One of the most Famous American Physicists, Richard Feynman, used to say "Suppose you could pass down just one idea to future civilizations, just one. It would be that stuff is made out of tiny bits."

You, me, all that we see is made up of collections of tiny bits of stuff, Our bodies are mostly water. water is composed of 2 Hydrogen Atoms and an Oxygen atom. Each hydrogen atom is composed of an electron and a proton. Each proton is composed of quarks, 2 "up" quarks and a "down" quark. And thats as far as we've gotten so far.

I'm sure by now you've seen hydrogen described as if the proton was like the earth and the electron is like the moon, ⇒ the electron orbits the proton.

What mysterious force holds the electron in orbit?

Gravity is too weak

The serious study of this mysterious force, Electromagnetism, is credited (by me) with being started by Benjamin Franklin. He postulated that the electrostatic phenomina we see (lightning, static discharge) results from a transfer of a fluid like (since it is composed of many tiny bits) substance he called charge. ~~Today~~ we ~~know that franklins charge is usually caused~~

Furthermore, charge exists in 2 flavors

⊕ and ⊖

<u>idea</u>

Rub a glass rod with silk, the "charge" gets redistributed and the glass ends up with net ⊕ charge & the silk has net ⊖ charge

Rub a rubber rod with fur, the rod ends up with a net ⊖ charge and the fur ends up with a net ⊕ charge.

2 charged up glass rods repel each other

2 charged up rubber rods repel each other

charged up glass and rubber rods attract each other.

So, for properties of charge we have so far

charge comes in 2 flavors ⊕ & ⊖ (3)
like charge repels

opposite charge attracts

charge is transfered & not created or destroyed.

$$\sum_{before} charge = \sum_{after} charge$$

might be $0+0 = -2+2$

And He was able to invent cool stuff like lightning rods.

By playing around with charge, he was able to determine that some materials allow charge to move about freely while others do not.

⇒ materials that allow charge to move about freely are called conductors

⇒ materials that do not allow charge to move about very well or at all are called insulators.

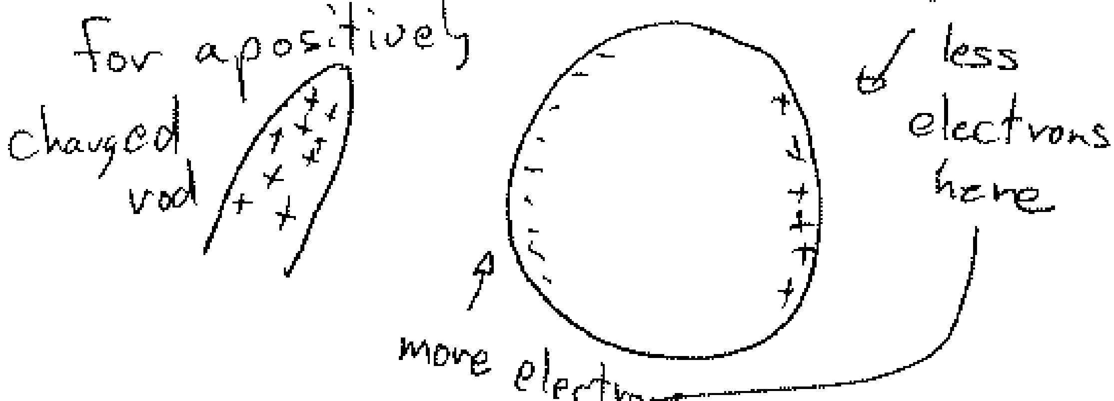
An insulator is a poor conductor &
A conductor is a poor insulator

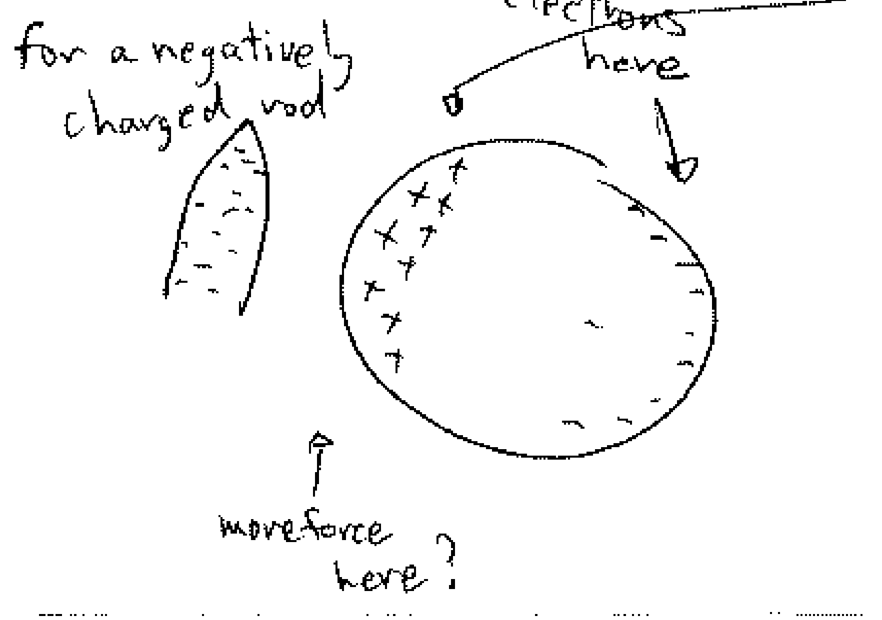
There are other classifications too:

Semiconductor: can control the flow of charge

Superconductor: conduct the best

Lets examine a conductor. Today, we know that in a lot of conductors, the atoms combine in such a way that the electrons (which have a ⊖ charge) are shared between atoms. That is, they aren't super locked in orbit and can move about the conductor. This means that as we charge up a rod and bring it close to a coke can, we'll see something interesting.



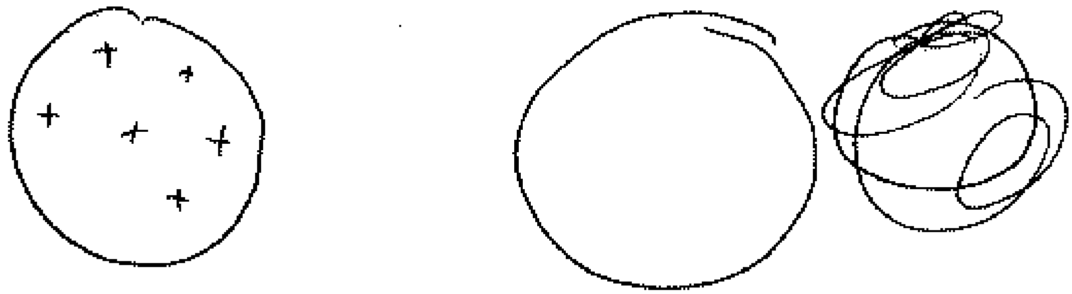


in both cases the can is attracted to the rod!

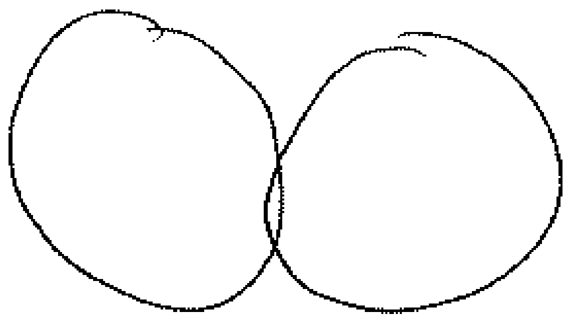
Other experiments are possible

Charged spheres are a favorite

2 identical spheres

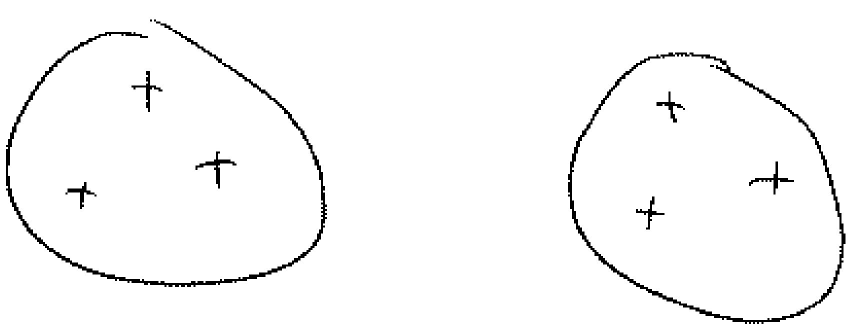


touch them (can use a wire)



move them apart

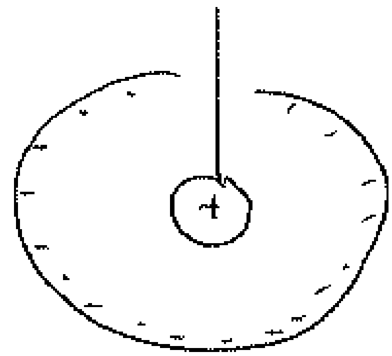
how much charge on each



+ Charges will move around till they get as far away as they can, then they stop moving and an equilibrium is obtained

Franklin tried this same experiment with a twist.

he charged up a Sphere



and placed some charged material in side. wierd!

you'd think it might be attracted to some thing! It wasn't

Franklinhad a friend. His friend, like some of you guys went "Aha! This is just like gravity!"

In 1785, a frenchman named Charles Coulomb measured this force using conducting spheres and measuring the force between them

He determined

$\text{Force} \propto \frac{1}{r^2}$ r is distance between the spheres

$\propto q_1 q_2$

$$|\text{Force}| = k \frac{q_1 q_2}{r_{12}^2}$$

& directed on a line between the 2 spheres

$$\vec{F} = k \frac{q_1 q_2}{r^2} \hat{r}$$

In 1897 the electron was discovered, there was much rejoicing.

Smallest bit we can see is an electron.

work is still force x distance

N m

N ↳ $kg \frac{m}{s^2}$

$W = kg \frac{m^2}{s^2}$ what's $\frac{m}{s}$?

Energy goes like mv^2

recall $KE = \frac{1}{2}mv^2$

ex suppose we have a 2 kg ball that has 1 C of charge and that ball is accelerated from rest in an electric field of strength 1000 N/C. How fast is the ball moving after going a distance of 1 m?

$F = ma = qE$ $\quad w = F \times d = (qEd)$

$KE = \frac{1}{2}mv^2$ $\quad \frac{1}{2}mv^2 = qEd$

$\sqrt{v^2} = \sqrt{\frac{2qEd}{m}} = \sqrt{\frac{2(1C)(1000 N/C)}{2kg}}$

~ 31.6 m/s

we'll learn about other properties next time