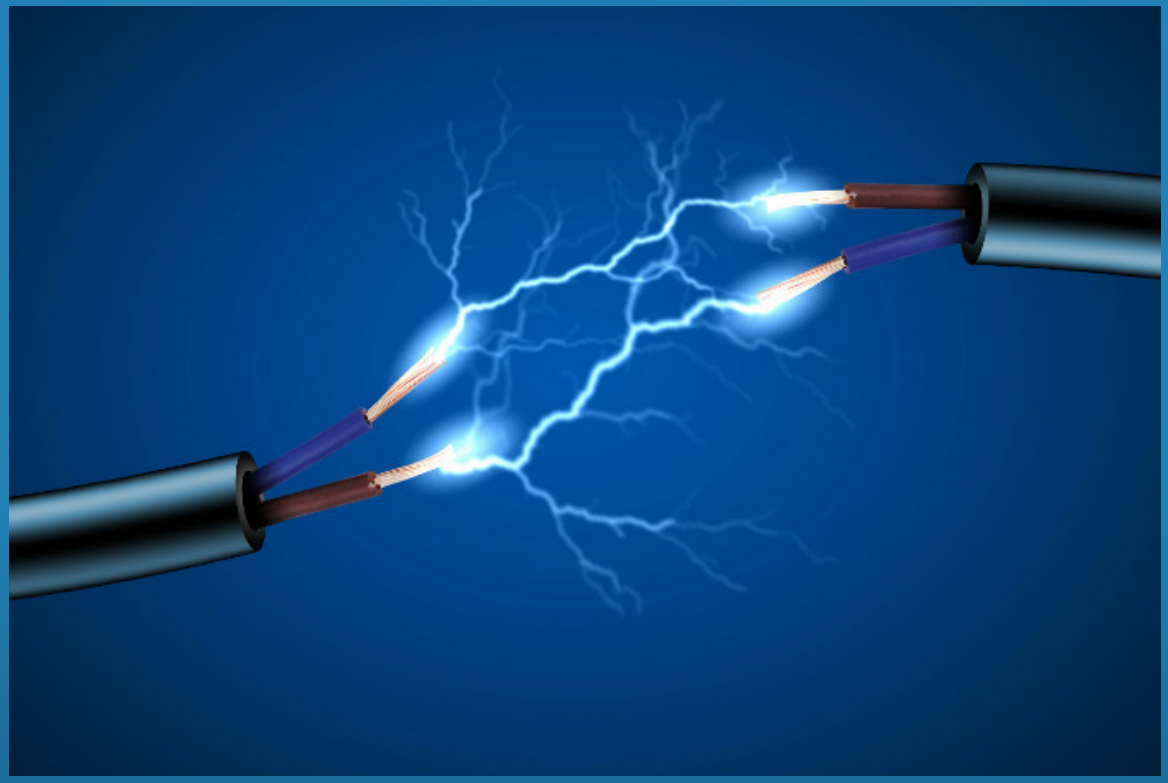
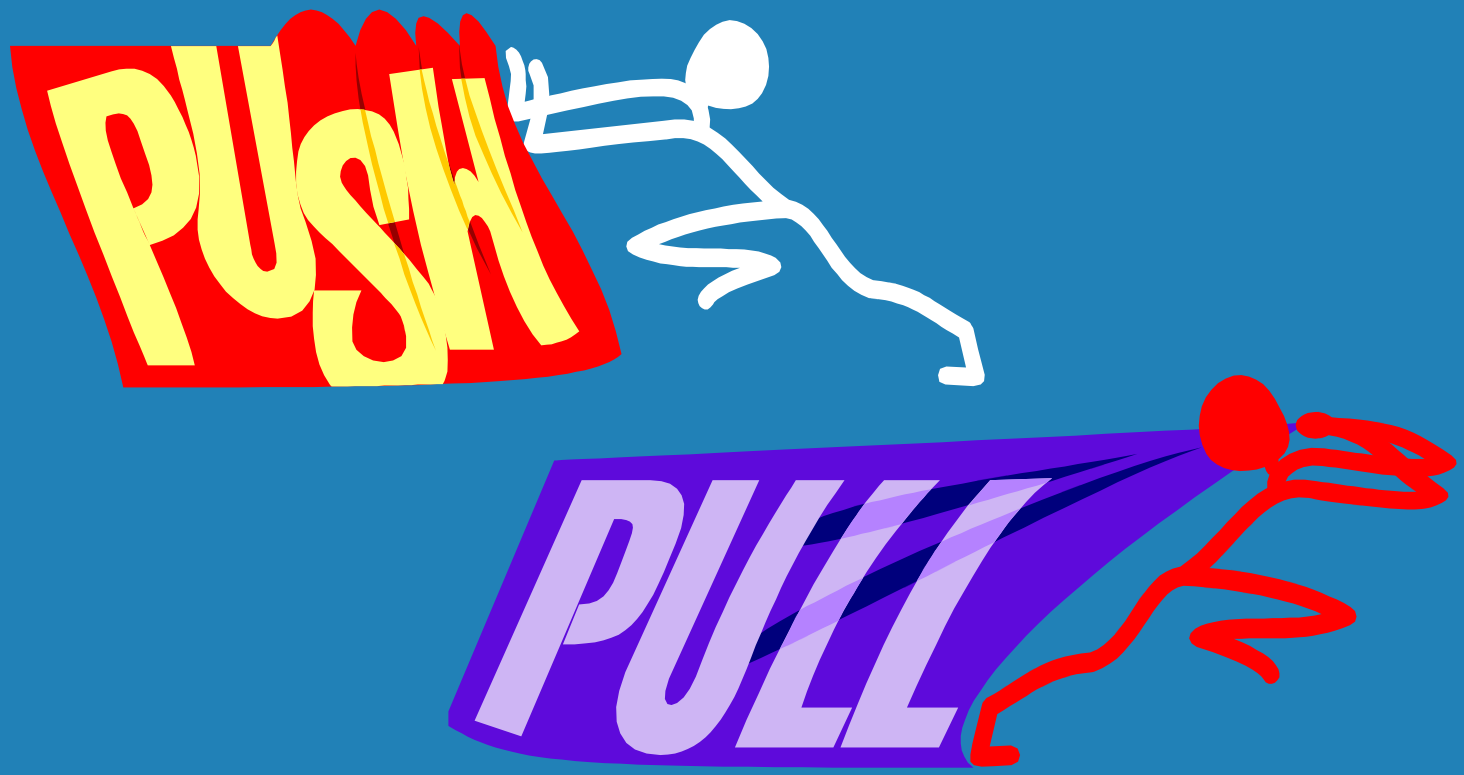
Electrical Charges and Static Electricity



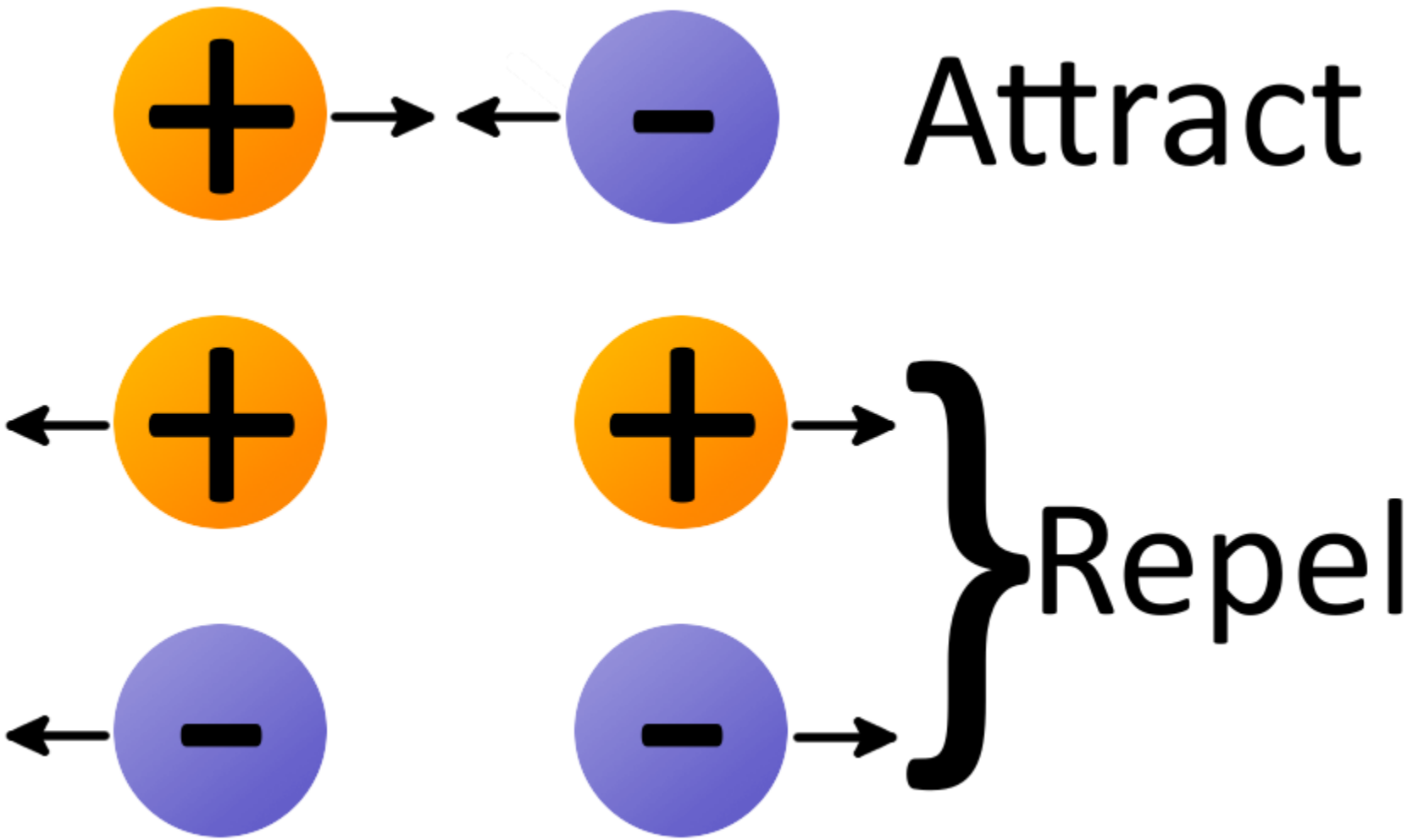
A charge is a physical property.

An object can have a positive charge, a negative charge, or no charge.

Charged objects exert a force – a push or a pull – on other charged objects.

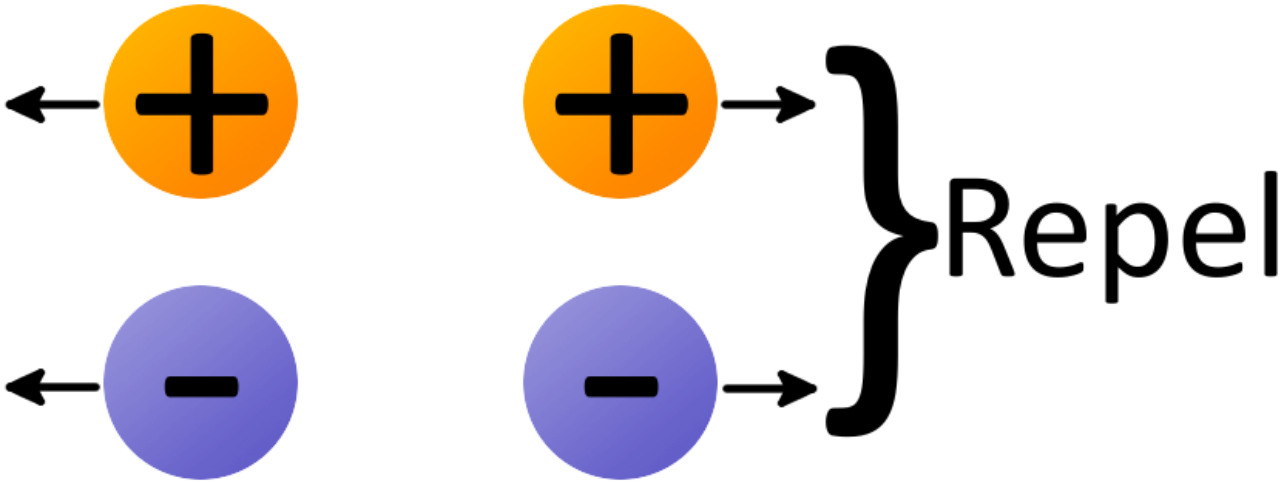


Charges Exert Forces



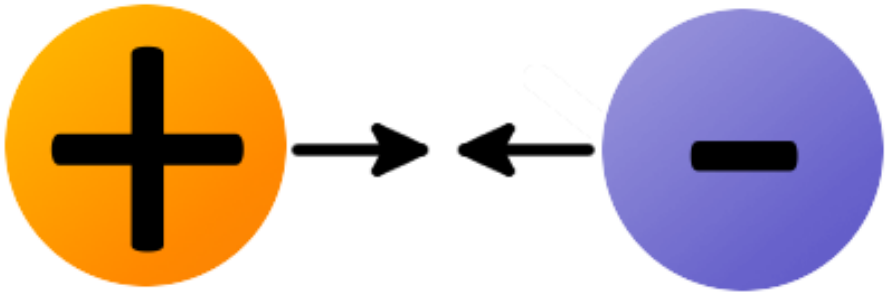
Objects that have the same charge repel each other.

Each object exerts a force on the other object. These forces push the objects apart.



Objects that have opposite charges are attracted to each other.

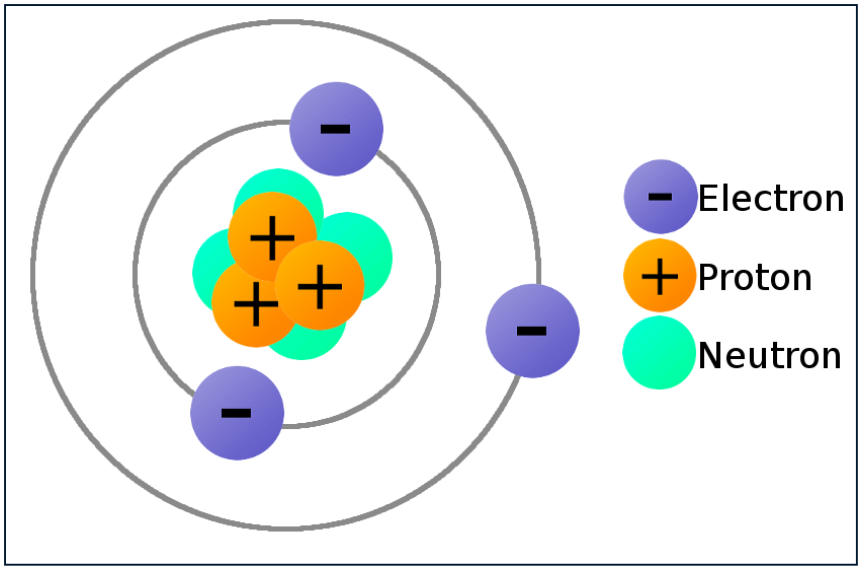
Each object exerts a force on the other object. These forces pull the objects together.



Attract

In atoms, protons are positively charged. Electrons are negatively charged.

Because protons and electrons have opposite charges, they are attracted to each other. Without this attraction, electrons would fly away from the nucleus of an atom.



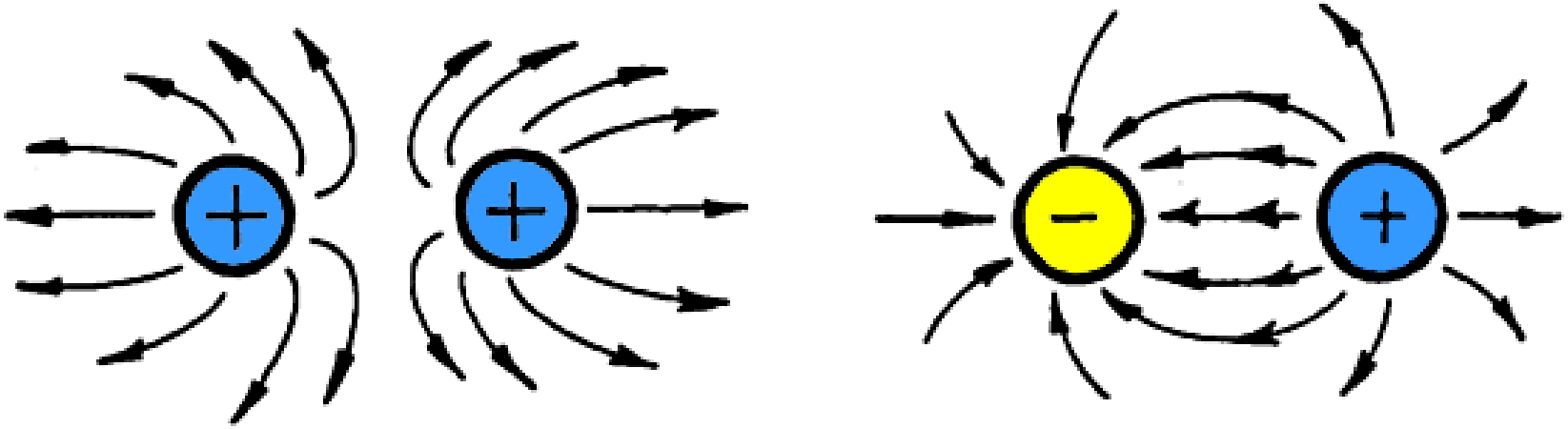
The force between charged objects is an electric force.

The greater the charges are, the greater the electric force is between objects.

The closer together the charges are, the greater the electric force is between objects.

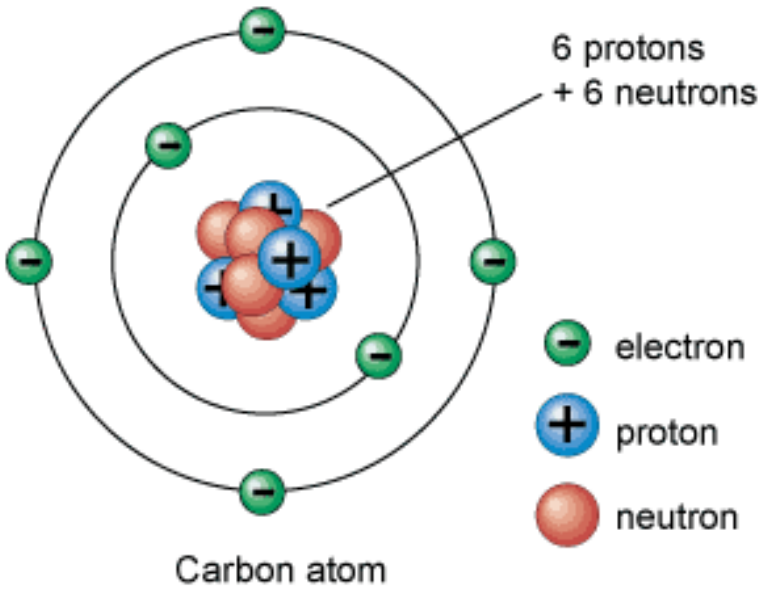
Charged things have an electric field around them.

A charged object in the electric field of another charged object is attracted or repelled by the electric force acting on it.



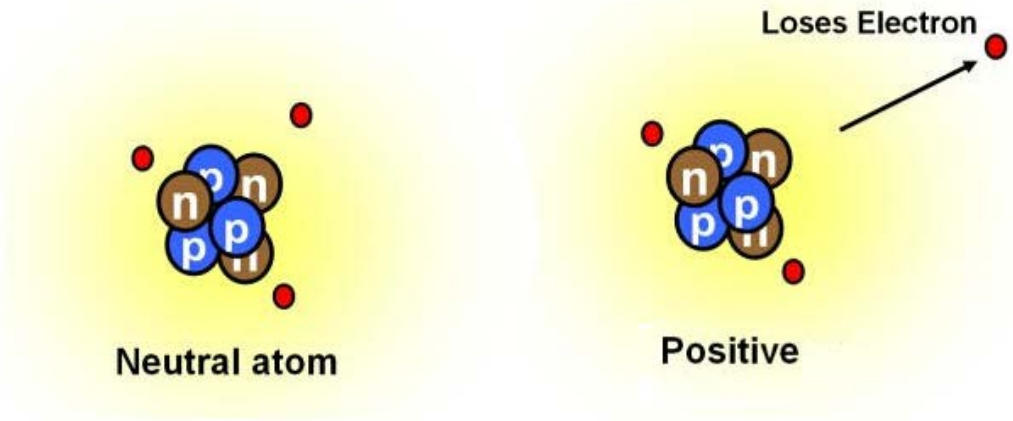
Electricity is simply the presence and/or flow of electric charges.

Atoms have equal numbers of protons and electrons. Because an atom's positive and negative charges cancel each other out, atoms do not have a charge.

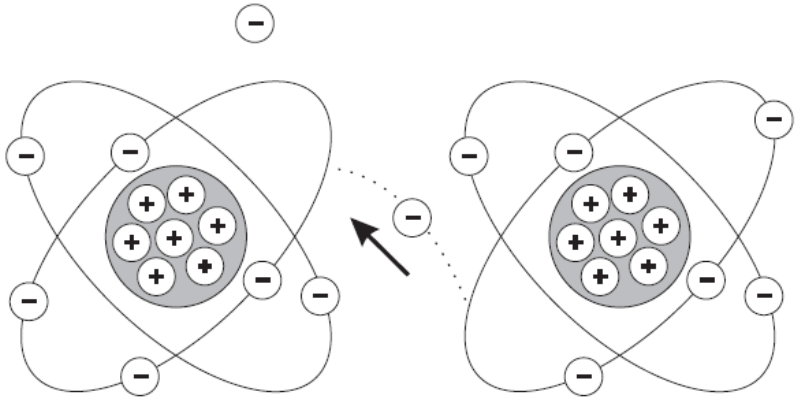


So, how can anything made of atoms be charged?

An object becomes positively charged when it loses electrons.



An object becomes negatively charged when it gains electrons.

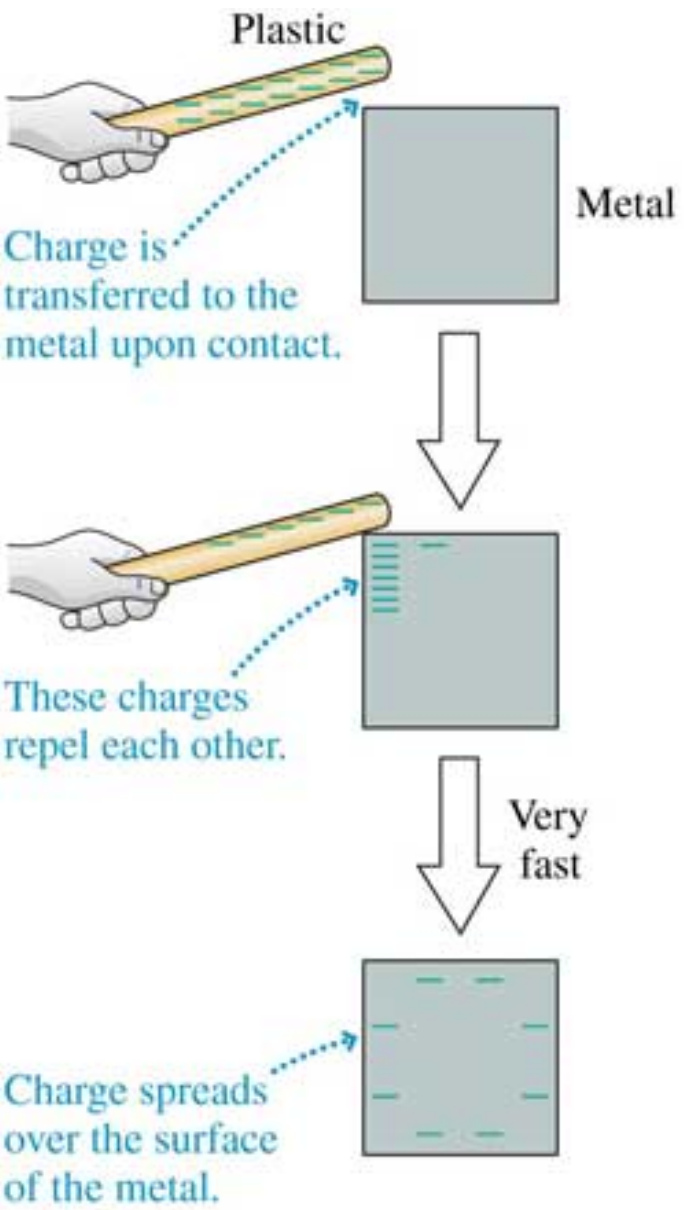


When trying to understand the transfer of electrons, think of a chalk board and eraser. How might this illustrate electron transfer?

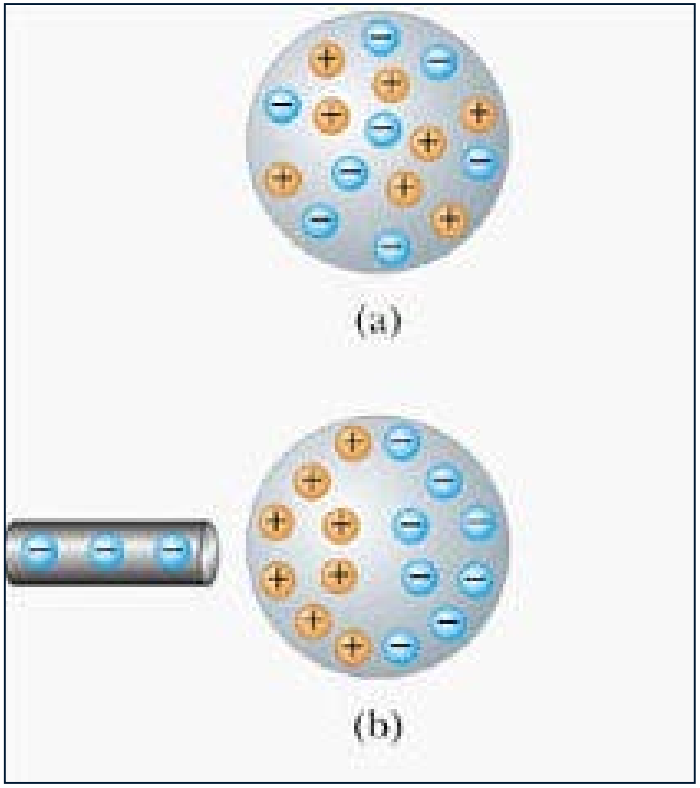
The eraser represents a positively charged object, the chalk particles represent electrons, and the (clean) board represents an uncharged object.

When the board is wiped by the eraser, there is an “electron trail” that the chalk leaves behind.

Objects can be charged when electrons move from one object to another by direct contact (conduction).



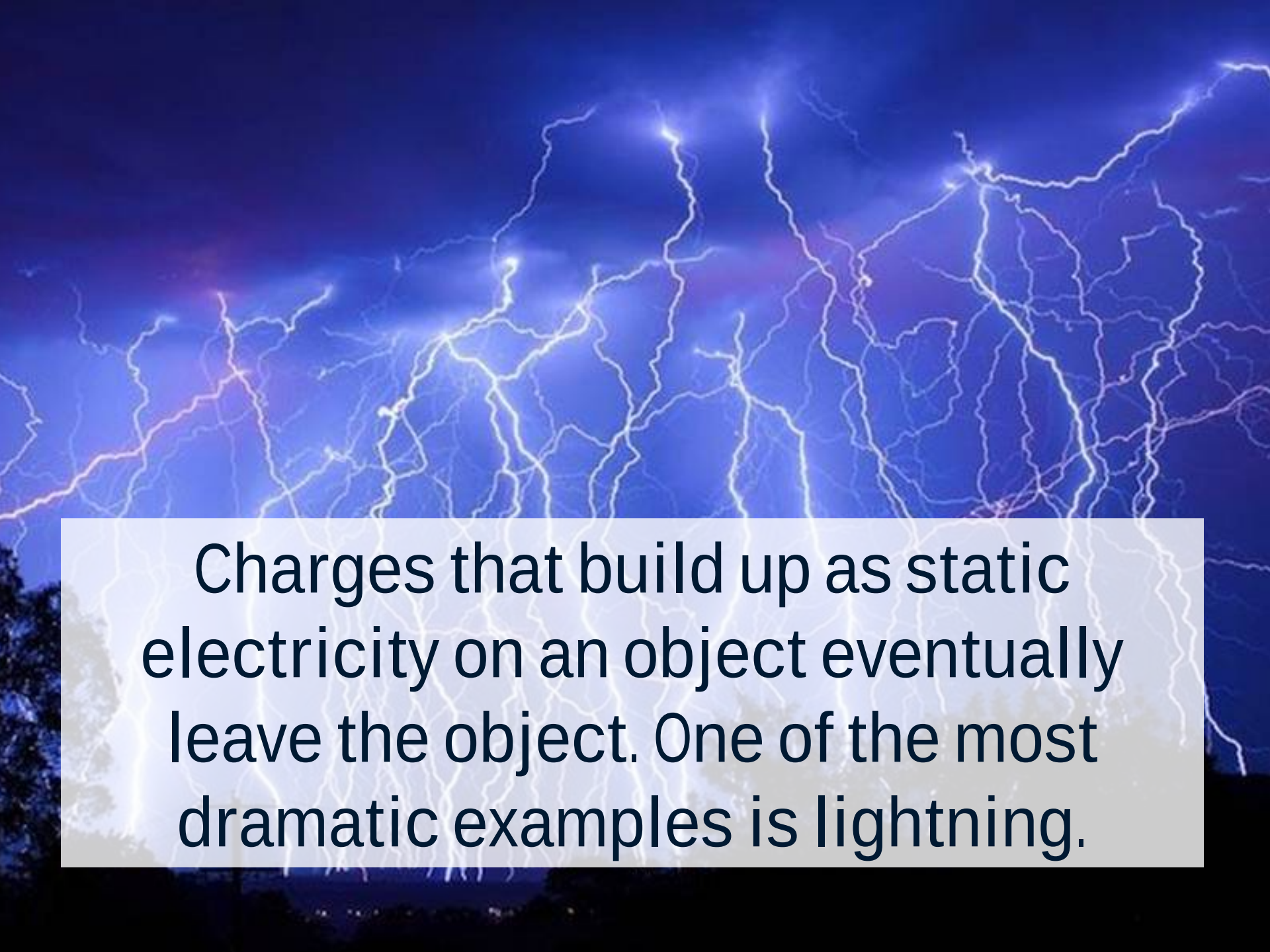
Objects can be charged when charges in an uncharged metal object are rearranged without direct contact with a charged object (induction).



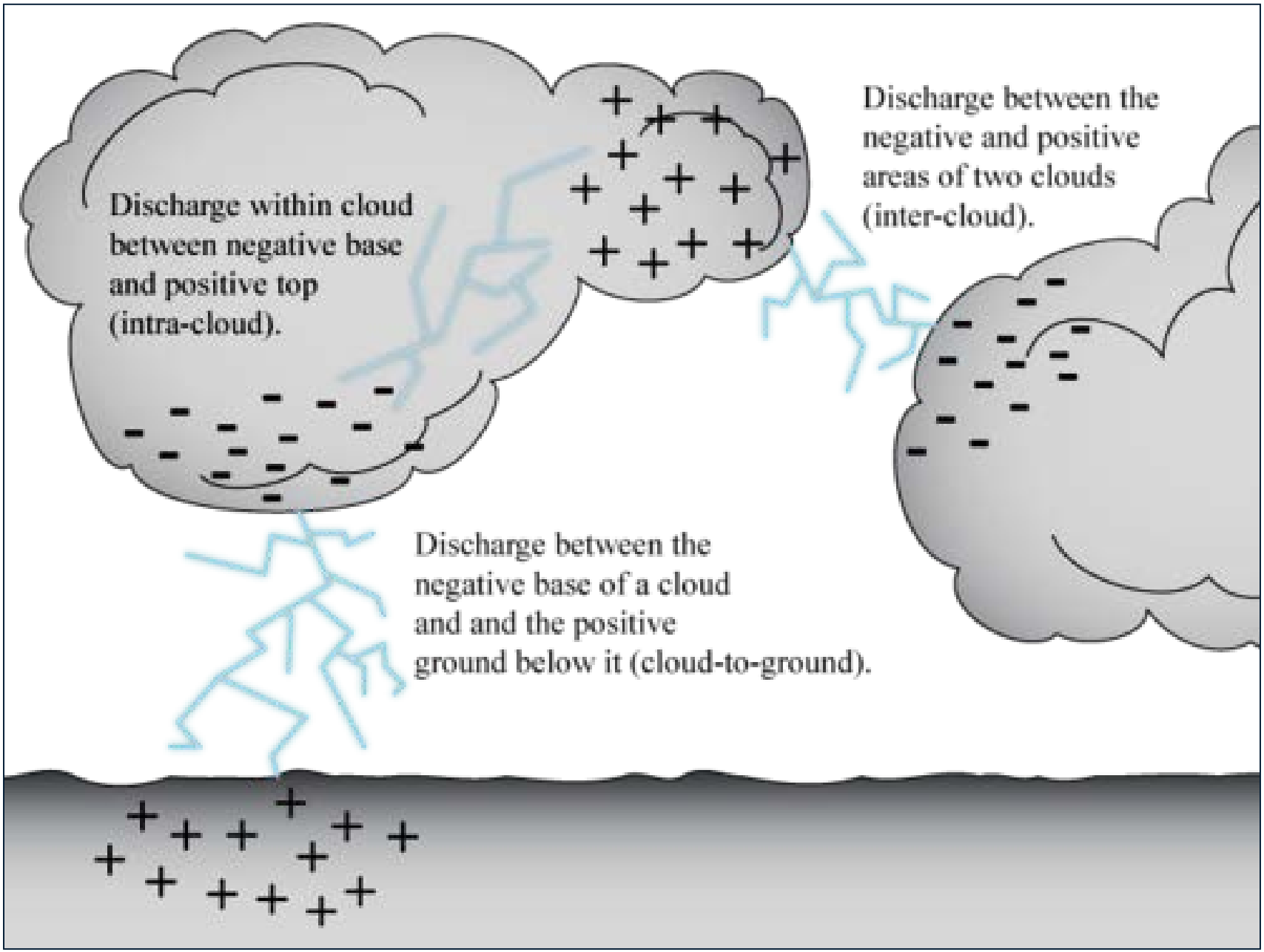
Static Electricity is an electric charge at rest; generally produced by friction or induction.

The charges of static electricity do not move away from the object that they are in. So, the object keeps its charge.

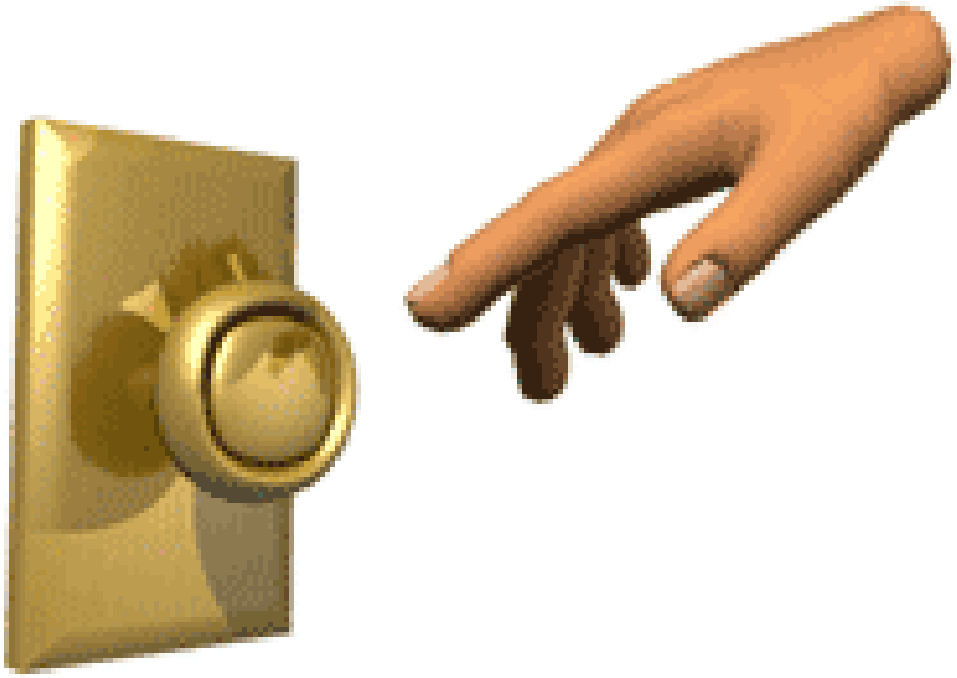
Your clothes are charged by friction as they rub against each other inside a dryer. As the clothes tumble, negative charges are lost by some clothes and build up on other clothes.



Charges that build up as static electricity on an object eventually leave the object. One of the most dramatic examples is lightning.


Discharge within cloud between negative base and positive top (intra-cloud).
Discharge between the negative and positive areas of two clouds (inter-cloud).
Discharge between the negative base of a cloud and and the positive ground below it (cloud-to-ground).

Shocking yourself on a door knob is a smaller example of built up static electricity being released.



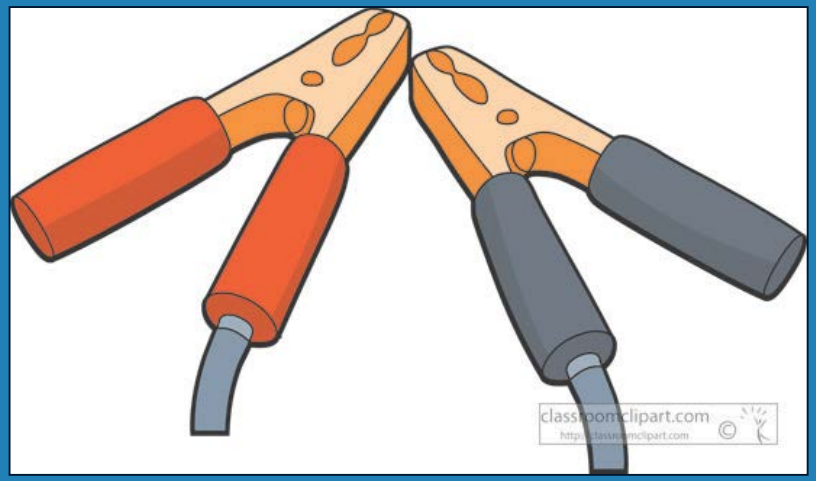
Electrical Conductors

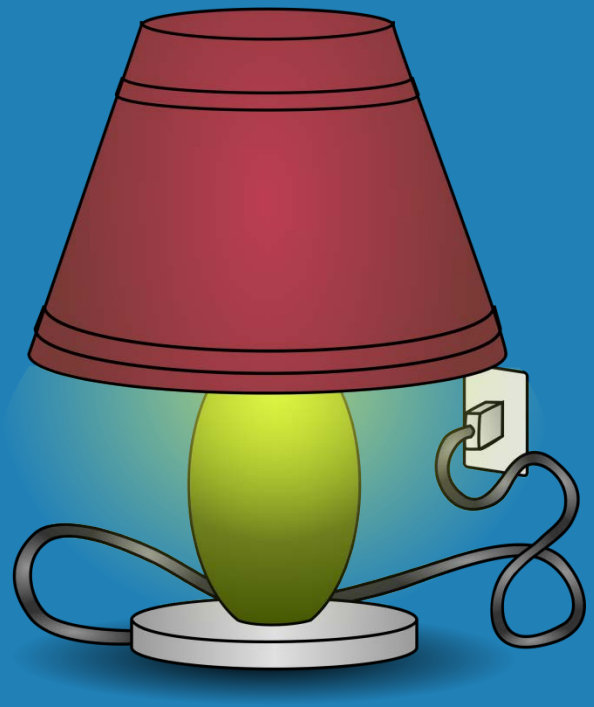
- An electrical conductor is a material in which charges can move easily.
- Most metals are good conductors because some of their electrons are free to move.
- Copper, aluminum, and mercury are good conductors.

Electrical Insulators

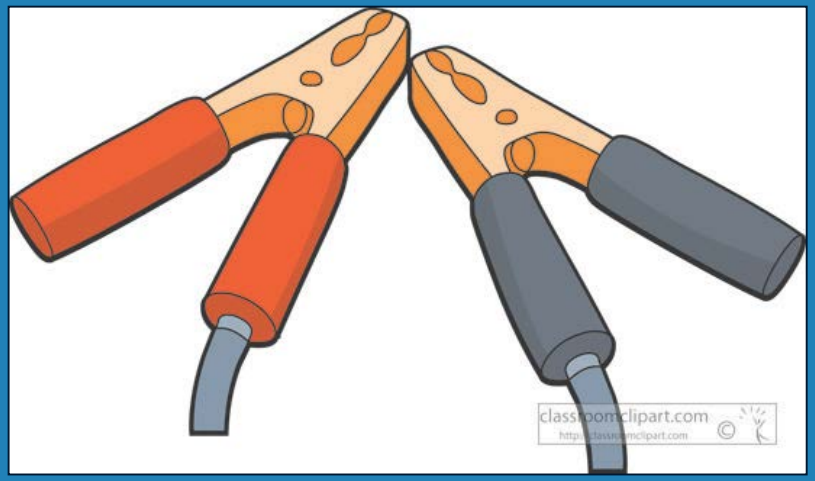
- An electrical insulator is a material in which charges cannot move easily (their electrons cannot flow freely).
- Plastic, rubber, glass, wood, and air are good conductors.

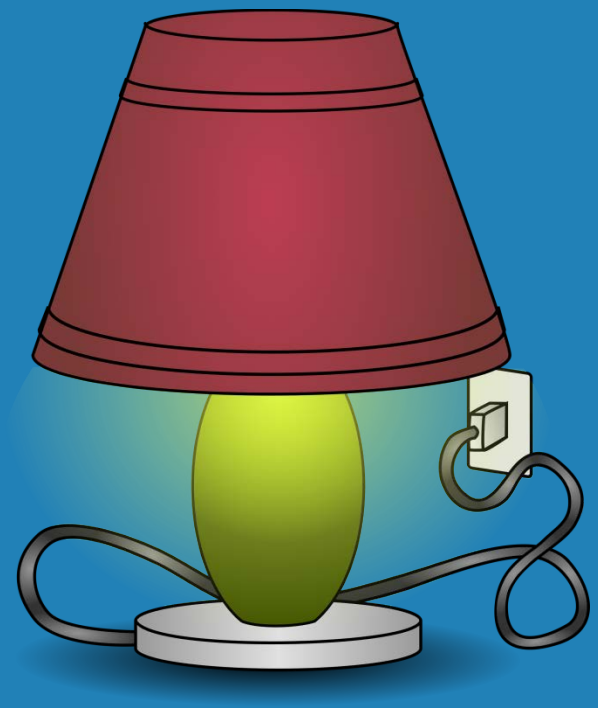
Explain why jumper cables and a lamp cord are made of both metal, a conductor, and plastic, an insulator.





The metal easily carries the electric charges while the plastic keeps the charges away from your hands.





Review of Big Concepts:

- Like charges repel and opposite charges attract.
- The size of the electric force between two objects depends on the size of the charges exerting the force and the distance between the objects.
- Charged objects exert a force on each other and can cause each other to move.

Review of Big Concepts:

- Objects become charged when they gain or lose electrons.
- Objects may become charged by friction (rubbing), conduction (direct contact), or by the rearrangement of charges without direct contact (induction).
- Static electricity is the buildup of electric charges on an object that are eventually released.