

Do You Want to be
Shocked?



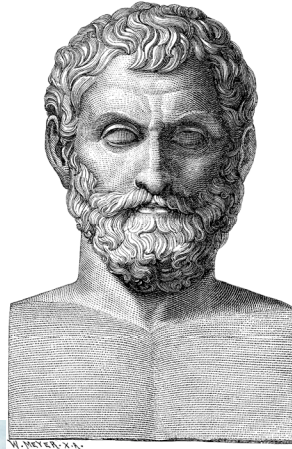
Story Time



Thales of Miletus (Greek)

c. 600 BCE

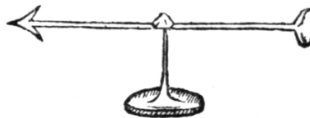
- This is the first recorded report that rubbing a piece of amber with fur caused it to attract small objects like pieces of straw and feathers.



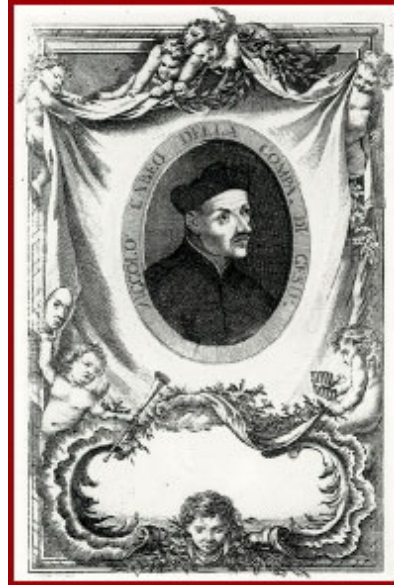
William Gilbert (English)

1600

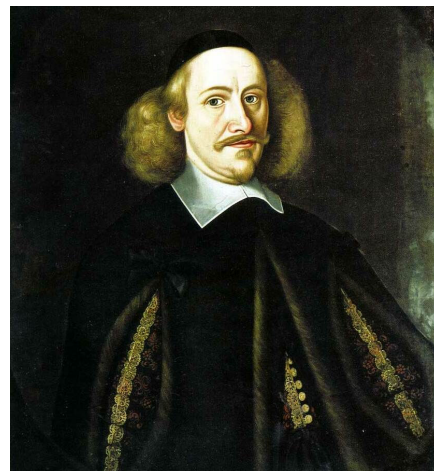
- Gilbert published a book in which he studied static electricity using amber.
- He called the force an electric force.
- He also invented the first electrical measuring instrument, the versorium (electroscope).



- Cabeo wrote that electricity can be not only attractive but also repulsive.

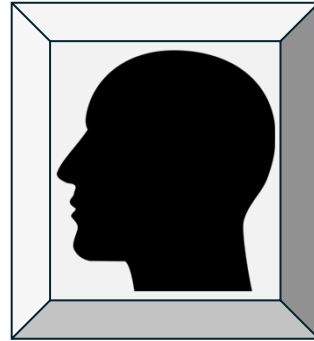


- von Guericke invented the first electric generator, which produced static electricity by applying friction against a revolving ball of sulfur.



Stephan Gray (English)
1729

- Gray was the first person to systematically experiment with electrical conduction.
- He showed that electricity can be conducted through metals and that it appeared on the surfaces of insulators.



Charles François du Fay (French)
1733

- Discovered that some charged items would repel while some would attract and posited the existence of two types of electricity and named them "vitreous" and "resinous."



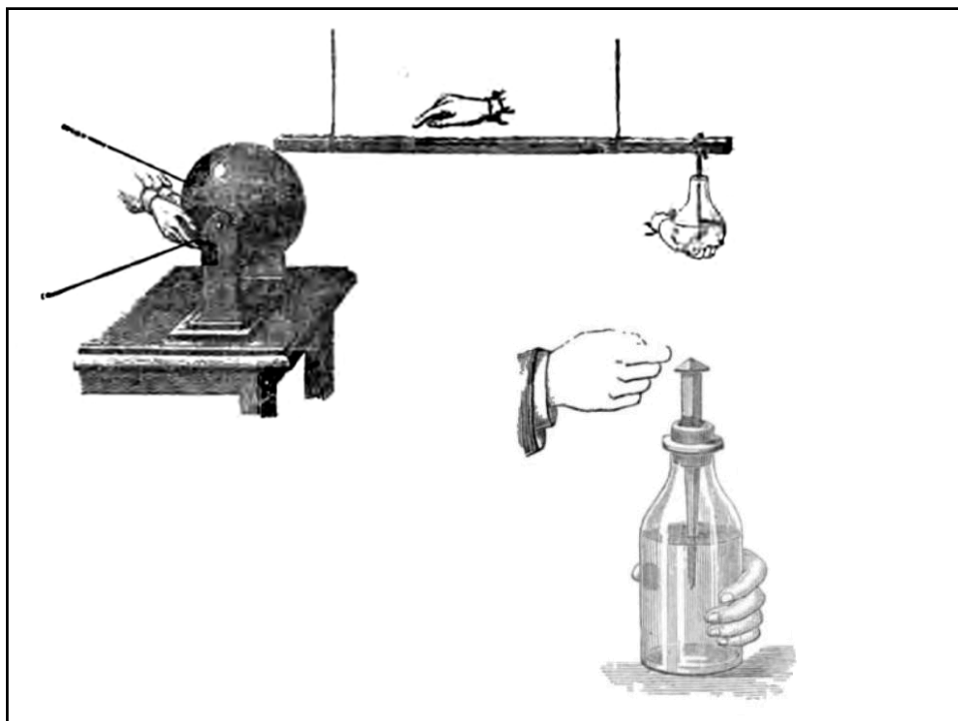
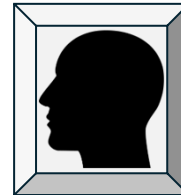
Ewald Jürgen von Kleist (German)

1745

Pieter van Musschenbroek (Dutch)

1746

- von Keist and van Musschenbroek independently built a device that could store electricity.
- The device became known as a Leydon jar.
- van Musschenbroek was teaching at Leiden University.



Benjamin Franklin (American)

1747

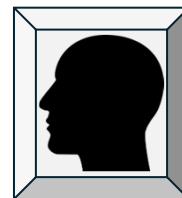
- Franklin coined the terms positive and negative for the two types charge.
- He also discovered the principle of conservation of charge.



Francis Ulrich Theodore Aepinus (German)

1759

- Aepinus was the first to show that a theory of action at a distance for electricity provides simple explanation for experimental findings now known as electrostatic induction, laying the foundations for electrostatics.



TENTAMEN THEORIAE ELECTRICITATIS ET MAGNETISMI.

Accedunt Dissertationes duae, quarum prior,
phaenomenon quoddam electricum, altera,
magneticum, explicat.

AVCTORE

F. V. T. AEPINO

Acad. Scient. Imper. Petropolitanae, Regiae Berolinensis et
Elect. Mogunt. Erford. Membr.

Mus. Supplementi Commens. Acad. Imper. Petropolitanae.

PETROPOLI
TYPIS ACADEMIAE SCIENTIARVM.

Alessandro Volta (Italian)

1793

- Volta invented the voltaic pile, the first true electric battery.



Hans Christian Ørsted (Danish)

1820

- Discovered that an electric current generates a magnetic field.



Michael Faraday

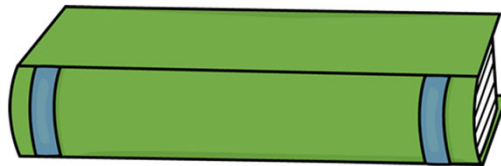
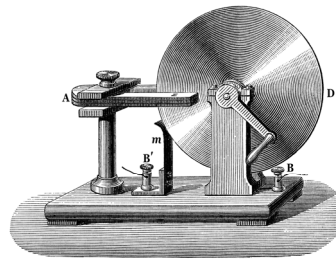
1821

- Invents the first electric motor.



1831

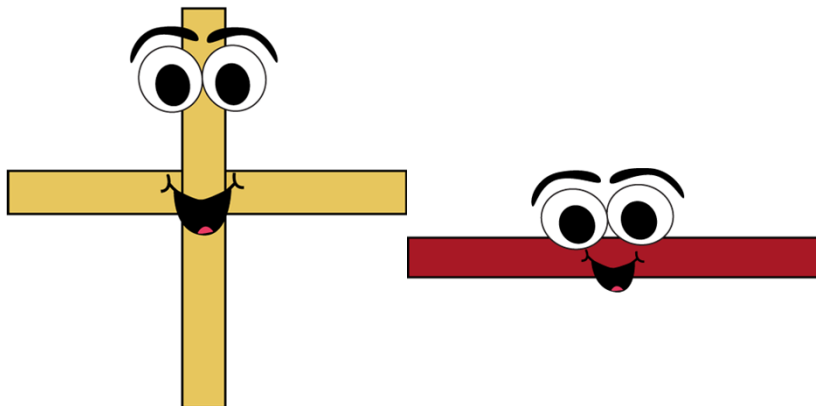
- Discovered that a changing magnetic field generates an electric current.



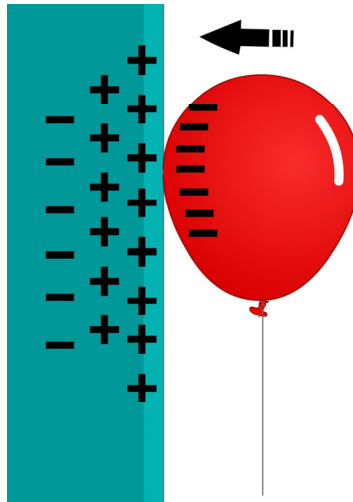
Static Electricity

Electric Charge

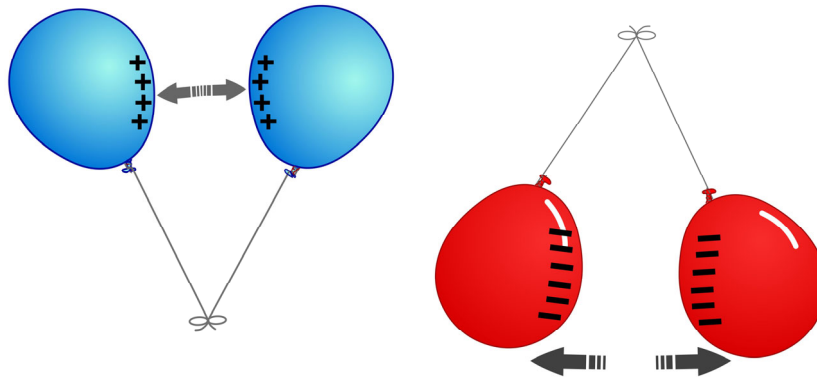
- Electric charge comes in two varieties; we call them positive and negative.



- Unlike charges attract each other.
- A positive charge and a negative charge attract each other.



- Like charges repel each other.

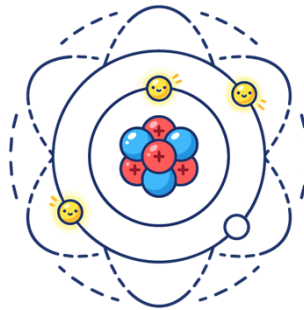


- Two positive charges will repel each other, and two negative charges will repel each other.

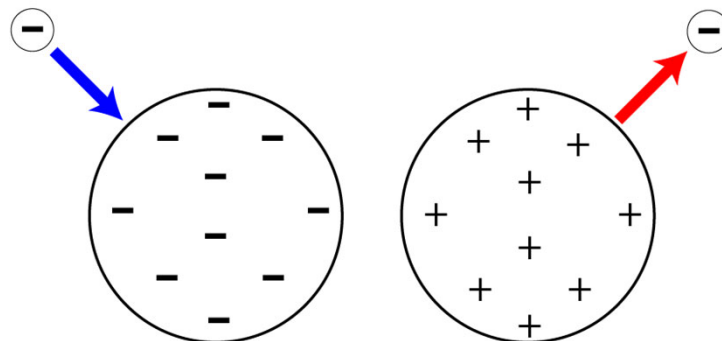
- The negative charges are electrons.



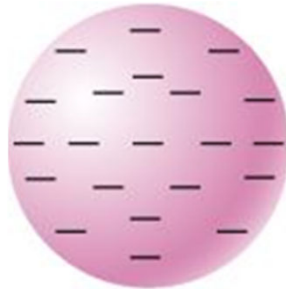
- The positive charges result from atoms losing electrons (becoming ions).



- We charge objects by transferring electrons from one object to another.
 - If we add electrons, it becomes negatively charged.
 - If we remove electrons, it becomes positively charged.



- Electrons can move freely within **conductors**.
 - Metals are conductors.
- If we add electrons to a conductor, they spread out evenly over the surface.

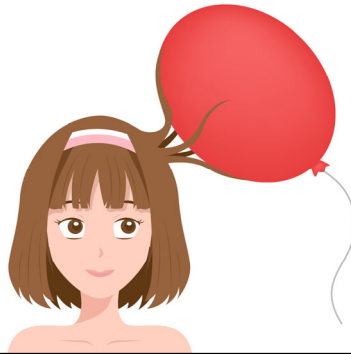


- Electrons cannot move within **insulators**.
 - Nonmetals are insulators.
- If we add electrons to an insulator, they will stay in place.

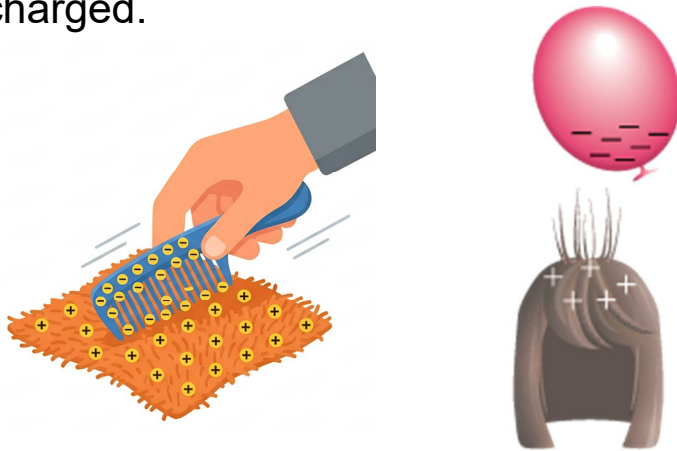


Charging Objects

- We can charge insulators by rubbing the surfaces of two different materials together.
- This is called charging by friction or contact.



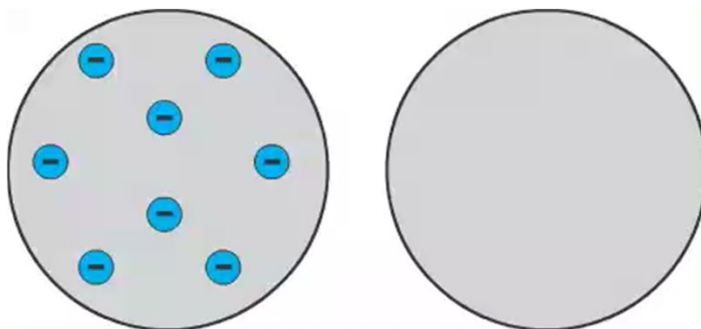
- The electrons will transfer from one material to the other.
- One material will become positively charged and one will become negatively charged.



- Some materials transfer electrons better than others.
 - In some cases, electrons may transfer from one object to another simply by being in close contact with each other.
 - packing peanuts and plastic wrap



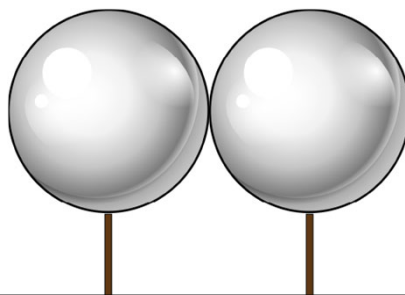
- If we touch a conductor with a charged object, the electrons will move so that **both** objects will have the **same** charge.
 - This is called charging by conduction.



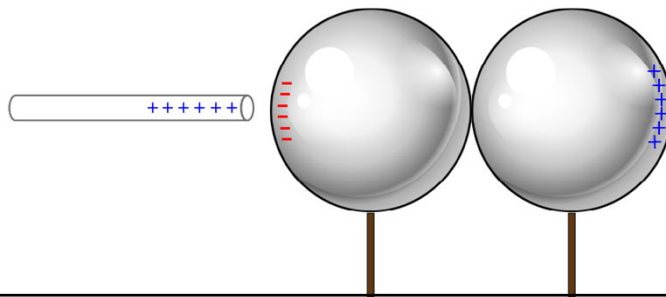
- If we bring a charged object near a conductor (but don't touch it), the electrons in the conductor will move.
- If the charged object is removed, the electrons will return to their original places.
- This is called polarization.



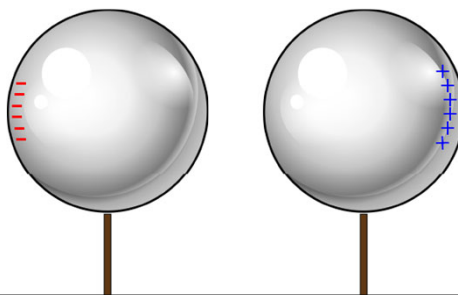
- Polarization can be used to charge objects.
- Consider two neutral metallic spheres (same amounts of positive and negative charge).
- If the two spheres touch, the charge is evenly distributed over the two spheres.



- We bring a glass rod with a positive charge near the left sphere.
- Because opposite charges attract, the negative charge is attracted to the glass rod, leaving a positive charge on the opposite side of the right sphere.



- Separating the spheres causes the charge to be “stuck” on the spheres.
- This is called charging by induction.



Law of Conservation of Charge

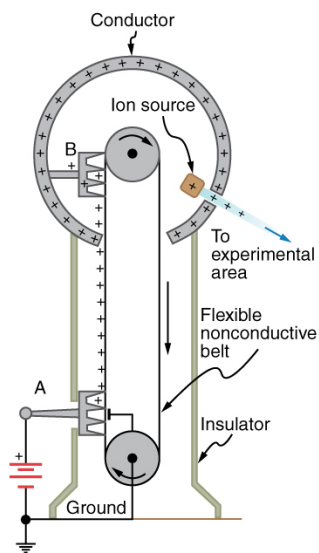
- Electrical charge cannot be created or destroyed it can only be transferred from one object to another.



Practical Applications of Static Electricity



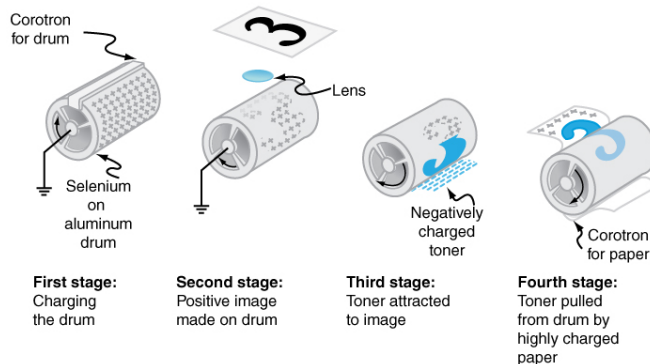
Van de Graaff Generator



- Schematic of Van de Graaff generator. A battery (A) supplies excess positive charge to a pointed conductor, the points of which spray the charge onto a moving insulating belt near the bottom. The pointed conductor (B) on top in the large sphere picks up the charge. (The induced electric field at the points is so large that it removes the charge from the belt.) This can be done because the charge does not remain inside the conducting sphere but moves to its outside surface. An ion source inside the sphere produces positive ions, which are accelerated away from the positive sphere to high velocities.

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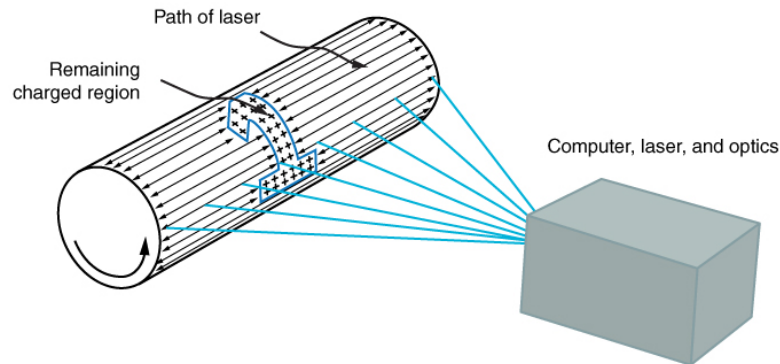
Photocopier



- Xerography is a dry copying process based on electrostatics. The major steps in the process are the charging of the photoconducting drum, transfer of an image creating a positive charge duplicate, attraction of toner to the charged parts of the drum, and transfer of toner to the paper. Not shown are heat treatment of the paper and cleansing of the drum for the next copy.

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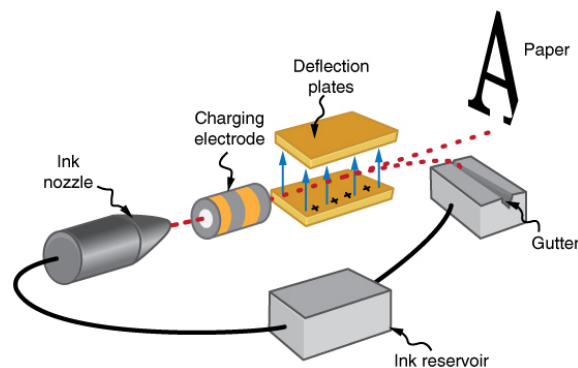
Laser Printer



- In a laser printer, a laser beam is scanned across a photoconducting drum, leaving a positive charge image. The other steps for charging the drum and transferring the image to paper are the same as in xerography. Laser light can be very precisely controlled, enabling laser printers to produce high-quality images.

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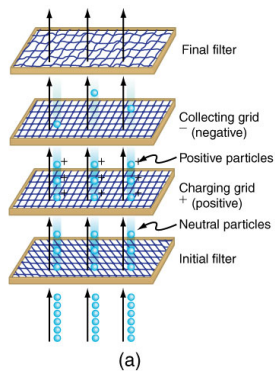
Ink Jet Printer



- The nozzle of an ink-jet printer produces small ink droplets, which are sprayed with electrostatic charge. Various computer-driven devices are then used to direct the droplets to the correct positions on a page.

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Electrostatic Precipitator



- (a) Schematic of an electrostatic precipitator. Air is passed through grids of opposite charge. The first grid charges airborne particles, while the second attracts and collects them.
- (b) The dramatic effect of electrostatic precipitators is seen by the absence of smoke from this power plant. (credit: Cmdalgleish, Wikimedia Commons)

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