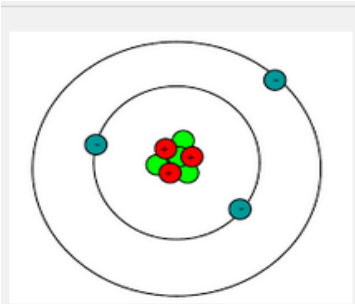
LAB ELECTROSTATIC

material: simple circuit battery, light bulb – aluminum – party balloon – foam cup+pencil – electroscope + glass rod +ebonite rod + wool + silk – fun-fly stick – electroscope- empty soda can – scotch tape – mini flying saucers aluminum from kit fun-fly stick and the shapes– 2 metal plates on a plastic stand (fun-fly stick kit) as a capacitor - Van Graaf generator – florescent tube – confetti – hand-made electrophorus.

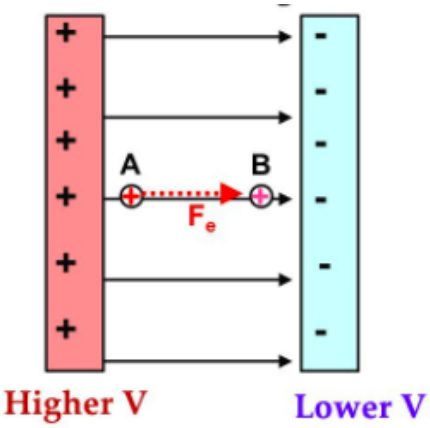
I conductor vs insulator

Atomic structure. Example: lithium. Only electrons can be moved or transferred.



It depends if the material is a conductor or an insulator.

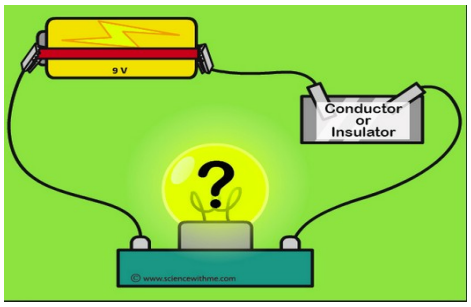
Conductor: The outer shell electrons called valence electrons are not bound to their nuclei. If you apply a potential difference (voltage) between 2 points the electrons are set in motion. An electric current flow. The electrons are boosted up to a higher level of energy. They move to the conduction band. Their energy is then " dumped" in loads. Between the high voltage and low voltage there is an electric field. The electric field exerts a force on the electrons so they move from low potential to high potential (opposite direction than current). The electric field is to the difference in potential what the weight (per unit mass) is to altitude.



Current flow from high potential to low potential.
Electrons flow in the opposite direction

Inductor: The electrons are bound to their nuclei. An electric field can not move the electrons. They can not to a higher level of energy.

Experiment 1:

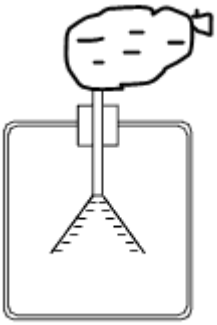


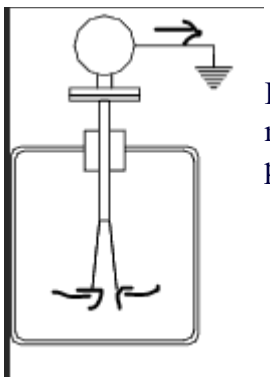
II charging by friction – positive and negative charges

But for an insulator you can separate the charges by doing work. Charging by friction. You need to do work on the insulator (like a balloon) to transfer the electrons (rubbing the balloon against the hair transfer electrons from hair to balloon).

Experiment 2: balloon + charge – the balloon becomes negative as rubber as more affinity for electrons than fur. The hair becomes positive. Like charge repel. The hair positively charged are moving away from each other.

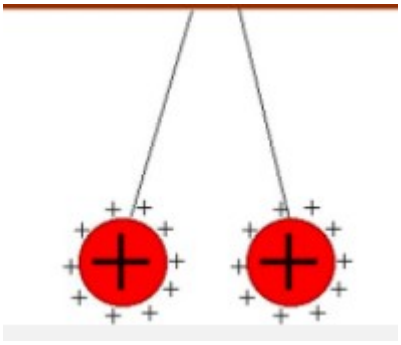
If we touch an electroscope then the leaves move away from each other because like charged repel.

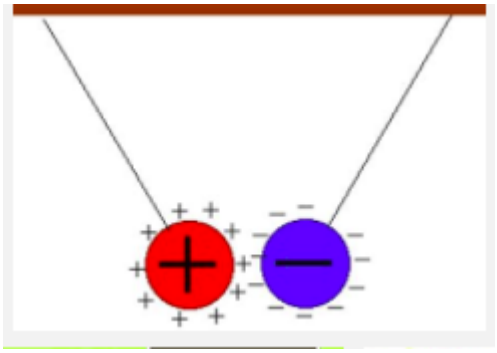




If we ground the electroscope with our hands, the charges move to the ground (earth) and the leaves move back in place.

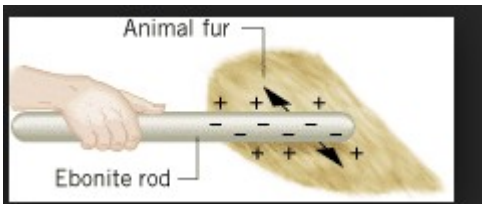
Experiment 3: like chage repell. Unlike charge attract. Experiment with the tapes

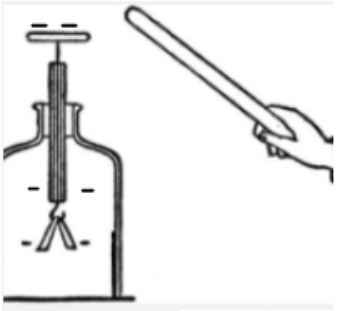


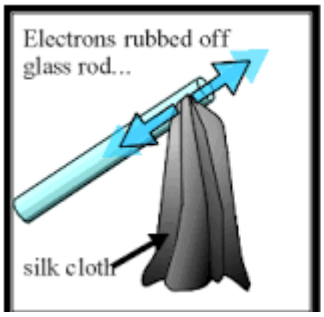


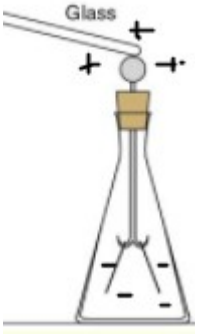
Experiment 4: ebonite rod + fur / glass rod + silk + electroscope

you rub an ebonite rod (like rubber)with fur, the rod becomes negative and the fur positive. Electrons are transferred from the fur to the rod (ebonite has more affinity for electrons). You can transfer this charge to an electroscope. If you rub glass with silk and get the opposite. Silk becomes negative and glass positive. If you touch the same electroscope the leaf comes back. The positive charge combine with the negative charge. The electroscope becomes neutral.

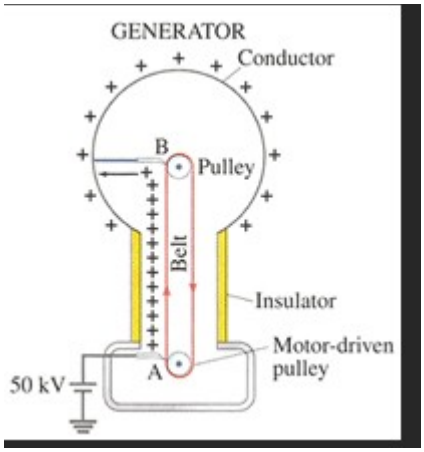




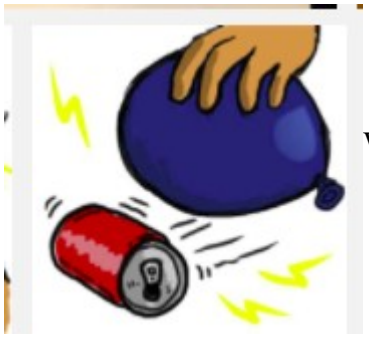




Experiment 5: Introducing the fun stick. A mini Van graaf.
Charging a conductive shape and repel it.



We can use the stick to charge the electroscope. Demo

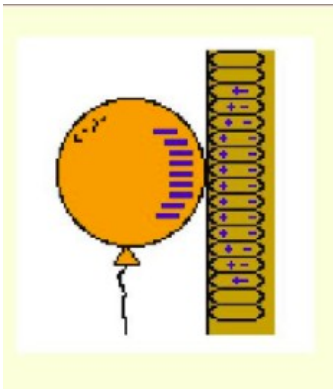


We can also charge a conductive can to repel it to make it roll.

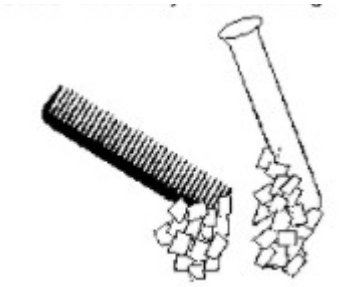
III polarization with insulator

Experiment 6: Balloon. Charge it first.

The balloon stick to the wall. This is called polarization
http://www.neatorama.com/pet/2015/03/28/Kitten-vs-Static-Electricity/
https://phet.colorado.edu/sims/html/balloons-and-static-electricity/latest/balloons-and-static-electricity_en.html Notice how the extra charges on the balloon (electrons) can not move. They stay were they have been transferred. Electrons on a conductor do move away from each other.



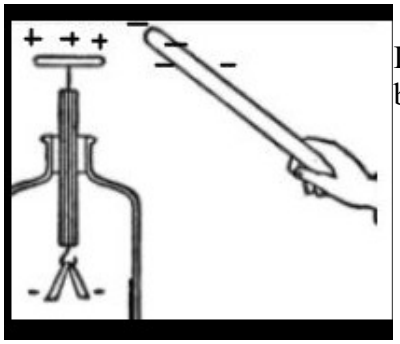
Other experiments polarization



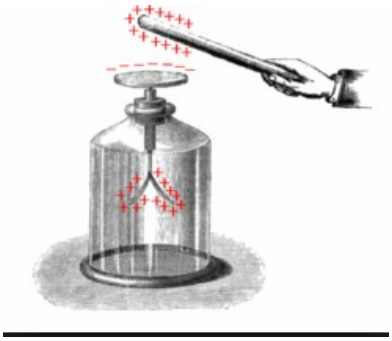
IV charges on a conductor move away from each other.

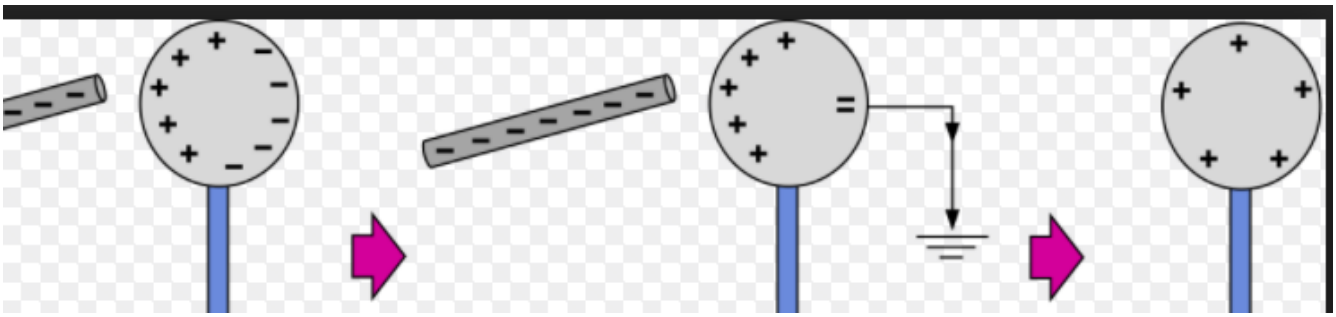
Conductor get charged. The charges don't stay at one place. They move away from each other. They try to get back to the round. https://phet.colorado.edu/en/simulation/john-travoltage

Therefore you use an electroscope to show this:



If you touch the top to ground at the same time. The electroscope becomes charged. This is called charging by induction.



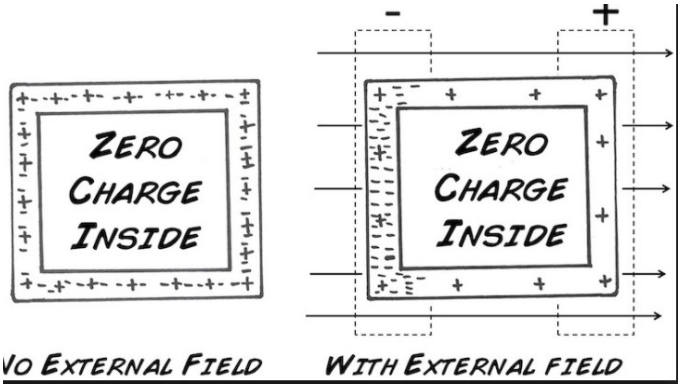


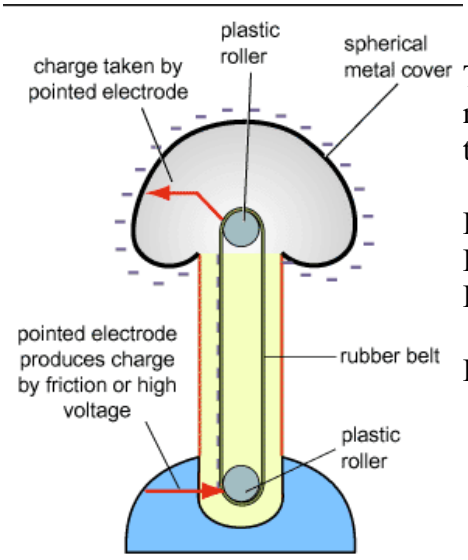
V. Faraday's cage. Van Graaf Generator

Experience 7:

Charges always move to the outside of a conductor.

The lightning can charge a car or a cage but we are safe inside the car.



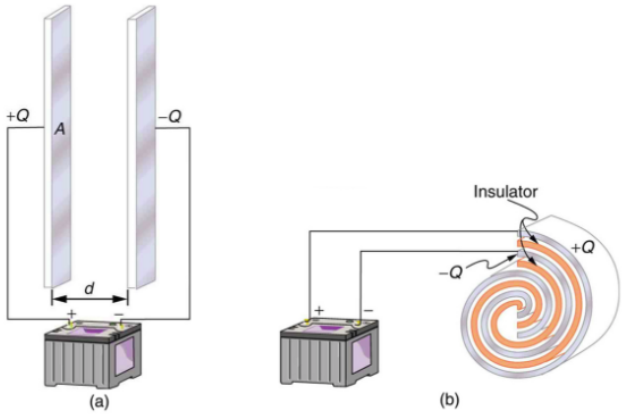


This is the idea behind Jthe Van Graaf generator. The charges move on the outside of the sphere. The belt transfers the charges to the dome.

Demo with the confetti.
Demo with the florescent tube. With LED.
Demo spark.

Demo human chain

VI Introducing the capacitor

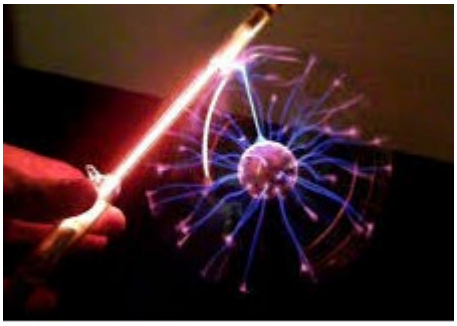


Experience 8: transfer of charge. Charge a capacitor. One plate is connected to ground. One is charged. Place a ball in between attached to a string. The ball (conductor) transfer the charges from one plate to the other. You can so the same experience with the Van Graaf (charged) and a helium balloon (with conductive envelop) between the dome and your head.
https://www.youtube.com/watch?v=f8d0A2rZ-QQ

VI the plasma globe

Experience 9: plasma globe

A fluorescent bulb will lit. as well as bulbs with gas like hydrogen gas, neon ... Show that with an oscilloscope we can detect a voltage difference. You are a conducting path when you hold a light bulb. Try with LED. It works too. Explain plasma.



VII electrophorus

Experience 10: