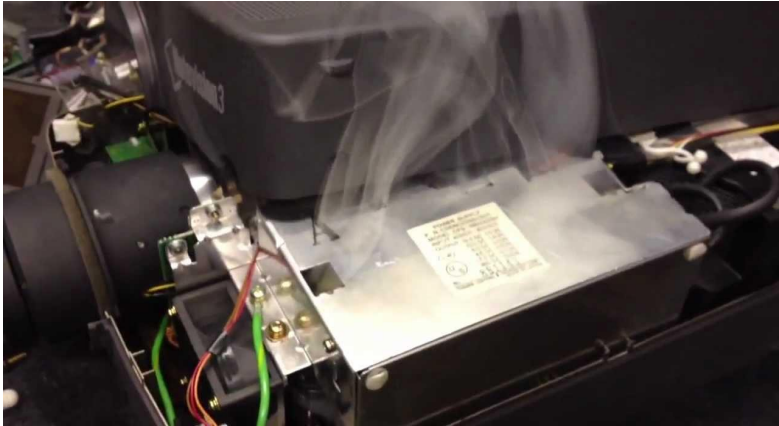


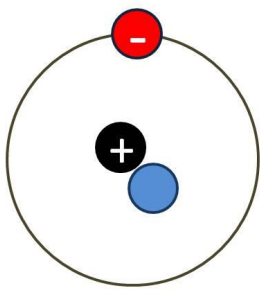
# Magic Smoke



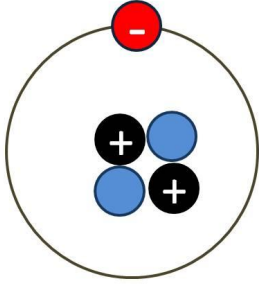
Magic smoke is a humorous name for the smoke produced by burning electronic circuits or components, by overheating, overvolting, or connecting them incorrectly. The smoke typically smells of burning plastic and other chemicals, and sometimes contains specks of sticky black ash.

-Wikipedia

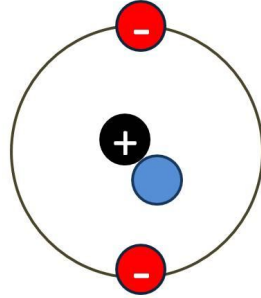
# Atom Structure and Electrical Charges



Atom Netral



Atom Positif



Atom Negatif

**Electron:** Negatively charged

**Proton:** Positively charged

**Neutron:** No charge

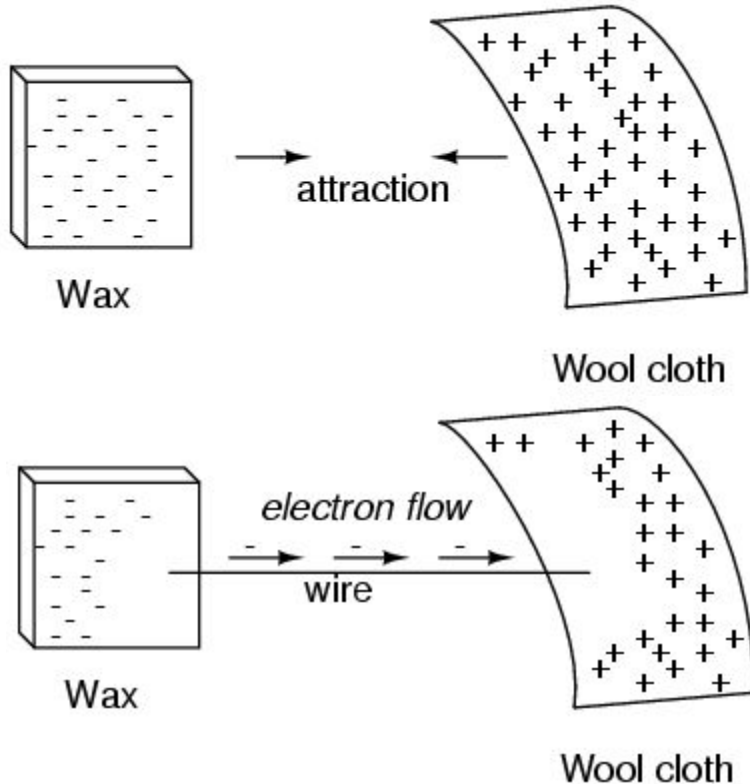
**Positive Charge:** Extra proton

**Negative Charge:** Extra electron

**Neutral Charge:** Same number of protons and electrons



# Electron Flow

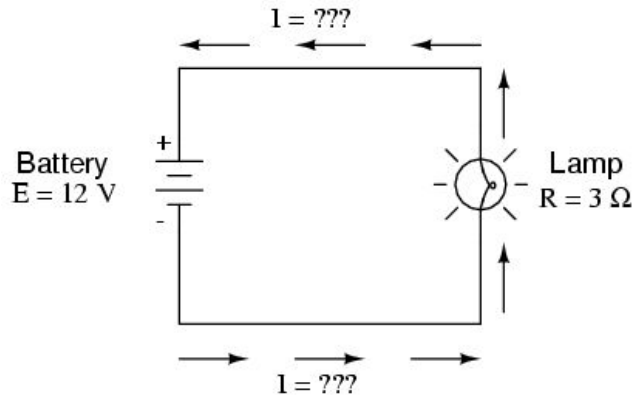


Atoms want to be neutral, so positively charged atoms will attract electrons from negatively charged atoms.

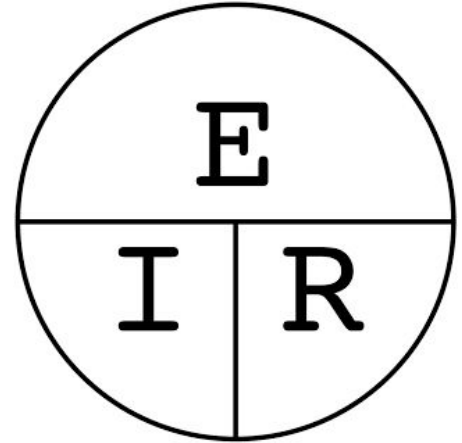
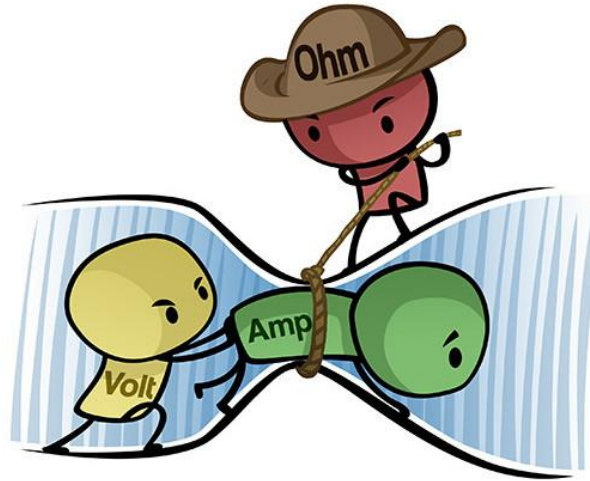
**No path:** Attract but no flow

**Path:** Flow but no longer attract

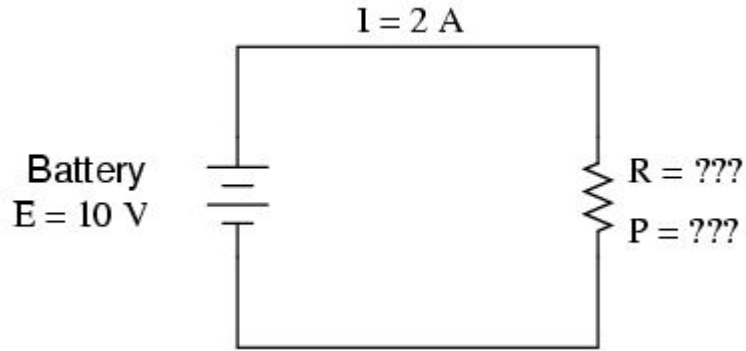
# Ohm's Law



$$I = \frac{E}{R} = \frac{12 \text{ V}}{3 \Omega} = 4 \text{ A}$$



# Wheel of Power



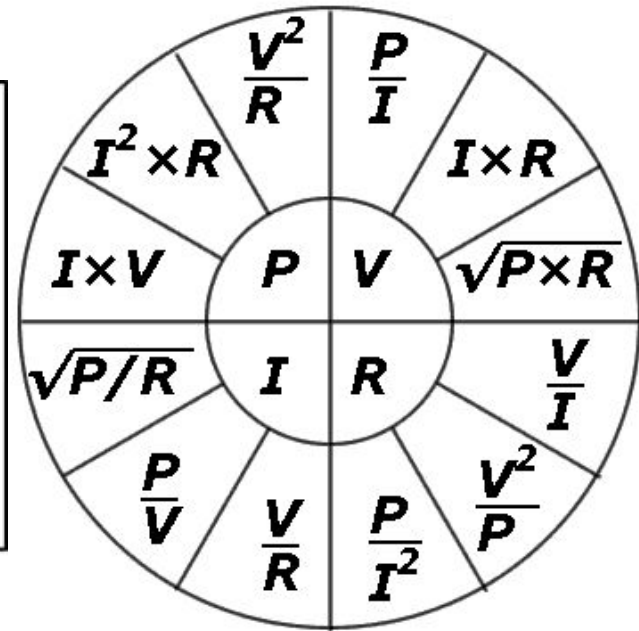
$$R = \frac{E}{I} \quad \text{and} \quad P = IE$$

$$R = \frac{10 \text{ V}}{2 \text{ A}} = 5 \Omega$$

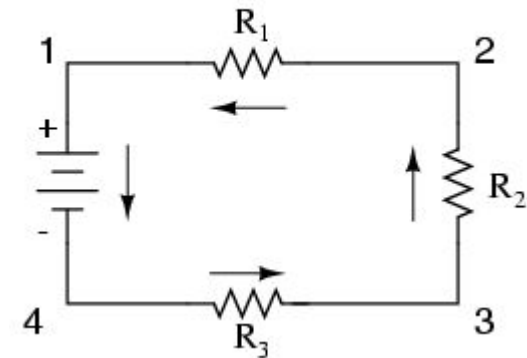
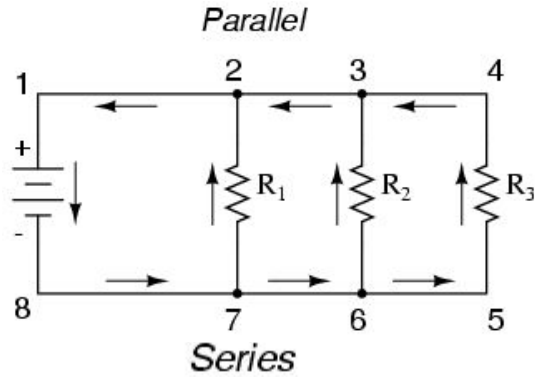
$$P = (2 \text{ A})(10 \text{ V}) = 20 \text{ W}$$



OHM NEVER FORGOT HIS  
DYING UNCLE'S ADVICE.

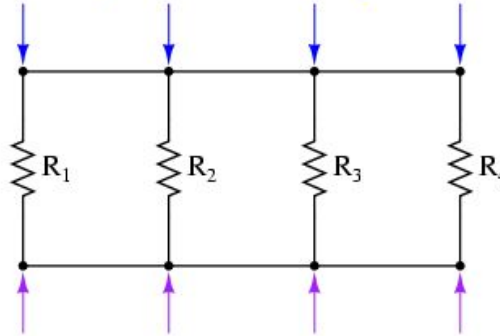


# Series and Parallel Circuits



*Parallel connection*

These points are electrically common



These points are electrically common

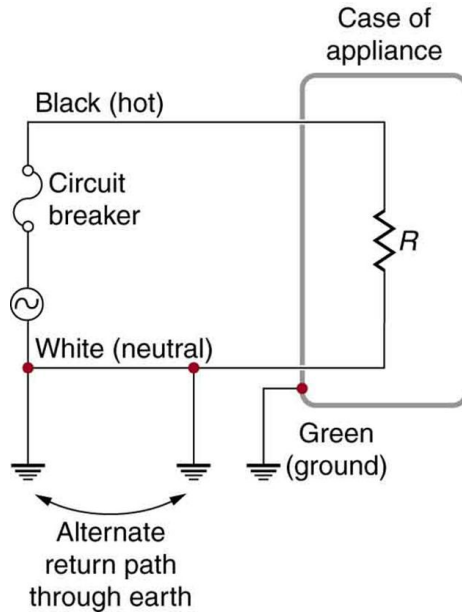
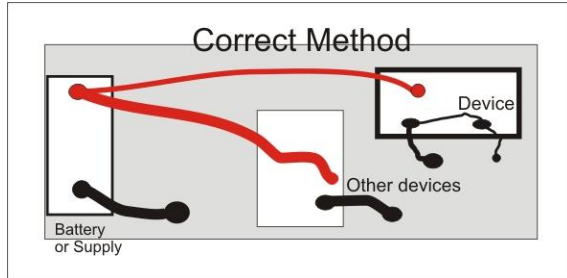
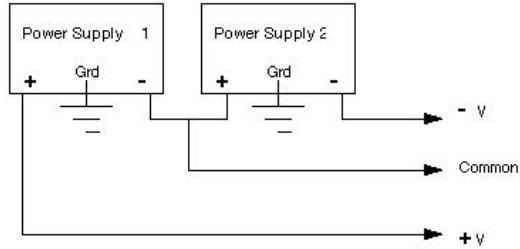
*Series connection*



only one path for electrons to flow!

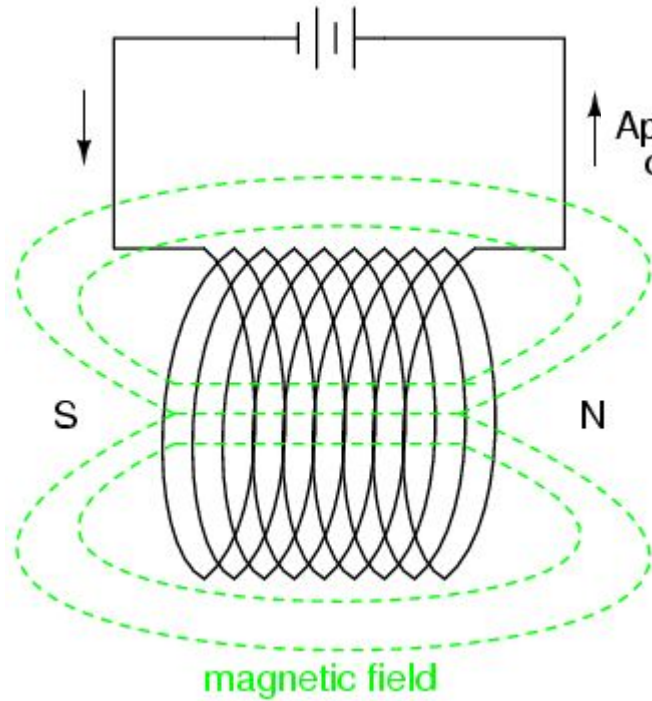


# Common vs Earth vs Ground vs Negative



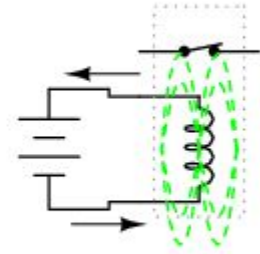
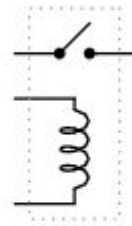
- Common is what all components have to connect to
- Earth and ground are  $\sim 0$  volts
- Negative has less potential voltage than positive
- Chassis, Clean, Protective

# Magnetism

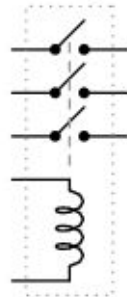


Applying current through the coil causes the switch to close.

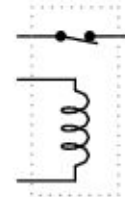
*Relay*



*Multiple-contact relay*



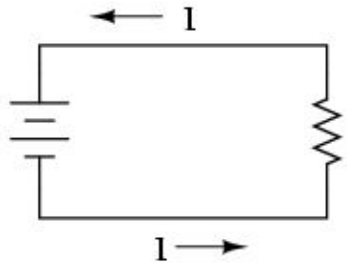
*Relay with "normally-closed" contact*



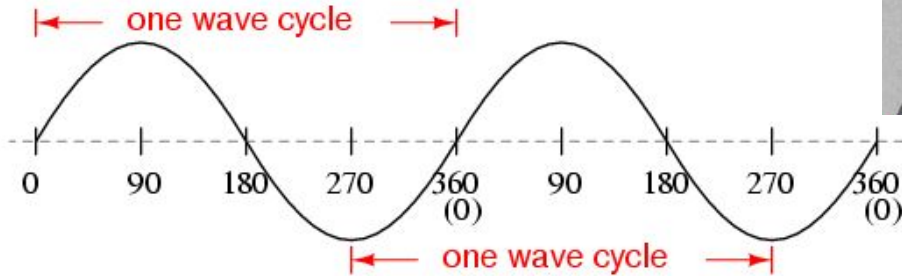
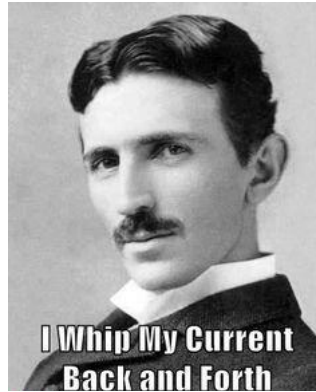
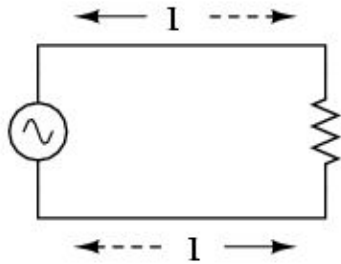


# Alternating Current

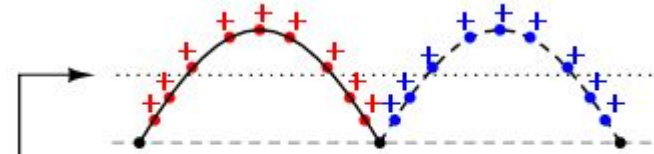
DIRECT CURRENT  
(DC)



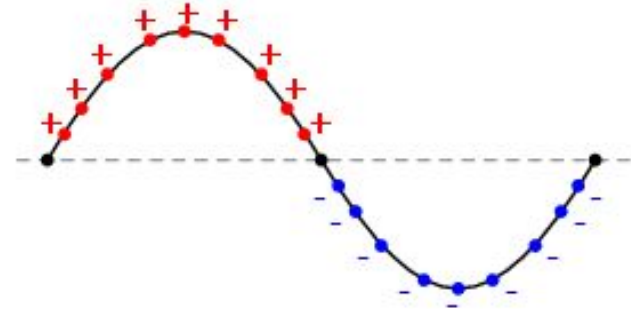
ALTERNATING CURRENT  
(AC)



Alternator shaft  
position (degrees) →



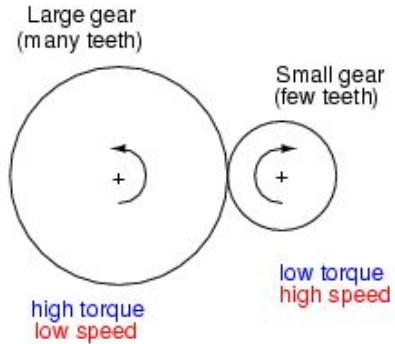
*Practical average of points, all values assumed to be positive.*



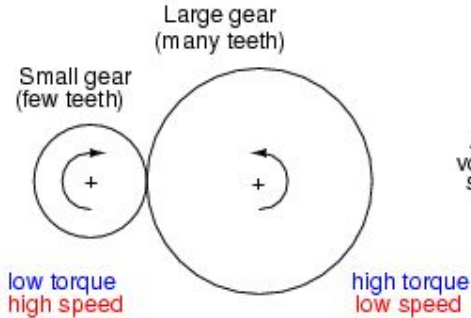
*True average value of all points (considering their signs) is **zero!***

# Transformers

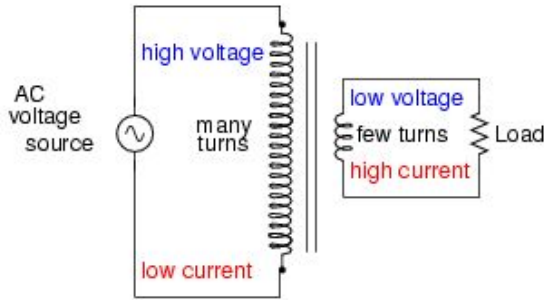
Speed multiplication geartrain



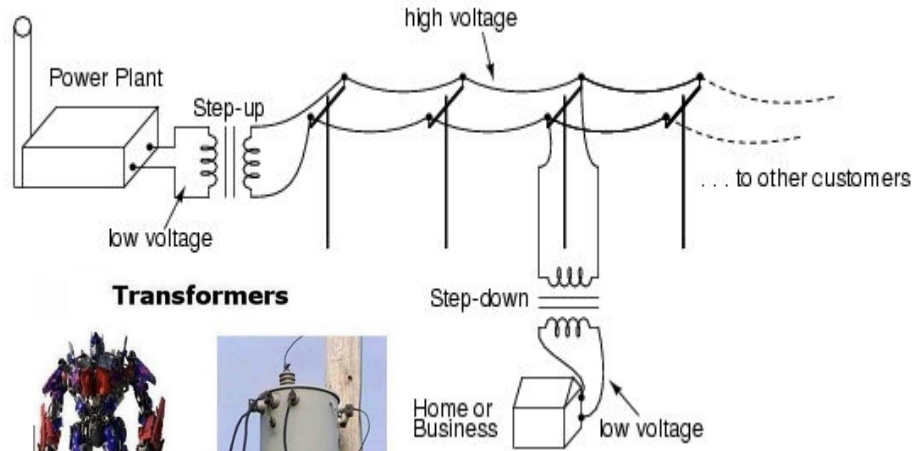
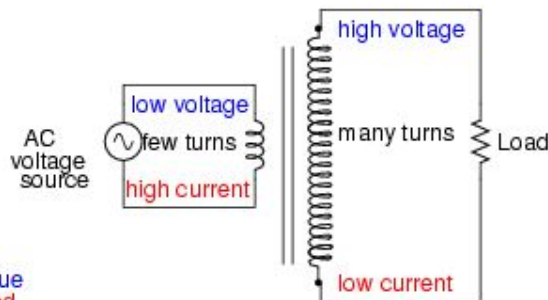
Speed reduction geartrain



"Step-down" transformer



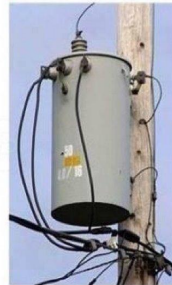
"Step-up" transformer



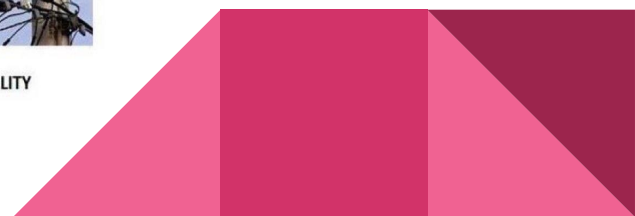
## Transformers



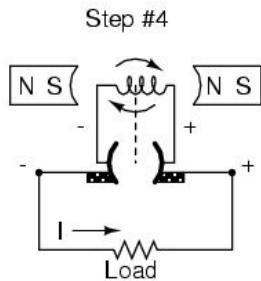
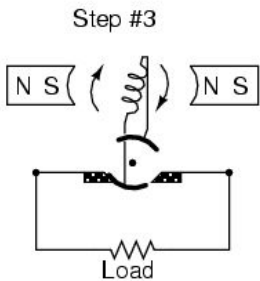
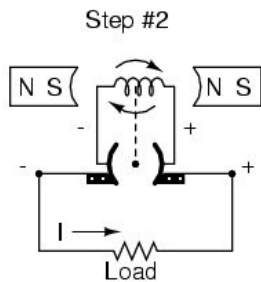
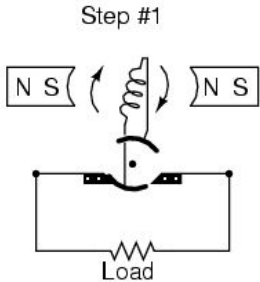
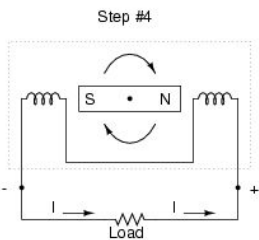
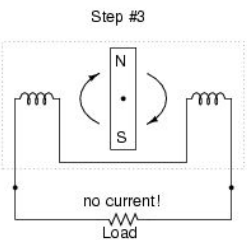
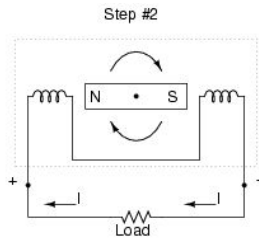
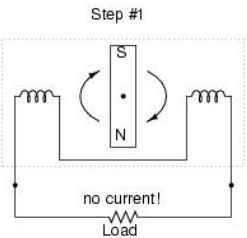
EXPECTATIONS



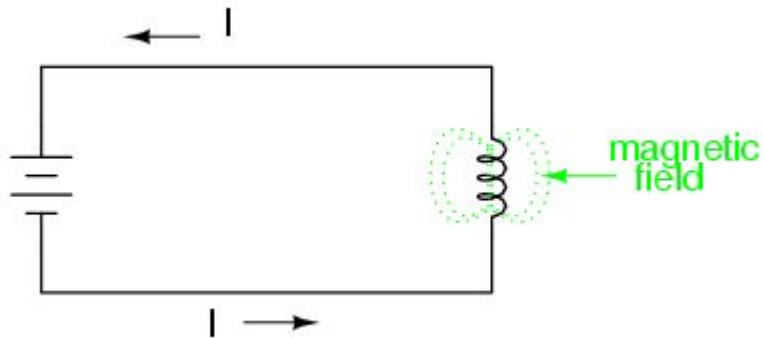
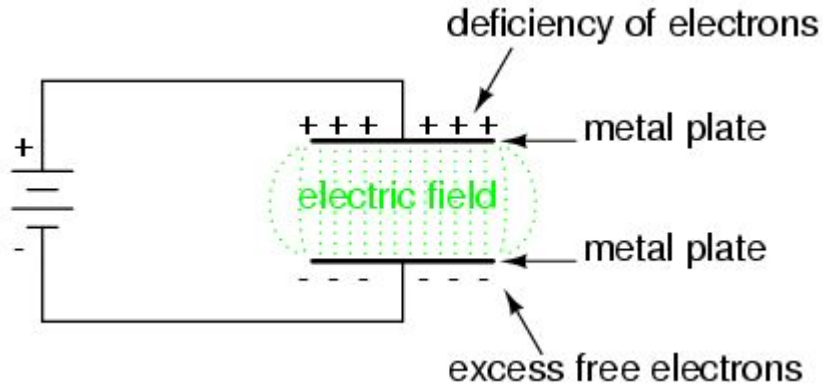
REALITY



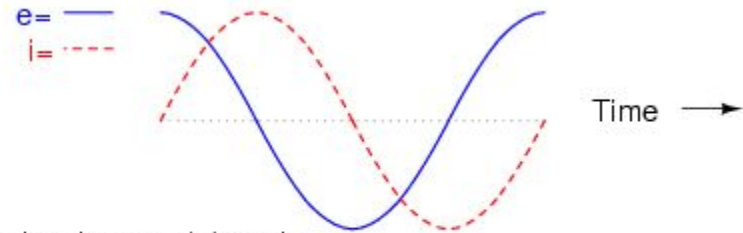
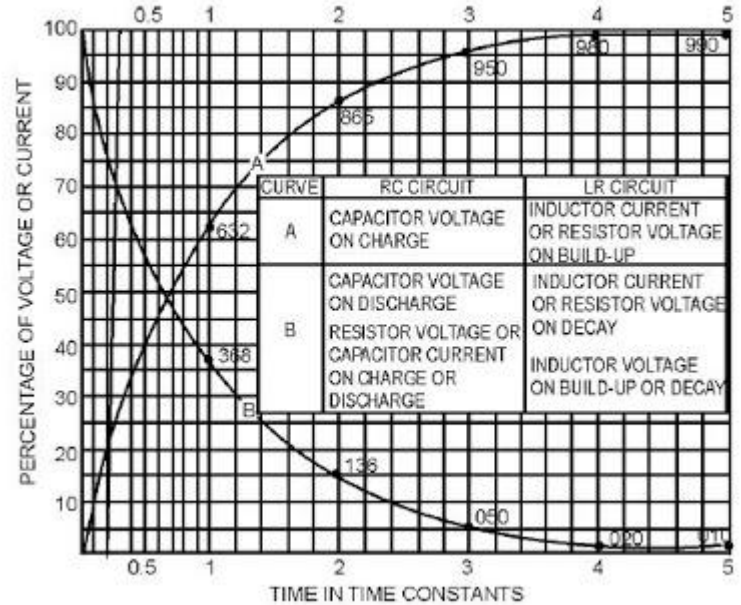
# Motors and Generators



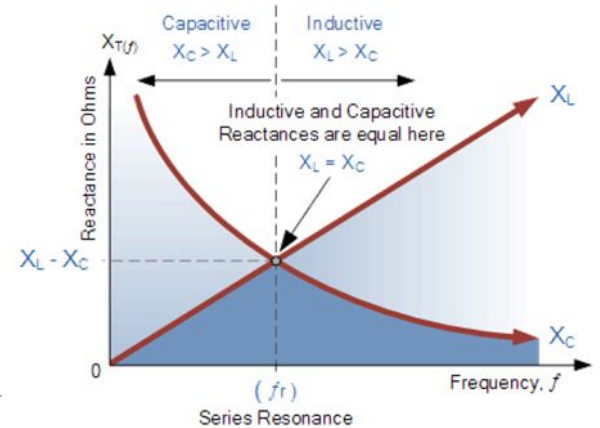
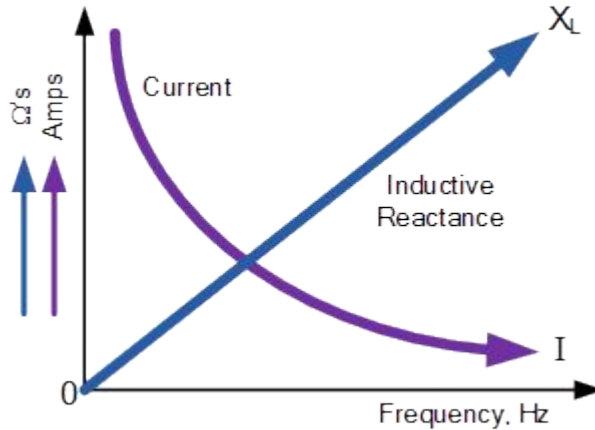
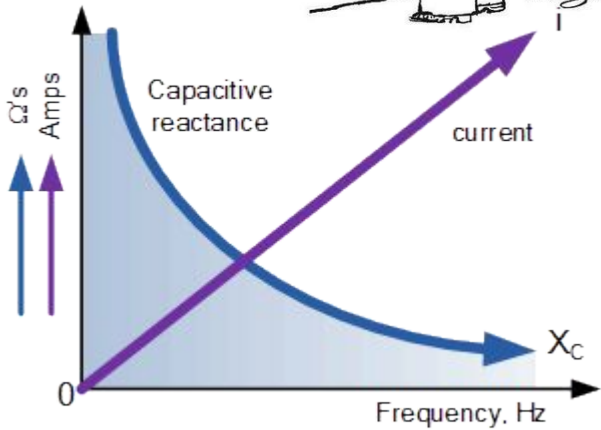
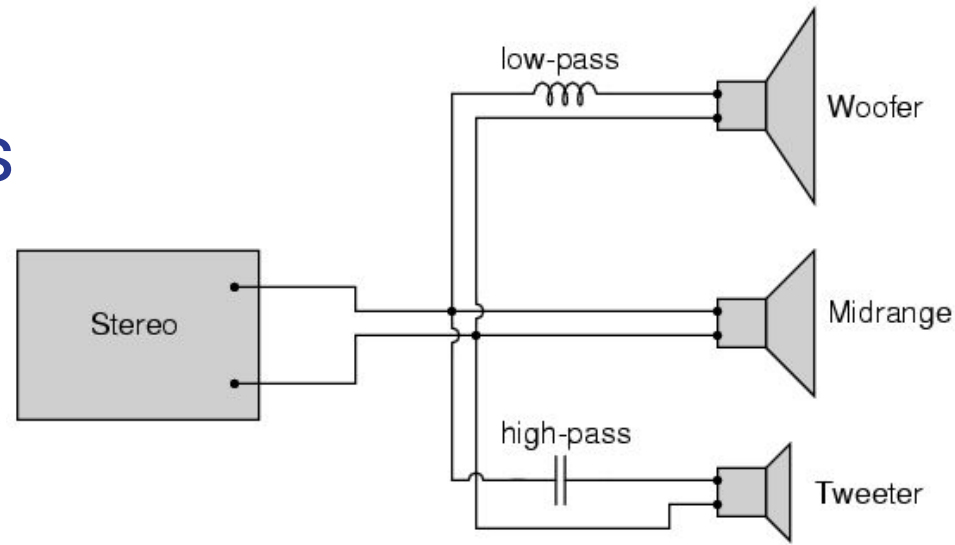
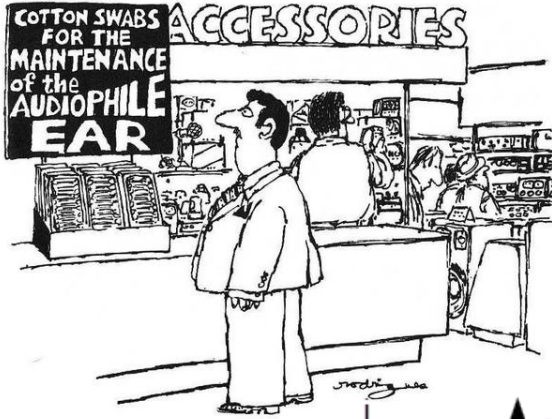
# Capacitors and Inductors



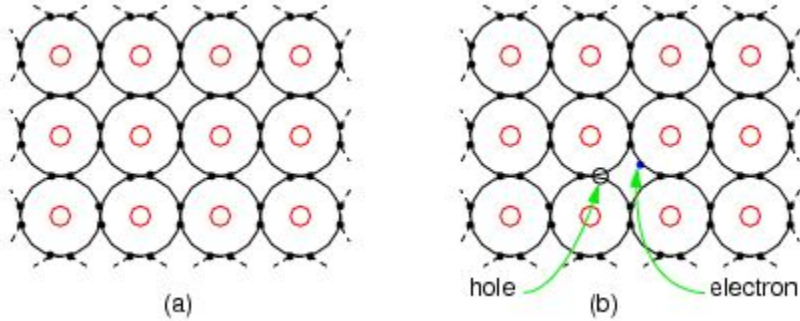
capacitor fully charged: voltage at (+) peak  
 inductor fully discharged: zero current



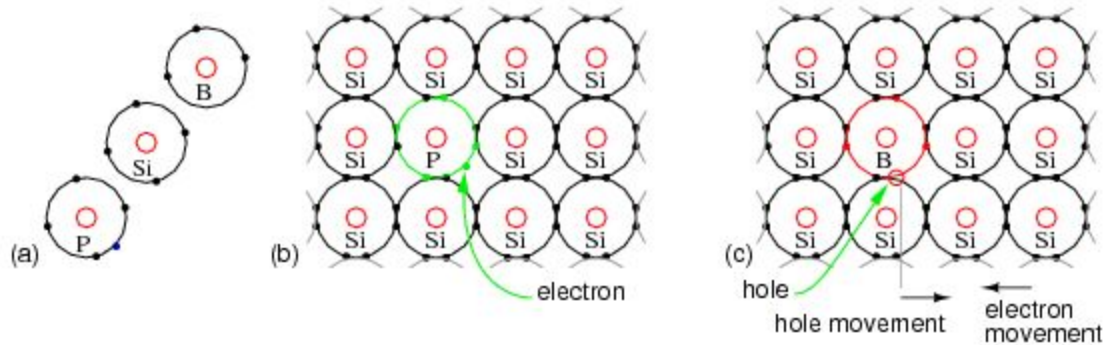
# Capacitors and Inductors



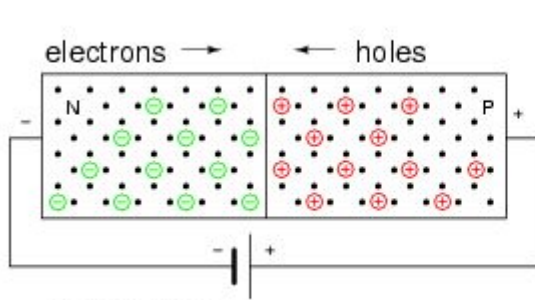
# Electron 'Hole' Theory Part 1



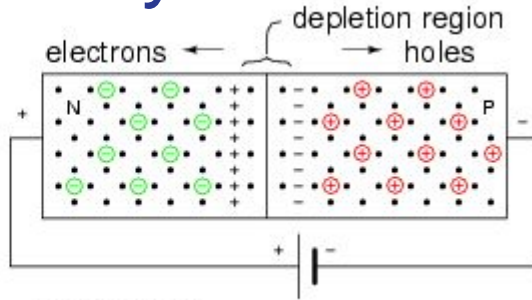
- Silicon is 'doped with other elements'
- Boron as an 'acceptor' or positively charged
- Phosphorus is a 'donor' or negatively charged



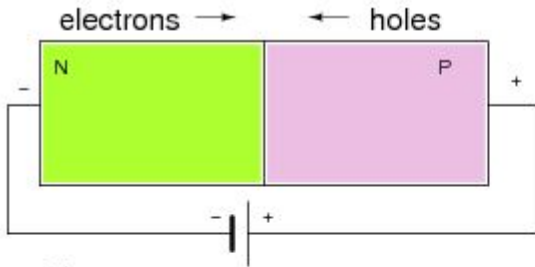
# Electron 'Hole' Theory Part 2



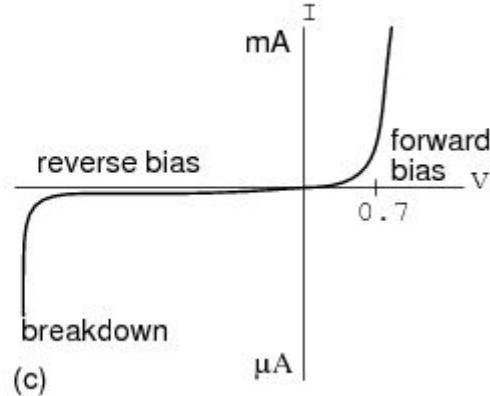
(a) Forward



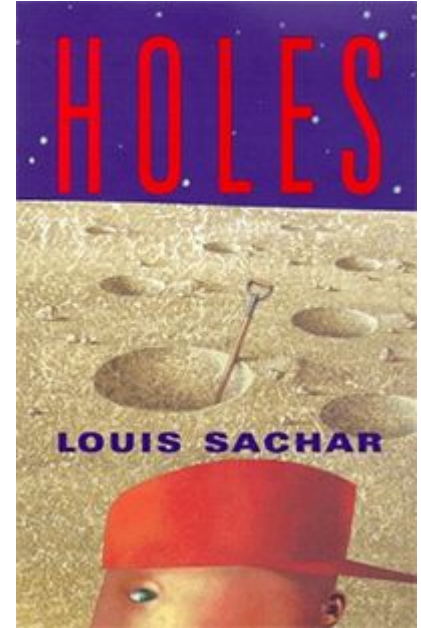
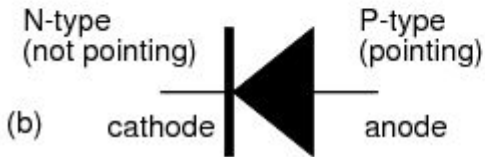
(b) Reverse



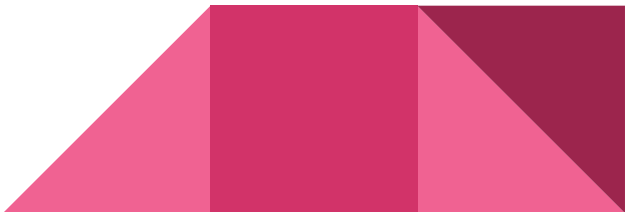
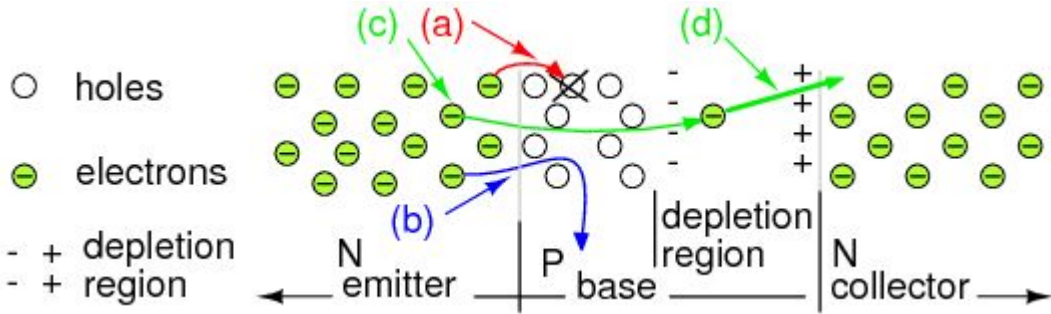
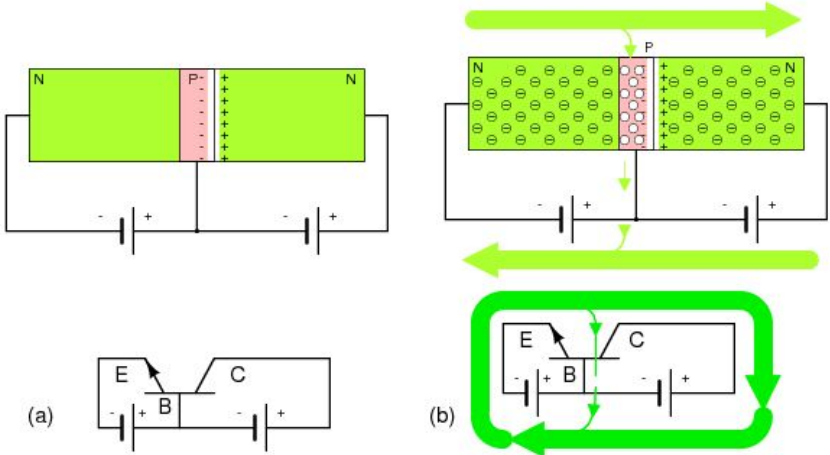
(a)



(c)

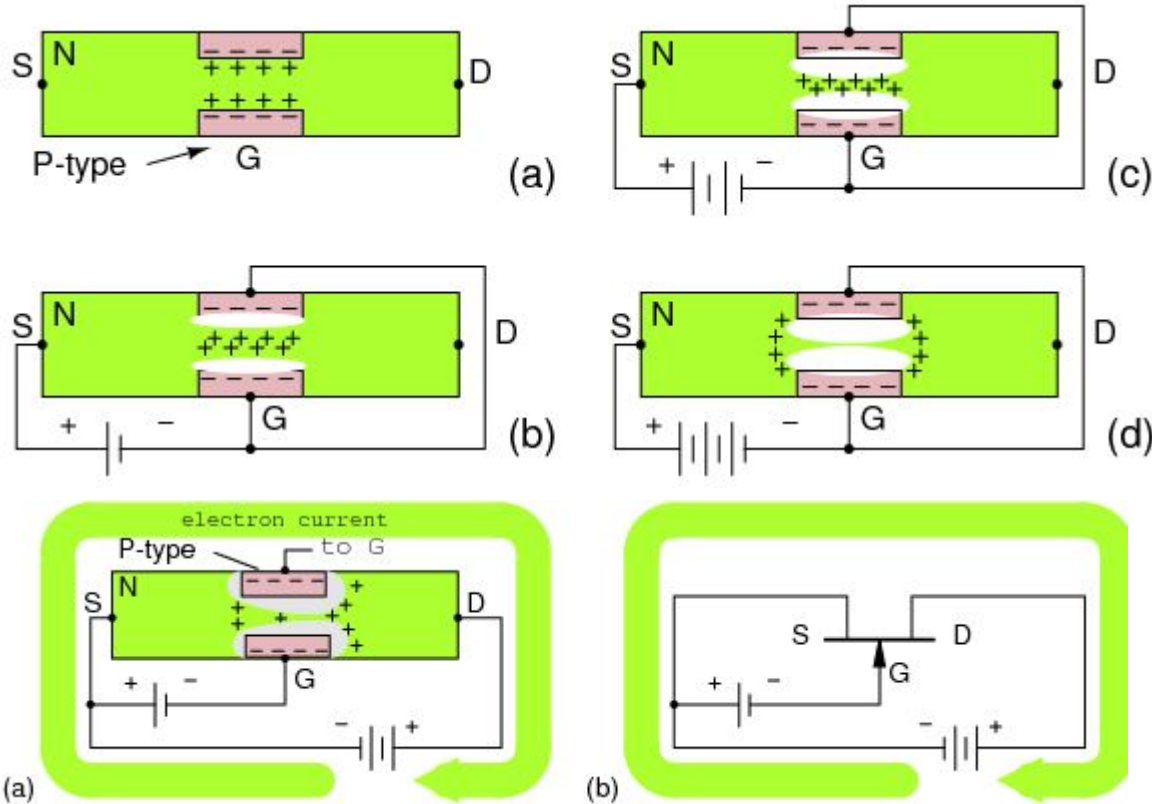


# Bipolar Junction Transistors

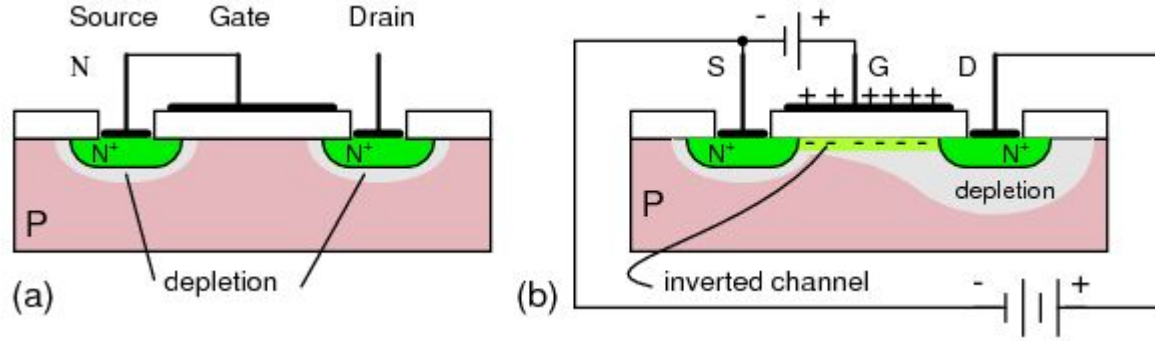




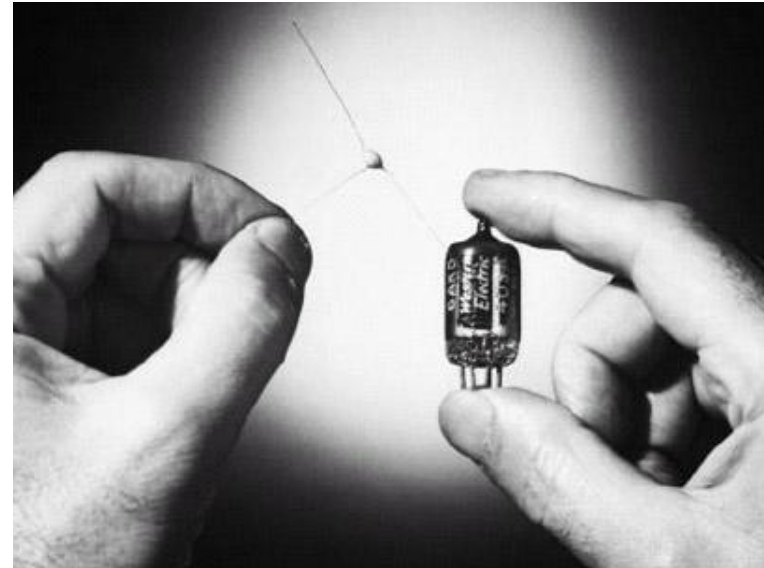
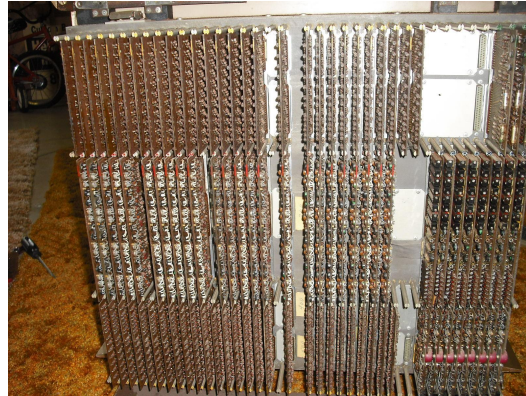
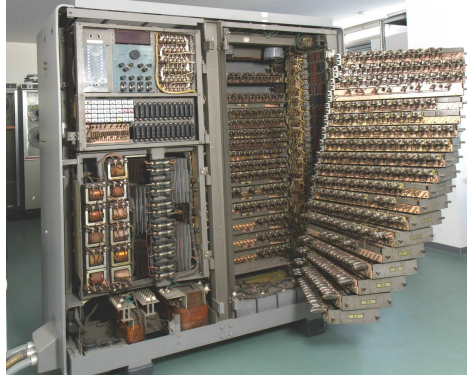
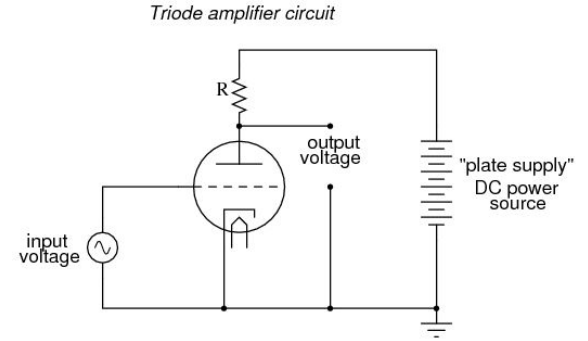
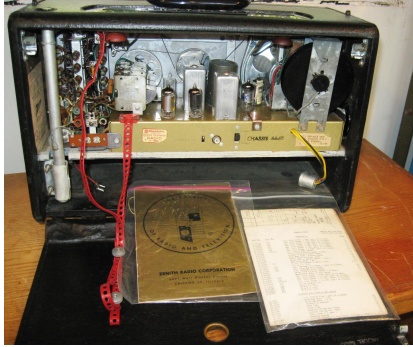
# Junction Field-Effect Transistors



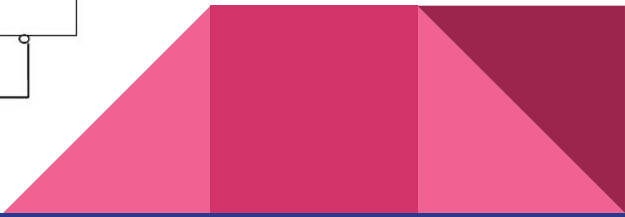
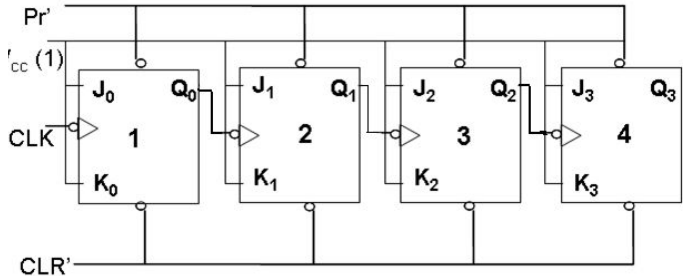
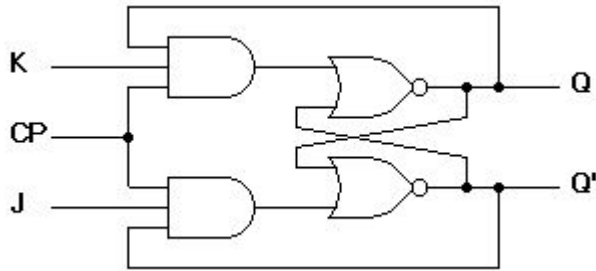
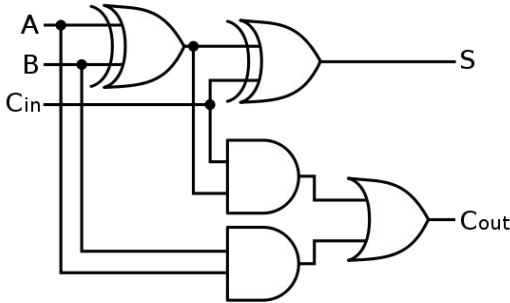
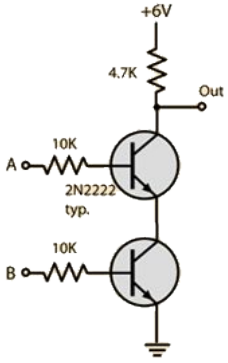
# Insulated-Gate Field-Effect Transistors (MOSFET)



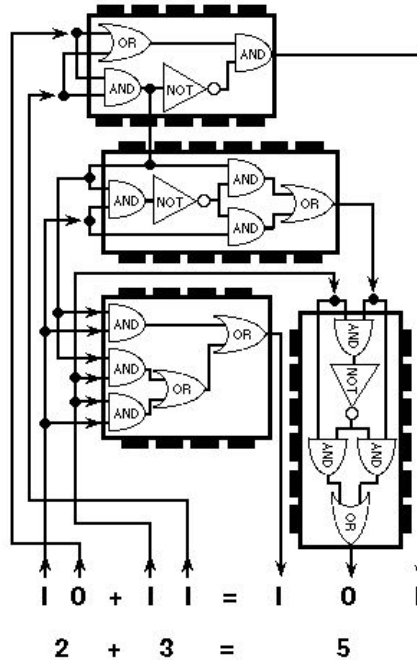
# Vacuum Tubes



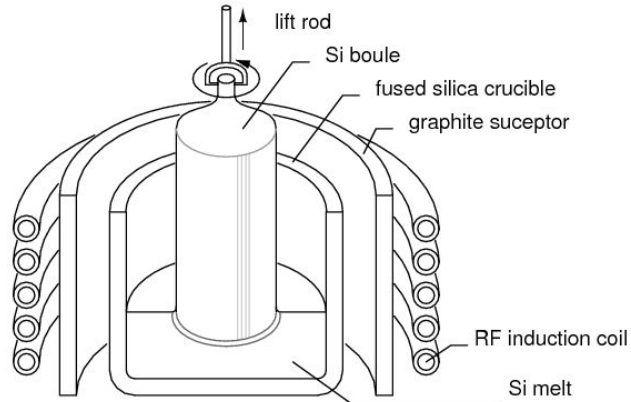
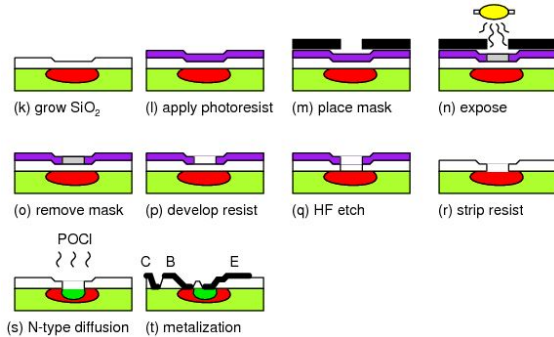
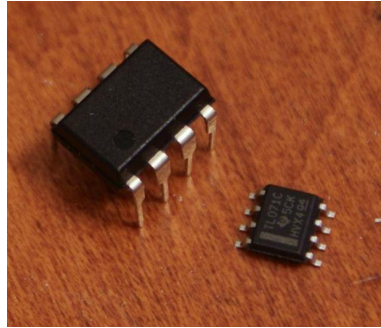
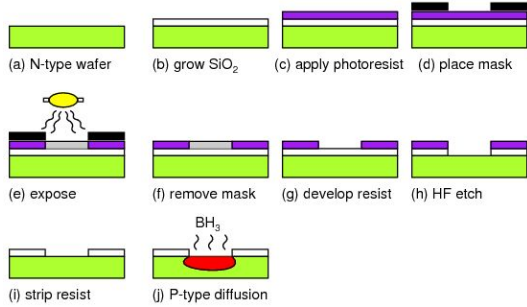
# Discrete Logic Circuits



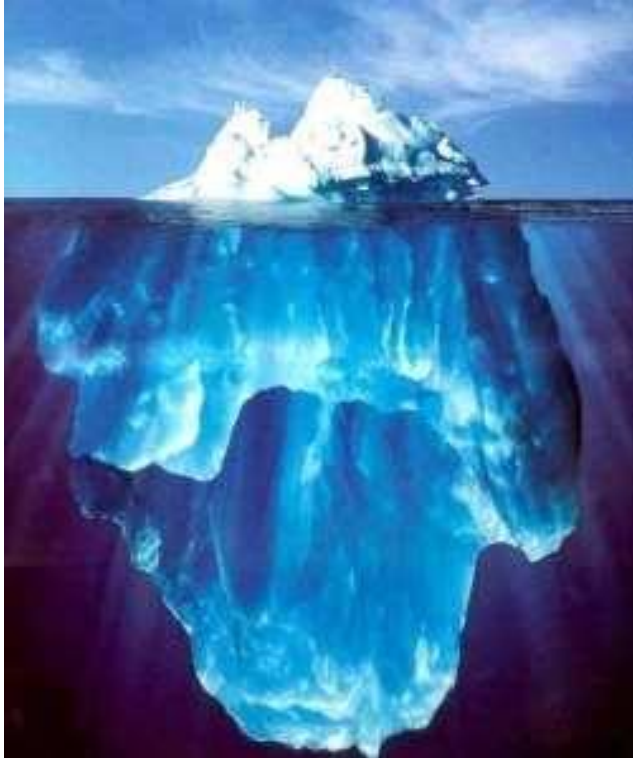
# It's an entirely different type of computing



# Manufacturing Techniques



# What now?



-Antenna Propagation and Waves

-Digital Logic (Computing)

-Digital Signal Processing

-High Voltage

-Radar

[allaboutcircuits.com/textbook](http://allaboutcircuits.com/textbook)

[http://www.waitingforfriday.com/index.php/4-Bit\\_Computer](http://www.waitingforfriday.com/index.php/4-Bit_Computer)