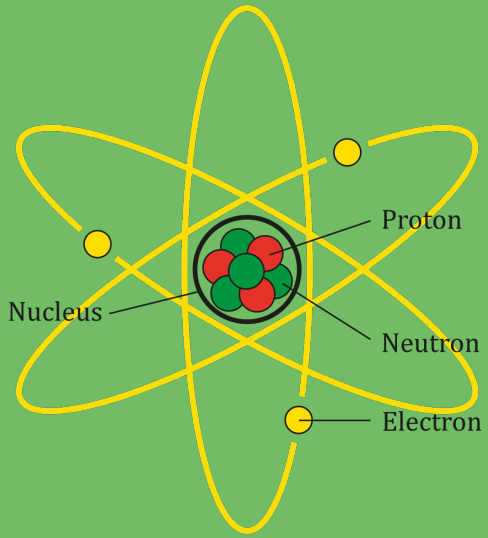
ScienceCraft 

Circuitry

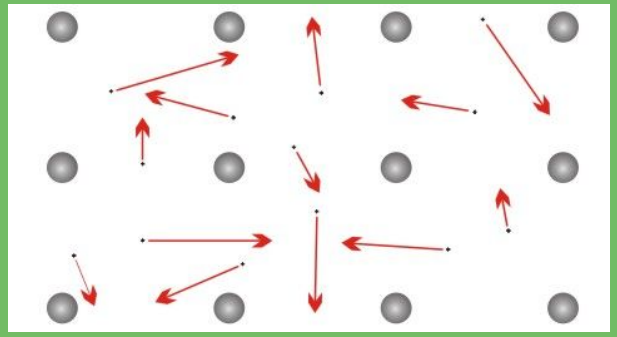
Charge

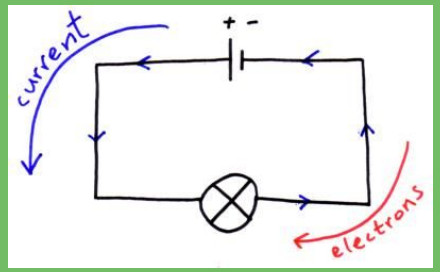


- An atom consists of 3 major parts
- **Protons** have a positive charge
- **Neutrons** have no charge
- **Electrons** rotate around the nucleus and have a negative charge
  - Located in the **orbitals**

Particle	Relative Mass	Relative Charge	Charge / C	Mass / kg
Protons	1	+ 1	$+ 1.6 \times 10^{-19}$	1.67×10^{-27}
Neutrons	1	neutral	0	1.67×10^{-27}
Electrons	0.0005	- 1	$- 1.6 \times 10^{-19}$	9.11×10^{-31}

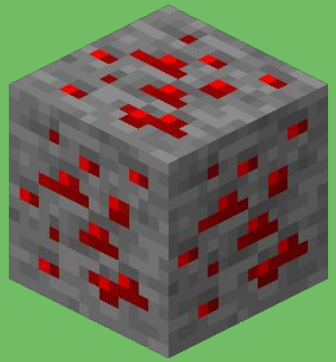
What is Electricity?



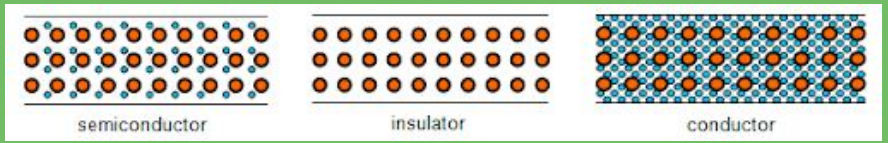


- **Electricity:** The flow of free electrons between atoms
- There are many careers working directly with electricity, such as:
  - **Electricians,** who install the physical hardware and circuitry
  - **Line Workers,** who install the “power grid” that carries electricity to houses from power plants
  - **Electrical Engineers,** who design and configure electronics

Conductors vs Insulators

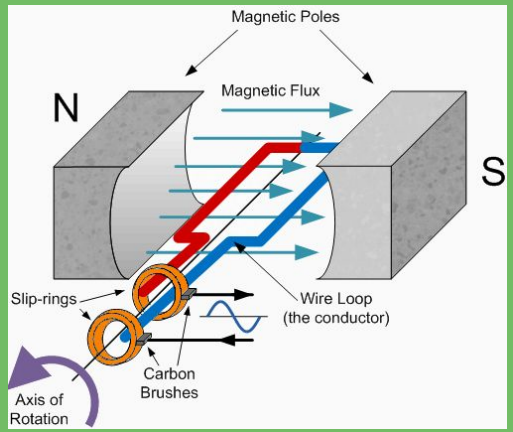


What do you think redstone is?



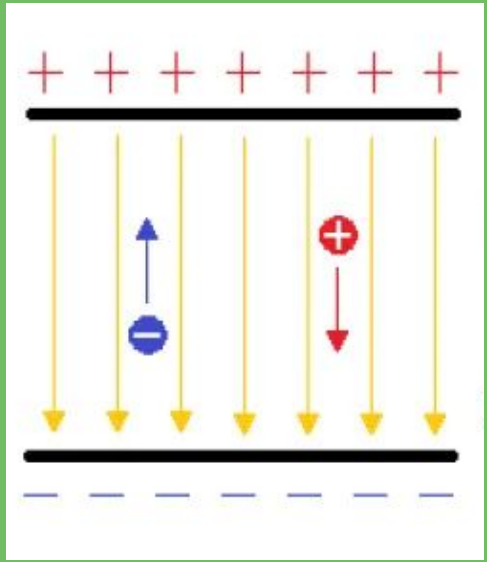
- **Conductors:** These allow electrons to flow freely through each atom
  - Generally these are metals such as copper, gold, or aluminium
- **Insulators:** These inhibit the flow of free electrons
  - Plastic and rubber tend to be insulators
- **Semiconductors:** The materials that conduct electricity, but significantly less than a conductor
  - Silicon is the most commonly cited semiconductor

How is electricity created?



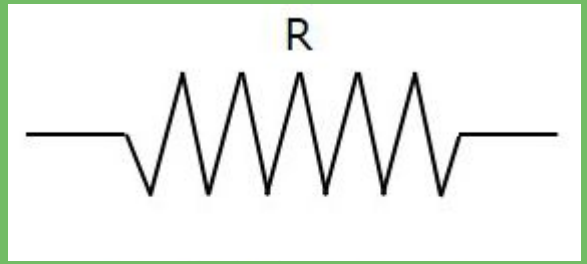
- **Electromagnetic Induction:** Consists of a conductor being spun in the middle of a magnetic field.
  - Forces electrons through a circuit, converting mechanical energy into electricity
- **Real life:** Windmills, solar power, nuclear power, coal, etc.. All of these produce **heat,** and this heat evaporates water, creating steam to spin the conductor.
- **Minecraft:** Can you name some power sources in Minecraft?

Voltage



- **Voltage:** The force that controls the motion of free electrons
- Voltage is used in reference to the amount of **potential energy** present in a circuit.
  - Potential energy: The amount of energy that *can* be released within a circuit as a result of an object's charge or it's position compared to other objects
- Can be compared to pressure, and is applied by the **power source**
- Measured in **Volts**

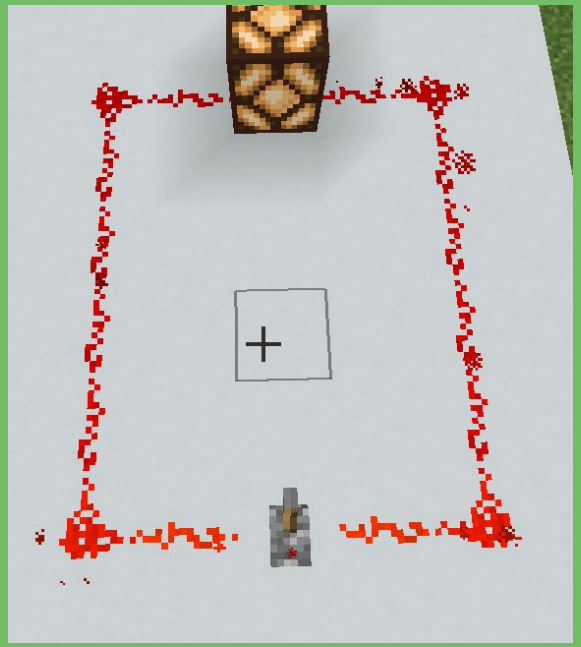
Resistance



- When electrons travel through a conductor, they encounter friction and may slow down
- This effect is known as **resistance**
- Measured in **Ohms**
- Resistance is encountered in the **path** of a circuit
- If a circuit has no resistance, it will short circuit

Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere ("Amp")	A
Voltage	E *or* V	Volt	V
Resistance	R	Ohm	Ω

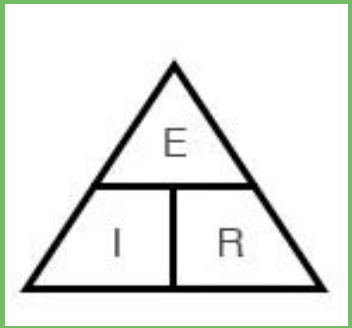
Circuit Basics



Can you identify power, path, and load?

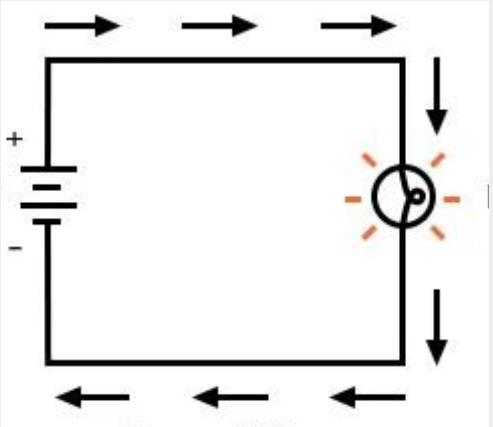
- **Electronic Circuit:** Closed loop that electrical current flows through
  - Consists of **power, path, and load**
- **Power:** This is your power source, such as a battery. Electricity will flow through the positive and negative terminals of the source.
- **Path:** The wiring (generally conductors) that enables electricity to flow
- **Load:** An item on the circuit that consumes the power flowing through it

Ohm's Law

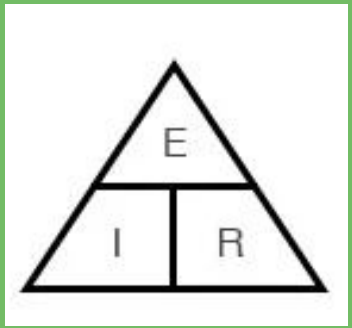


- **E = Voltage (Volts)**
- **I = Current (Amperes)**
- **R = Resistance (Ohms)**

- **Ohm's law** defines the relationship between current, voltage, and resistance.
- **E = IR**
- Voltage = Current * Resistance



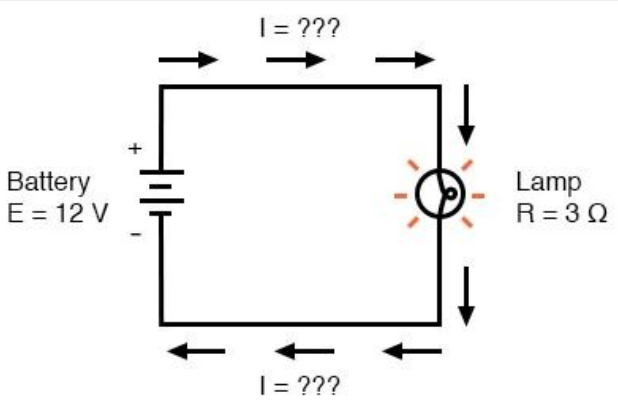
Applying Ohm's Law



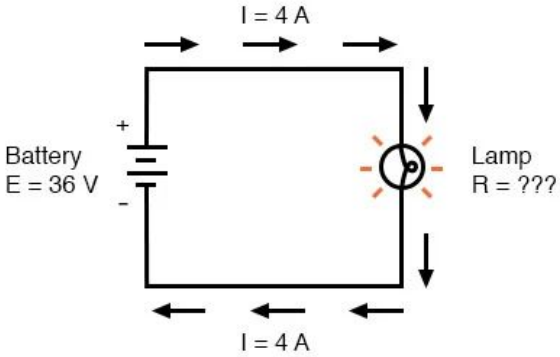
- E = Voltage (Volts)
- I = Current (Amperes)
- R = Resistance (Ohms)

$E = I \times R$

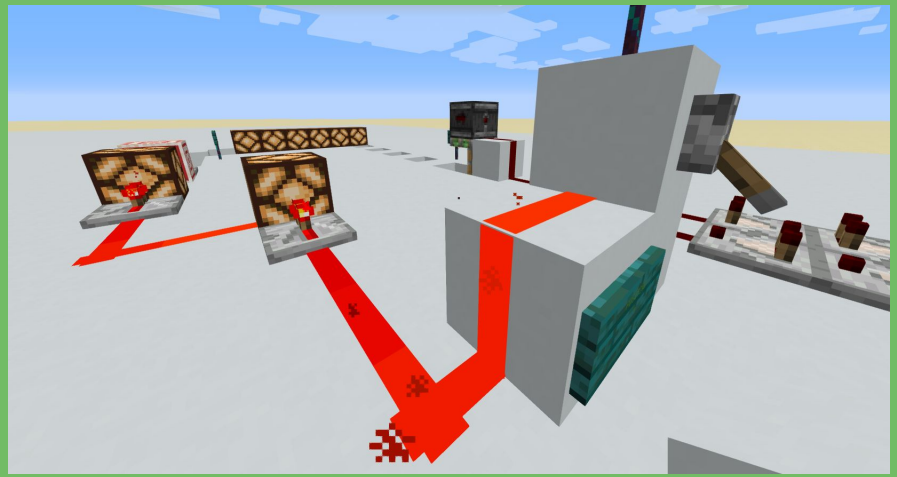
- Find I (Current)



- Find R (Resistance)



Challenge: Build a circuit



- ✘ Construct a **circuit** – it can be as simple or complicated as you want and can do anything.
- ✘ Try to include **labels** for positive and negative terminals, current, power, path, load, voltage, electron flow direction, and so on.