Electricity

Merit Badge

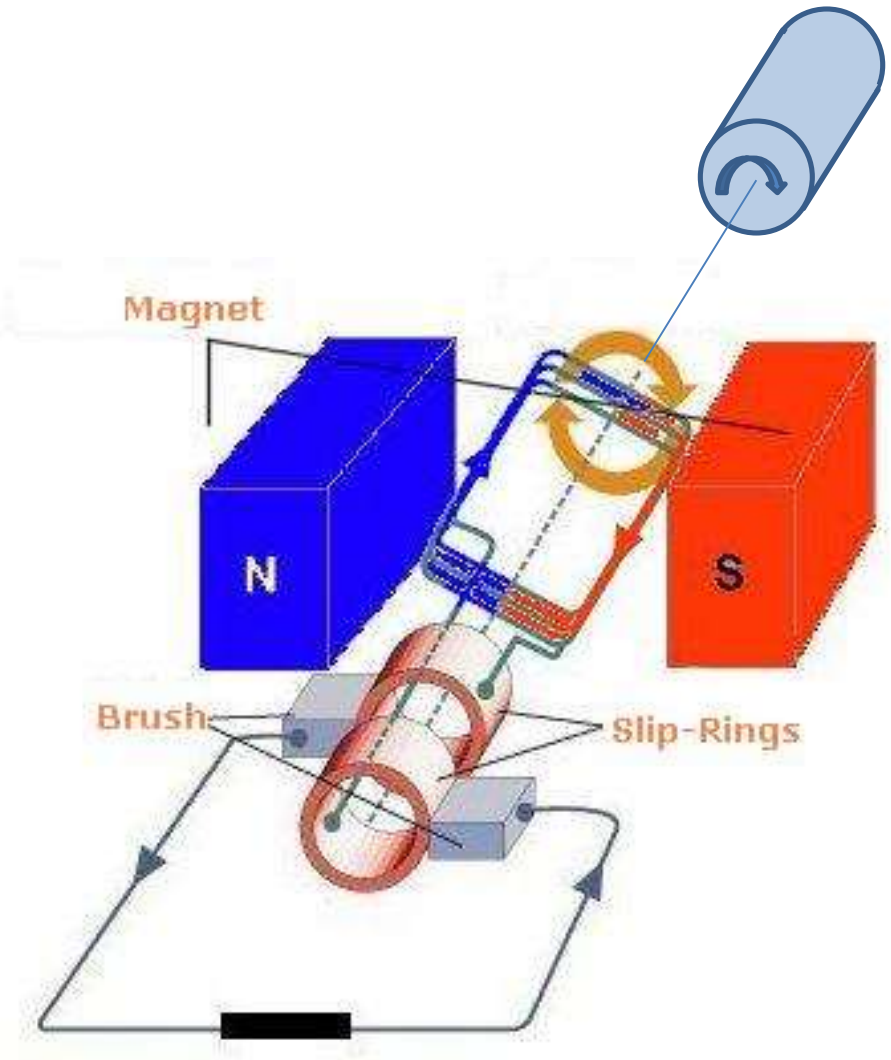
Week 2

Stations

1. **<u>Power Generation and Distribution – 40 min</u>**
2. Household Electrical – 40 min

Power Generation

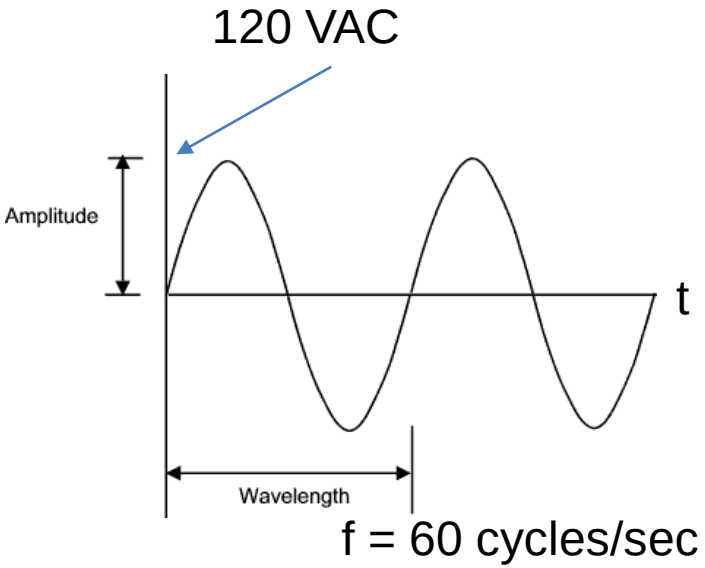
- Mechanical Power Source turns the rotor of a Generator
- Moving Conductor in a magnetic field causes a voltage
- Connected circuit causes a current to flow



AC vs DC

Alternating Current (AC) – Current flow changes direction periodically

- Direction changes 60 times per second in US = 60 Hz



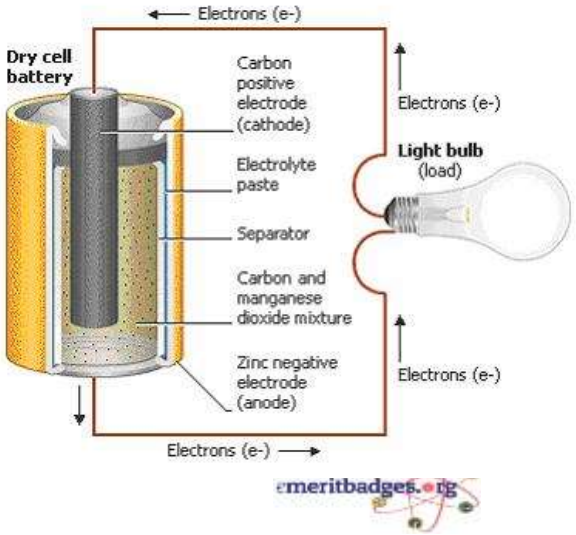
Examples of AC usage:

1. Production and transportation of electricity
2. Home and office outlets
3. Appliances

Direct Current (DC) - Current only flows in one direction

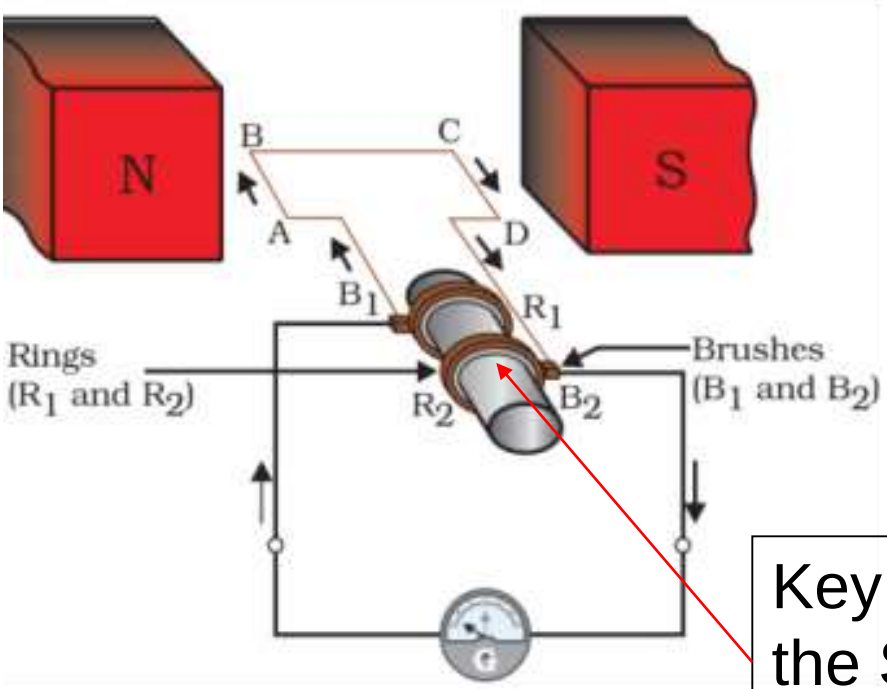
Examples of DC usage:

1. Cell Phones and Computers
2. Electricity in cars.
3. Anywhere you use a battery for power.

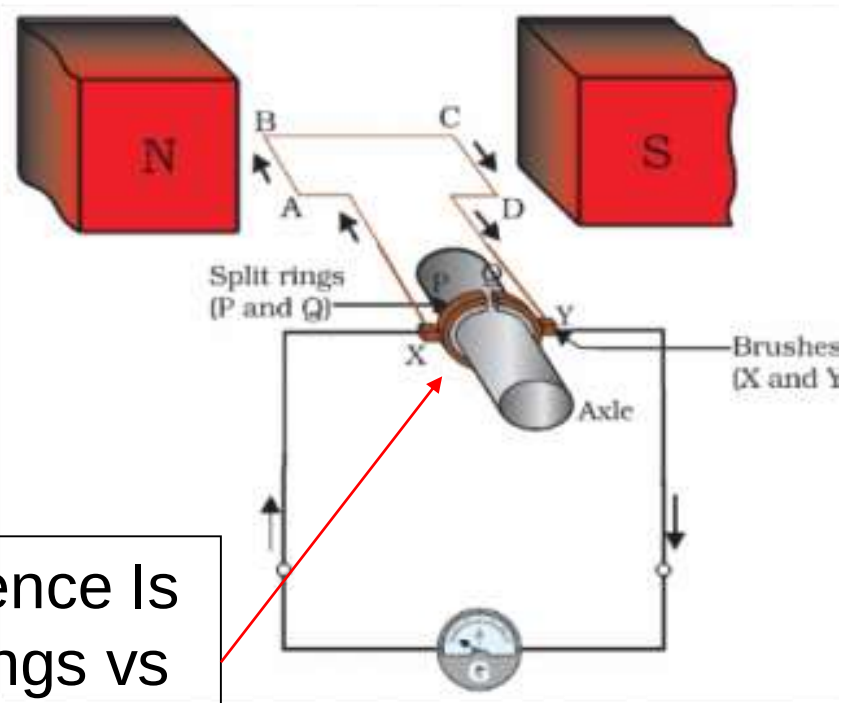


AC vs DC Generators

AC Electric Generator



DC Electric Generator

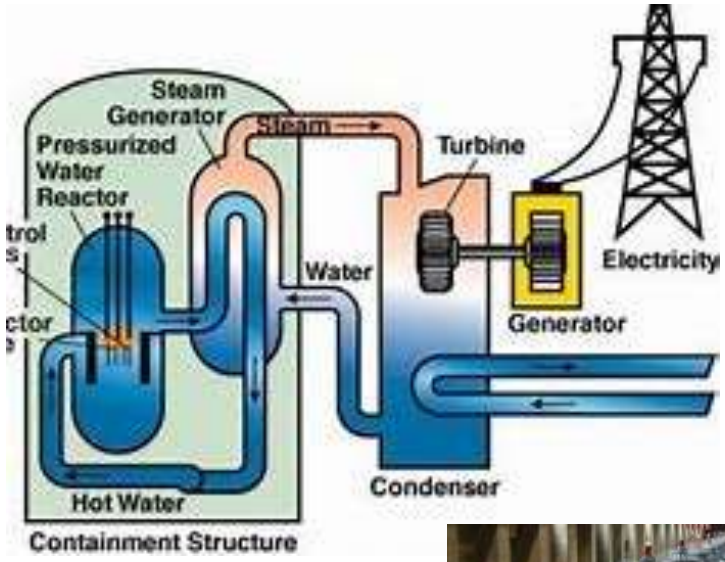


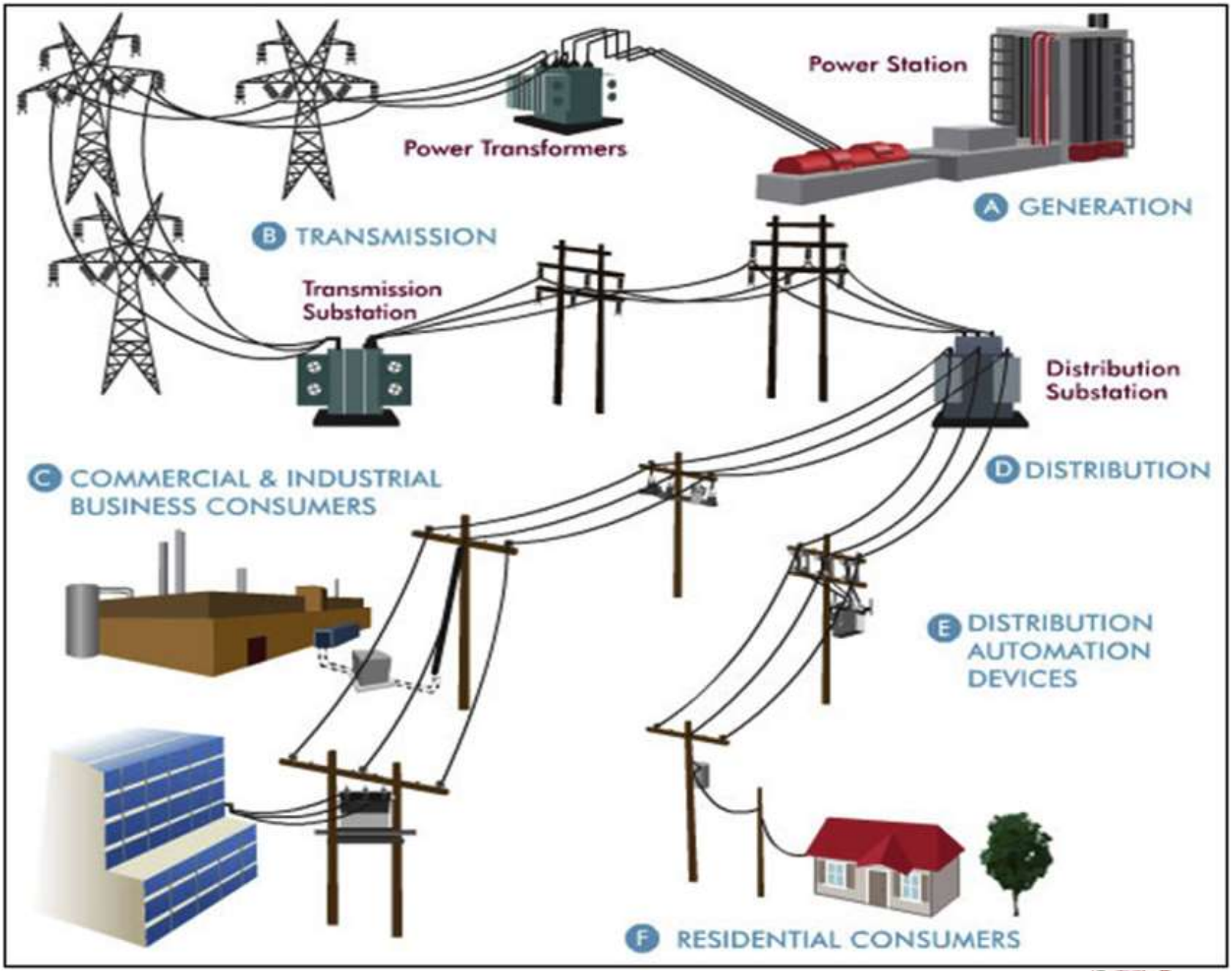
Key Difference Is the Slip Rings vs the Commutator

Diesel Generator

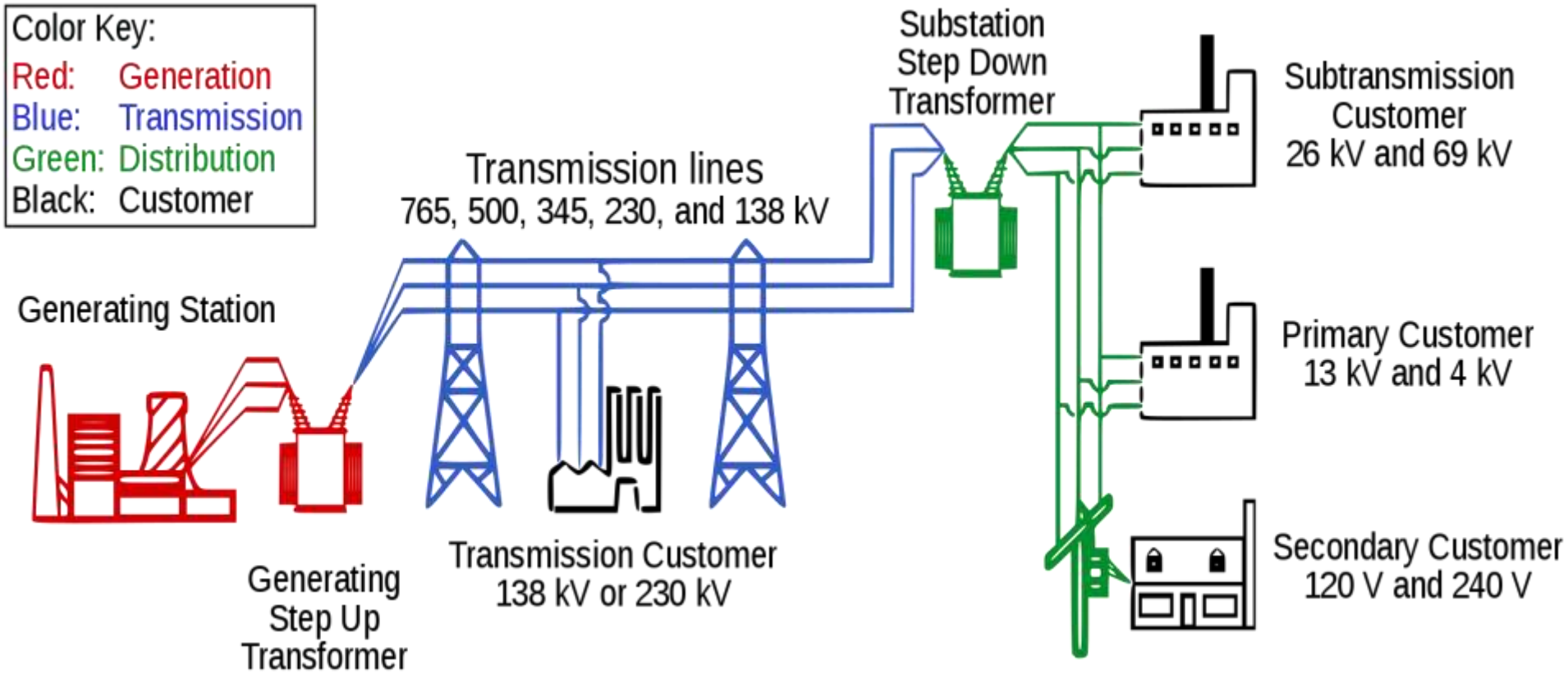
Types of Generators

- **Nuclear Power Plant –** Nuclear core generates heat to boil water that turns a turbine
- Coal Power Plant – Coal is burned to heat water, create steam and turn a turbine
- Natural Gas Power Plant – NG is burned to heat water, create steam and turn a turbine
- **Hydro-electric, Tidal** – water pressure turns a turbine
- **Wind** – wind power turns a turbine
- **Geo-Thermal** – hot water from the ground turns a turbine
- Diesel Generator and Gas Turbine
- Solar– works differently, Solar Cell creates voltage diff

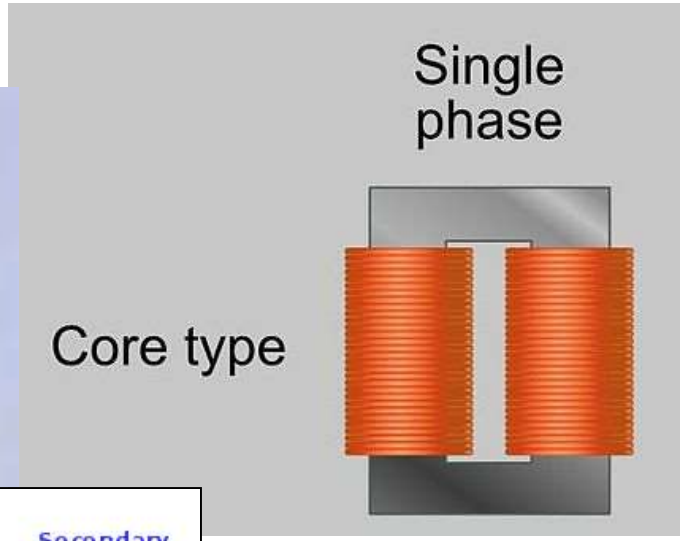


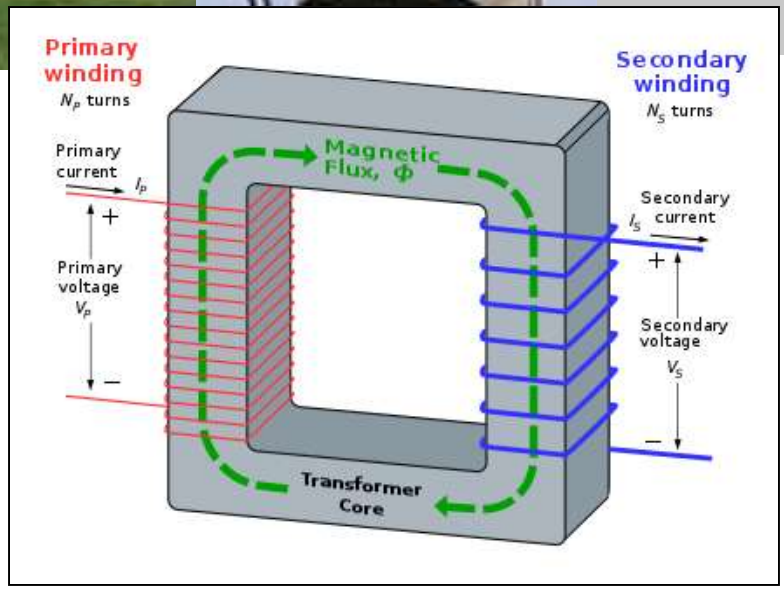


Transmission Voltages



Transformers





Why Change Voltages?

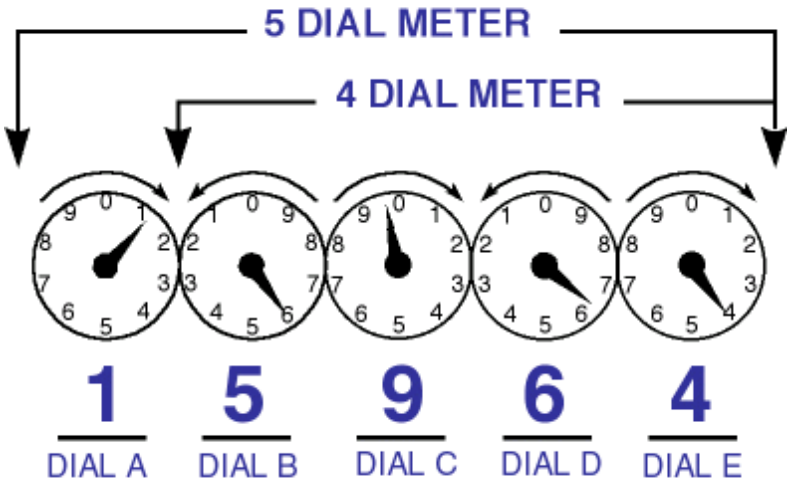
Power company sends 120,000 watts to a shopping center

- P = V * I
- 120,000 = 120V * I
- I = 1,000 amps
- BIG wires
- BIG pole to hold the BIG wires

- P = V * I
- 120,000 = 120,00V * I
- I = 1 amp
- small wires
- little pole to hold the little wires

Electric Meters – Measure Electricity Used

Old Meter Style – Needle Points to Number



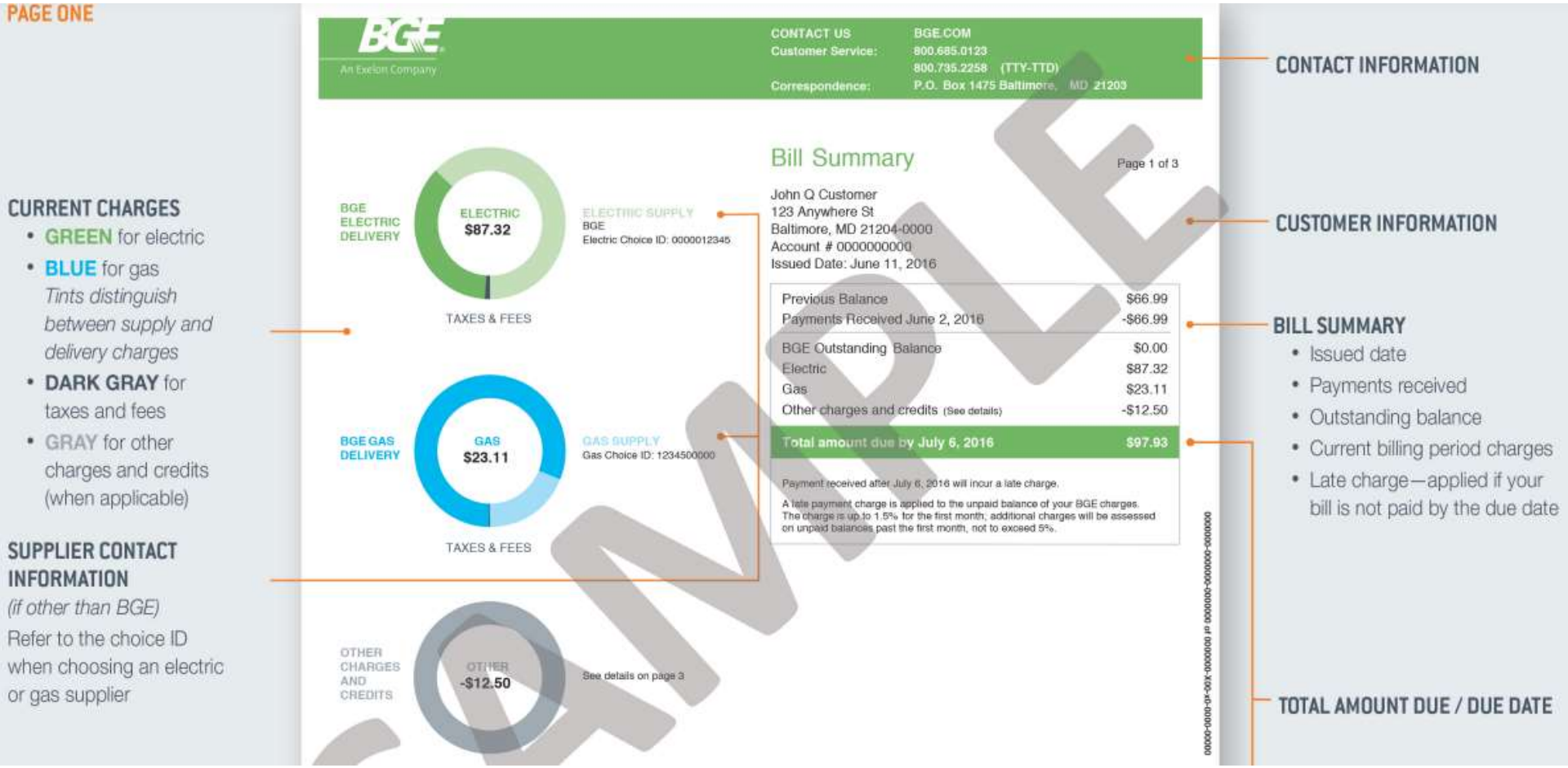
New Meter Style

Read meter from left to right

Notice some numbers go clock-wise, some go counter clock-wise

Read two months, subtract to find kilowatt hours used

Calculating an Electric Bill



Electric details

ANNUAL ELECTRIC USAGE

Residential - Schedule R
Billing Period: May 8, 2016 – Jun 9, 2016
Next Scheduled Reading: July 10, 2016 Days Billed: 31

Meter #0000012345 Read on Jun 9

Current Reading		Previous Reading		
3567	–	2950	=	617 kWh used

ELECTRIC SUPPLY				$55.43
BGE	617 kWh	x	.0898300	55.43
BGE ELECTRIC DELIVERY				$31.06
Customer Charge				7.50
EmPower MD Chg	617 kWh	x	.0048100	2.97
Distribution Chg	617 kWh	x	.0293700	18.12
RSP Chg/Misc Cr	617 kWh	x	.0038200	2.36
Dmd Res Chg/Cr	617 kWh	x	.0000100	.01
ERI Initiative Chg	617 kWh	x	.0001700	.10
TAXES & FEES				$.83
MD Universal Svc Prog				.36
Envir Srchg	617 kWh	x	.0001500	.09
Franchise Tax	617 kWh	x	.0006200	.38
TOTAL				$ 87.32

Meter Readings

Electrical Power Used

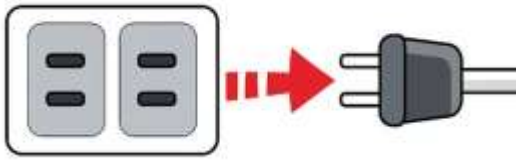
Electrical Supply Rate

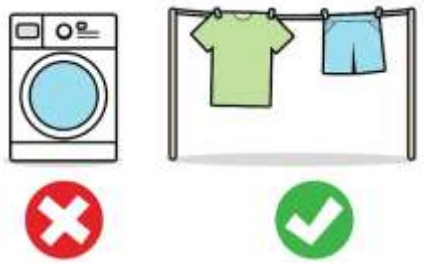
Electrical Distribution Rate

Taxes and Fees

Conserving Electricity

1. Unplug devices you're not using.
2. Turn off unnecessary lights.
3. Replace your old light bulbs with energy-efficient LEDs.
4. Only run full loads of laundry and dry clothes on a line.
5. Take shorter showers.
6. Not home? Turn off the air conditioner.
7. Skip the heat-dry setting for the dishwasher.
8. Thaw your frozen foods before you cook them.





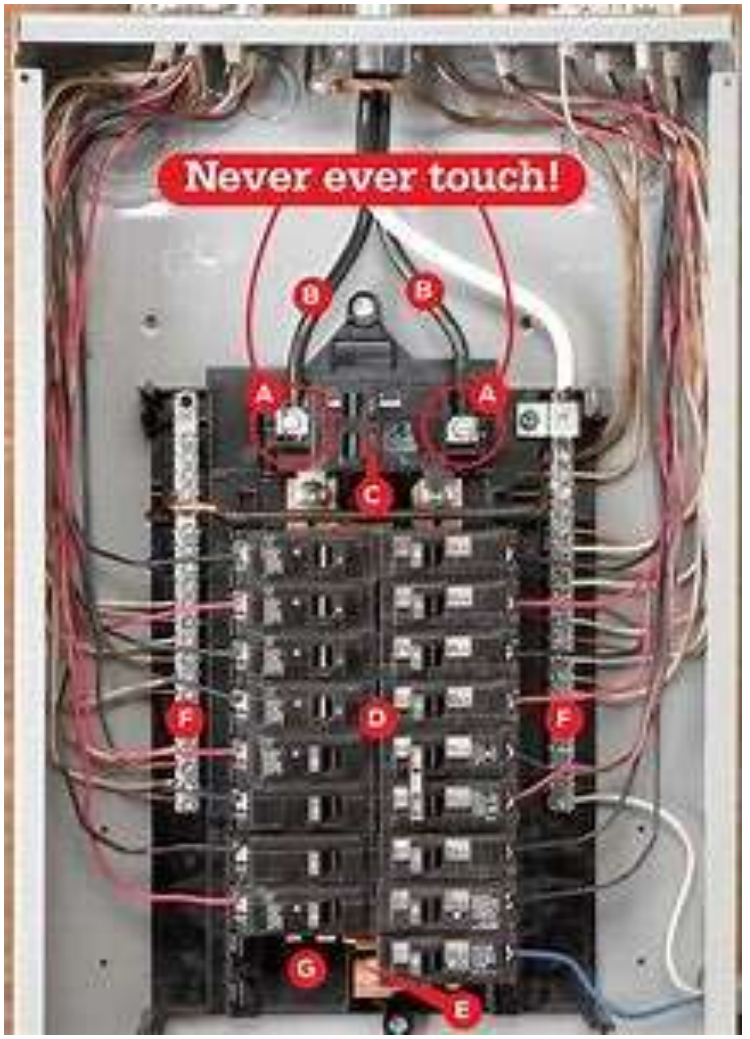
Stations

1. Power Generation and Distribution – 40 min
2. **Household Electrical –40 min**

Electrical Terms

- Switch-Electronic or Mechanical means for opening and closing a circuit.
- Fuse-A device that protects a circuit from over-current by melting a link in the device.
- Circuit Breaker-A device that protects a circuit for over-current by opening the circuit with a switch.

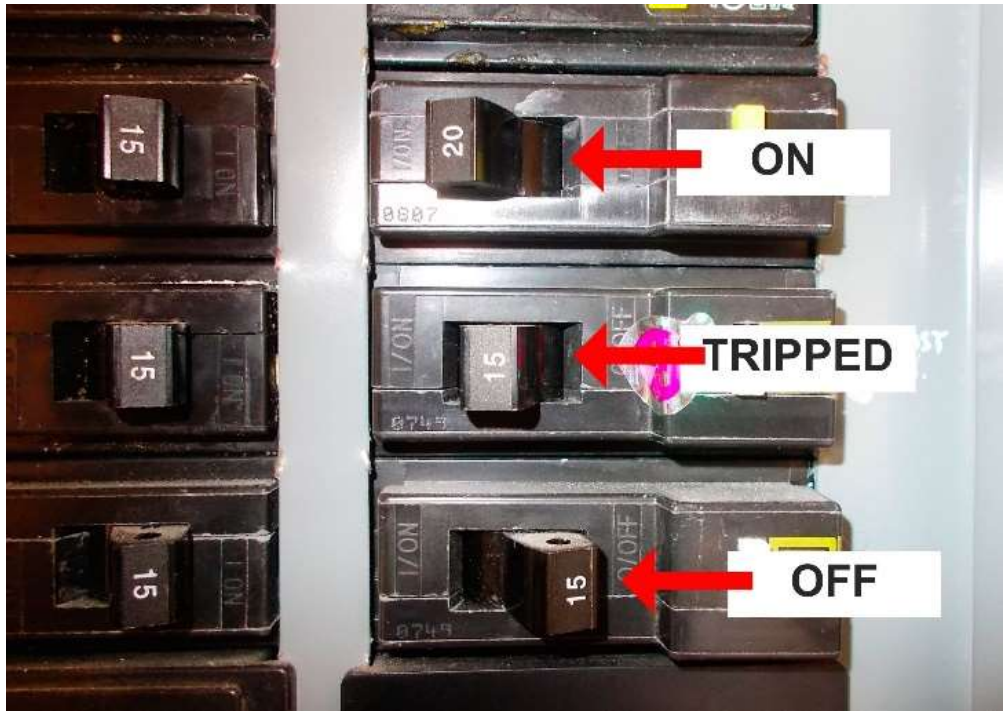
Circuit Breaker Box



Circuit Current Rating

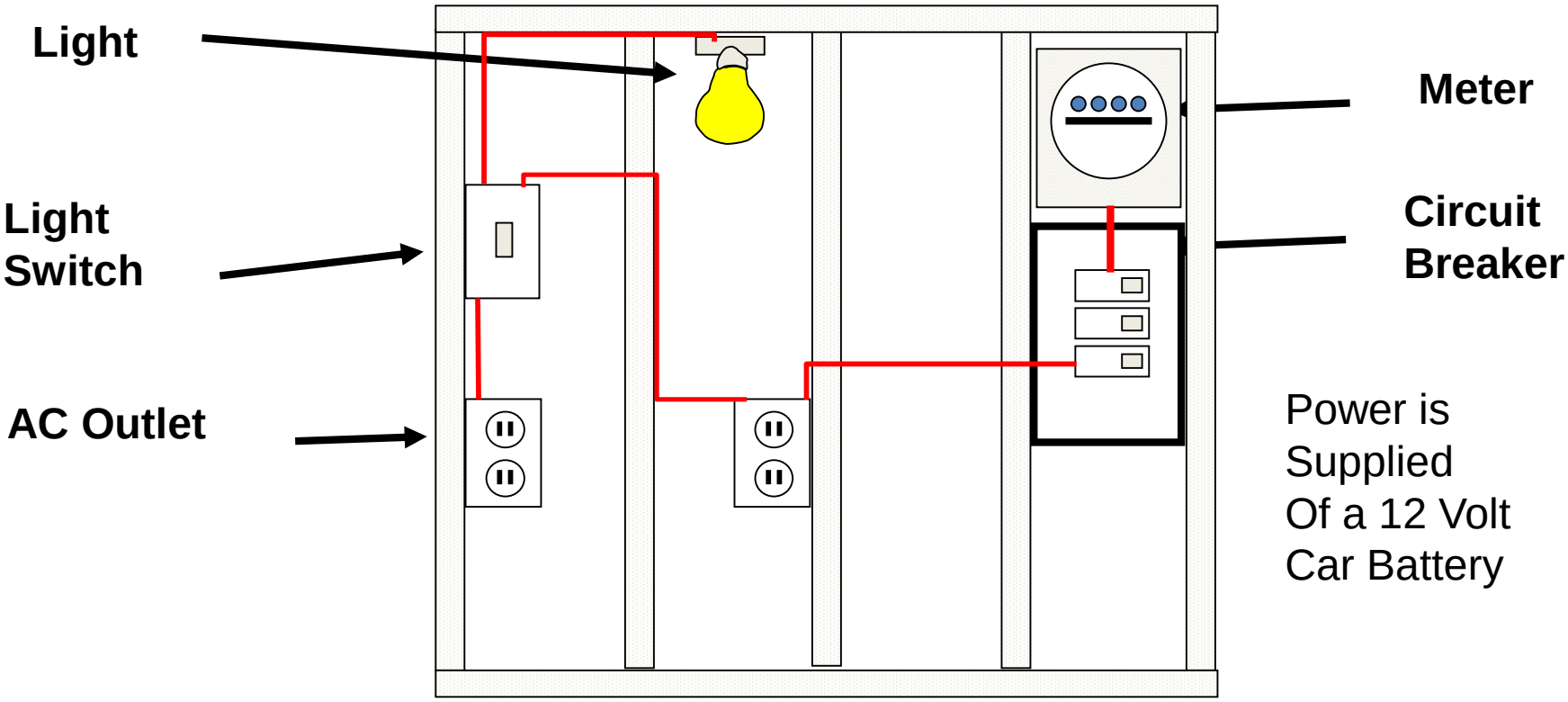
Tripped Breaker or Blown Fuse

- An overloaded circuit is the most common reason for a tripped breaker
- It occurs when a circuit is attempting to draw a greater electrical load than it is intended to carry.
- When too many appliances or light fixtures are operating at the same time



- The internal mechanism heats up, and the breaker "trips"
- To find a tripped breaker, look at your panel for a breaker that is now in the “off” position or between “on” and “off.”
- If it's placed in between, move the breaker to the “off” position before returning it to the “on” position.

House Wiring Demonstration



Household Wiring - Switches

On-Off – Single pole, single throw

3-way Switch – Single pole, double throw

Dimmer switch – adjust the light level using a slide or dial

Household Wiring - Outlets

Ungrounded

Grounded

Tamper Resistant

Surge Suppressor/USB

GFCI Outlet

240V Outlet

Dryer - 30A

Oven - 50A

GFCI

- Ground Fault Circuit Interrupter – Prevents shock by quickly shutting off power if there is a spike in the current
  - Protects against short circuits, especially through water
  - Should be used in Kitchens, baths, laundry, basements, crawlspaces, and outdoors
  - Could use a GFCI Circuit Breaker instead

Electrical Terms

- **Short Circuit** - An abnormal connection of low impedance (resistance) between two points of different potential

- **Ground** - A point of common connection of zero volts often the earth

Electrical Power and Energy

Power

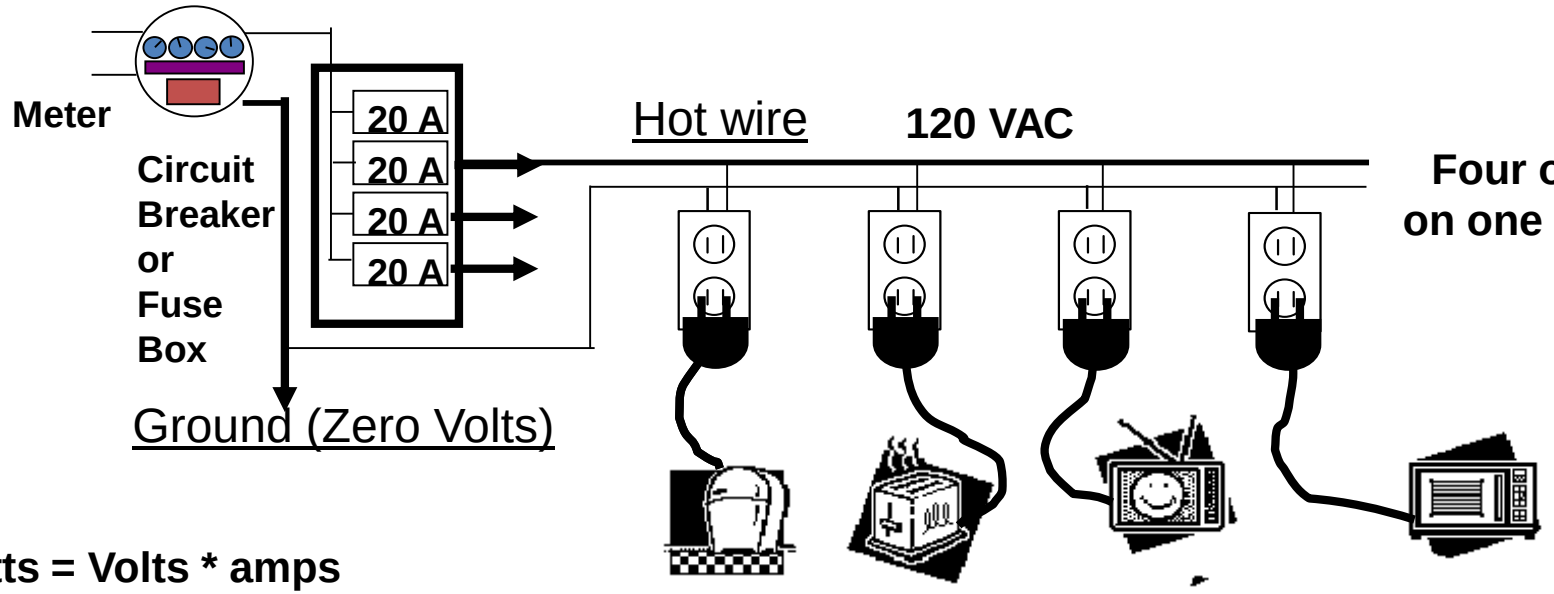
- **Watt**- Power to do work at 1 joule/sec
- W=V x I
- KW = 1000 W

Energy (Power delivered over a period of time)

- KW*Hr = 1 KW of power delivered for 1 hour

House Wiring

Determine if the circuit breaker is overloaded. Calculate total power on the Circuit.



Watts = Volts * amps

Amps = $\frac{\text{Watts}}{\text{Volts}}$

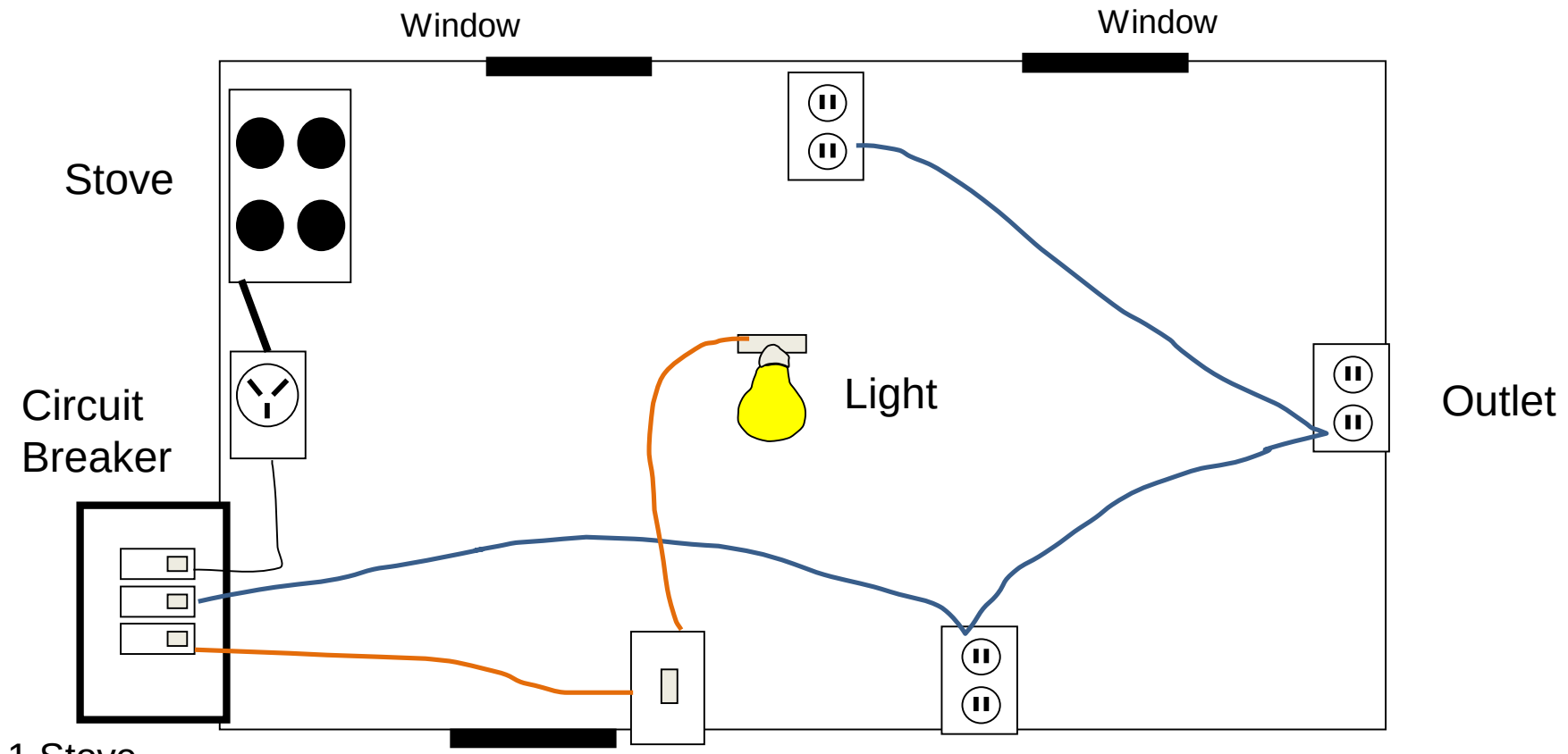
Refrig. **Toaster** **TV** **Microwave**

Power = _____ + _____ + _____ + _____ = _____ Watts/hour

Amps = $\frac{\text{watts}}{\text{volts}}$ = _____ = _____ amps Overload Yes or No _____

120VAC

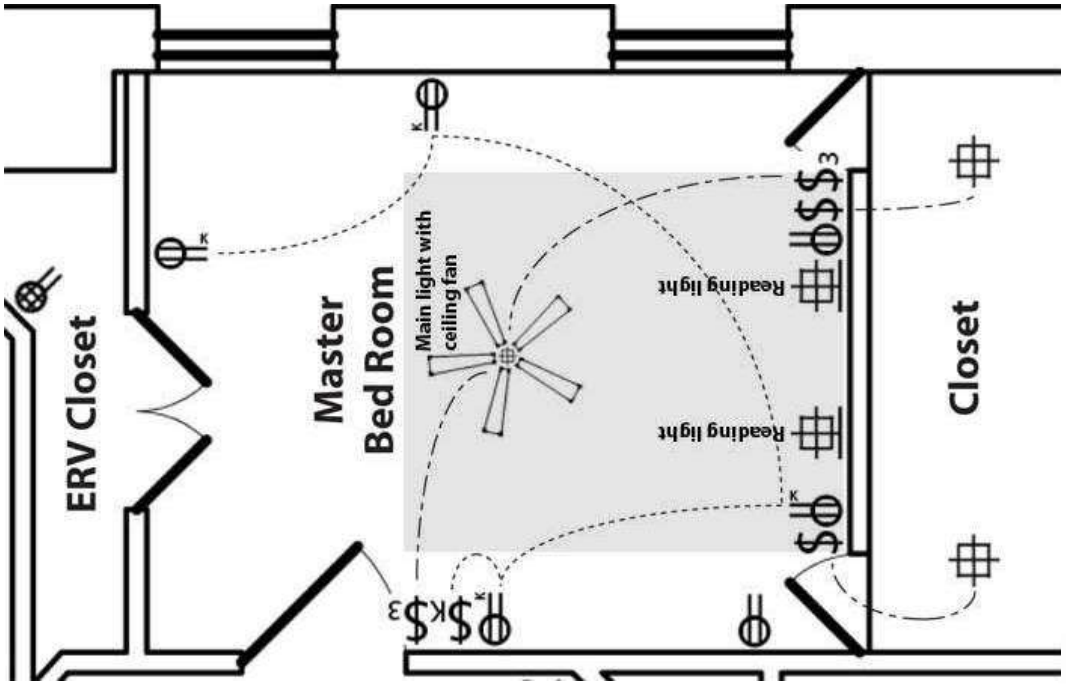
Electrical Wiring – Drawing Example



1 Stove
2 Outlets
3 Light

In room, draw electrical outlets, switches, and lights. Draw only one side of electricity called the Hot side. Also show doors and windows.

Requirement 8

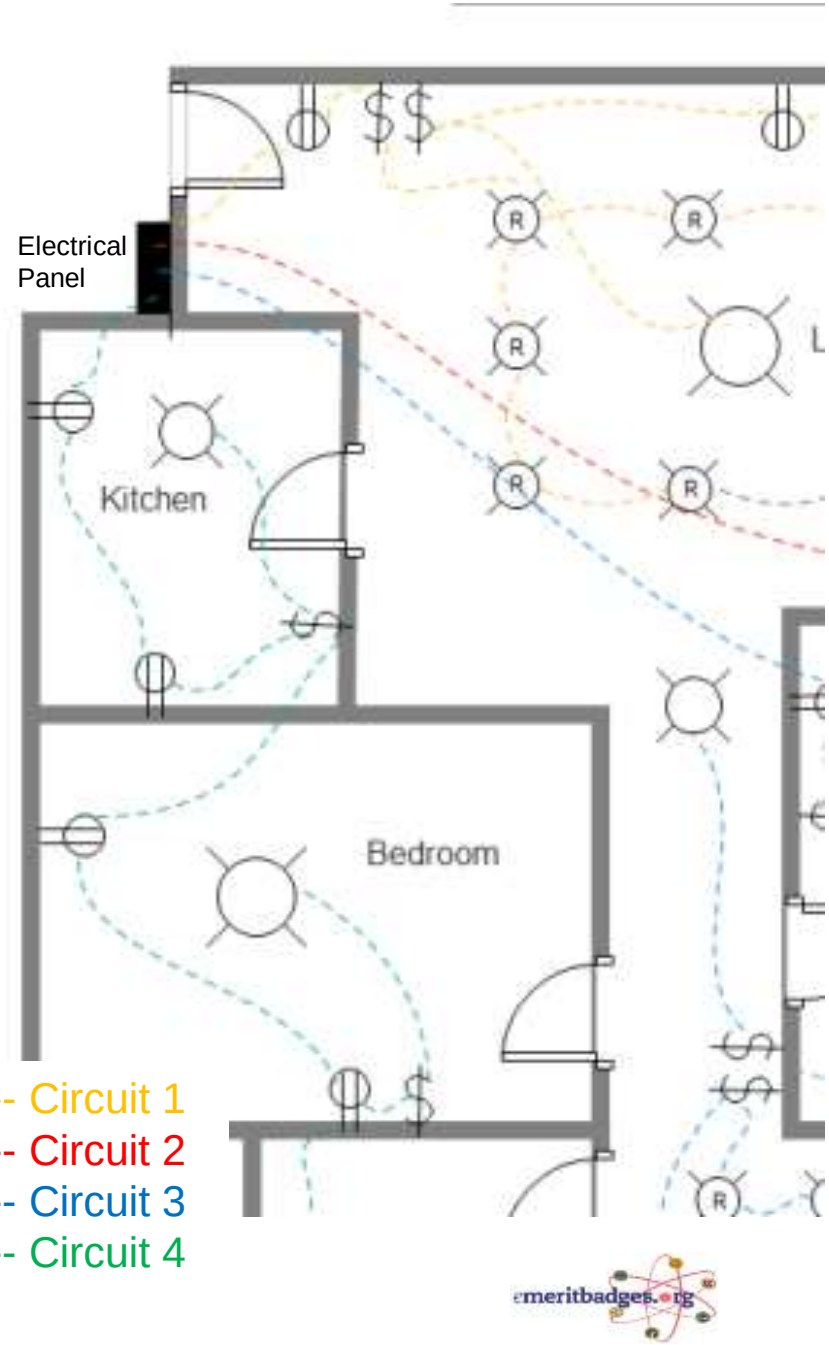


	Electrical switchbox	S	Single Pole Switch
S_3	Three-Way Switch		SinglePlex Receptacle
	Duplex Receptacle	WP	Duplex Receptacle WP= Waterproof
GFCI	GFCI Duplex Receptacle	*	Isolated Ground Receptacle
	Switched Receptacle		FourPlex Four Gang Receptacle
	240-Volt Receptacle	PC	Ceiling Mounted Light Fixture PC= Pullchain
	Wall-Mounted Light Fixture	R	Recessed Light Fixture
WP	Weatherproof Light Fixture		Fluorescent Light Fixture
CF	Ceiling Fan		Combination Light & Fan
VF	Power Vent Fan	2	Electric Motor Number=HP
SD	Smoke Detector		Circuit Breaker
	Telephone Jack	T	Doorbell Transformer
	Doorbell Pushbutton		Ground

- Draw a simple floor plan of a room in your house with lights, switches, and electrical outlets penciled in.
- Then use the electrical wiring symbols to draw in the overhead and wall lights and to show where electric switches and electrical outlets are located.

Requirement 8

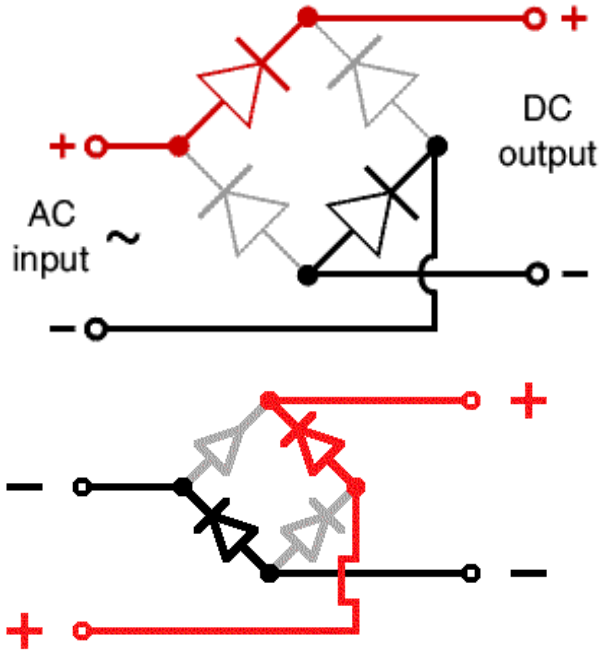
- Ask a parent or guardian to go to the main breaker box and turn off the circuit that supplies power to the room you have chosen.
  - Turn on the lights in the room before the adult flips off the circuit breaker.
  - If there is more than one circuit breaker that corresponds to the room, note which breaker supplies power to what outlets, lights, and switches by checking them while the power is off.
- To the side of your room drawing, make a box and highlight the circuit breakers that supply power to the room.



Requirement 10

Rectifier

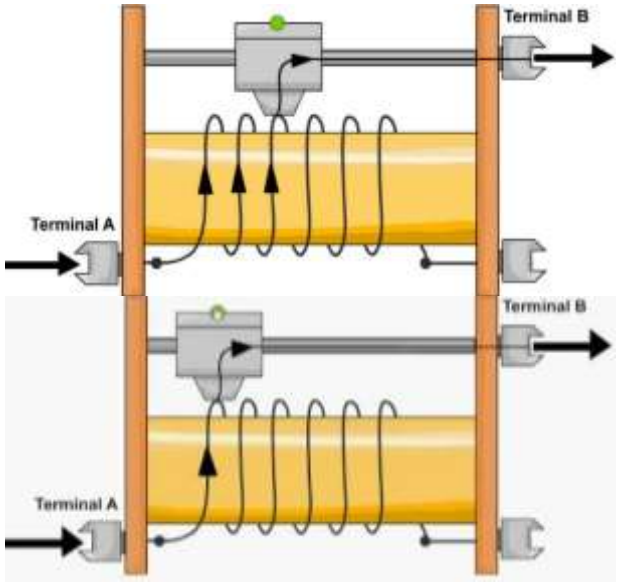
- An electrical device which converts an alternating current into a direct one by allowing a current to flow through it in one direction only.



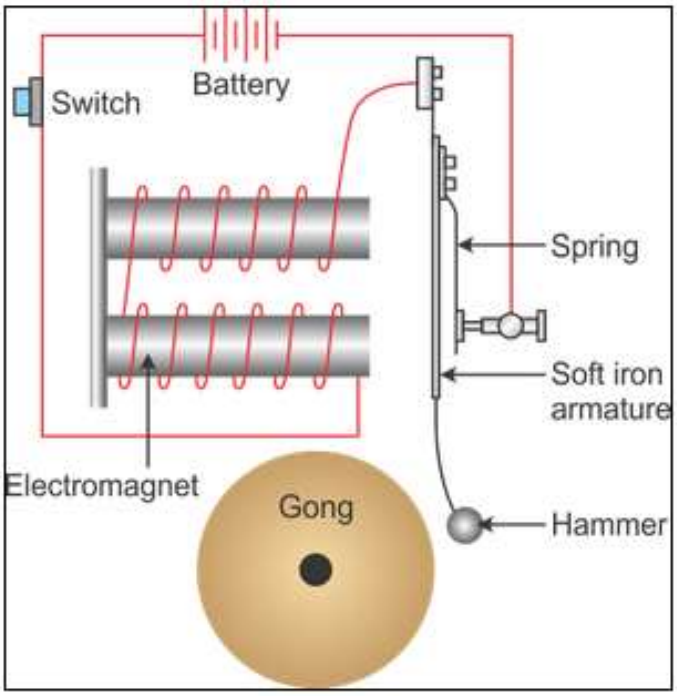
Requirement 10

Rheostat

- A resistor built so that the current traveling through the circuit can be adjusted at will. Volume controls and dimmer switches are examples.



Battery and Electric Bell



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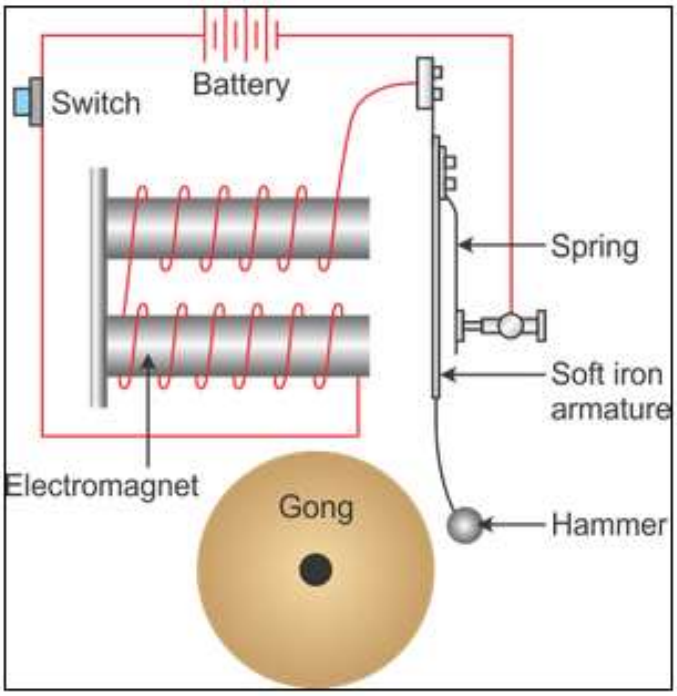

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