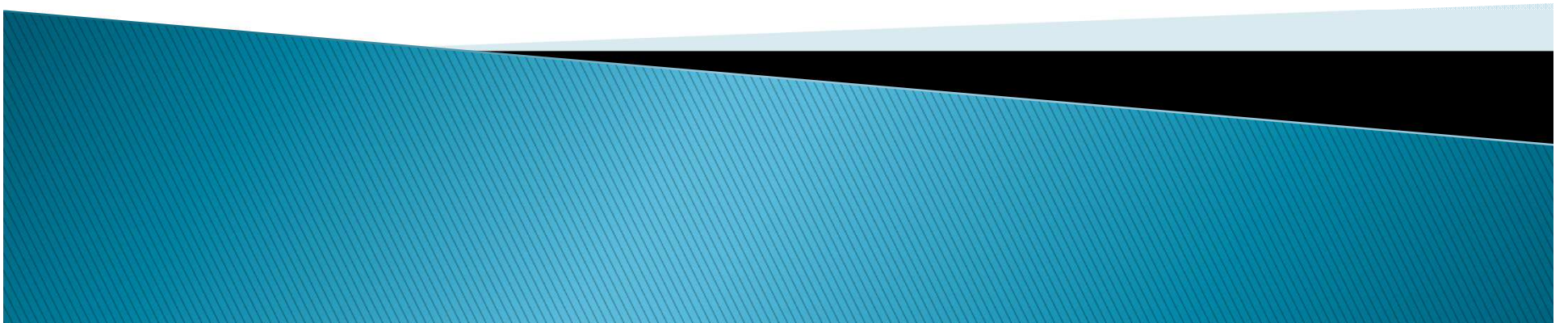
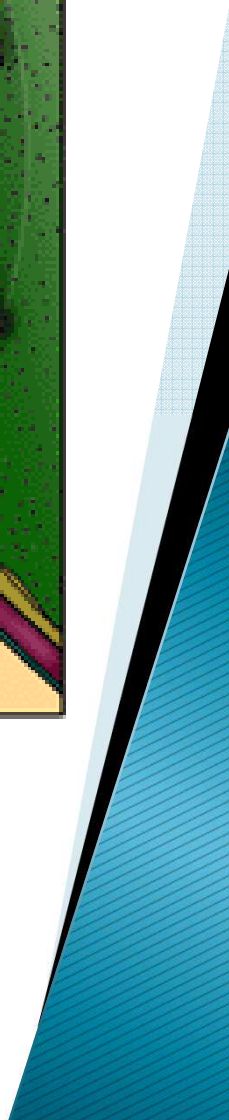


# Charge and Electric Force

AP Physics 1  
April 14, 2015



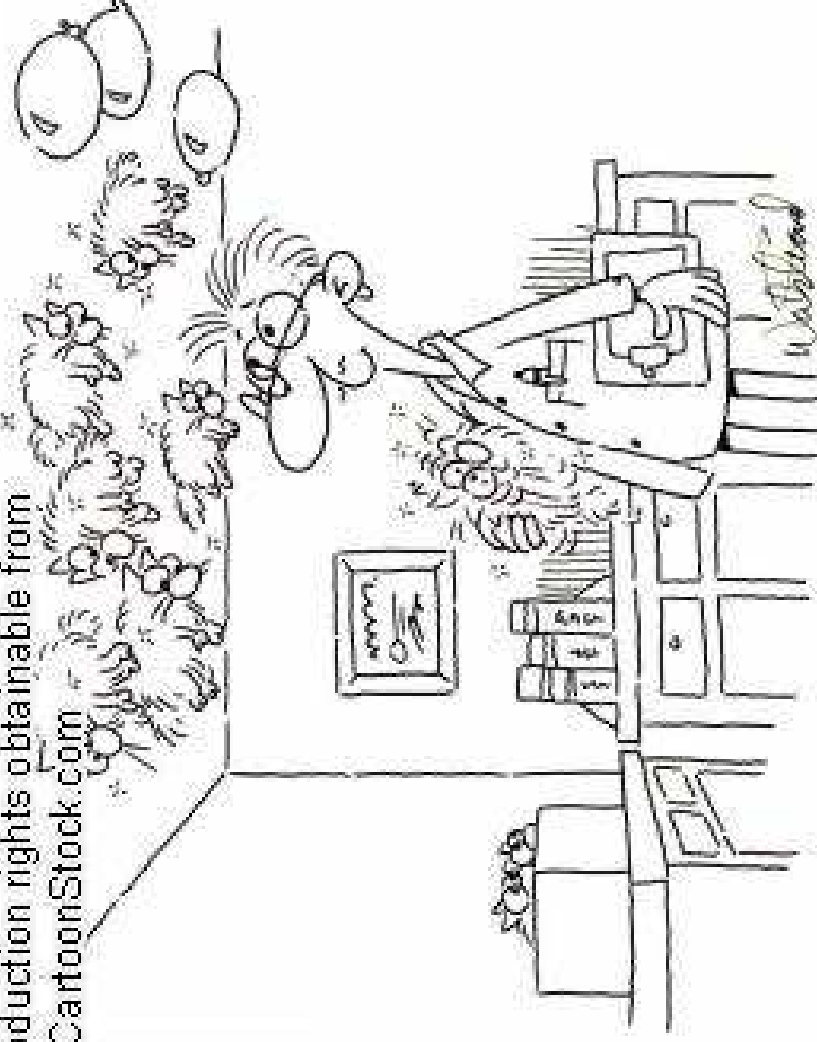
**MCHUMOR.COM** by T. McCracken



# Video: Part 1-3 - Charge

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In spite of the protests from animal rights groups, doctor Clemens continues his experiments on static electricity.

# Electric Charge

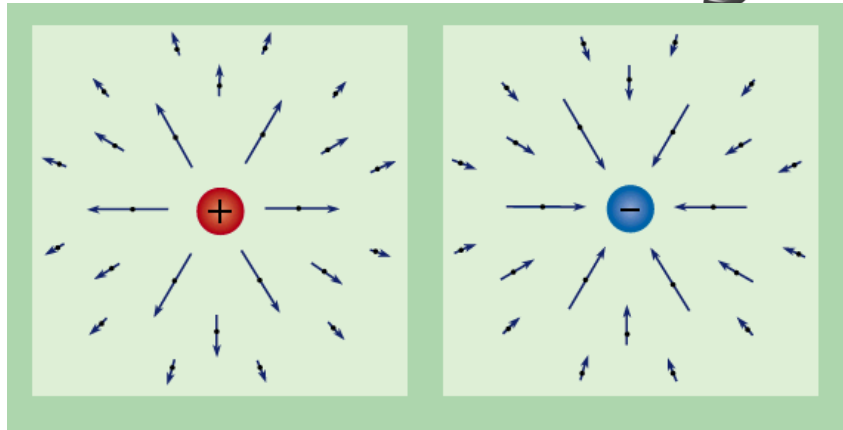
“Charge” is a property of subatomic particles.

Facts about charge:

- ▶ There are 2 types basically, positive (protons) and negative (electrons)
- ▶ LIKE charges REPEL and OPPOSITE charges ATTRACT
- ▶ Charges are symbolic of fluids in that they can be in 2 states, STATIC or DYNAMIC.



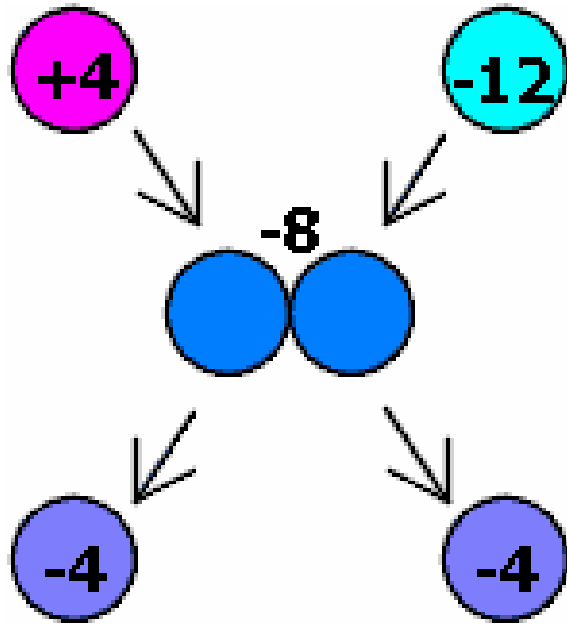
# Electric Charge – The specifics



- The symbol for CHARGE is “q”
- The unit is the COULOMB(C), named after Charles Coulomb
- If we are talking about a SINGLE charged particle such as 1 electron or 1 proton we are referring to an ELEMENTARY charge and often use, **e** , to symbolize this.

| Particle | Charge                  | Mass                      |
|----------|-------------------------|---------------------------|
| Proton   | $1.6 \times 10^{-19}$ C | $1.67 \times 10^{-27}$ kg |
| Electron | $1.6 \times 10^{-19}$ C | $9.11 \times 10^{-31}$ kg |
| Neutron  | 0                       | $1.67 \times 10^{-27}$ kg |

# Charge is “CONSERVED”



Charge cannot be created or destroyed only transferred from one object to another. Even though these 2 charges attract initially, they repel after touching. Notice the NET charge stays the same.



# Conductors and Insulators

The movement of charge is limited by the substance the charge is trying to pass through. There are generally 2 types of substances.

**Conductors:** Allow charge to move readily through it.

**Insulators:** Restrict the movement of the charge



Conductor = Copper Wire  
Insulator = Plastic sheath

# Charging and Discharging

There are basically 2 ways you can charge something.

1. Charge by friction
2. Induction



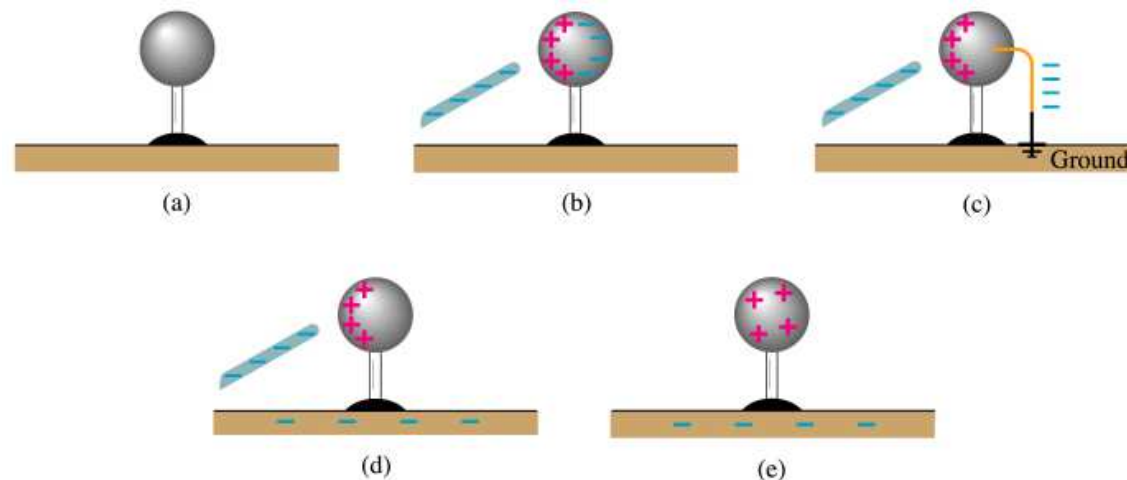
“BIONIC is the first-ever ionic formula mascara. The primary ingredient in BIONIC is a chain molecule with a positive charge. The friction caused by sweeping the mascara brush across lashes causes a negative charge. Since opposites attract, the positively charged formula adheres to the negatively charged lashes for a dramatic effect that lasts all day.”





# Induction and Grounding

The second way to charge something is via INDUCTION, which requires NO PHYSICAL CONTACT.



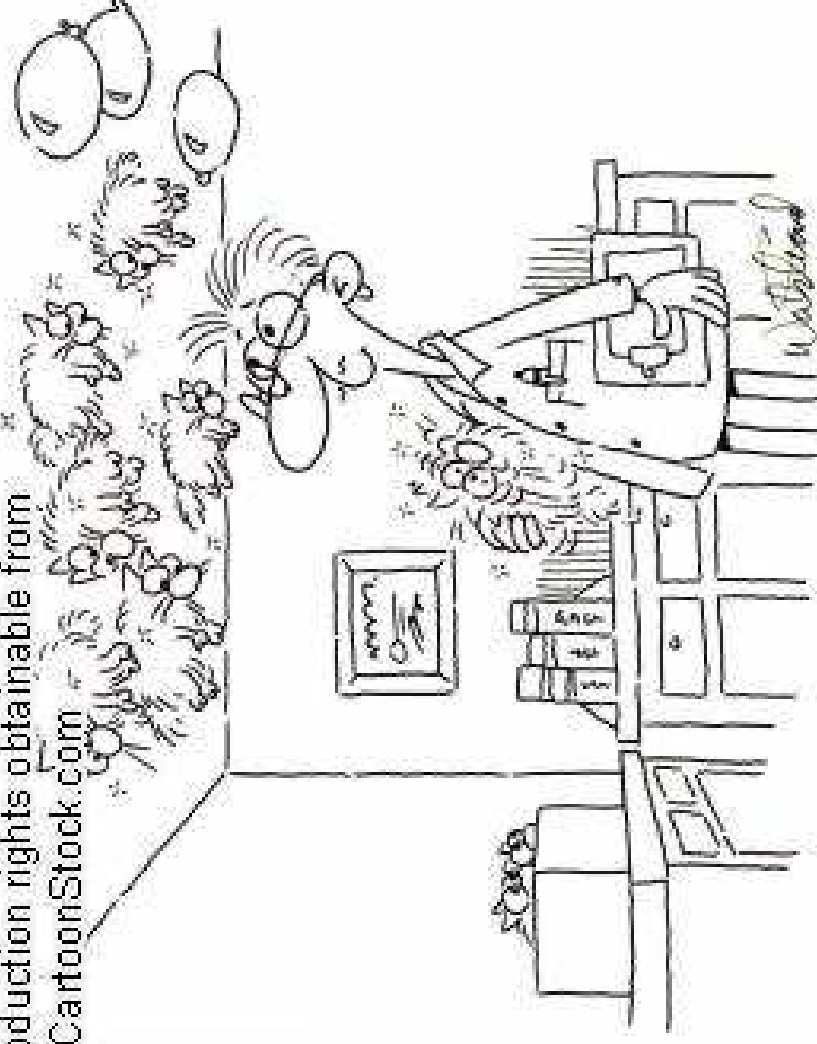
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We bring a negatively charged rod near a neutral sphere. The protons in the sphere localize near the rod, while the electrons are repelled to the other side of the sphere. A wire can then be brought in contact with the negative side and allowed to touch the GROUND. The electrons will always move towards a more massive objects to increase separation from other electrons, leaving a NET positive sphere behind.

# Video: Part 4 – Coulomb’s Law

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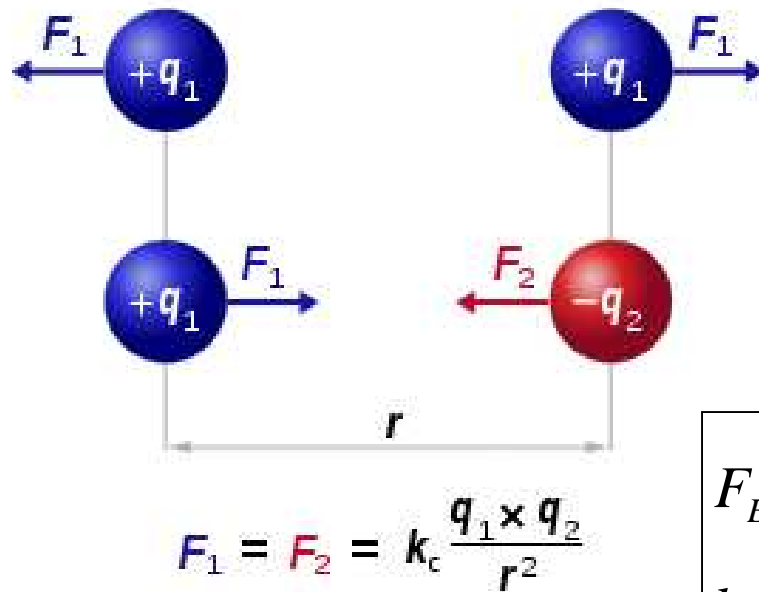
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# Electric Force

The electric force between 2 objects is:



$$F_E \propto q_1 q_2 \quad F_E \propto \frac{1}{r^2} \quad F_E \propto \frac{q_1 q_2}{r^2}$$

$k$  = constant of proportionality

$$k = \text{Coulomb constant} = 8.99 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$$

$$F_E = k \left| \frac{q_1 q_2}{r^2} \right| \rightarrow \text{Coulomb's Law}$$