STATIC ELECTRICITY:

A Particle Model of Electricity

OUTCOME QUESTION(S):

S1-3-04:

How does the Atomic Model help to explain static electricity?

Vocabulary & *Concepts*

Neutral
Conservation of Charge
Insulator
Conductor
Polarization

Electrostatics:

Study of **static electricity** – static means "***at rest***."

- *Electricity that is localized; not moving*

Greek Philosophers noted:

Amber rubbed with fur attracts bits of dust.

Electric, electricity and electron all come from the Greek word for amber - ***elektron***

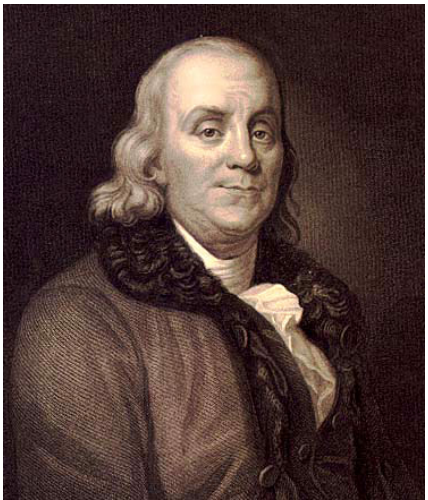
Benjamin Franklin (1750)

- *Experimented* with friction; causes objects to **repel** ***or*** **attract** materials – "*charged*"

Atoms (and *subatomic particles*) were not discovered yet – try explaining electricity without electrons…?

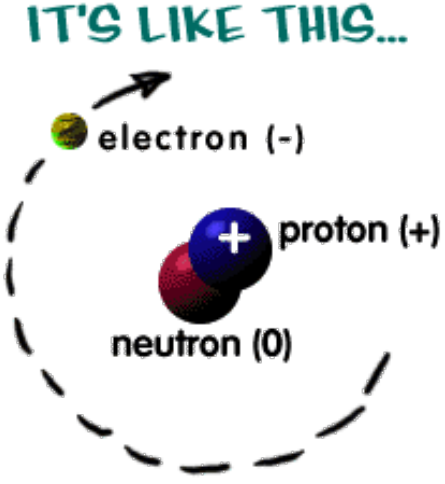
- Knew *electric* ***charge*** came from a transfer of invisible *SOMETHING*

First to use words "***positive***" and "***negative***" as description



Atoms contain *3* subatomic particles (1890)

- **Neutron** – *stationary* particle with ***no*** charge (*nucleus*)
- **Proton** – *stationary* particle with a ***positive*** charge (*nucleus*)
- **Electron** – *moving* particle with a ***negative*** charge (*orbits*)

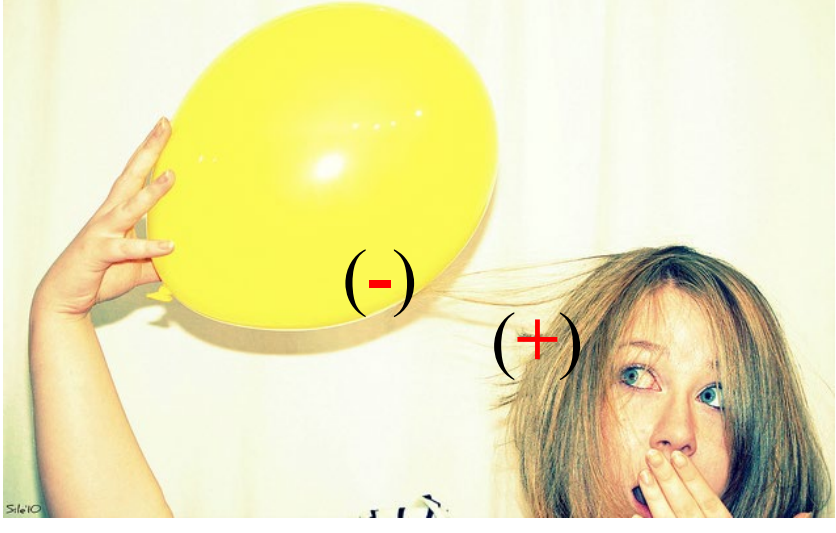


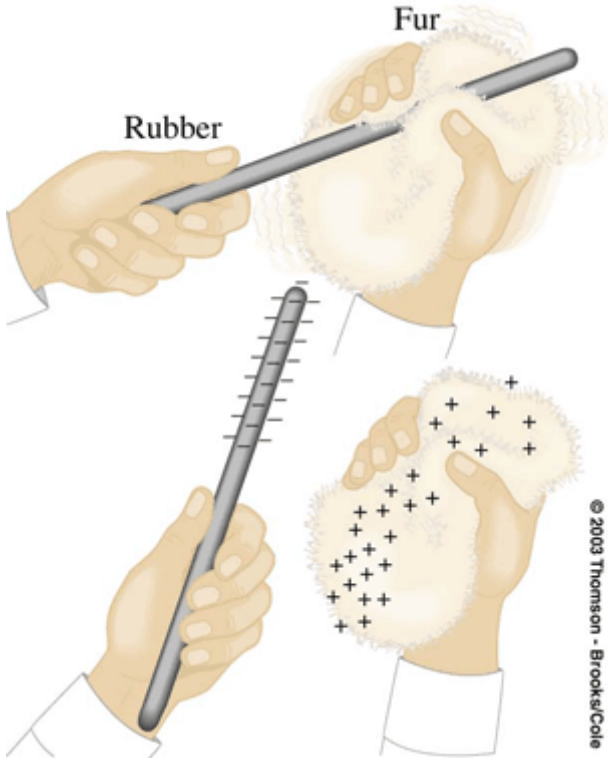
- **All atoms** start off ***neutral***: *no net electric charge*

We now KNOW:

Friction (*rubbing*) provides enough **energy** to cause ***electrons to transfer between*** materials

Negative *and* ***positive*** *static charges result from the* ***addition*** *and* ***removal*** *of* ***electrons*** *ONLY*





Particle model of Electricity

- Three states of charge exist : (+), (-) and *neutral*.

positive negative (0)

- ***Neutral*** objects are *charged by* ***friction.***

(movement of electrons)

Static: an ***excess*** *or* ***lack*** *of* ***electrons*** *on a material.*

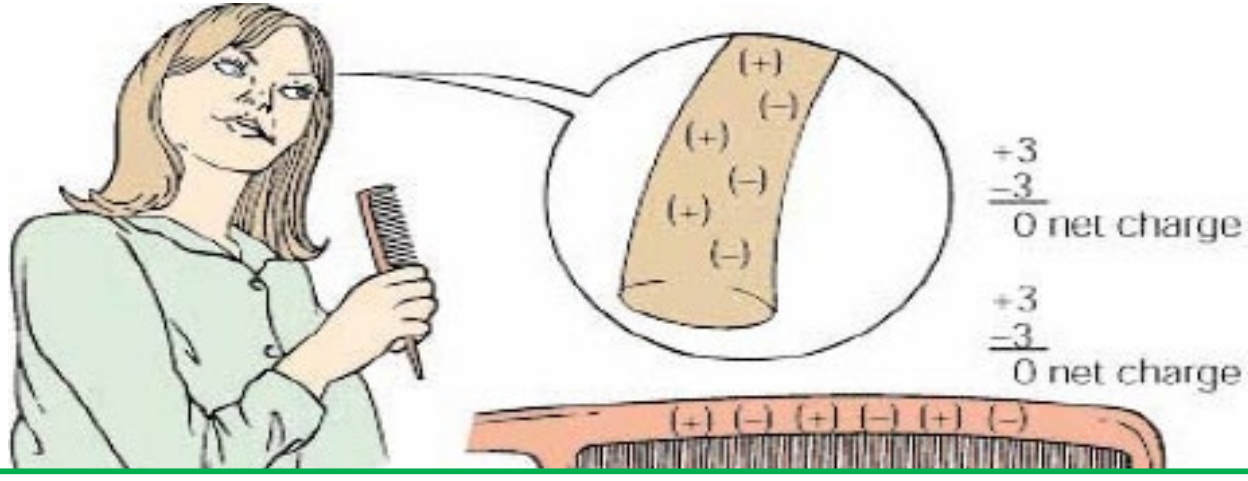
lots, extras

- ***Creates forces*** of **attraction** and **repulsion**

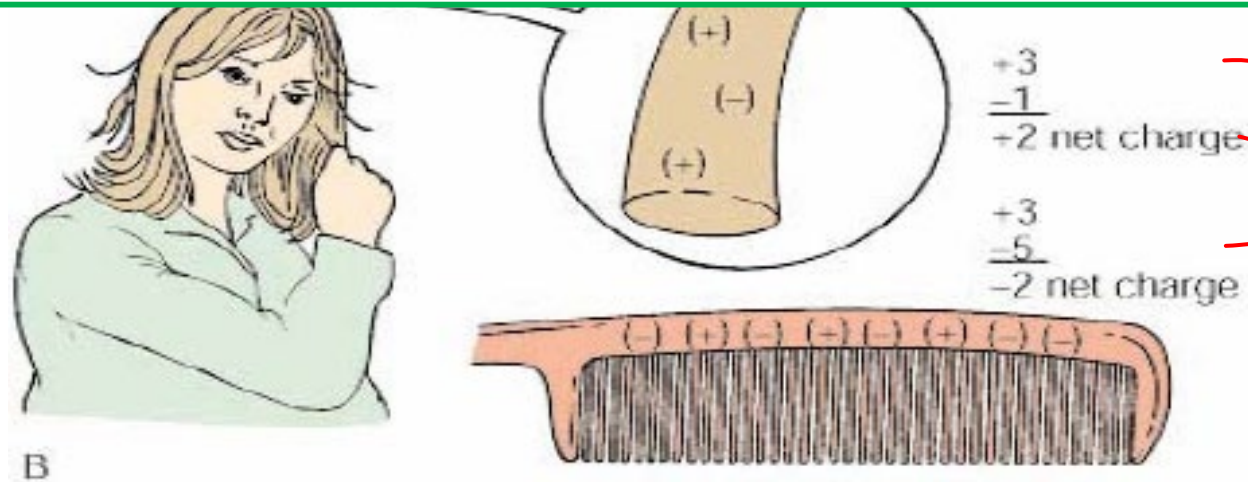
(+) and (-) *(-) and (-) OR (+) and (+)*

Conservation of Charge:

Since *no new* particles are created (*Conservation of Matter*) the total number of (+)/(-) stay the same always.



Notice the **Conservation of Charge** – after the transfer of electrons the *net charge* (together) *still* adds to ***zero***



+2
2
0

When rubbed together, *materials* have a different *strength* of *attraction* for the *electrons*

Most Positive (+)

Easily lose electrons

Human Skin
Fur +++
Glass
Human Hair
Wool
Silk +
Paper

Cotton

Rubber
Copper -
Silver
Polyester
Plastic - - -

Easily gain electrons

Most Negative (-)

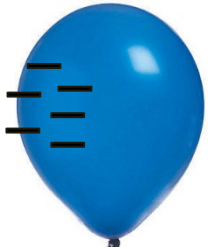
*Since **static** electricity is **stationary** charge (stays put) **only** **some materials** can **maintain** a charge*

Insulators:

Electrical charge is localized - fixed

Electrons can't move around

Rubber, plastic, cloth, glass, wood



Conductors:

Electrical charge spreads through material

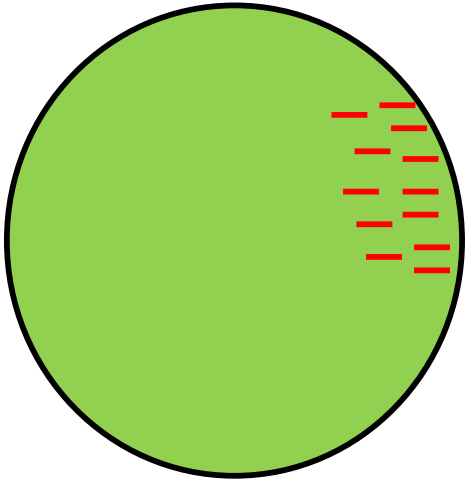
Electrons move around, weakening charge

Most metals are good conductors

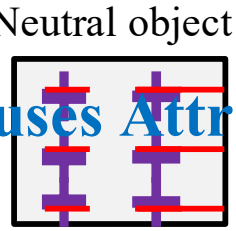
Consider which balloon you can charge by rubbing on your hair and have stick to a wall

Charged objects **attract** a **neutral** object by inducing electrons to move over to one side:

Polarization – **separation of charges** within a neutral material *creating (+) and (-) areas*

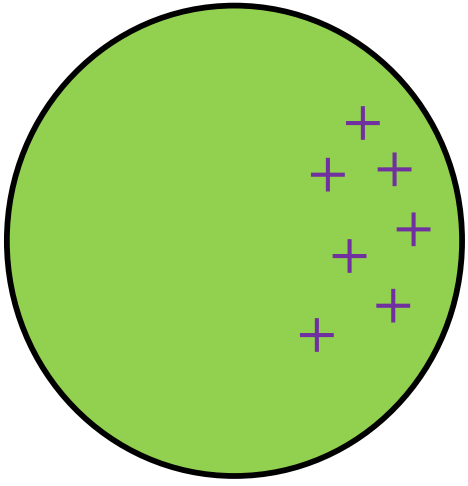


(-) charged object



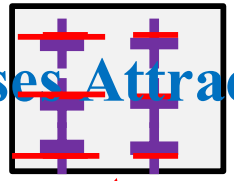
Causes Attraction!

Electrons ***repel*** – polarization of paper atoms



(+) charged object

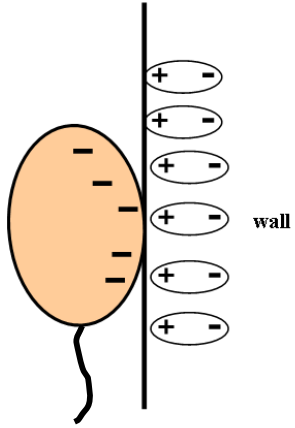
Neutral object

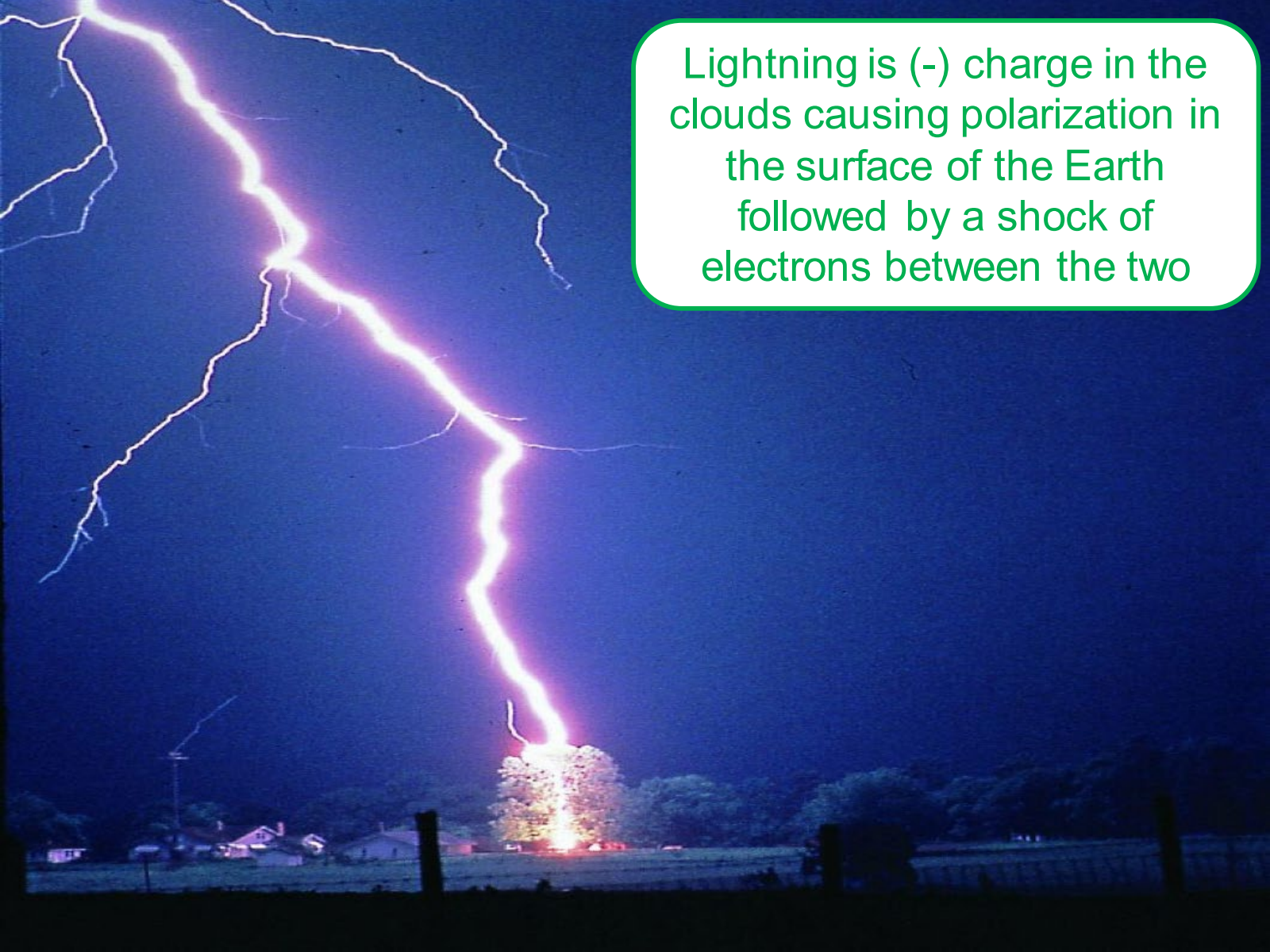


Causes Attraction!

Electrons ***attract*** – polarization of paper atoms

This separation of charges explains why **neutral objects attract to both** (+) and (-) charged objects




Lightning is (-) charge in the clouds causing polarization in the surface of the Earth followed by a shock of electrons between the two

CAN YOU ANSWER THESE QUESTIONS?

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