have electrons that move easily through the material

Insulator

- is a substance that doesn't let electrons move through it
- Nonmetals tend to be good insulators

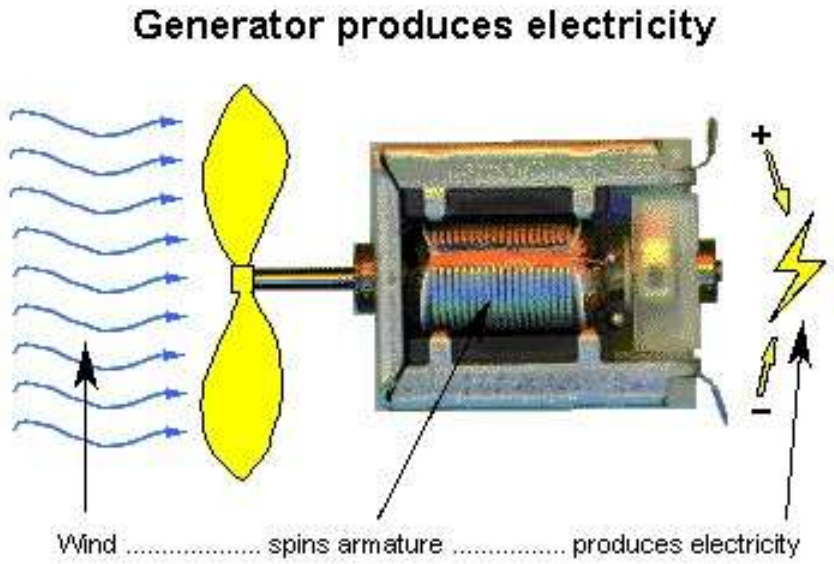
- Ground
  - The earth is a large body that can absorb a large amount of electric charge
  - This is why there is a ground used in your house

Current

- is the movement of electrons or charges
- Charges are measured in Coulombs
  - A coulomb is $6x10^{18}$ electrons
- One measurement of electricity is the coulombs that flow through a wire each second
  - The unit for this measurement is the ampere
  - 1 amp = coulomb/second

Producing Current

- There are several ways that current can be produced
  - Wet cell battery
  - Dry cell Battery
  - Generator



There is two types of current

- Direct current (DC) is electricity that flows steadily in one direction
  - An example is how electricity flows from a battery
- Alternating current (AC) is produced when the current is changing direction over and over
  - An example of this would be what a generate would produce
  - This is the type of electricity in your house

Potential Difference

- Energy that is pushing the electrons is
- Potential difference in energy is either when there is a lot of electrons built up in one place or there are positive and negative plates
  - This is measured in potential energy/ coulomb
    - Or since the unit for energy is the joule, it is joules /coulomb
  - The unit for potential difference in electricity is the volt
    - So one volt = joule/coulomb

Resistance

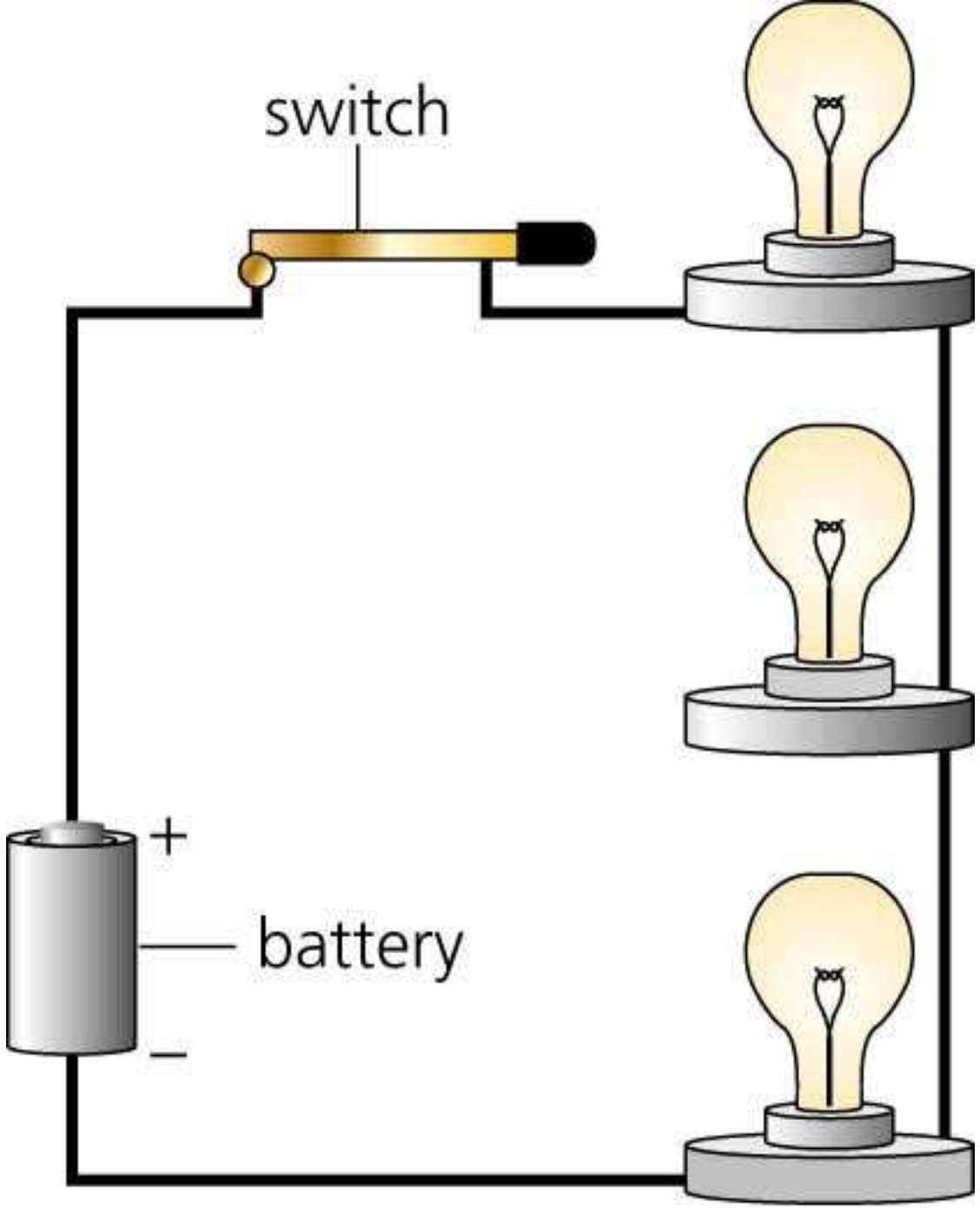
- is the opposition to the flow of electrons and is measured in ohms (Ω) after the Swiss Scientist George Ohm
- All matter resists the flow of electrons to a certain degree
- Ohms Law states current is equal to potential difference divided by the resistance
  - Current = voltage/resistance, I = V/R, or V=IR
  - A conductor that has a large resistance for its size is called a resistor
- Sometimes it is helpful to think of electricity a little like water.
  - In this comparison:
    - Current is like the amount of water that runs/minute
    - Voltage is like the amount of pressure the water has
    - Resistance would be like the size of the hose/pipe that you are running water through

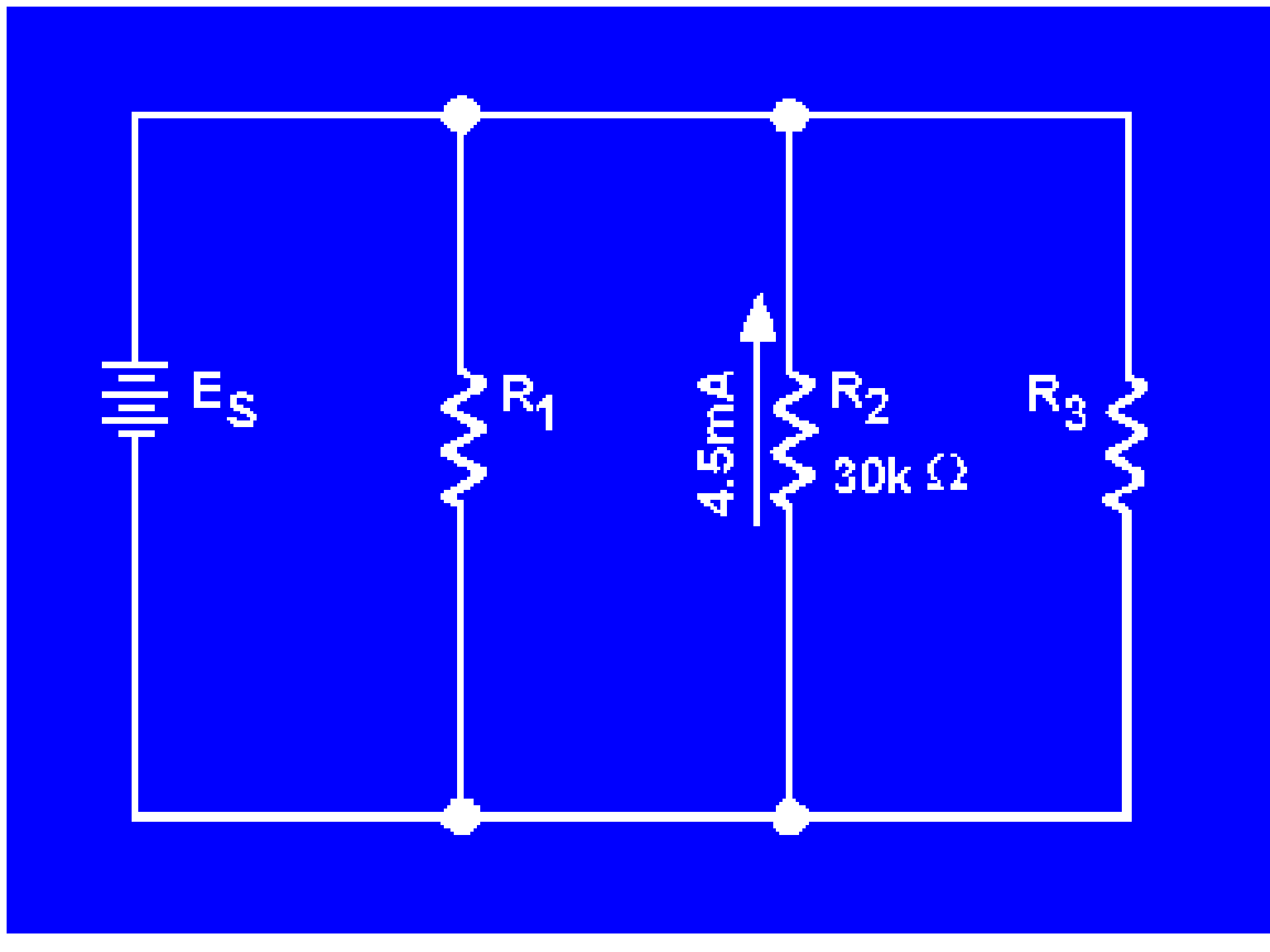
Practice with Ohm's Law

Ohms	Volts	Amps
	100	25
	150	10
	30	15
9		5
6	48	

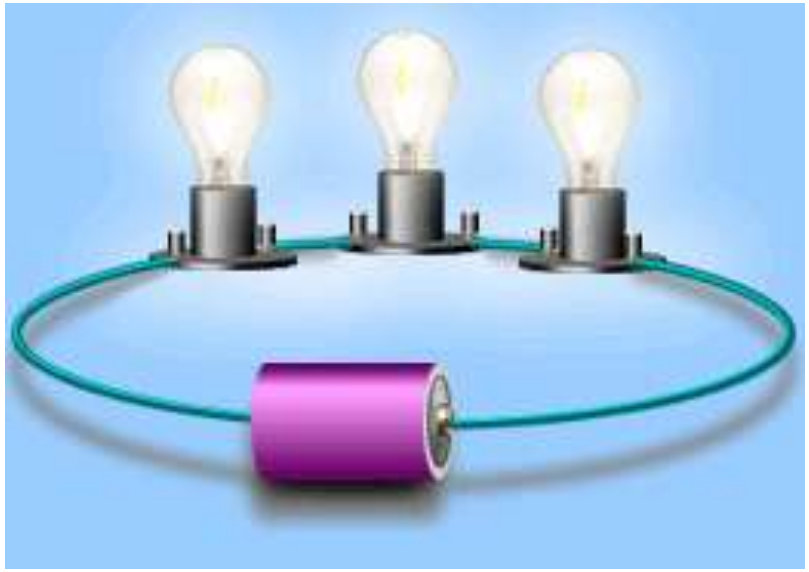
Circuits

- are a path that electricity follows
- Parts of a circuit
  - Switch is something that connects or breaks the circuit
  - Wire
  - Resister
  - Power source
    - Battery
    - Generator
- Two types of Circuits
  - Series Circuit has only one path for current to flow
    - Current is the same throughout the circuit
    - As energy passes through each appliance in a circuit some energy is lost
  - Parallel circuits has more than one path for electricity to flow
- Circuit diagram shows the difference parts of a circuit

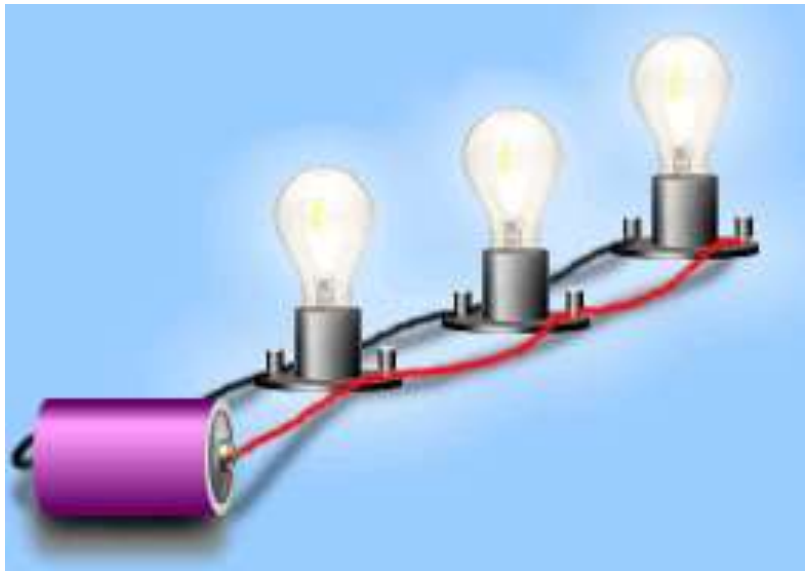

switch
+
battery
–
Academy Artworks


E_S
R_1
4.5mA
R_2
30k Ω
R_3

Simple Circuits



- Series circuit
  - All in a row
  - 1 path for electricity
  - 1 light goes out and the circuit is broken

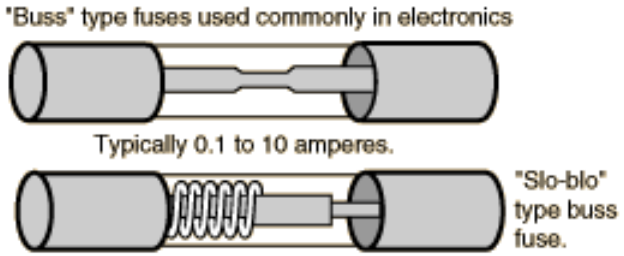


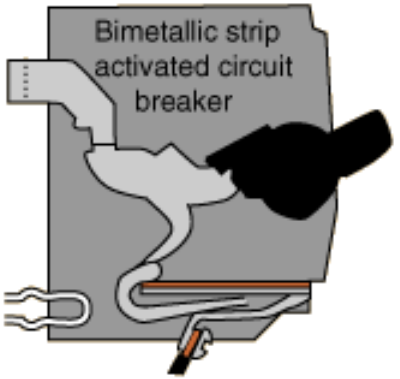
- Parallel circuit
  - Many paths for electricity
  - 1 light goes out and the others stay on

Fuses & Breakers

- Fuses are devices connected in series with appliances that melt if to much current runs through

- Breaker is a device that will shut off if to much current runs through it.





Power

- Anything that does work in a certain period of time is called power and is measured in watts
- To find the power in a circuit multiply the number of volts times the number of amps
  - Volts X Amps = Watts
  - Watts X time = Energy

Calculating electric energy used

- Energy of electricity is in Kilowatt hours
- A watt hour is equal to one watt of power used for an hour
- A kilowatt hour is equal to 1000 watts being used for an hour