

Unit 4: Electrical Principles and Technologies

Topic 1

Electrical Charges

Producing Electricity

Materials that attract or repel other materials are said to be charged, or carry an electrical charge.

Charges are produced when materials are rubbed, touched or moved together and then separated.

The amount of electric charge is measured in Coulombs (C).

[Hand Held Tesla Cannon](#)

When you get a 'shock', feel a 'jolt', or, a 'spark', you are experiencing the same type of electrical effect that makes lightning. **Static electricity** happens when there is an imbalance of electrons (which have negative charges).

Static electricity: the charge produced by rubbing or touching something together



Electrical Charges

[Static electricity explained video](#)

Most objects have the same number of positive charges (protons) and negative charges (electrons).

This makes them neutral (no charge).

If there are more positive charges the object carries a positive charge.

If there are more negative charges the object carries a negative charge.

+ + - + - -
- - + - + +

(a) neutral ("uncharged")
equal positive and
negative charge

+ + + + - +
- - + + + +

(b) positive charge
excess positive charge

- - + - - +
- - - + - +

(c) negative charge
excess negative charge

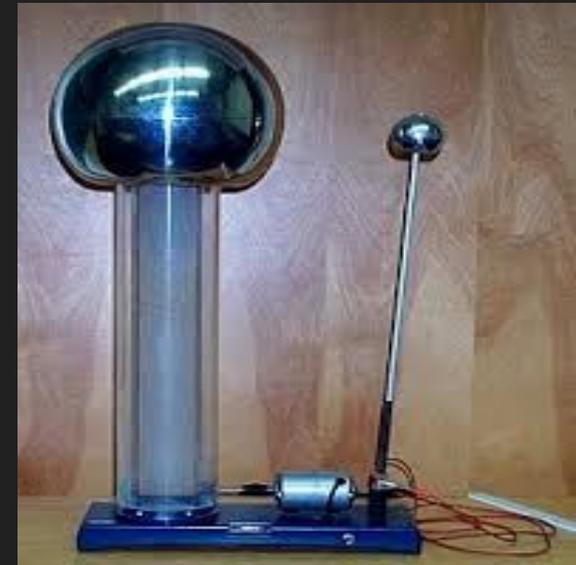
When there is a difference in electrical charge, most actions are predictable because of the

Law of Electrical Charges (Charge Laws):

1. Unlike charges attract
2. Like charges repel
3. Charged objects attract uncharged (neutral) objects

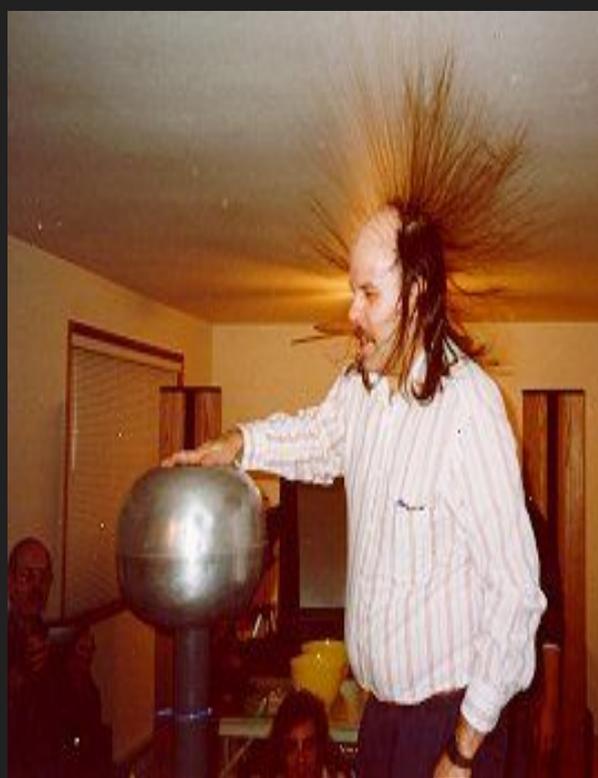
Van de Graaff (VDG) Generators

- These generators build up an excess of static charge using friction. A rubber belt rubs a piece of metal and transfers the charge to a sphere. When you touch the sphere the charge builds up on you.



The Law of Charges states that like charges repel - that is why your hair strands separate as you touch the sphere.

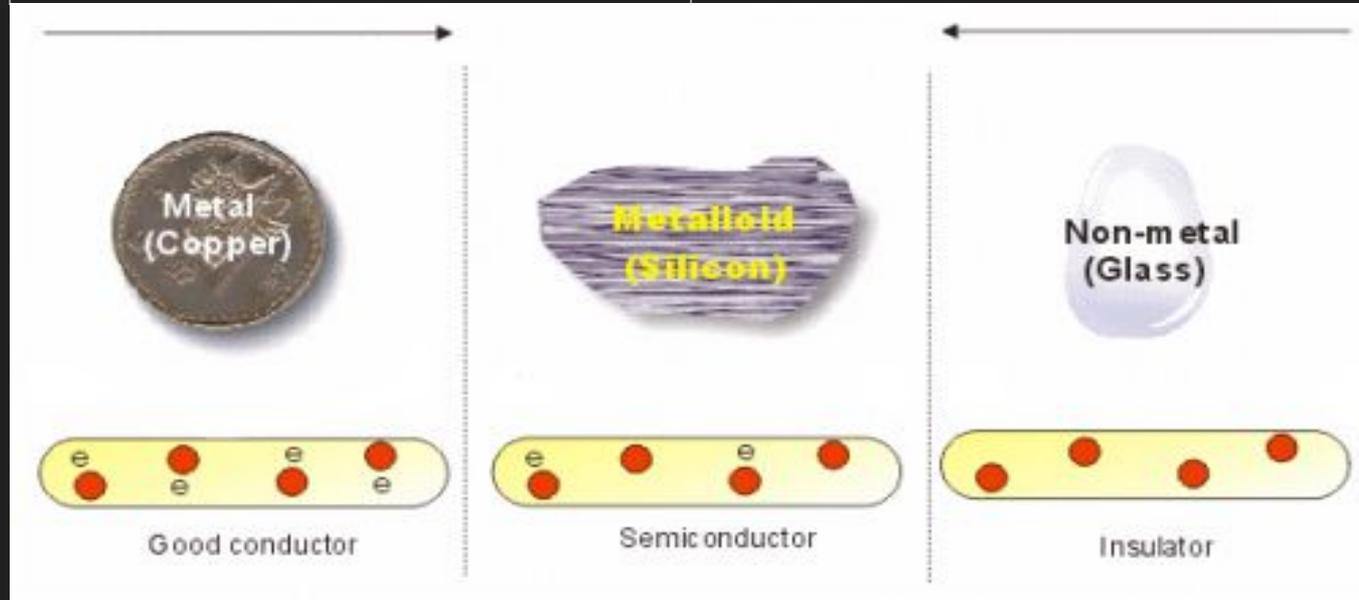
Electrons repel each other as they move into your body, travelling up into your hairs



Insulators vs. Conductors

Matter can be sorted into two main categories:

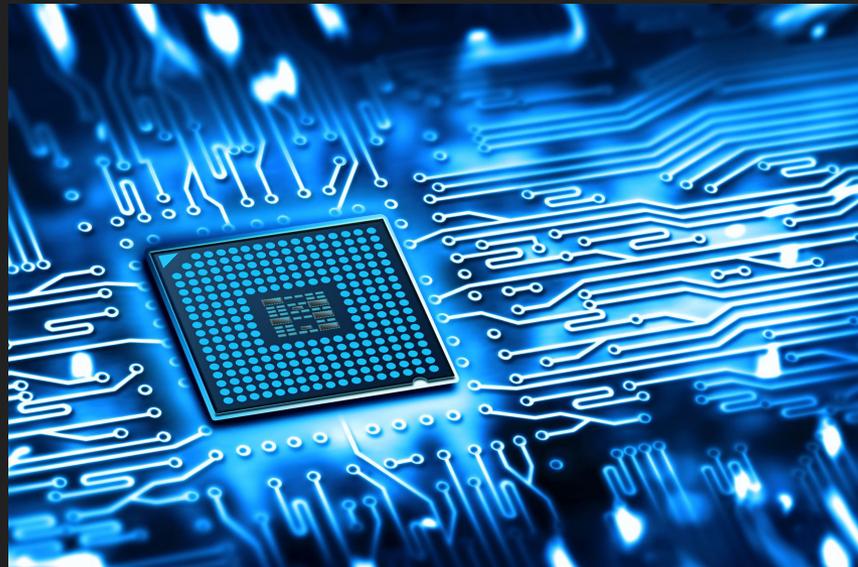
Conductors	Semi Conductors
Allow electrons to flow	Do not allow electrons to flow
Metals	Non metals



Semi Conductors

Some conductors provide some resistance but will still allow electrons to flow. These are called semiconductors and are often found in computers

Example: silicone with gallium added to it



Superconductors

Superconductors are materials that have close to no resistance to the movement of electrons

In order to create superconductors, they must be kept at very cold temperatures, which can make them impractical

[Superconductor video](#)
[Maglev Trains](#)



Neutralizing Unbalanced Charges

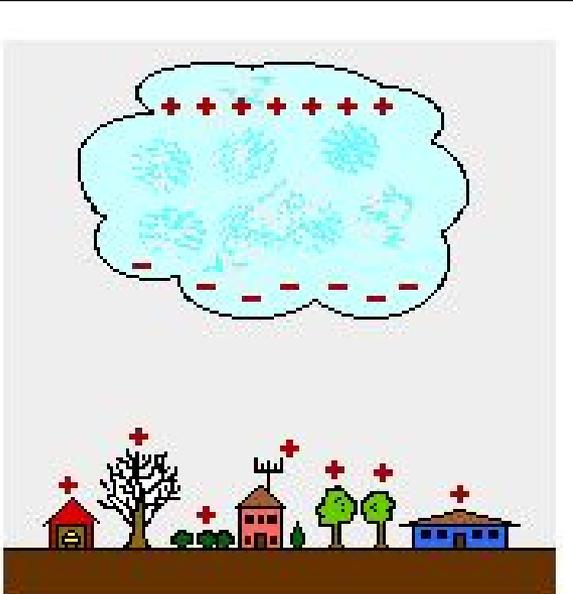
Discharge is the movement of charges whenever an imbalance of charges occurs. The action results in the neutralization of the objects.



Two methods of Neutralization:

1. Grounding

By connecting the item to the ground, electrons will pass from the item to the Earth, neutralizing the item



⚠ CAUTION

**Prevent Static Spark
Discharge.**

Use Grounding Devices.



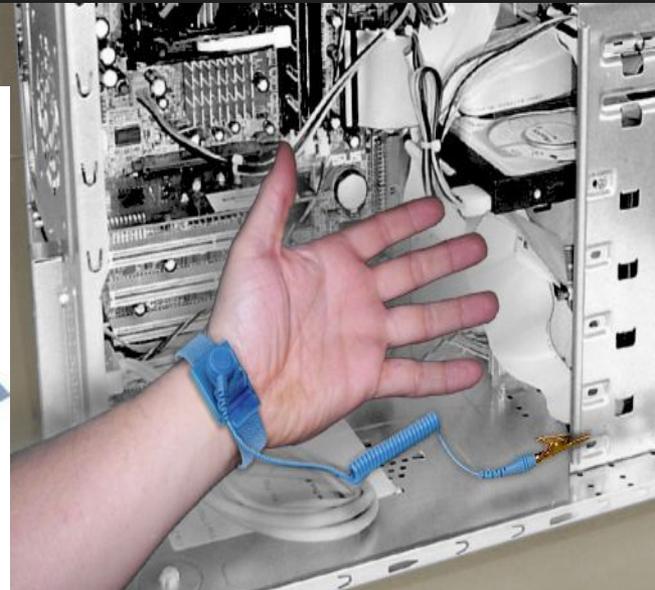
2. Ionizing

Insulators must be neutralized through ionization. These devices produce both positive and negative charges, which will attach themselves to charged insulators



Preventing Electrostatic Buildup

Static discharge can be very dangerous to either the product or the person dealing with it. To prevent static buildup, antistatic products can be used, including grounding straps and antistatic packaging



Review Questions

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