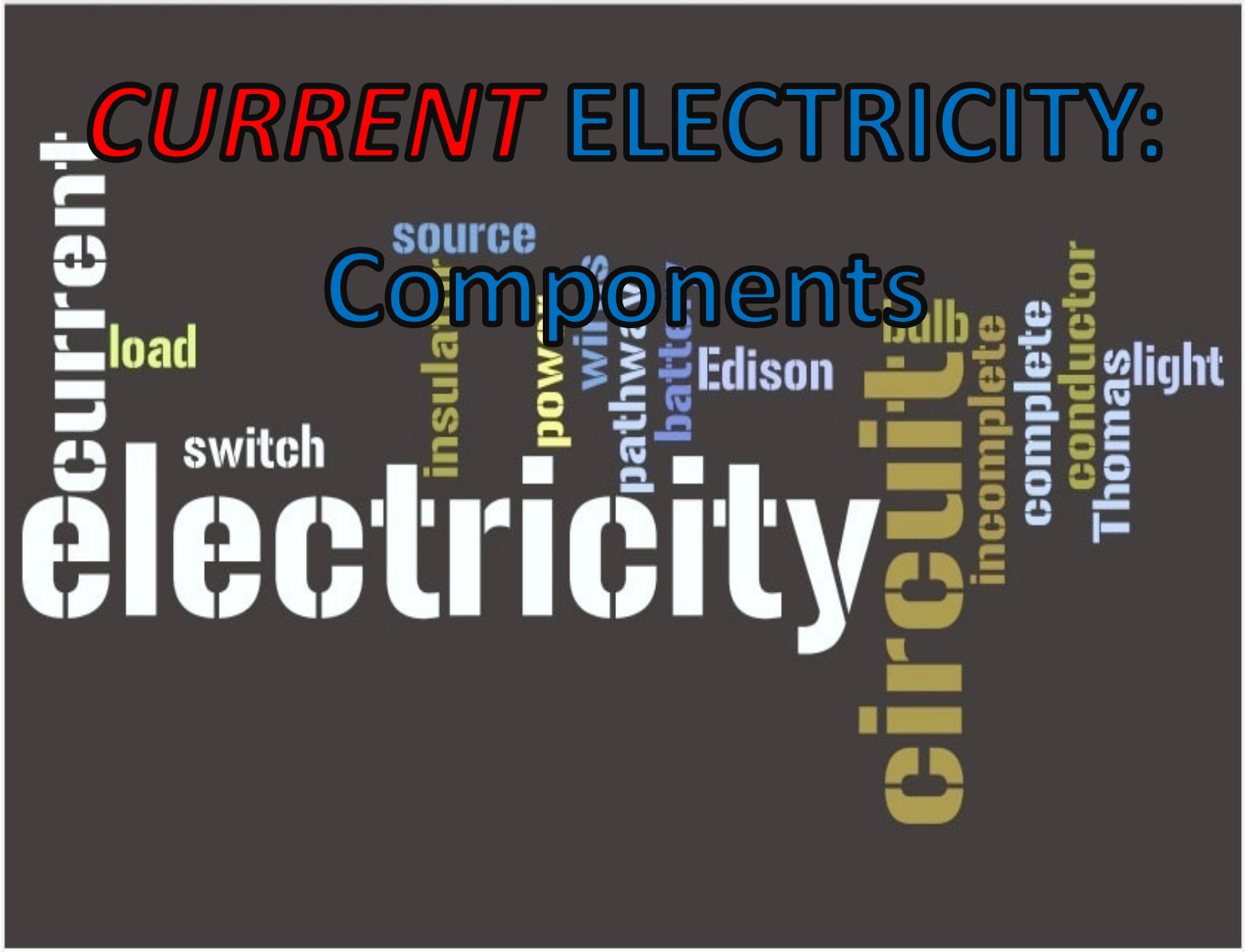
STATIC Vs. CURRENT ELECTRICITY

SIMILAR	DIFFERENT
Both: need **input of energy** to create charge *(friction or other source)*	**Static**: displaced electrons are ***localized*** **Current**: displaced electrons ***move***
Both: 1st step is charge separation 2nd step is **charge transfer** *(neutral object or battery)*	**Static**: ***brief*** transfer of small amounts of charge **Current**: ***continued*** transfer of large amounts of charge
Both: will **discharge** (*run out*) when all electric charge is transferred back	**Static**: discharges ***randomly*** **Current**: discharges through a ***conducting path***

CURRENT ELECTRICITY:

Components



OUTCOME QUESTION(S):

S1-3-09/10/12:

What do current, voltage and resistance mean for electrons?

Vocabulary & *Concepts*

Cell	Coulomb	Voltage
Volt	Voltmeter	Current
Ampere	Ammeter	Resistance
Resistor	Ohm	Load

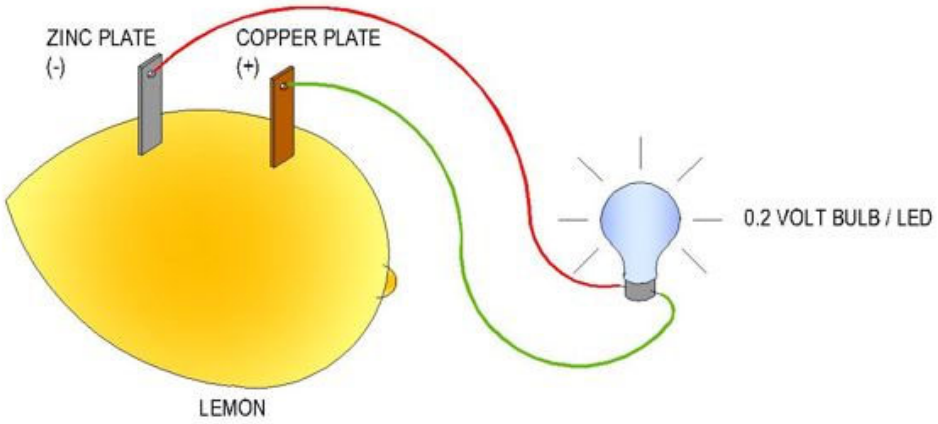
Cell: device that uses a ***chemical reaction*** to create a ***flow*** of electrons between different materials.

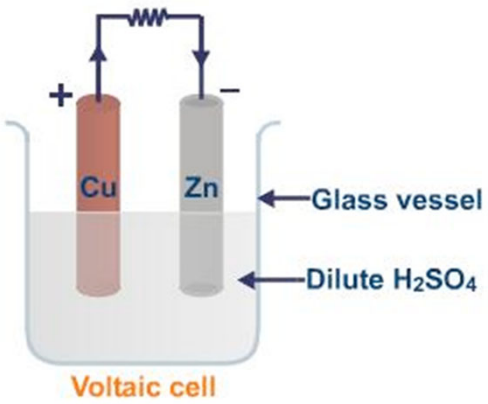
Battery

NEED:

- metal to ***lose*** electrons – (-) electrode (*anode*)
- metal to ***gain*** electrons – (+) electrode (*cathode*)
- chemically ***reacting*** substance – electrolyte

The acidic lemon **juice** acts as the **electrolyte** to aid the chemical reaction





The original Voltaic “wet” cell does not have practical use today and has been replaced by the “dry” cell - ***battery***

Rod: **(+) electrode** (*cathode*)

Casing: **(-) electrode** (*anode*)

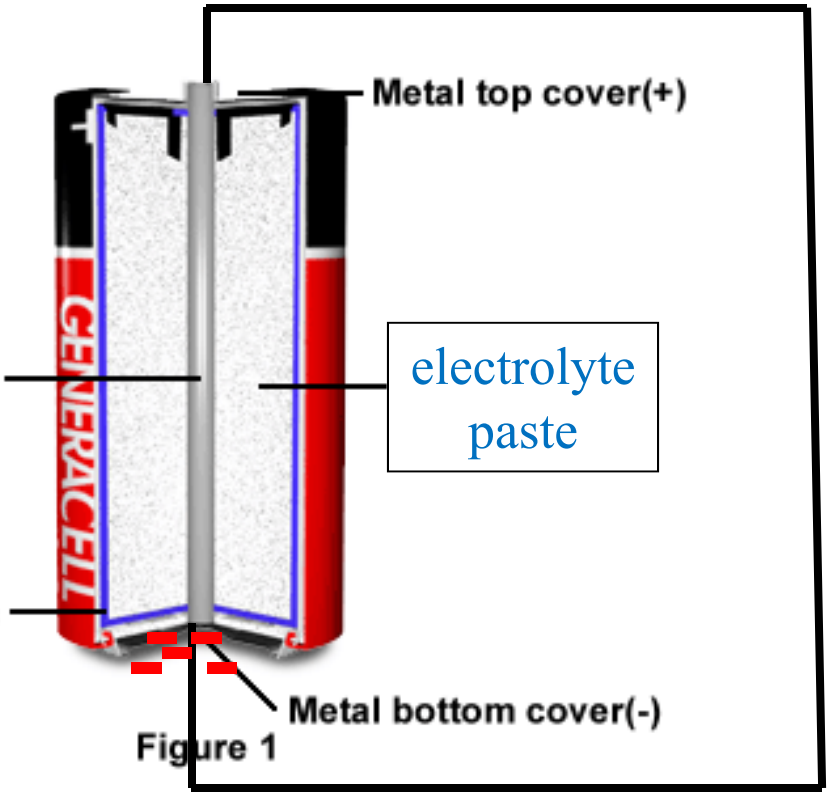


Figure 1

Cell Measurements:

Electrons are measured and counted in bundles called a **coulomb**: **That's 6 250 000 000 000 000 000**

- *1 coulomb = 6.25 quintillion (6.25×10^{18}) electrons*

Think of a coulomb as *very, very* large "dozen"

1. Voltage (V)

Electrical potential of electrons in a **source**: (cell or battery)

- electrons ***convert*** their ***potential energy*** **into work**

Potential: *unrealized* ability to accomplish something
Voltage: *energy* the electrons have to *potentially* do something

- *Measured by a* **Voltmeter**
- *Units:* **Volt (V)**

voltage

$$V = \frac{E}{Q}$$

- **E** is *energy/work potential* in **joules**
- **Q** is the number of **coulombs**

Voltage (volts) measures the potential energy available in every coulomb of electrons

As electrons move to the other end of the source, they lose all potential (stored) energy

1.5 Volt battery

1.5 joules of energy released by every coulomb of electrons

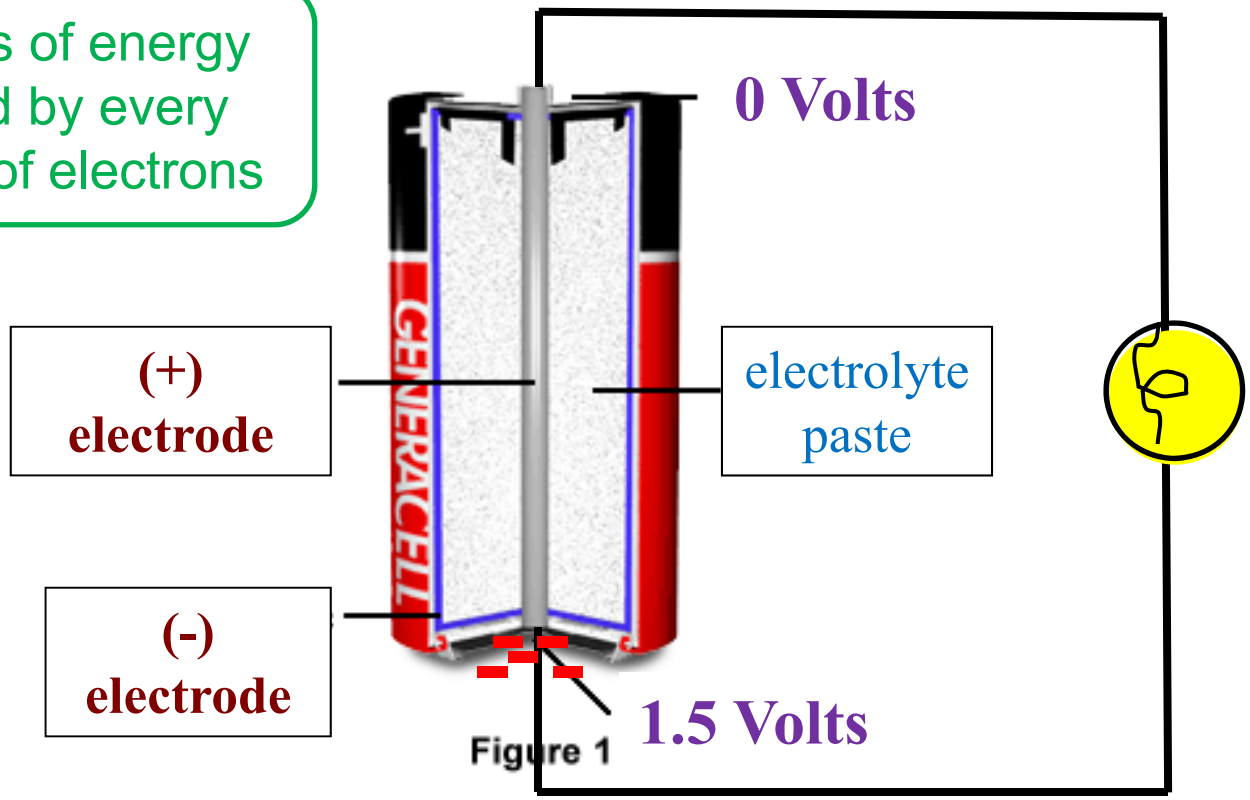


Figure 1

550 V – typical *Power station*
120 V – typical *wall outlet*
1.5 V – typical *battery*

2. Current (I)

The rate (***speed***) at which electrons move *through the conductor*.

- *Measured by an* **Ammeter**
- *Units:* **Ampere /Amps (A)**

$$I = \frac{Q}{t}$$

- **Q** is the number of **coulombs**
- **t** is *time* in **seconds**

Current (amps) measures the number of electrons passing a point every second

1 Amp = electrons moving at a **rate** of *1 coulomb per second*

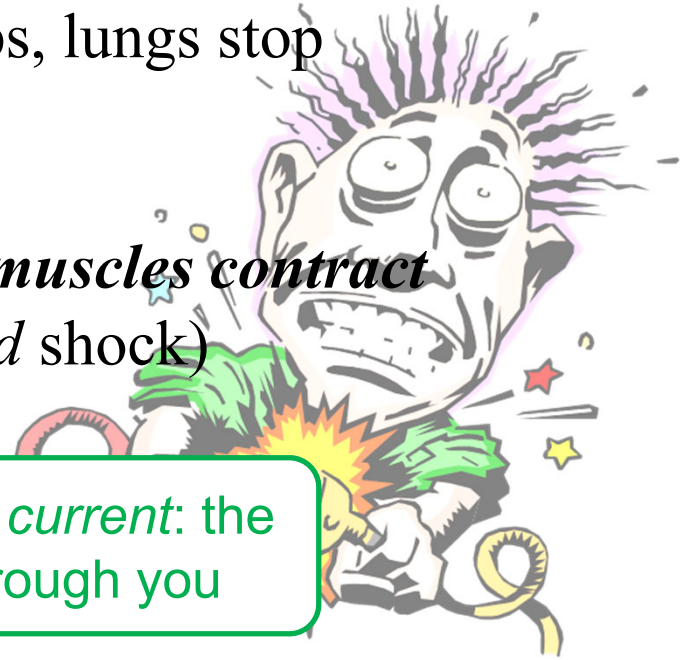
0.83 A – current needed for a typical light bulb

0.2 A – severe burns, heart stops, lungs stop

("let go" threshold)

0.02 A – breathing affected, ***muscles contract***

0.002 A – muscles tingle (*good* shock)



Its not the voltage that **kills**, it's the *current*: the **number of electrons** running through you

3. Resistance (R)

Anything that *slows down* ***electrons*** and *takes potential* ***energy away*** in the process.

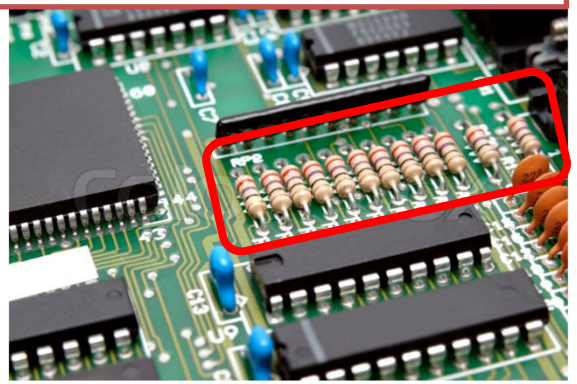
decreases voltage

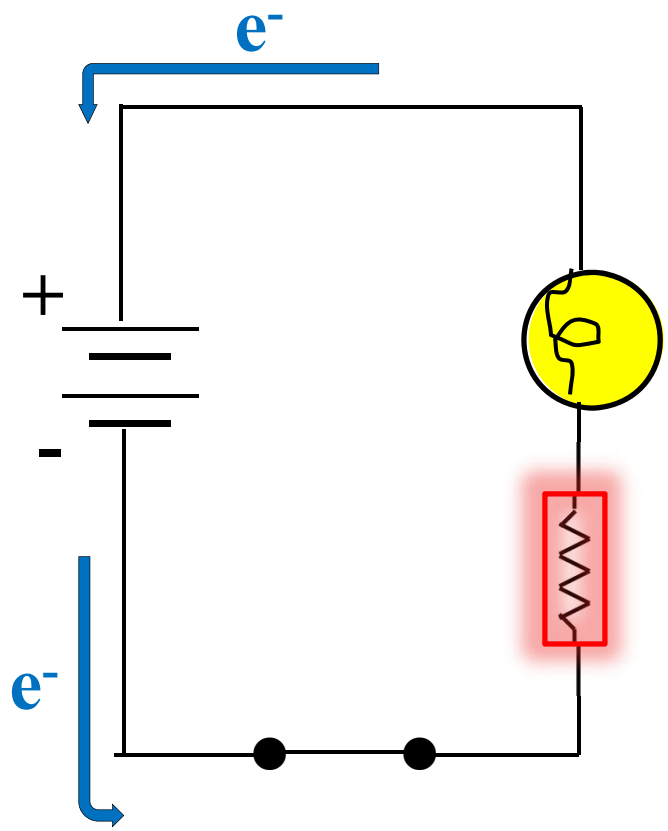
Resistors are electrical *components* used to control the ***current*** and voltage *to protect the device*.

- *Units:* **ohm (Ω)**

Energy** taken is **converted** as **work** or lost as **heat

The loss of potential energy as electrons slow through a resistor is called the "**voltage drop**"





Load

light bulb, charger, fan,

- a *resistor* that converts energy for ***use***

Resistor

- slows electrons and take energy as ***heat***

Even the conducting wire provides some resistance
*(takes some energy away converting it to **heat**)*