

INTRODUCTION TO ELECTRICITY

EGY 105 – ENERGY IN OUR WORLD

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ELECTRICITY IS A FAMILIAR CONCEPT



Power everyday
devices



Carried by wires



Stored in batteries

WE ALSO KNOW THAT:



Natural
Phenomenon



Generated by
power plants



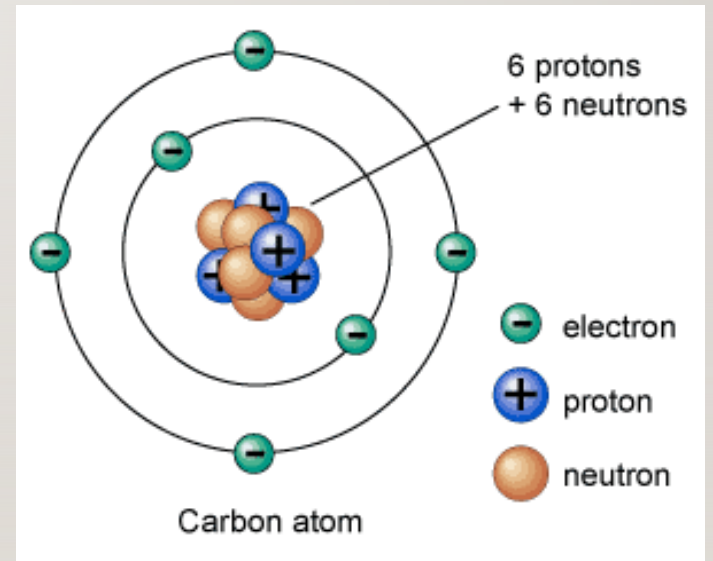
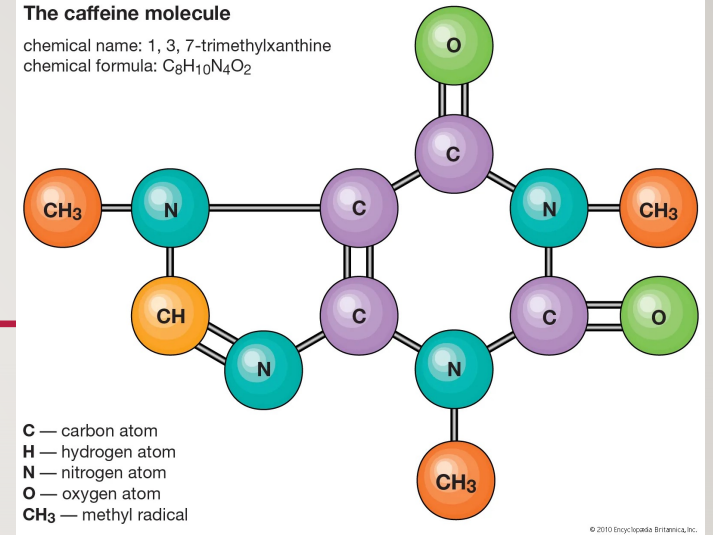
Can be
hazardous

POINTS TO BE COVERED:

- What is electricity?
 - Atomic level
- Conductors vs non-conductors
- Electrical circuits
- Voltage, Amperes, and Ohms
- How generated?
 - Role of spinning magnets
 - Photoelectric effect
- Electricity generation in US

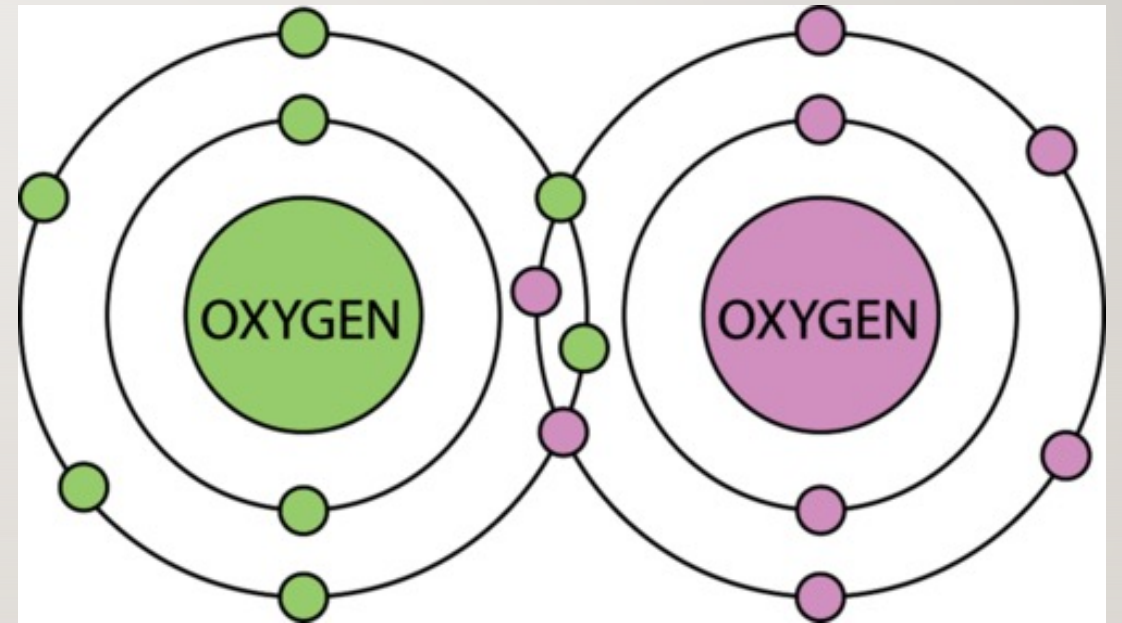
WHAT IS ELECTRICITY?

- All matter made up of molecules and atoms
- Atoms have three categories of particles
 - Protons (In nucleus, positively charged)
 - Neutrons (In nucleus, no charge)
 - Electrons (Outside of nucleus, negatively charged)



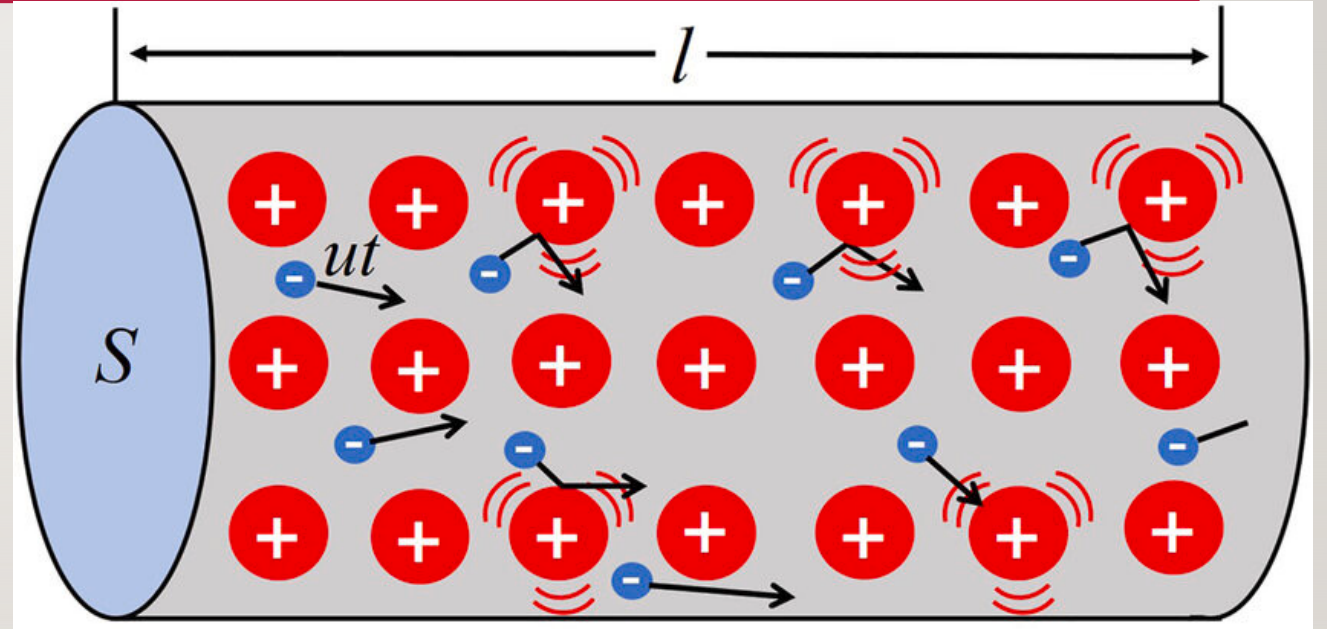
STATIONARY VS MOBILE ELECTRONS

- In some atoms, electrons adhere to the nucleus
 - Often shared between adjoining nuclei forming a bond

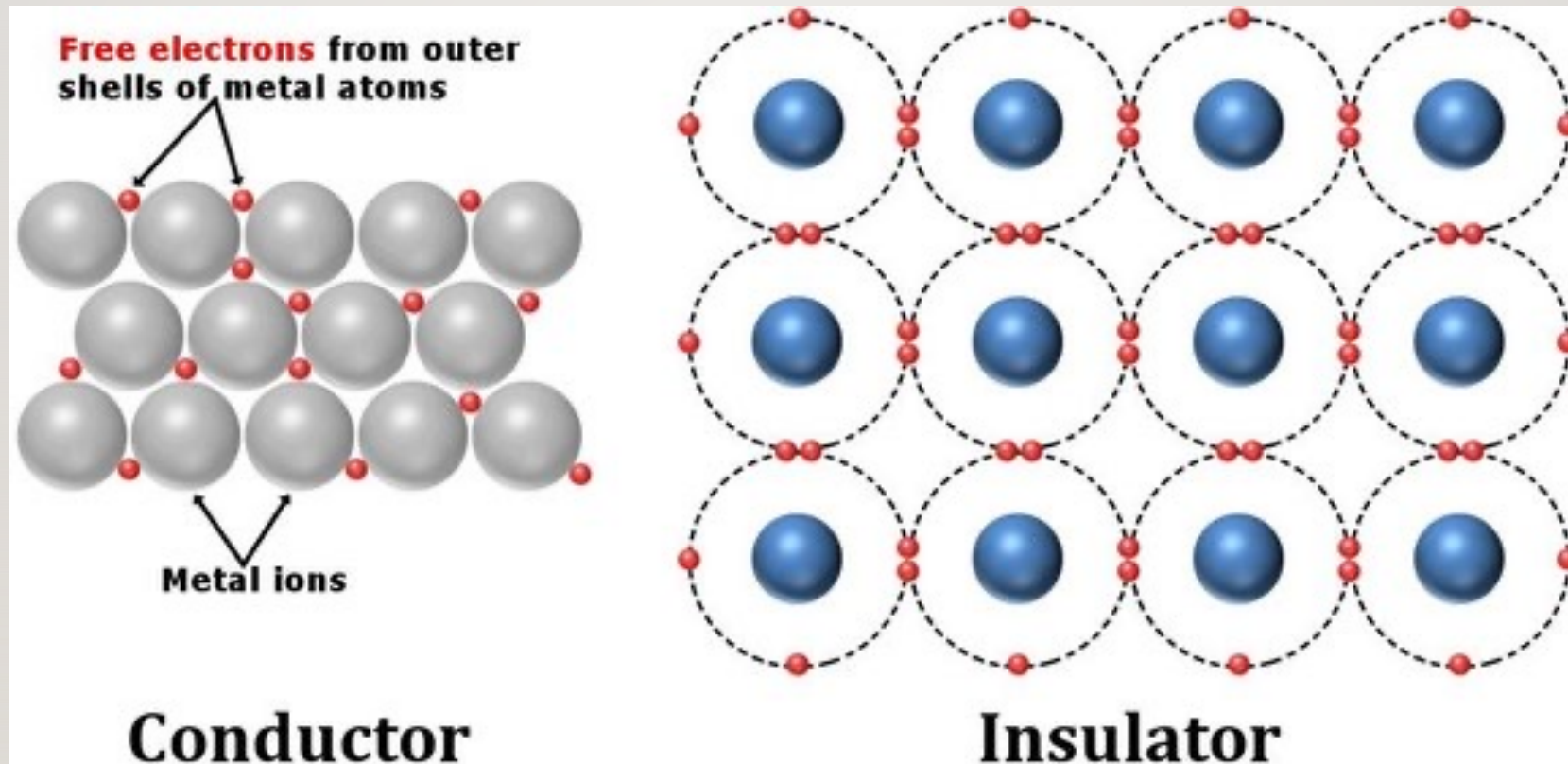


STATIONARY VS MOBILE ELECTRONS

- In other atoms, electrons move from nucleus to nucleus
- Note nuclei are positively charged



CONDUCTORS VS INSULATORS



CONDUCTORS VS INSULATORS

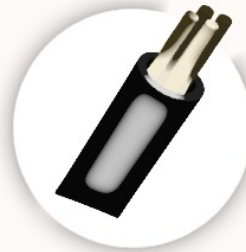
5 Electrical Conductors



silver



gold



copper



steel



sea water

5 Electrical Insulators



rubber



glass



oil



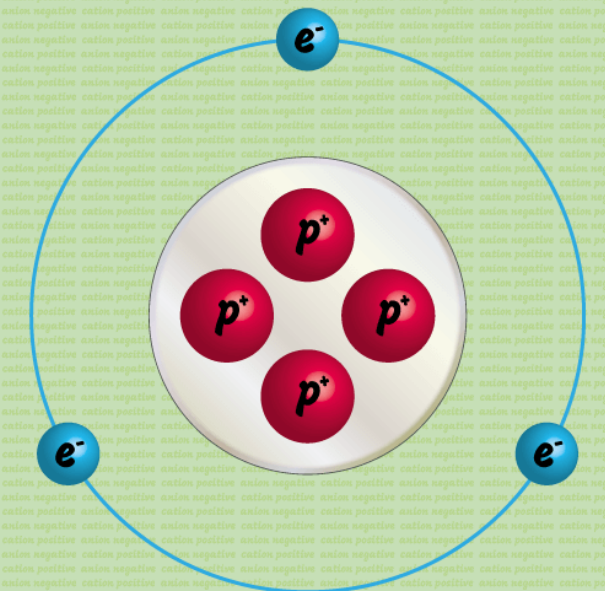
diamond



dry wood

CATIONS VS ANIONS

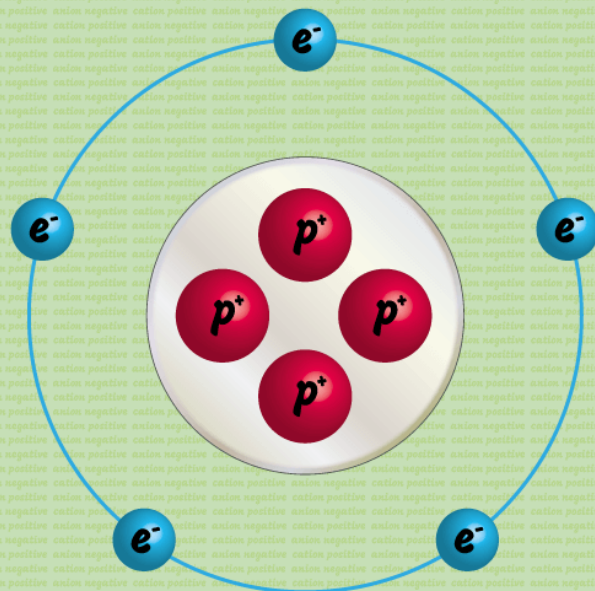
CATION



Net Positive Charge

More protons than electrons

ANION



Net Negative Charge

More electrons than protons

ELECTRODES, ANODES, AND CATHODES

Electrode - a substance that helps in the ***conduction of electricity***

The anode is the electrode where electricity moves into.

The anode is usually the positive side.

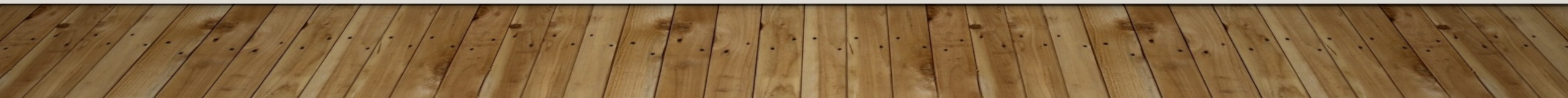
It acts as an electron donor.

The cathode is the electrode where electricity is given out or flows out.

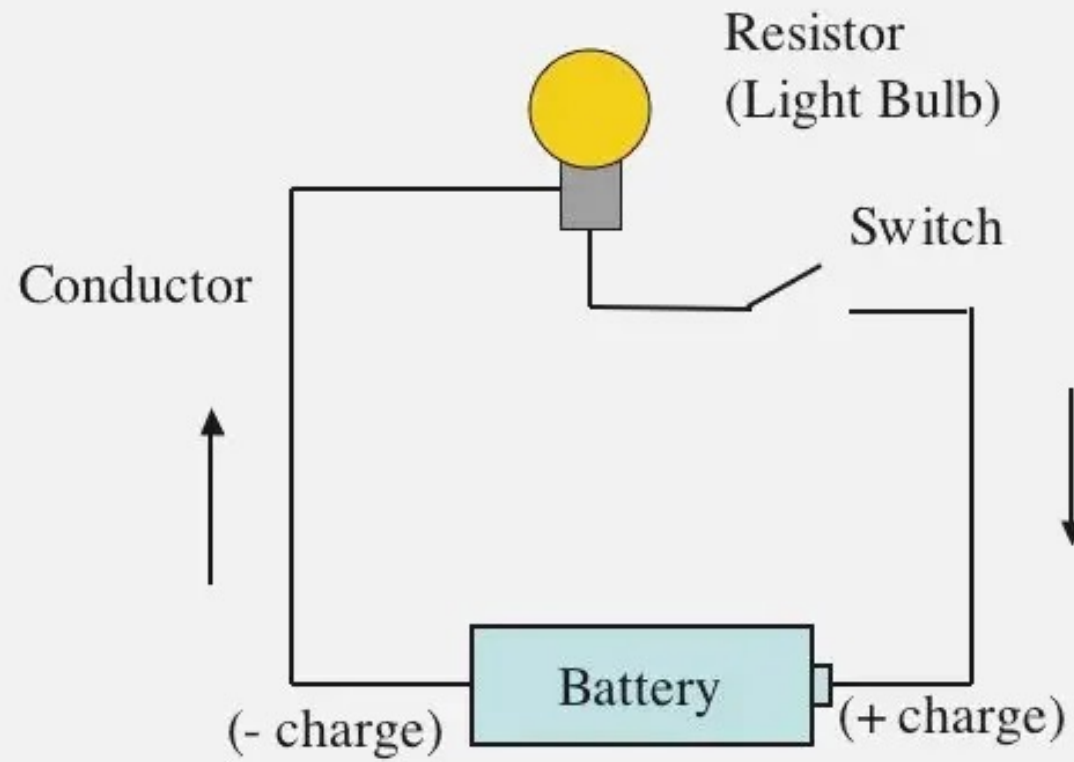
A cathode is a negative side.

It acts as an electron acceptor.

<https://byjus.com/chemistry/cathode-and-anode/>



CIRCUITS



VOLTAGE, AMPERAGE, AND RESISTANCE

- Voltage - the pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop.
 - The amount of voltage is indicated by a unit known as the volt (V), and higher voltages cause more electricity to flow to an electronic device.

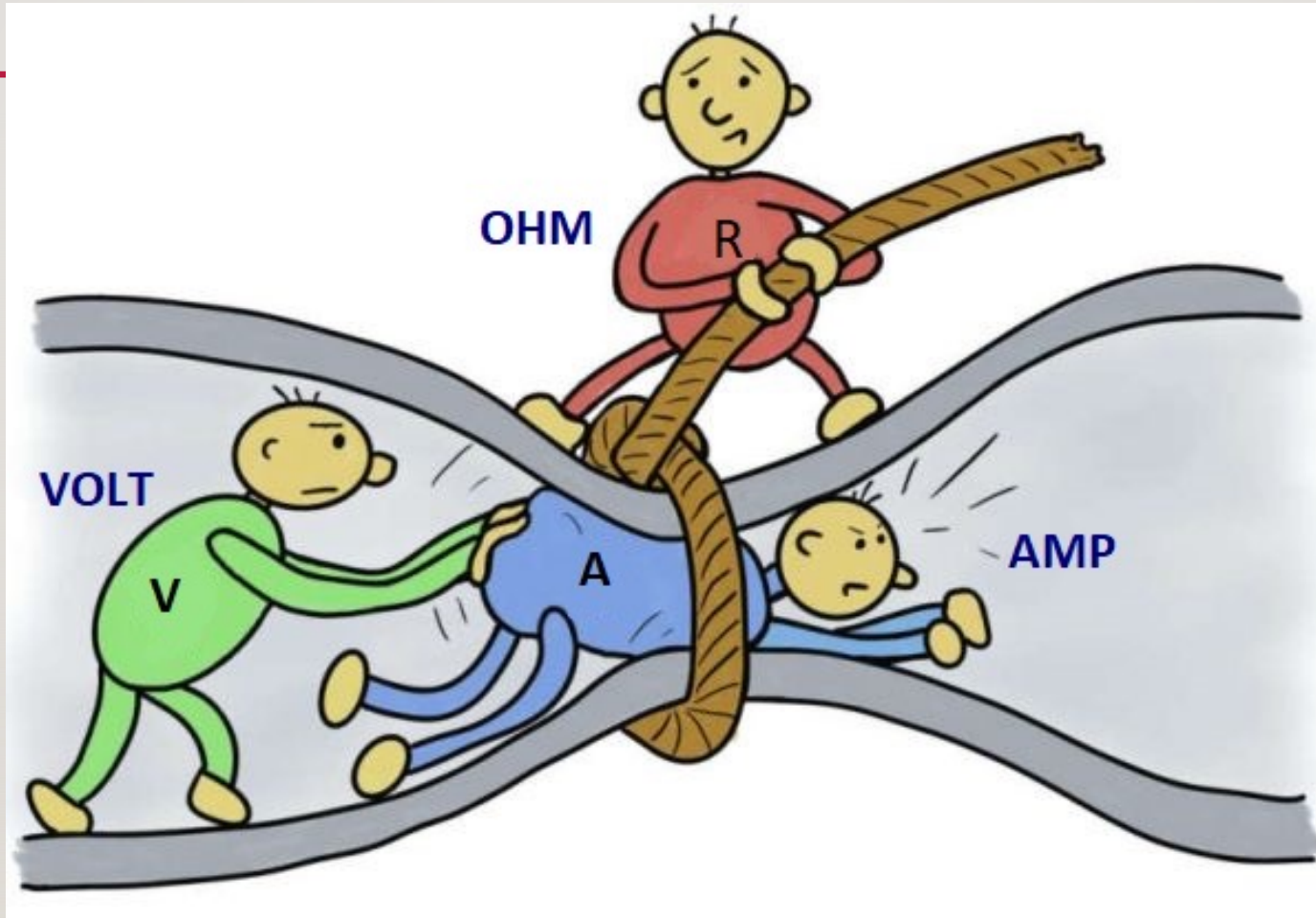
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 - Current is a count of the number of electrons flowing through a circuit.
 - One amp is the amount of current produced by a force of one volt acting through the resistance of one ohm.

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- Resistance - a measure of the opposition to current flow in an electrical circuit
 - An ohm is the resistance in a circuit transmitting a current of one ampere when subjected to a potential difference of one volt.

AMPS, VOLTS, AND OHMS EXPLAINED



OHM'S LAW

- $V = IR$
 - V = Voltage
 - I = Current (amps)
 - R = Resistance (ohms)
- $R = V/I$
- $I = V/R$



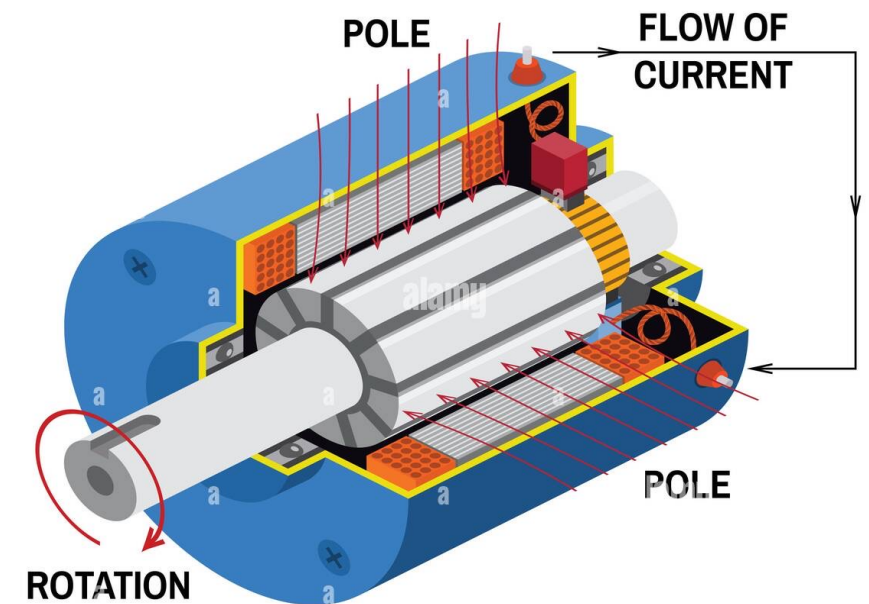
Georg Ohm (1789 – 1854)

GENERATING ELECTRICITY WITH MAGNETS AND WIRES

Spinning a magnet in the presence of wires, or spinning wires in the presence of a magnetic field generates electricity.

Principle behind most electrical generation involving steam, wind, or water.

ELECTROMAGNETIC INDUCTION



GENERATING ELECTRICITY WITH LIGHT

Photoelectric effect.



GENERATING ELECTRICITY WITH LIGHT

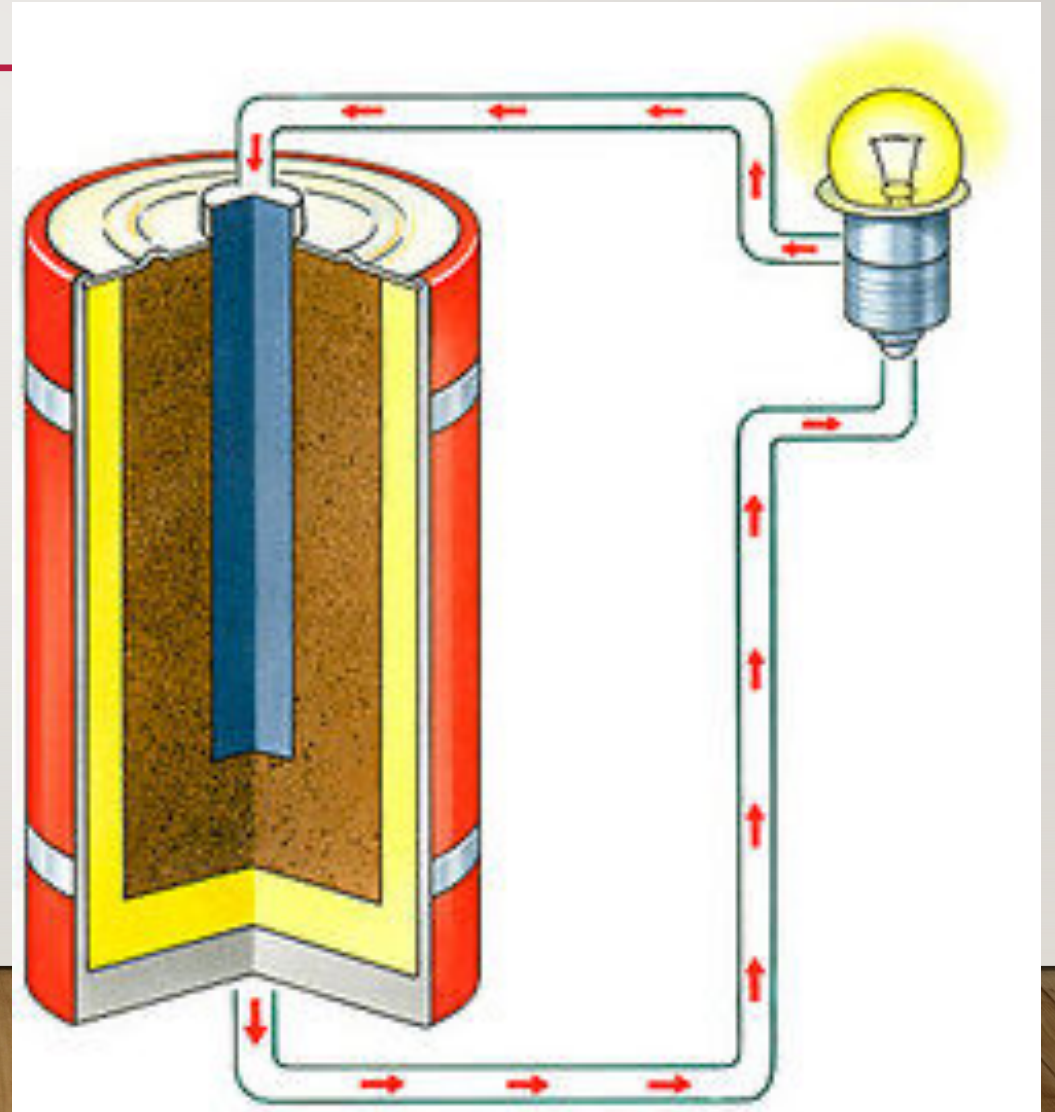
Photoelectric effect.

Will discuss in more
detail in presentation
on solar power.



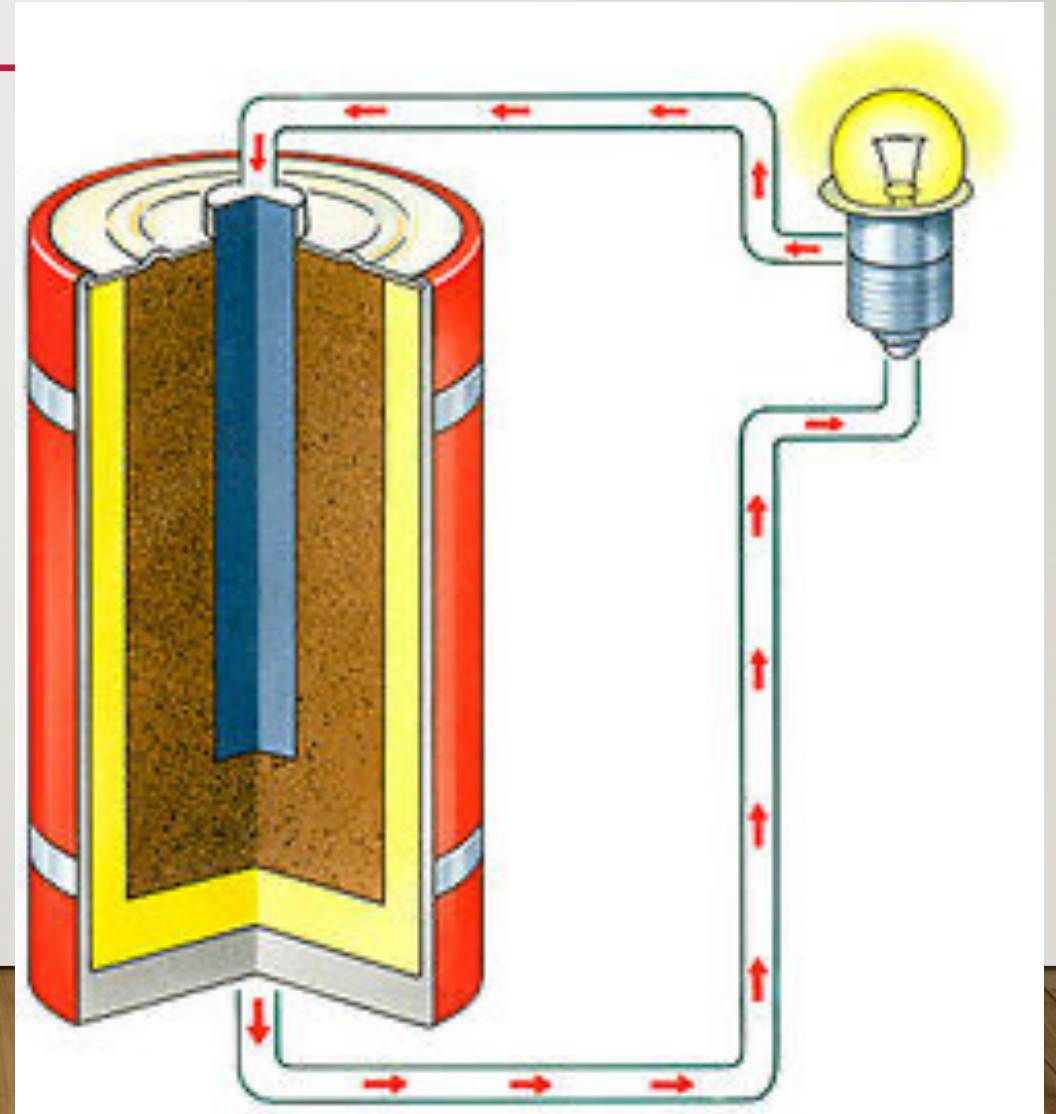
BATTERIES

- Devices that are able to convert chemical energy to electrical energy.



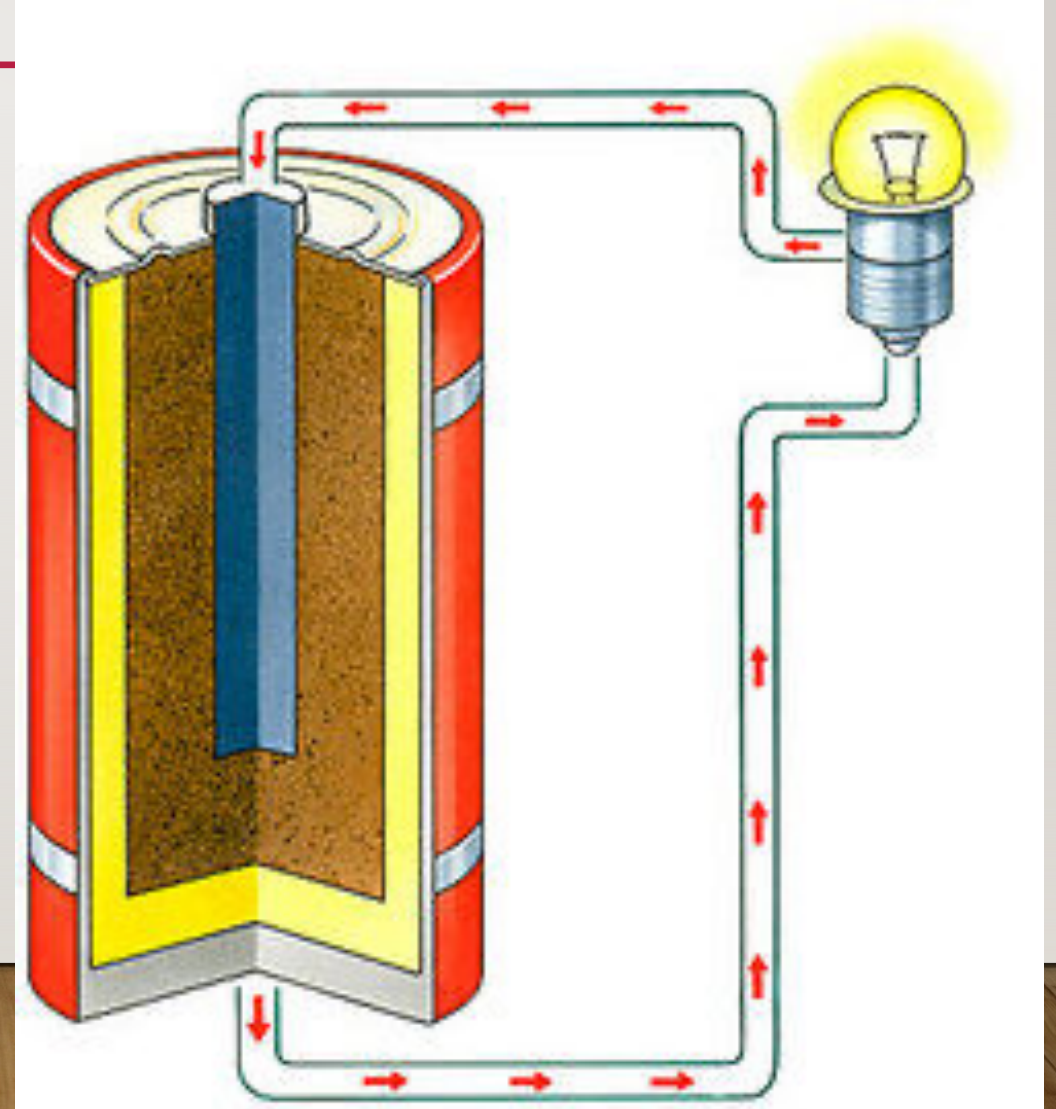
BATTERIES

- Devices that are able to convert chemical energy to electrical energy.
- Consist of one or more electrochemical cell that are made up of two electrodes separated by an electrolyte.

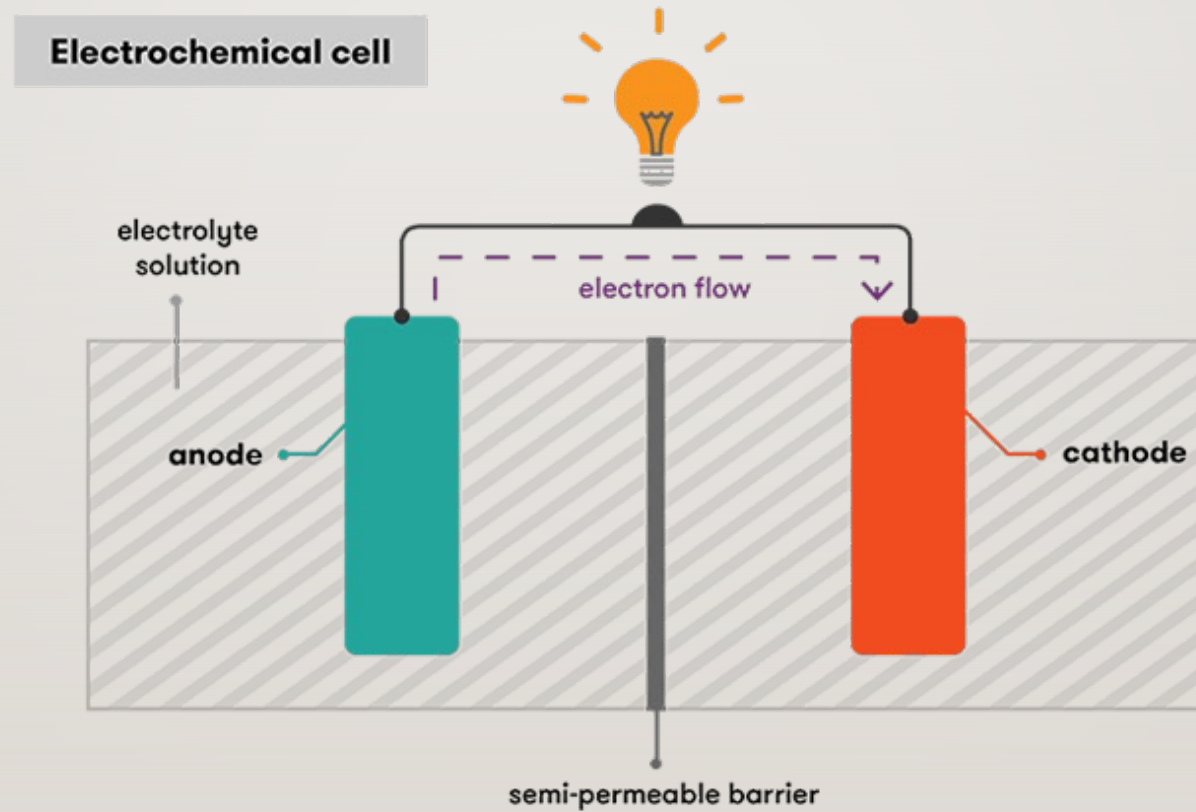


BATTERIES

- Devices that are able to convert chemical energy to electrical energy.
- Consist of one or more electrochemical cell that are made up of two electrodes separated by an electrolyte.
- Some single use, others rechargeable.



BATTERY STRUCTURE

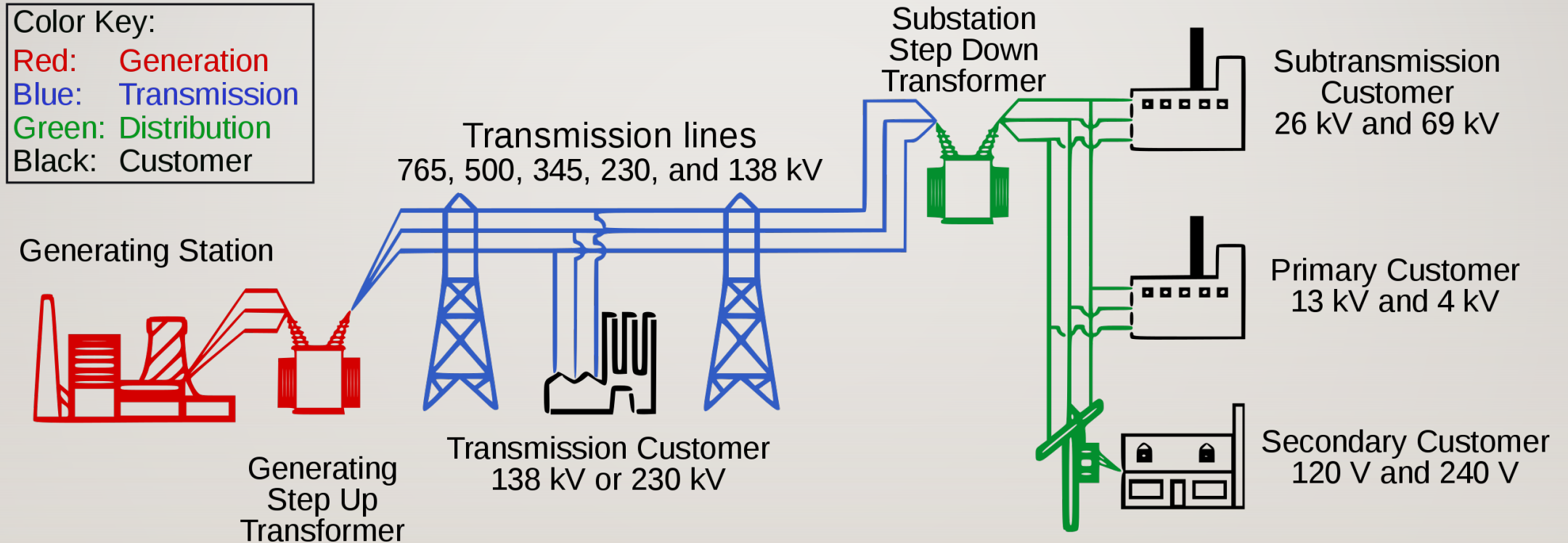


FUTURE BATTERY NEEDS

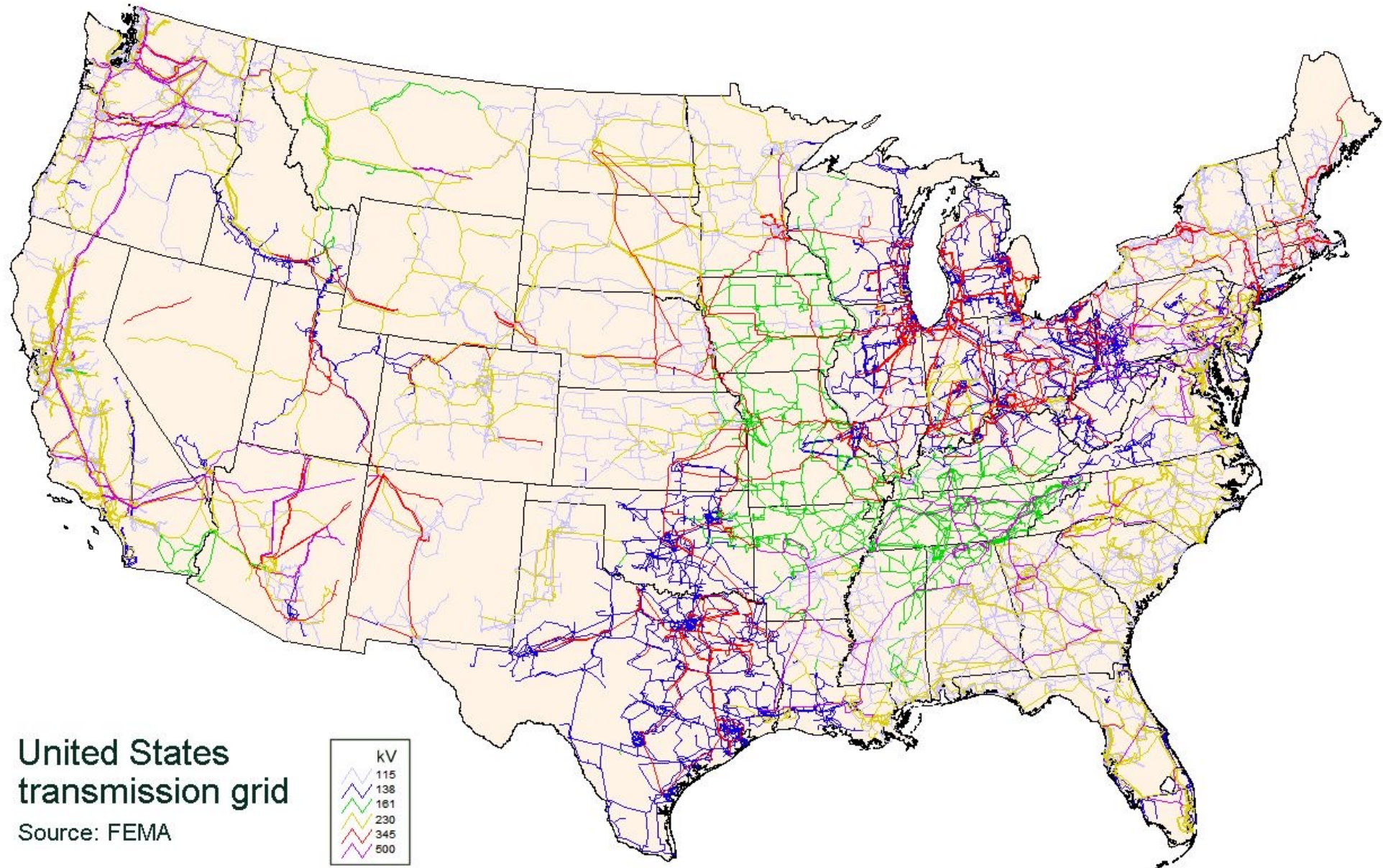
Much research is needed to produce lighter, safer, more efficient renewable batteries to power transportation and store electrical energy when production exceeds demand.



ELECTRICITY DISTRIBUTION



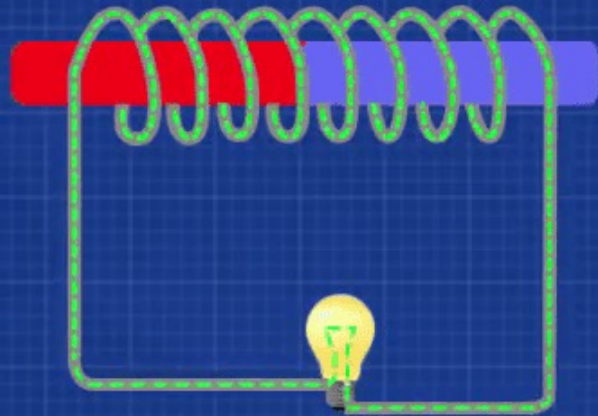
US ELECTRICAL POWER GRID



ALTERNATING VS. DIRECT CURRENT

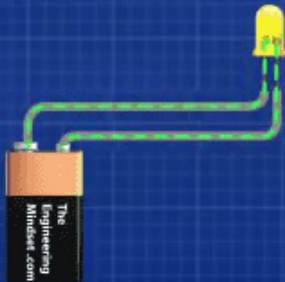
Types Of Electricity

There are two types of current electricity



Alternating Current (AC)

In AC the current moves back and forth with the changing magnetic field
This is the type of electricity from wall sockets in your home

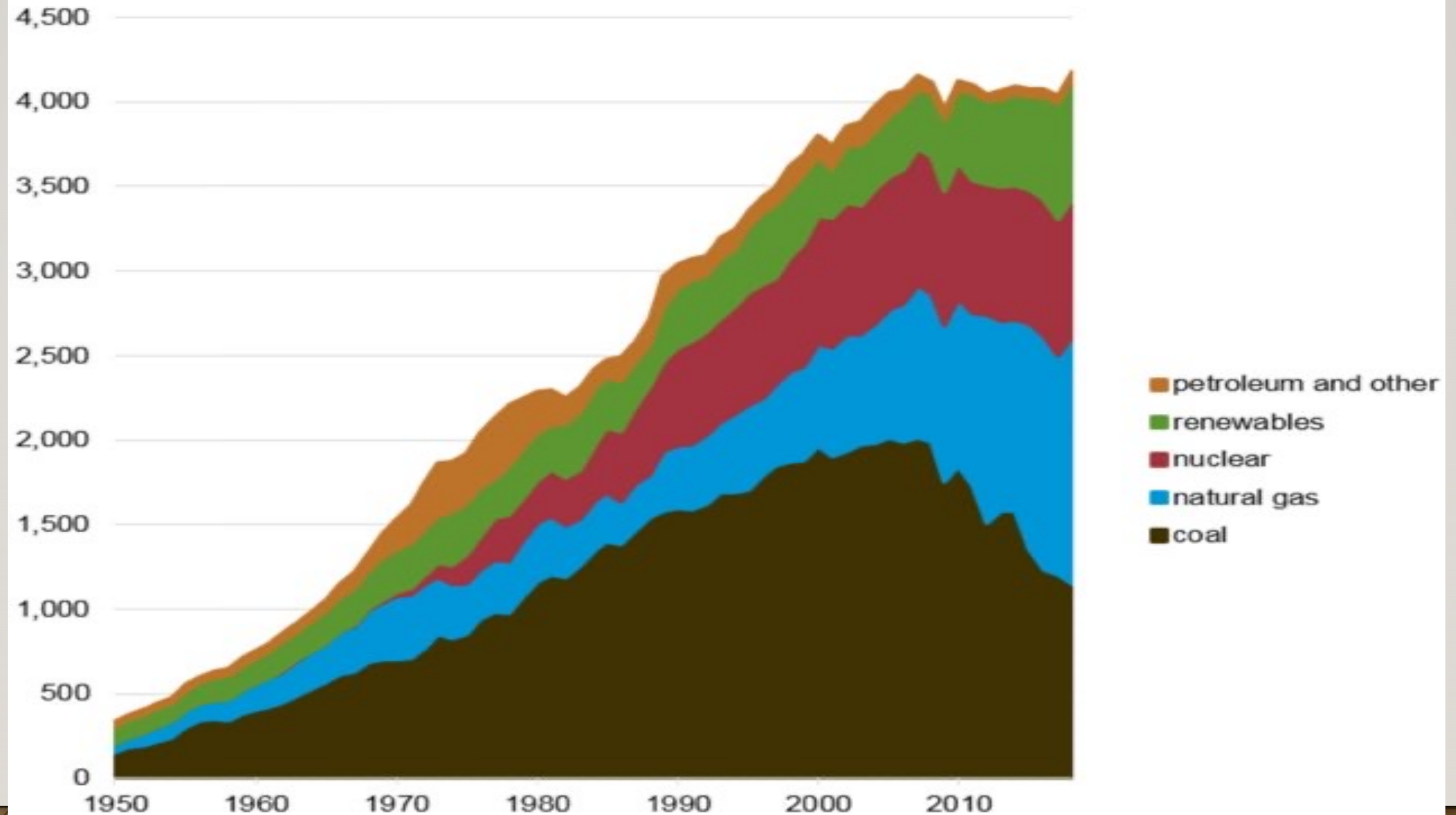


Direct Current (DC)

In DC the current travels only in one direction
This is the type of electricity in batteries

U.S. electricity generation by major energy source, 1950–2018

billion kilowatthours



Note: Electricity generation from utility-scale facilities.

Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2a, March 2019

SO MUCH MORE TO KNOW REGARDING ELECTRICITY

