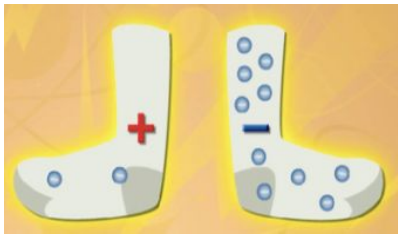
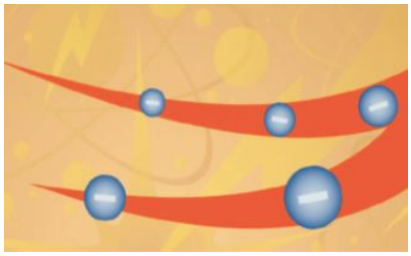
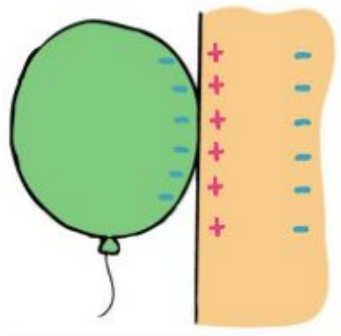
Electrostatics

"He sends it forth under the whole heaven, His lightning to the ends of the earth."
Job 37:3

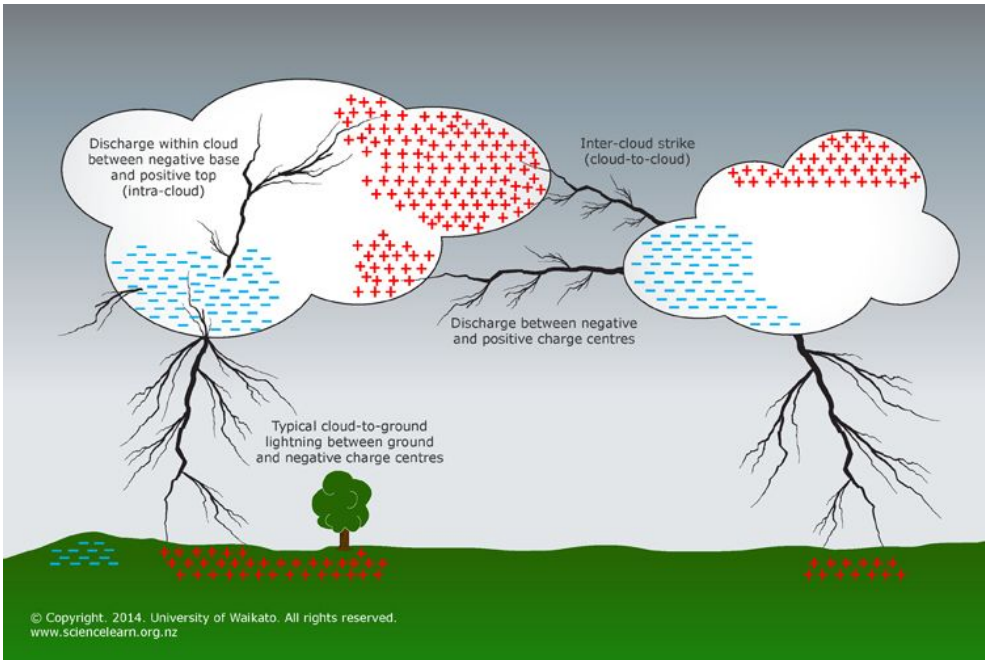
- Electrostatics: study of nature, behavior, and uses of static electricity
  "Electron": [Gr.] amber → based on movement of electrons
- Electric charge: property that allows protons and electrons to attract and repel other charged particles by the electromagnetic force
- Electricity: interactions between electrons and other charged particles
- Charges of an electron (e-) and proton are equal in magnitude → equal and opposite charges cancel each other when they come into contact; neutral atom/object has equal number of positive and negative charges
- Static electricity:
  -simplest form of electricity
  -electrons remain stationary on the surface of the object
  -an imbalance of electric charges within or on the surface of a material
- Atoms can gain or lose e- through heat, friction, chemical reactions or exposure to certain types of radiation

	• When clothes move around in the dryer, they rub together and against the metal inside of the dryer. • Electrons move from one object to the other, and some of the clothing becomes negatively charged and other pieces are positively charged. • Because the charges are opposite, the charged pieces of clothing stick together. • Fabric softener will reduce the amount of charge exchanged between the clothes and thus reduce the amount of static cling.
	• When you rub a balloon on your head it causes opposite static charges to build up both on your hair and the balloon. • When you pull the balloon slowly away from your head, you can see these two opposite static charges attracting one another and making your hair stand up. • Your hair stands up on its own because the negative charges in your hair strands are repelling each other.

	• If you rub a balloon against your sweater, the balloon will steal electrons from the sweater, which leaves the sweater positively charged and the balloon negatively charged. • The balloon will most likely be attracted back to the sweater because opposite charges attract. • The reason that the balloon will stick to the wall is because the negative charges in the balloon will make the electrons in the wall move to the other side of their atoms (like charges repel) and this leaves the surface of the wall positively charged. • Because opposite charges attract, the negatively charged balloon will be attracted to the positively charged surface of the wall.

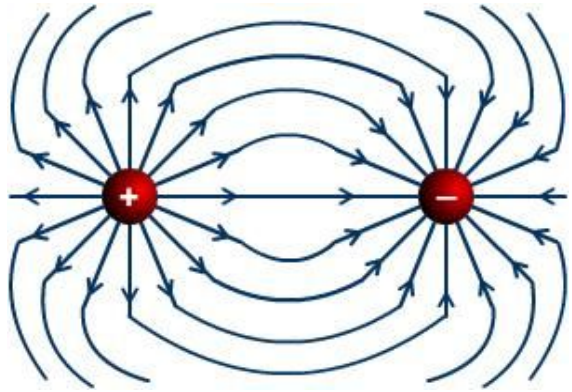
<u>Lightning</u>

- frictional charging
- Clouds are known to contain countless millions of suspended water droplets and ice particles moving and whirling about in turbulent fashion.
- Within a thundercloud, the rapid upward and downward movement of water droplets and ice crystals can separate and concentrate these charges. The negative charges accumulate at the bottom part of the cloud and the positive charges towards the top.
- Electrons on Earth's outer surface are repelled by the negatively charged cloud's bottom surface. This creates an opposite charge on the Earth's surface.
- With the cloud polarized into opposites and with a positive charge induced upon Earth's surface, lightning can strike.



Electric Field

- region around a charged object in which other objects are attracted or repelled by an electric force
- lines of force: indicate direction and strength of the field; (+) lines radiate out, (-) radiate inward



- SI unit of charge is the coulomb (C) = charge of 6.24 x 10^{18} electrons
- Law of electric charges: opposite charges attract each other, but like charges repel each other

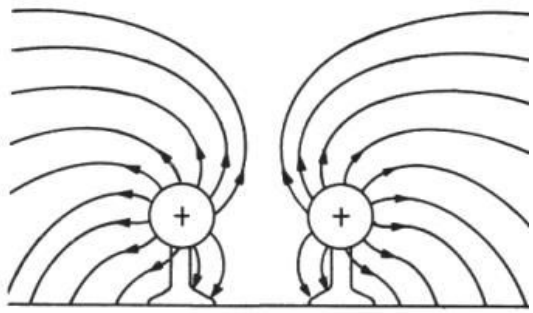
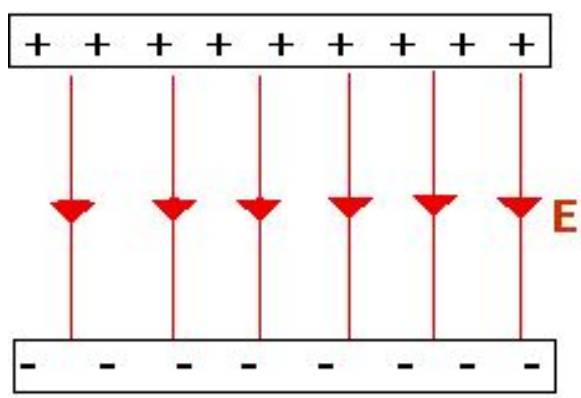


FIGURE 8–8. Field around two positively charged bodies.

- Uniform electric field: formed if two plates of opposite charge are close to each other; strength of the field is uniform throughout

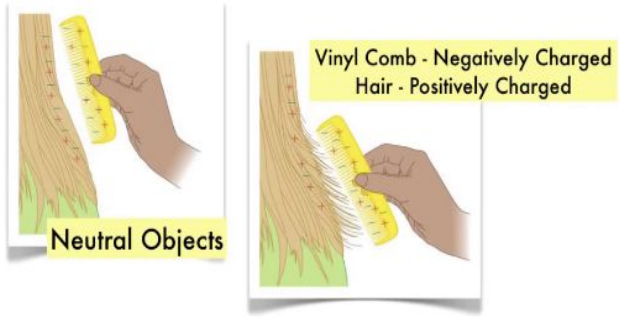
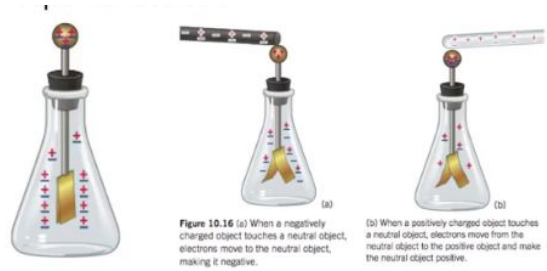


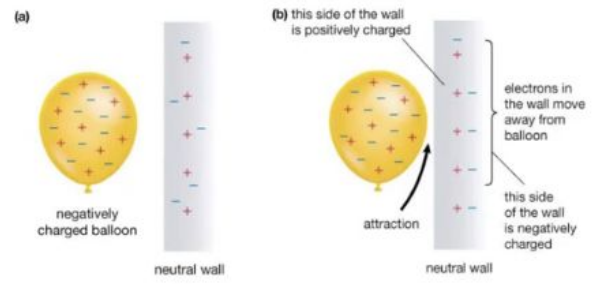
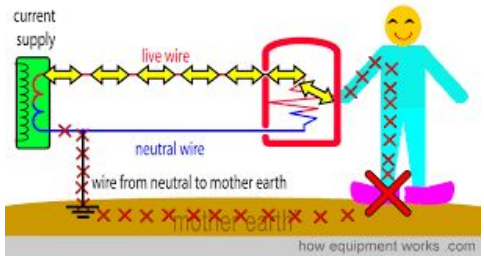
- Law of electric force: strength of the attraction or repulsion between two charged objects is directly related to the strength of the charges and inversely related to the distance between them:

  $F = \text{constant} \times \frac{\text{strength of charge}_1 \times \text{strength of charge}_2}{(\text{distance between objects})^2}$ OR $F = k \times \frac{q_1 \times q_2}{d^2}$

Transferring charges

- Electric charge can be transferred between objects
- Law of conservation of charge: total charge is the same before and after an interaction; true bc e- are neither created nor destroyed according to the law of conservation of matter

Type of charge transfer	Description	Example
Friction	Charging of two neutral objects made of different material by rubbing them together	
Conduction	-Charge between a charged and a neutral object -Neutral object becomes charged with the same charge as the object that touched it	 **Figure 10.16** (a) When a negatively charged object touches a neutral object, electrons move to the neutral object, making it negative. (b) When a positively charged object touches a neutral object, electrons move from the neutral object to the positive object and make the neutral object positive. (a) (-) charged object touches neutral object → e- transferred → object becomes (-) (b) (+) charged object touches neutral object → e- move from the neutral object to the (+) object → neutral object becomes (+)

Induction	Charging a neutral object by bringing another charged object close to, but not touching, the neutral object	
Grounding	-Connecting a charged object to the Earth's surface -Provides a path for e-	

Also...

- Ion: atom/group of atoms that has an electric charge
  anions: (-) ions
  cations: (+) ions
- Air can conduct a current, though it is not a good conductor of electricity
- Liquids and solutions conduct current through the movement of ions
- Solid - atoms occupy fixed positions → charge can flow only through the movement of electrons