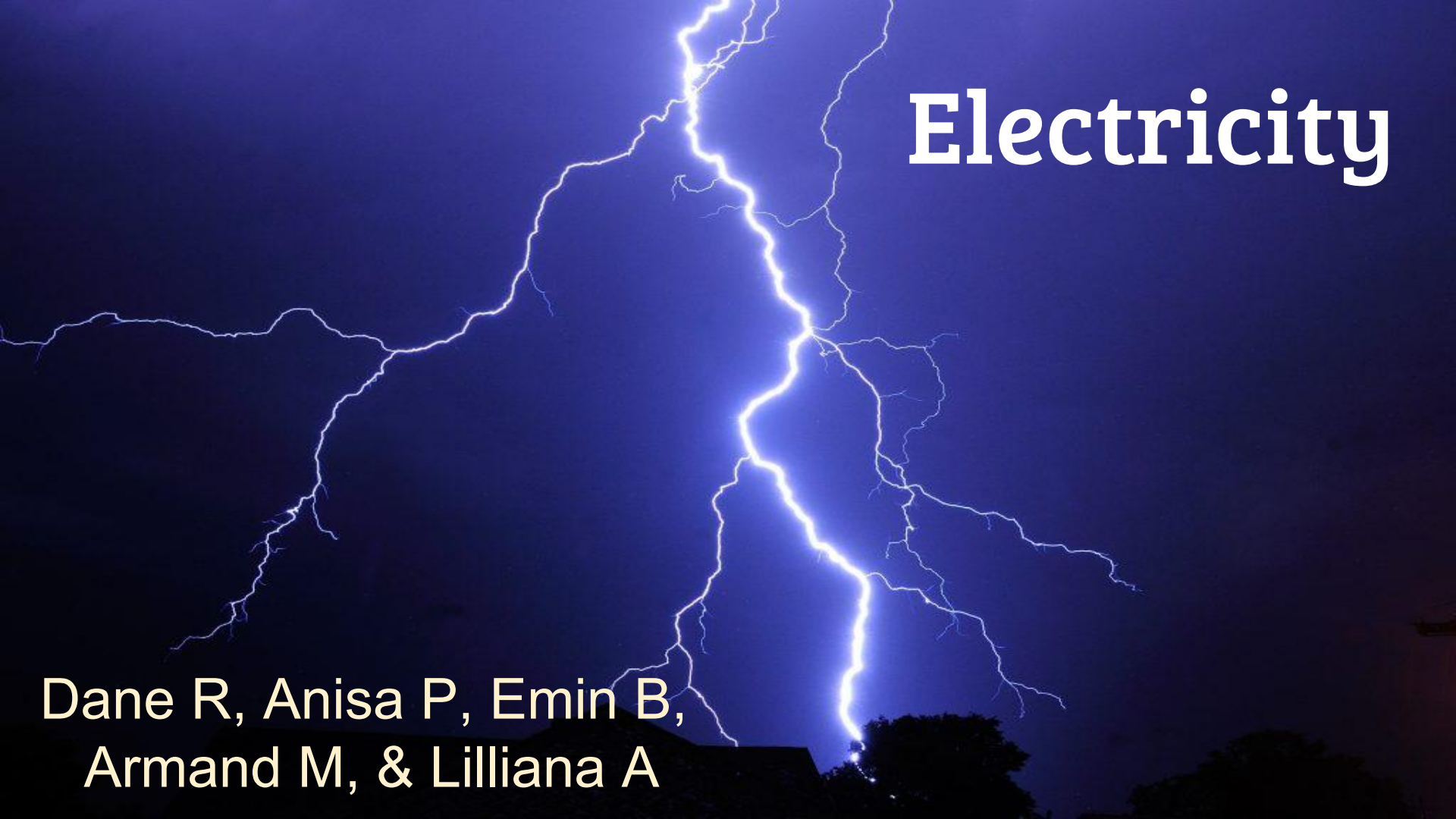

Electricity

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Electricity 101

Electricity is charge in motion.

Static electricity is the presence of a negative (-) or positive (+) charge on an object.

A current is the flow of electrons, usually through a wire or other conductor.

Current can either flow in AC or DC. AC is used in transformers and across long distances.

Current

Current is how much charge passes a specific point in a specific amount of time.

Charge is carried by electrons as they flow through a wire. Batteries supply current, by pushing this charge, but they do not supply electrons.

$I = \Delta Q/\Delta t$ *(I=Current) Current is measured in Amperes, or A.*

An Ampere is a Coulomb per Second.

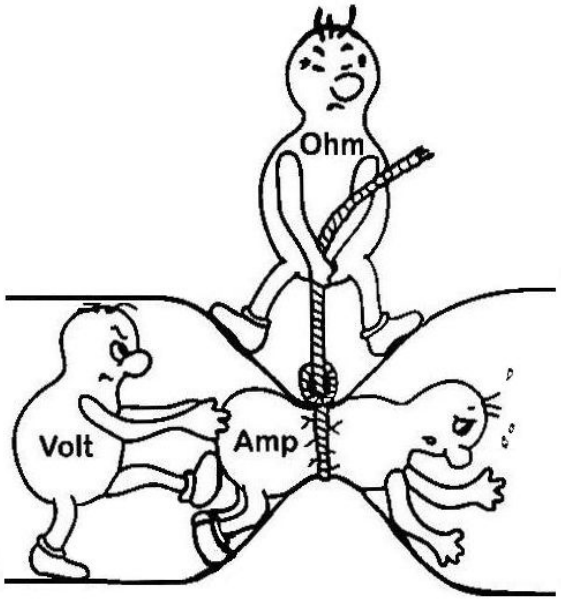
Ohm's Law

Georg Ohm discovered the current in a wire existed in proportion to the voltage across the circuit.

Currents, when travelling through wires, will be met with resistance. This can be simple from the atomic nature of the wire itself, the length of the wire, or from purposefully placed resistors.

Resistance (R) is the value found by dividing the Voltage (V) by the Current (I).

V/I = R measured in Ohms (Ω)



Resistance

Resistance is influenced by specific conditions.

Thin wire has more resistance than thick.

Long wire has more than short.

Semiconductors have more than Conductors.

Figure 1

Different materials will have different resistivities.

Resistivity is marked by *p.*

$R = pL/A$

p = resistivity

L = length of wire

A = Area of wire

Power

Electricity is useful because it can be transformed into other sources of energy, like thermal, mechanical, and light energy.

Thermal can be hairdryers, heaters, or warmers. Light can be flashlights or light bulbs. Mechanical can be motors.

$P = IV$

$P = I^2 \cdot R$

$P = V^2 / R$

Series and Parallel

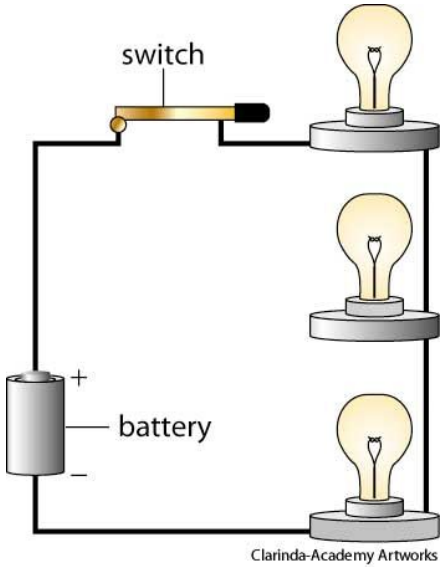
Circuits can be built in Series or Parallel.

Series circuits mean the current passes through resistors once after the other. This means the voltage will drop across each resistor. Ohm's Law will help us determine how much.

$V = I \cdot R, V = I \cdot R, V = I \cdot R$

$V = V(2) + V(3) + V(4) + V(5)$

$R = R(1) + R(2) + R(3) + R(4)$



Parallel

Resistors built in parallel will split the current between resistors.

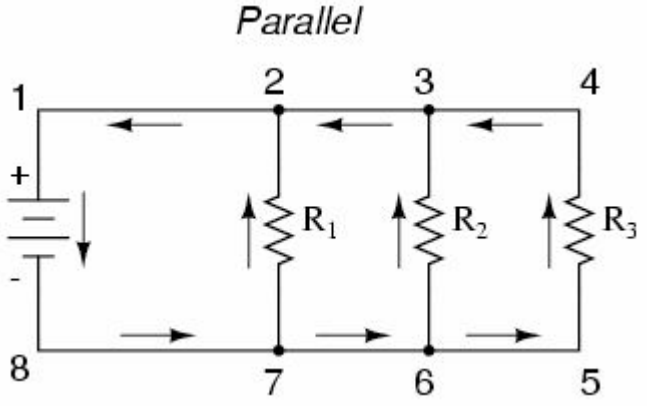
These splits are called *junctions*.

In this situation, Current is found by adding. I = I(1) + I(2) +I(3)

However, Resistance is found in the adding the reciprocals.

1/R = 1/R(1) + 1/R(2) + 1/R(3)

I = I(1) + I(2) + I(3)



Kirchhoff's Rule

Junction Rule: at any junction, the sum of currents in equals the sum of currents out

➤ (conservation of charge)

Loop Rule: the sum of the changes in potential around any closed path of a circuit must be zero

➤ (conservation of energy)

Capacitors in Circuits

- Parallels
  - Charge in equals charge out
    - Ceq = C1 + C2 + C3
- Series
  - Electric potential equals the sum potentials used up by circuit components
    - 1/C = 1/C + 1/C + 1/C

Lightening

- The average lightning bolt can deliver roughly 10,000 A of current in the span of only 100 μs.
- There are 150 million joules of energy in a bolt of lightening

Misconceptions

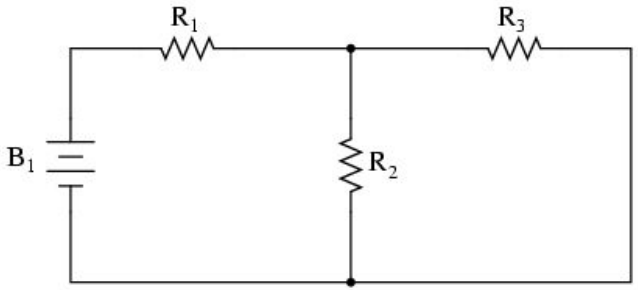
- *Conventional current* runs from positive to negative, even though electrons are really flowing through wires.
- Batteries do not create or supply a charge. They only *push* charge.
- If a wire of the resistance *R* was stretched to twice its length, the resistance *R* would increase by a factor of 4. The area, in the equation V = AL, is affected when the length is affected.
- Resistivity increases with temperature.

Multiple Choice

1. Nathan Fulmer often leaves his house with his electrical appliances on for no good reason. If Fulmer leaves a 60 watt light bulb on for four hours while he's out buying suspenders, how many kilowatt hours did he just waste?
   a. 0.60 kWh
   b. 0.24 kWh
   c. 0.36 kWh
   d. 0.5 kWh

Answer: B
Power*Time=Energy Used

2. Below is a parallel circuit. The battery has a voltage of 12 V, R1 has a resistivity of 4 Ω, R2 has one of 6 Ω, and R3 has one of 5 Ω. WHat is the equivalent resistance?



a. 1.52 Ω
b. 1.24 Ω
c. 1.34 Ω
d. 1.62 Ω

Answer: D

$1/R_{eq}=1/R_1+1/R_2+1/R_3$

3. Which of the following will cause the current through an electrical circuit to decrease? Choose all that apply.

a. decrease the voltage

b. decrease the resistance

c. increase the voltage

d. increase the resistance

Answer: A & D

4. The resistivity of a wire depends on:

a. Length
b. Material
c. Area of cross section
d. All of the above

5. Using Kirchhoff's Junction Rule, find the current of I_1

a) 5 A

b) 2 A

c) 15 A

d) 50 A