Physics 30 - Forces & Fields
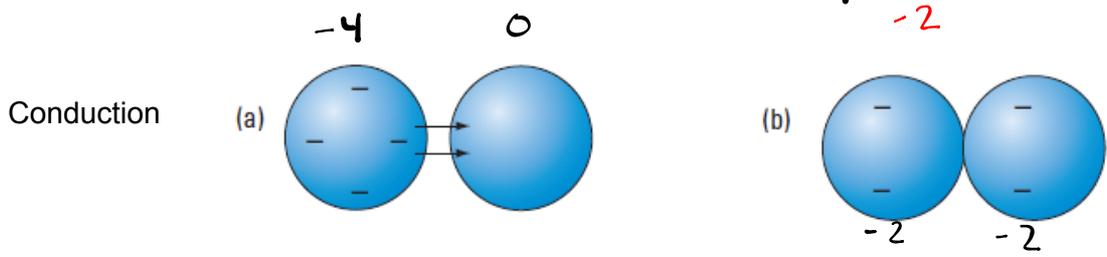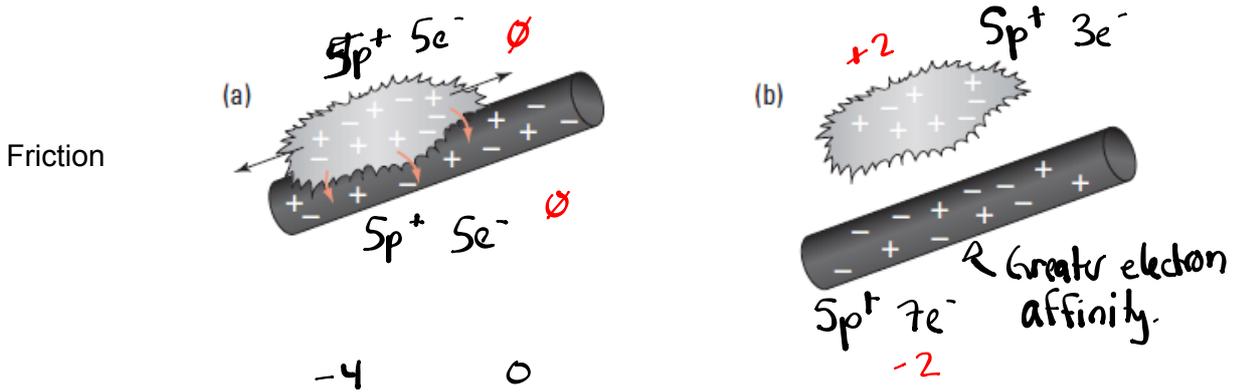
L01 - Electrical Interactions

DEMOS

PP7: Conservation of Charge - The net charge of an isolated system is conserved.

Friction

(a) $5p^+$ $5e^-$ $\emptyset$

$5p^+$ $5e^-$ $\emptyset$

(b) $+2$ $5p^+$ $3e^-$

$5p^+$ $7e^-$ -2

↳ Greater electron affinity.

Conduction

(a) -4 $\quad$ 0

(b) -2 $\quad$ -2

Induction

(a) $\qquad$ (b)

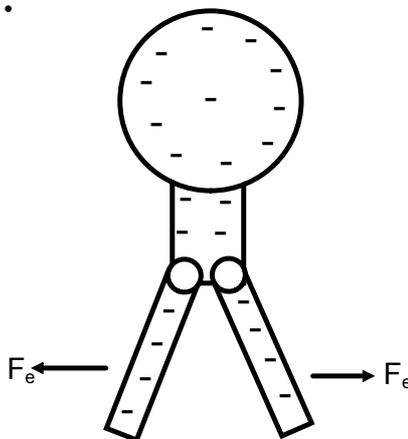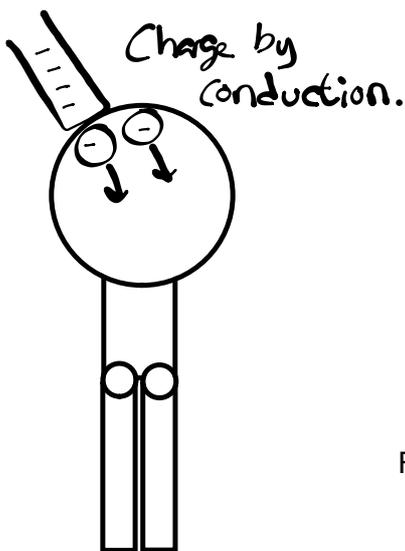negatively charged

e^-

negatively charged
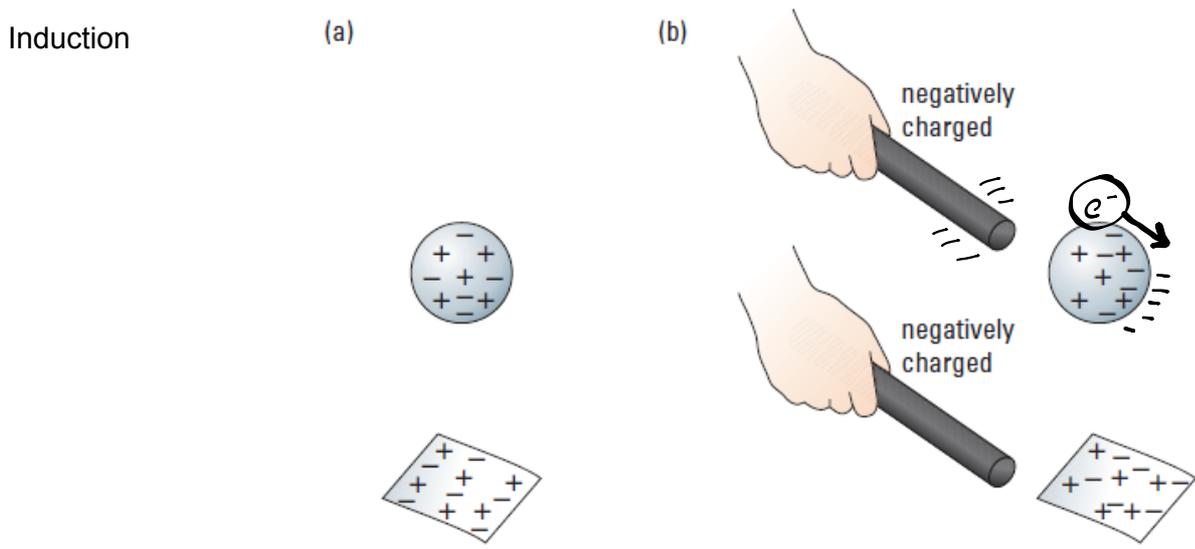
Charge by Induction

When you rub a balloon on your hair, you are charging it by friction. Explain why the balloon will then stick to a wall for a long time.
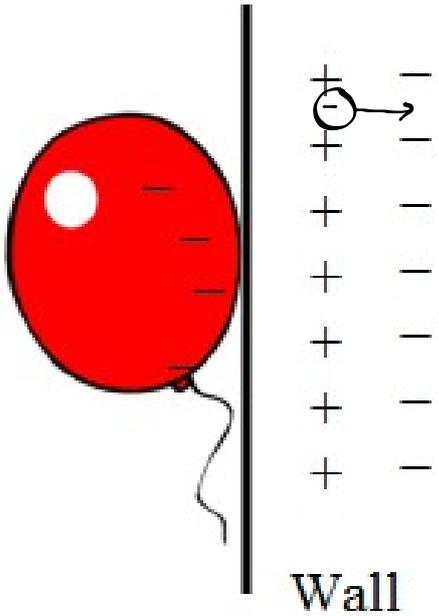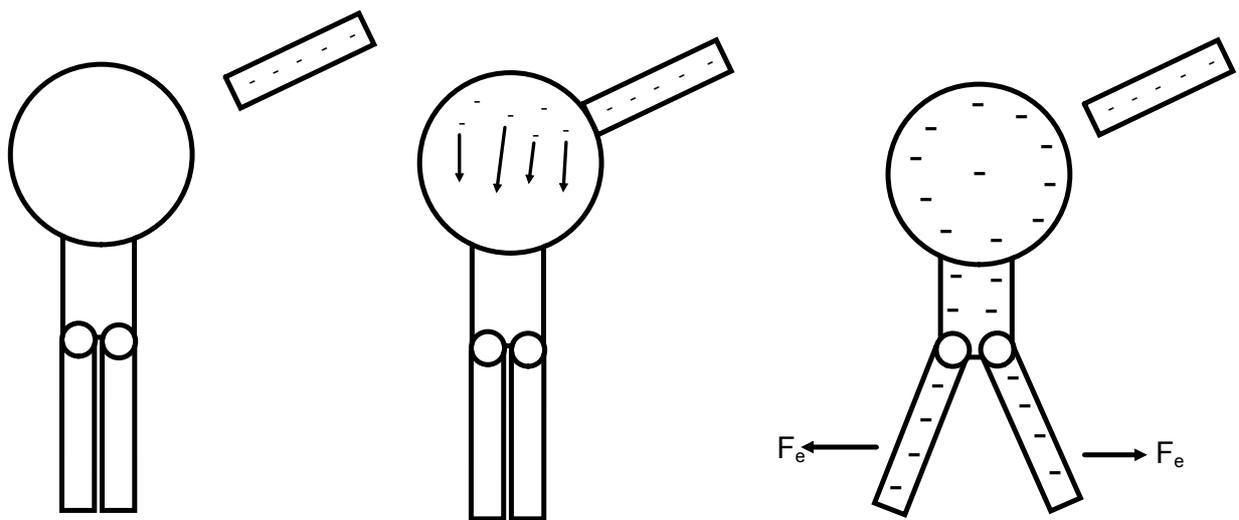
Balloons and Static Electricity

Wall

Electroscopes

Charge by
Conduction.

$F_e \longleftarrow \qquad \longrightarrow F_e$

Video: What is an Electroscope?

Electroscope – Charge by Conduction

F_e ← → F_e

Negative Rod + Conduction = Negative Electroscope

Electroscope – Charge by Induction – Not Grounded

F_e ← ... → F_e
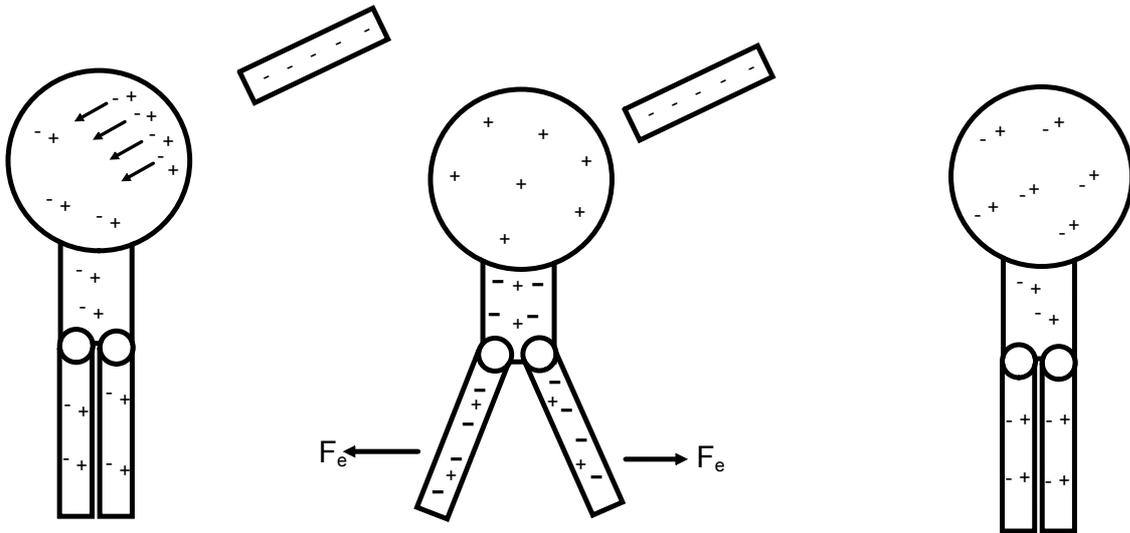
Negative Rod + Induction = Neutral (Polar) Electroscope

Electroscope – Charge by Induction – Grounded

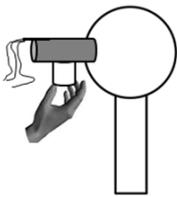F_e ← ... → F_e

F_e ← ... → F_e
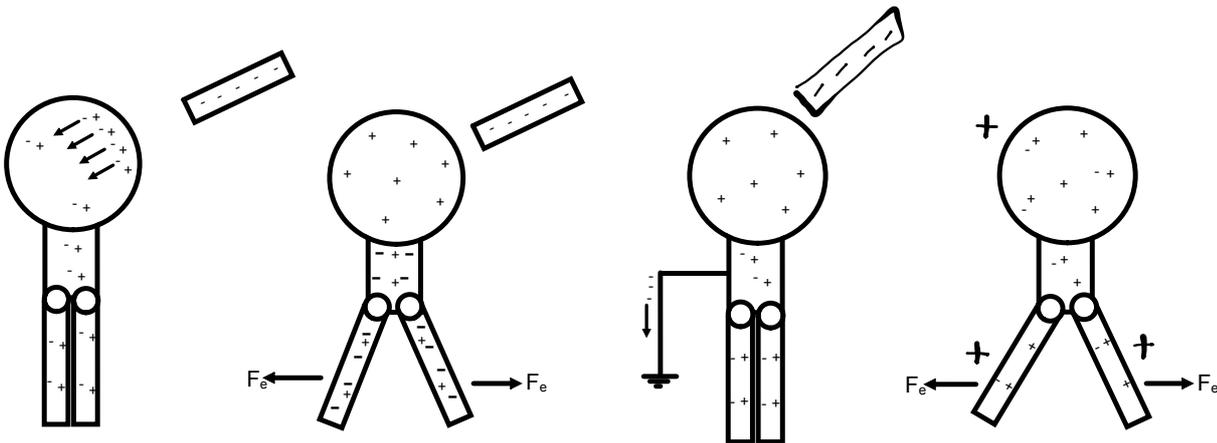
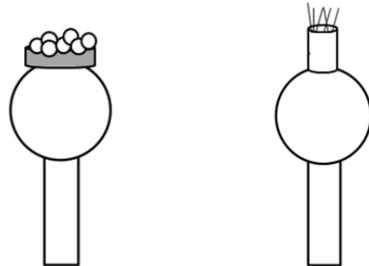*Negative Rod + Induction & Grounding = Positive Electroscope*

Van De Graff Generator Demos
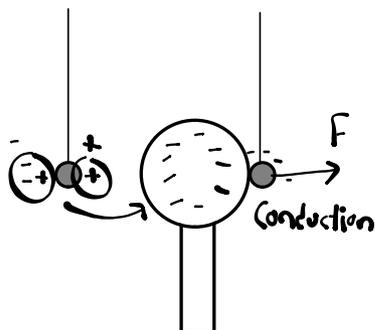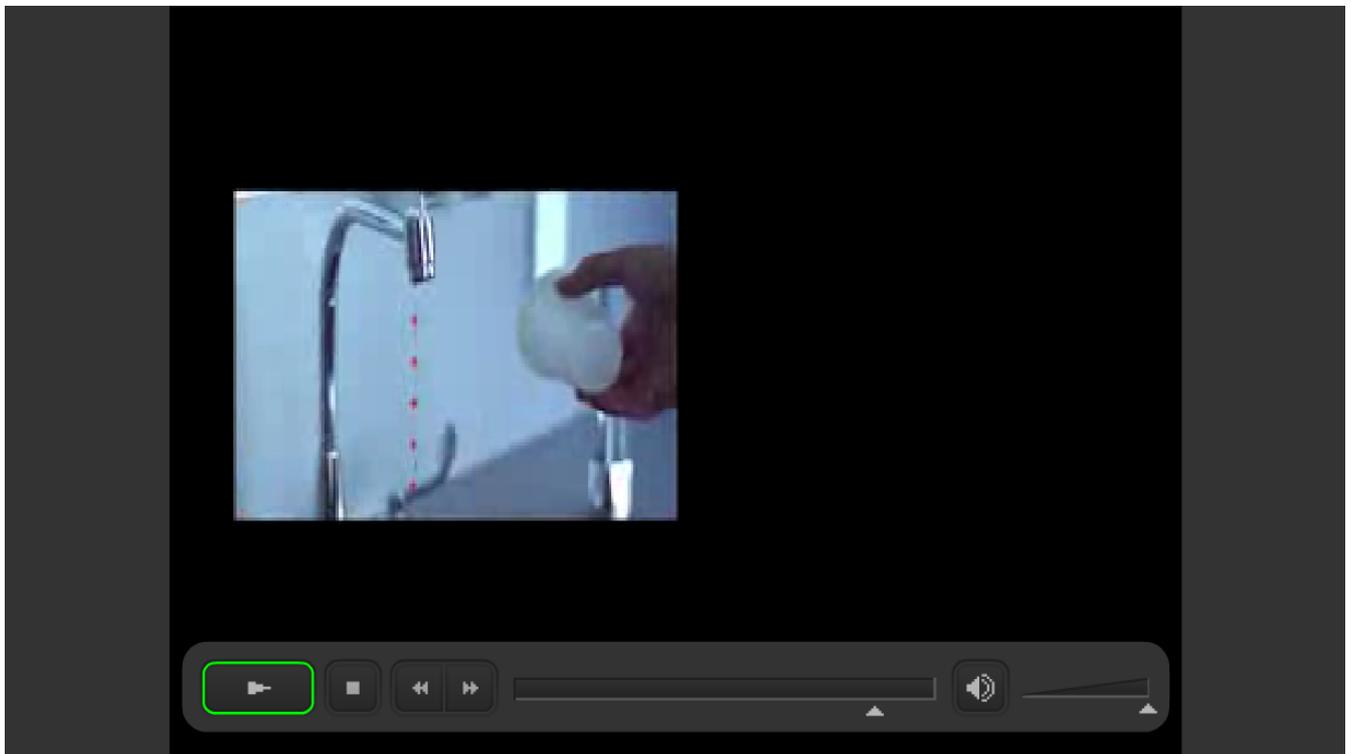
Agenda:
- Homemade Electroscope

- Charge by Conduction (Packing Peanuts, Toothpicks)
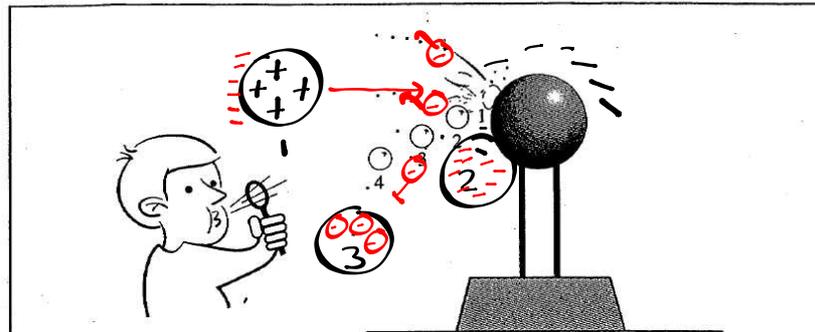 > *Discussion of Current as Charge over Time*

- Hanging Pith Balls

Video: Charge by Induction in Water?

Use the following information to answer the next question.

In a classroom demonstration, the dome of a Van de Graaff generator was initially charged negatively. A stream of closely spaced neutral soap bubbles was blown toward the dome of the generator. Much to the surprise of the teacher and the students, the following observations were made:
• the bubbles were initially attracted to the top of the dome of the generator until the first bubble hit the dome
• the first bubble hit the dome and splattered
• all the other bubbles then stopped in mid-air
• the other bubbles were then repelled from the dome of the generator and from each other

| Written Response – 15% |

1. Using the concepts of electrostatic forces and charge distribution, explain
   • why the soap bubbles were initially attracted to the top of the generator
   • why, after the first soap bubble splattered, the other bubbles were repelled from the generator and from each other
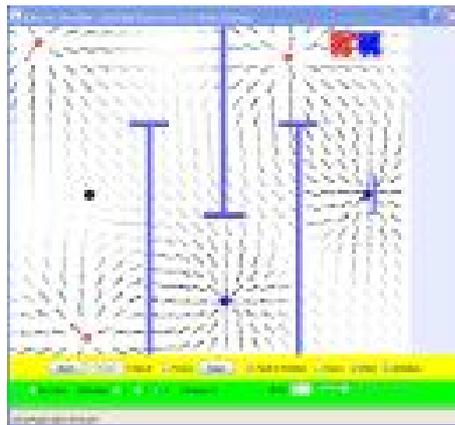
Static Electricity and Bubbles

The "Inverse r²" Relationship

Gravitational Force	Electrostatic Force
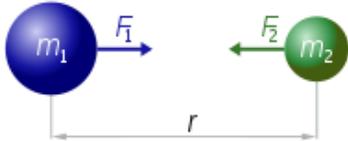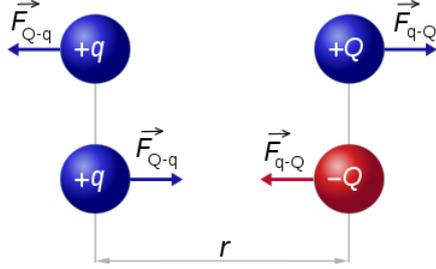
$$F = G\frac{m_1 m_2}{r^2},$$

$$G \approx 6.674 \times 10^{-11} \text{ N (m/kg)}^2$$

$$F = k_e\frac{q_1 q_2}{r^2}$$

$$k_e = \frac{1}{4\pi\varepsilon_0} = \frac{c^2 \mu_0}{4\pi} = c^2 \cdot 10^{-7} \text{ H} \cdot \text{m}^{-1}$$
$$= 8.987\ 551\ 787\ 368\ 176\ 4 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$$

Similarities? Differences?

http://phet.colorado.edu/en/simulation/electric-hockey

Electric Field Hockey