Electrostatics - Charging Methods

Method	How?	Outcome?
Charging by friction	Rub two neutral objects together.	Both objects end up with opposite charges.
Charging by contact (or conduction)	Touch an already charged object to a neutral object.	Both objects end up with like charges.
charging by induction	Use an already charged object to charge a neutral conductor without direct contact between them.	Both objects end up with opposite charges.

Electrostatic Series (or Triboelectric Series)

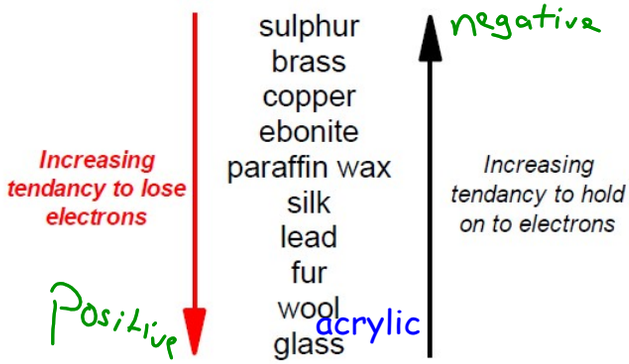


Figure 1: Electrostatic Series

ex. rub ebonite and fur

ebonite gains electrons — ebonite-negative

fur loses electrons — fur-positive

ex. rub glass and wool

Wool
~~ebonite~~ gains electrons — Wool ~~ebonite~~-negative

~~fur~~ loses electrons — ~~fur~~-positive

glass — glass

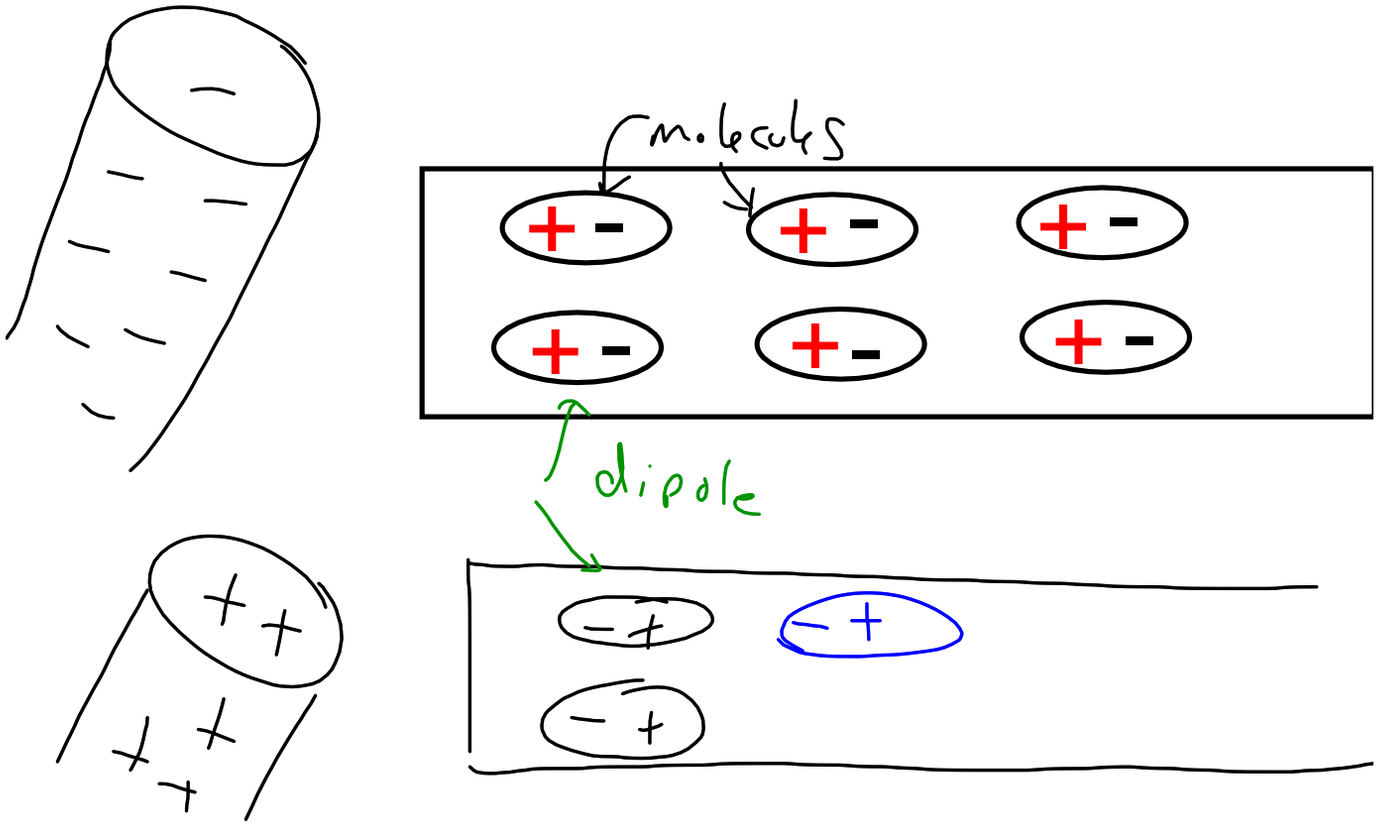
Insulators - Temporary Electric Diploles

Insulators have no free valence electrons.

However, the orbit of the trapped valence electrons can be modified.

Ex. Bring a negatively charged rod close to an insulator.

The trapped electrons will attempt to move away from the negative charge. However, these electrons remain held in the molecule.



Induced Charge Separation

Temporary positively and negatively charged areas may be produced in a neutral object if another charged object is brought close to it.

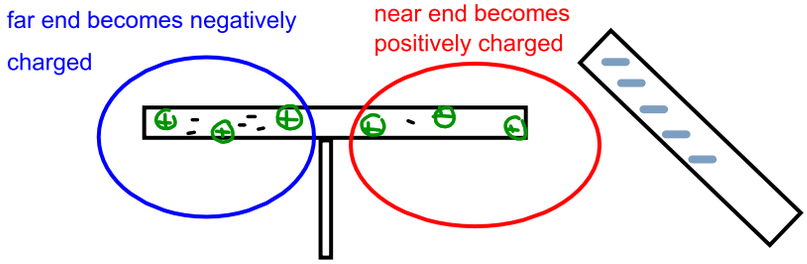
Only a good conductor can be charged this way.

Here is how it works....

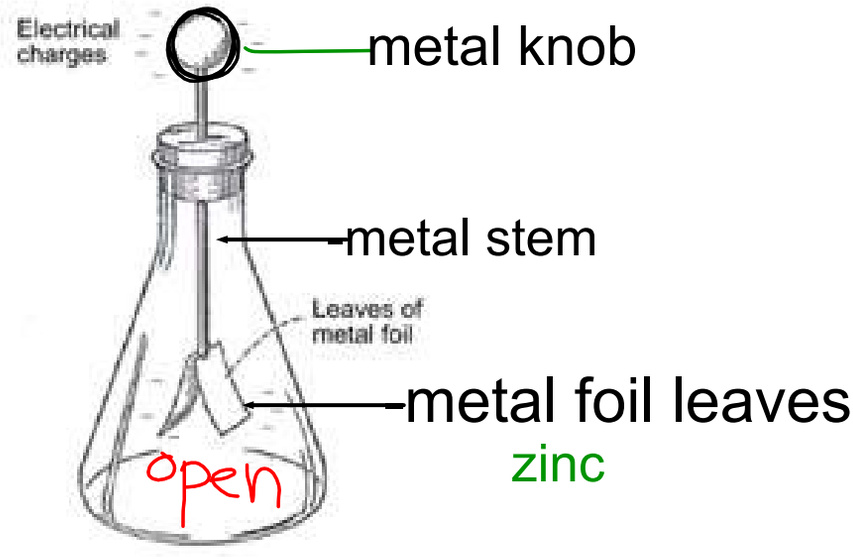
Hold the charged object at one end of the neutral conductor. The free valence electrons inside of the conductor will **either be attracted to or repelled by** the charge on the object.

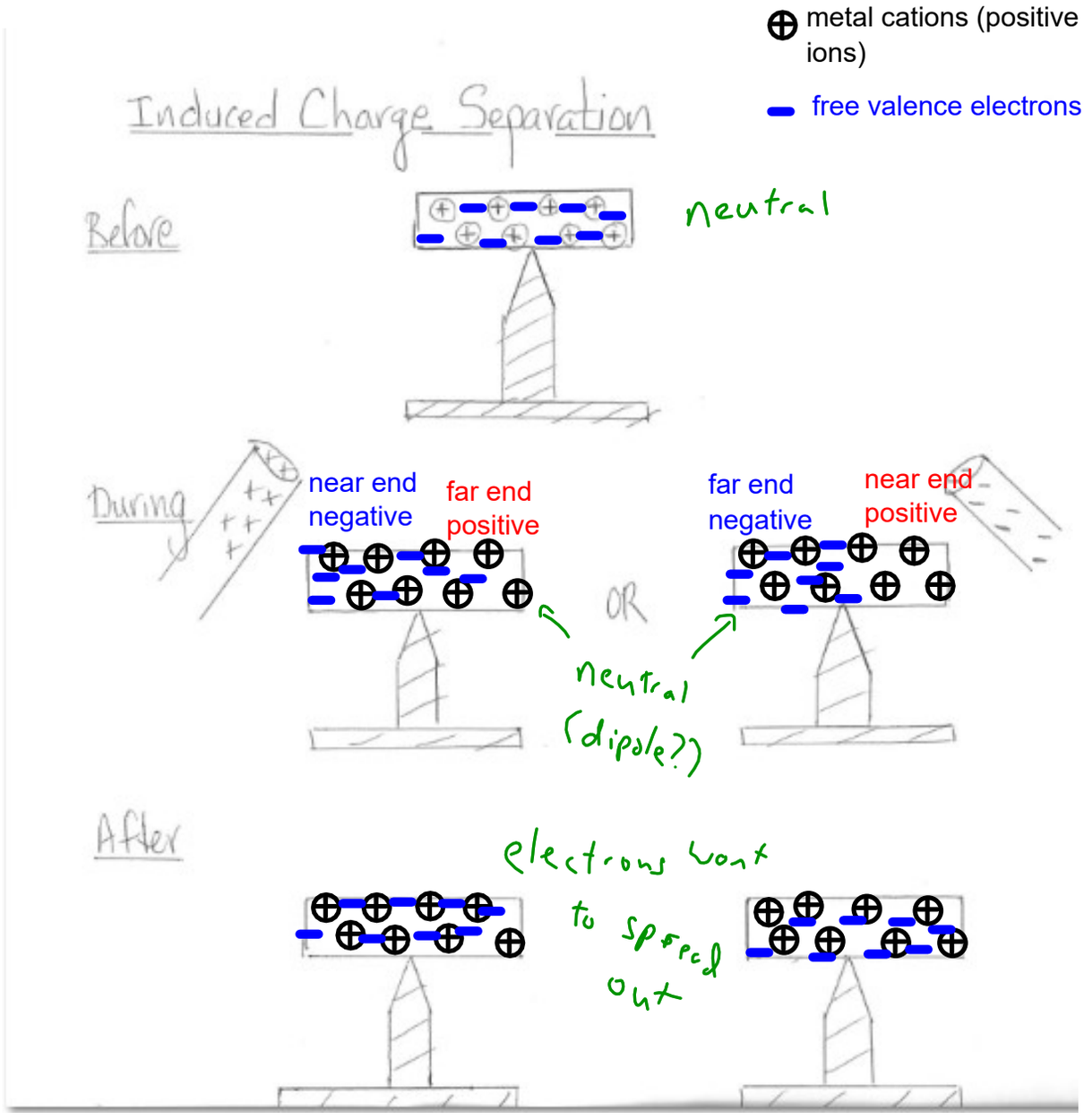
These valence electrons will move creating a positive zone and a negative zone in the conductor.

Note that the conductor is still neutral. No electrons were added or removed. The condition is temporary. As soon as the charged object is removed, the valence electrons spread back out again.

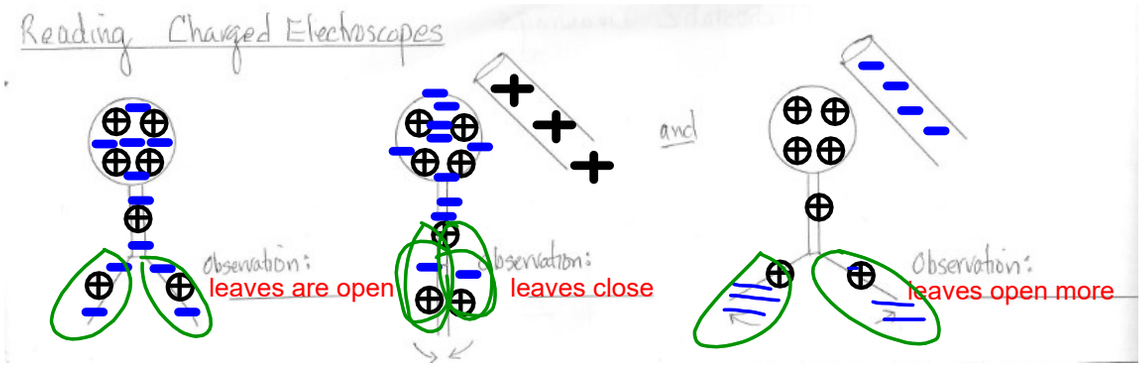


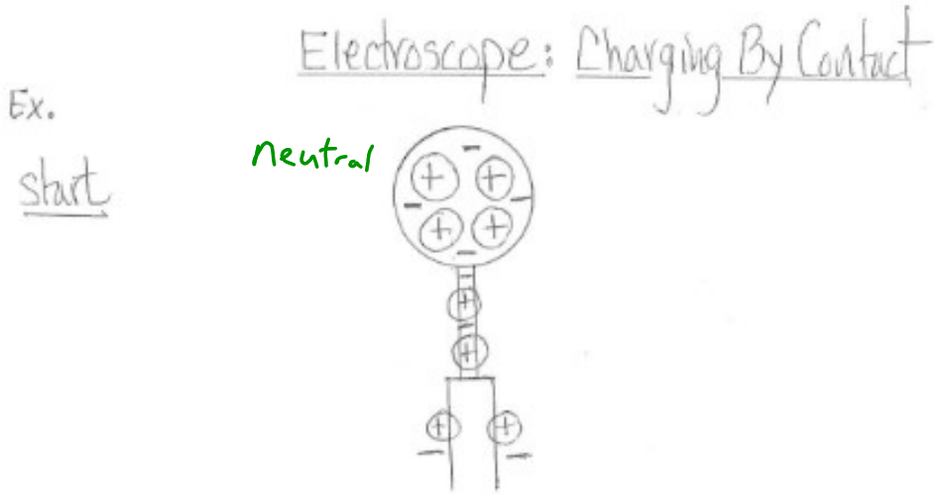
The electroscope is a device used to determine the presence of an electrostatic charge.

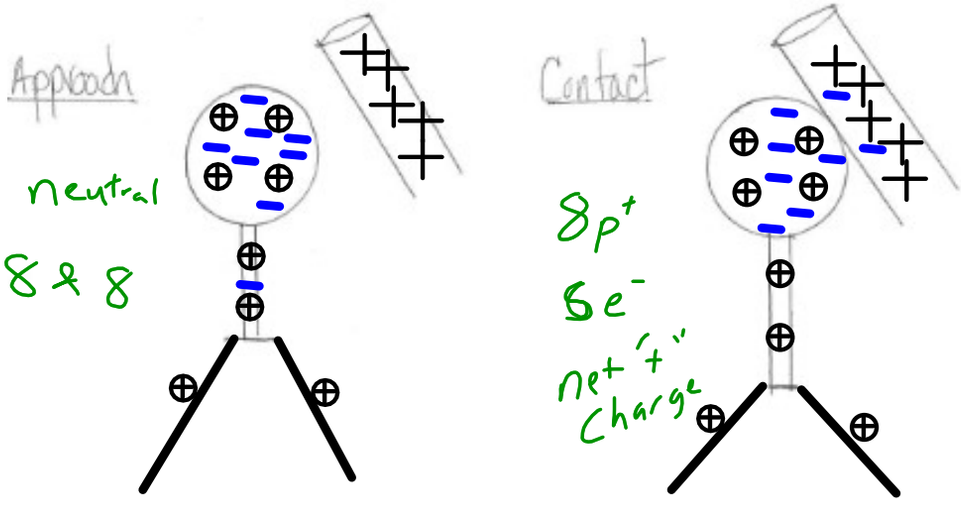



metal cations (positive metal ions)
free valence electrons
Induced Charge Separation
Before
neutral
During
near end
negative
far end
positive
OR
far end
negative
near end
positive
neutral
(dipole?)
After
electrons want
to spread
out

If the scope was negatively charged, you would observe these behaviours.







induced charge separation occurs causing leaves to open

electroscope loses electrons becoming positive charged

Electroscope has same charge as rod

positive rod becomes less positive as it gains electrons

Charging By Induction
x.
free valence electrons are repelled down to bottom of the electroscope making leaves negative
by touching the finger to the knob, the electrons are able to move off of the scope and into the finger as they are repelled by the negative charge on the rod and in the leaves
remove the finger to prevent the lost electrons from returning to the scope
remove the charged rod allowing the remaining free valence electrons to distribute themselves throughout the scope