Basic Concepts
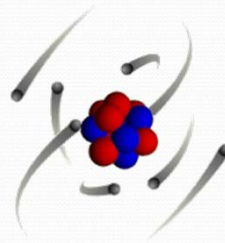
Section 02

Electrons

- Atoms and Electrons
- Heat and Free Electrons
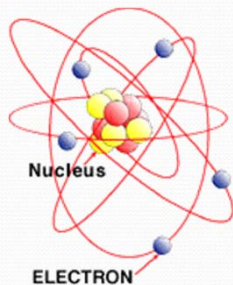
Is It Like This?!
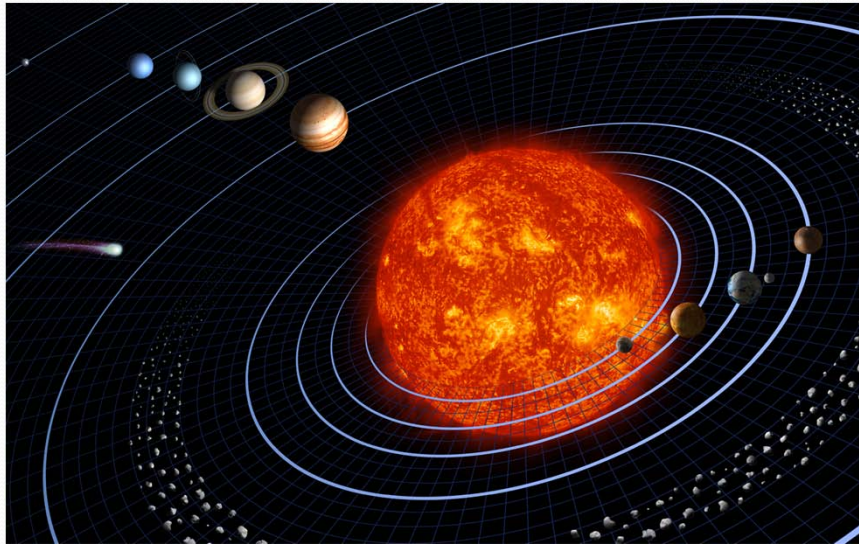
Electricity

- If electrons were pushed, they produce a current
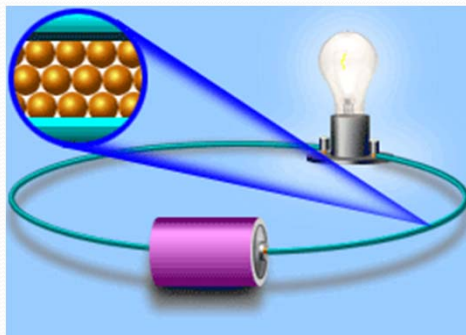
Battery

- Source of pushing electrons
- Electrochemical reactions
- Look for types of batteries in Wikipedia!!

Volt

- Alexander Volta (first battery)
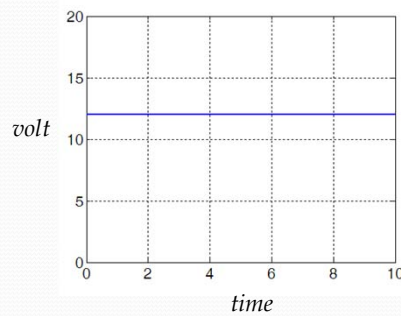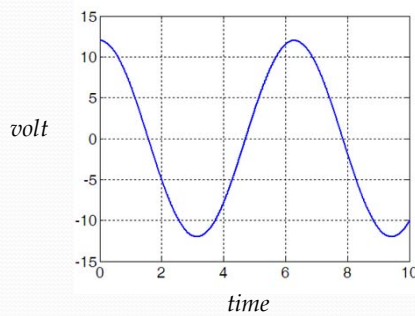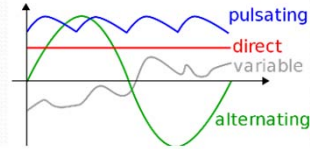- Electromotive Force
  - 1.5V, 110V, 13.8kV

AC and DC Currents

- Cascade 73 batteries in series. Do they generate 110V?
  - DC: direct current
  - AC: alternating current

Frequency of AC Signal

- Frequency = Number of cycles per second
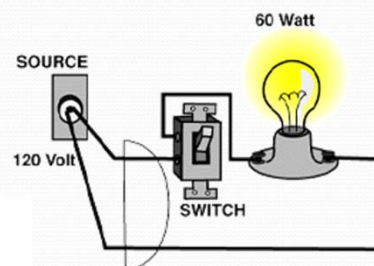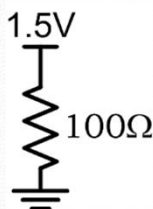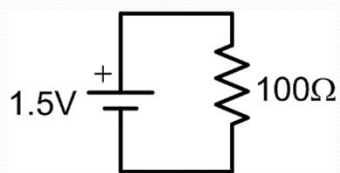
$$f = \frac{1}{T}$$
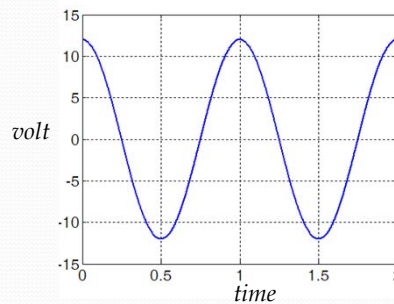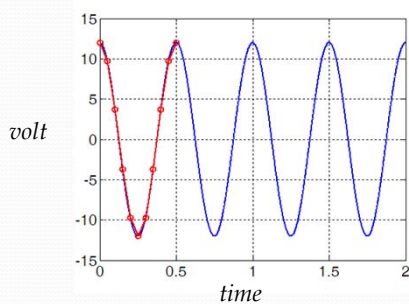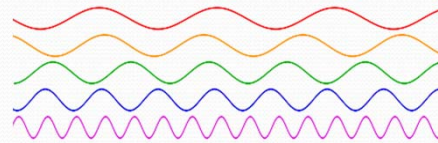
Experiment!!

- What's the highest frequency your eyes can notice?
  - *frequency vs. amplitude..*

- What is the frequency of 110V battery?

Closed Loop Circuits

- No current will flow in an open loop circuit..

1.5V — 100Ω

1.5V — 100Ω

60 Watt

SOURCE

120 Volt

SWITCH

Closed Loop Circuits
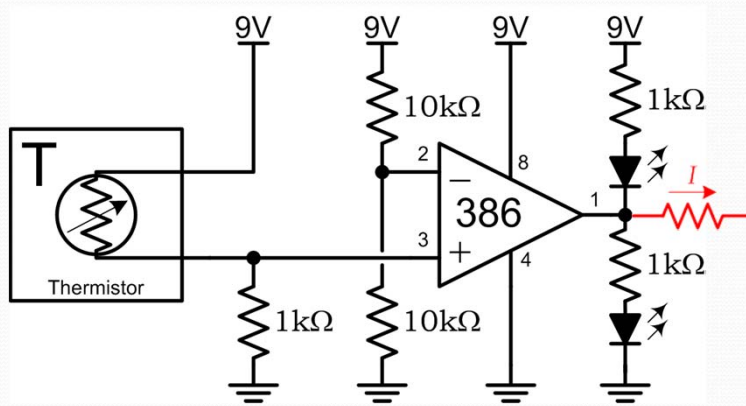
Ground Currents

1. Why birds do not get shocked by high voltage lines?

2. Can you safely touch one node of home electricity?

3. What about lightening?

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Current

- Number of electrons passing every second
- Ampere (A) is a unit of current
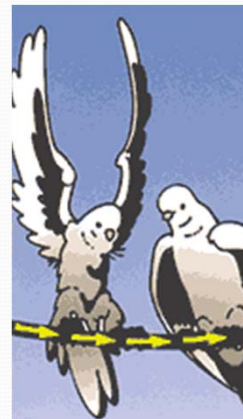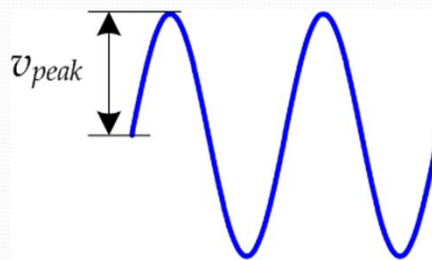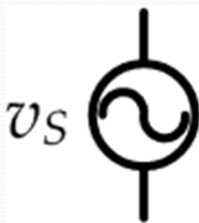 - $1\,A = 6.28 \times 10^{18}$ electrons/sec

- At home: 60A,100A (20A per phase)
- Electronics: 10mA

AC Source

- Generally produces sine wave

v_S

v_{peak}

$$v_s = v_{peak} \times \sin(\omega \times t)$$
$$v_s = v_{peak} \times \sin(2\pi \times f \times t)$$

RMS

- RMS: Root Mean Square
  - power is measured instead of peak voltage

$$V_{RMS} \equiv \sqrt{\frac{1}{T}\int_0^T v^2(t)\cdot dt}$$

  - for sine or cosine signals, $v(t) = A\cos(2\pi t/T)$

$$V_{RMS} = \frac{v_{peak}}{\sqrt{2}}$$

RMS

- If your meter reads $10V\sim$

  - then $v_{peak} = 10*1.4 = 14\text{V}$

- If your peak voltage is $154V_p$

  - then the meter reads RMS = $154*0.7 = 110\text{V}\sim$