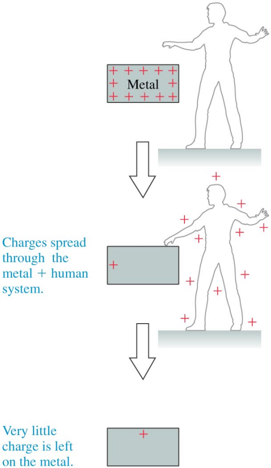
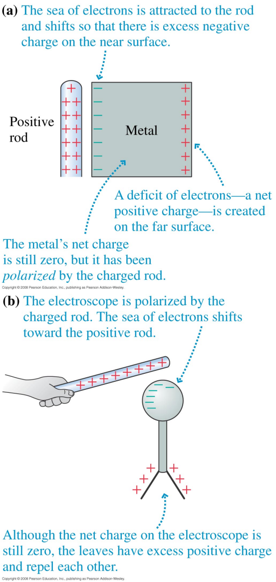
Discharging



- Place two conductors in contact with each other and the charge gets shared.
- A human is composed mainly of salty water, making us good conductors (Na+ and Cl- ions).
- For example, touch a positively charged conductor, donate electrons to the metal and share the net positive charge over your combined surfaces. You become positively charged.
- The earth is a giant conductor which we can purposely share charge with - through grounding.
- Moist air is also a conductor – a poor one. Charged objects in air slowly lose their charge.

Charge Polarization



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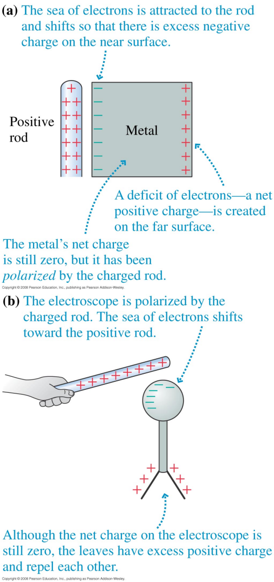

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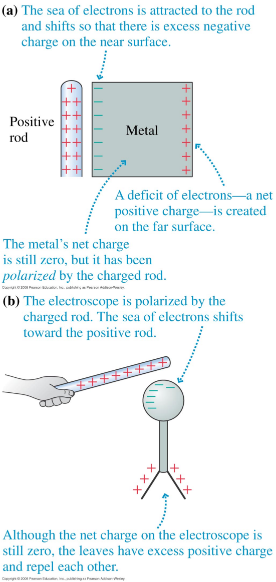

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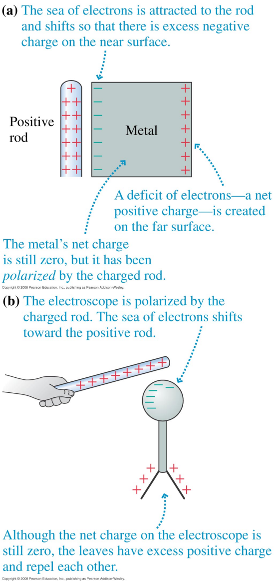

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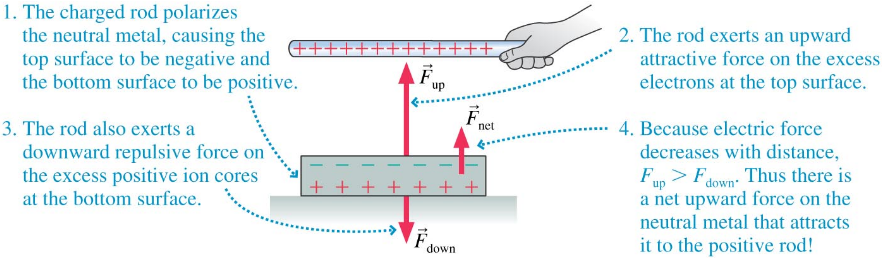
- The presence of a charged object can polarize another object.
- The object is neutral, but positive and negative charges become separated.
- The positive ions also attract the surface electrons, quickly creating an equilibrium and ensuring that the object de-polarizes once the charged rod is removed.

Charge Polarization



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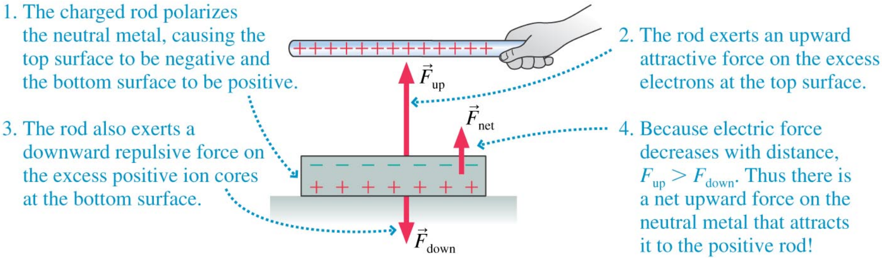

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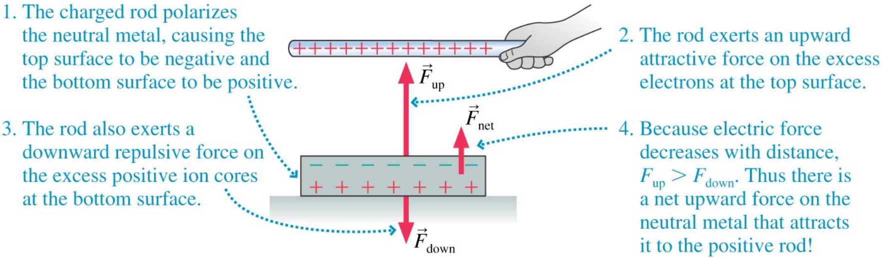

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- Net attraction also occurs if the rod is negatively charged: because then the polarization is reversed.

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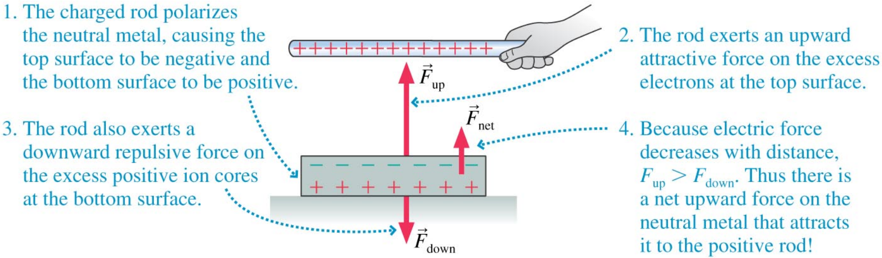

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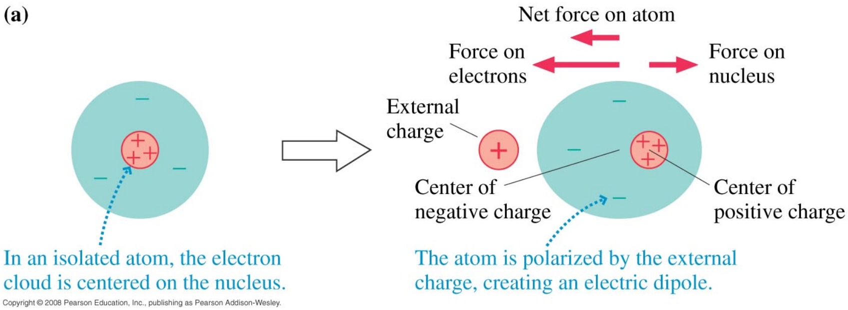
- Net attraction also occurs if the rod is negatively charged: because then the polarization is reversed.
- A neutral object is attracted to a charged object!

The Electric Dipole



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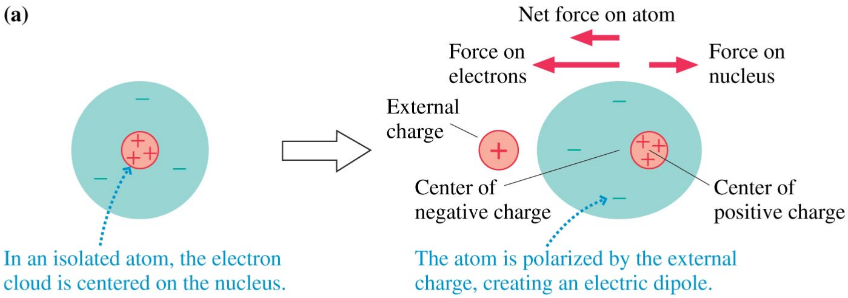

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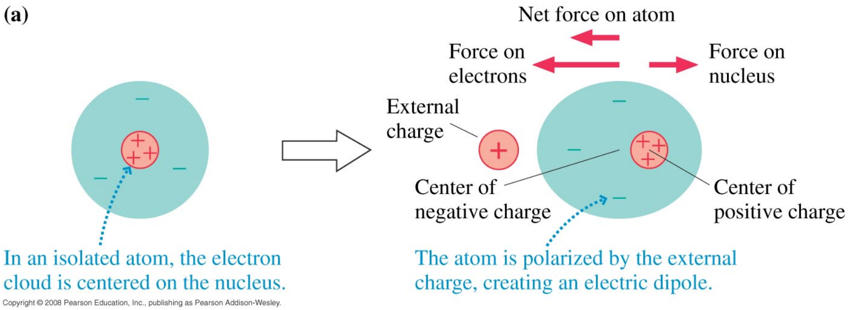
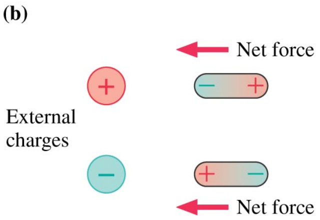
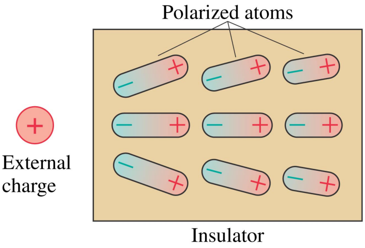


- So far we have been talking only about conductors. But we know that a charged rod will pick up paper (an insulator).
- In this case the charge will polarize the atoms.
- The atom forms an electric dipole



Electric dipoles can be created by either positive or negative charges. In both cases, there is an attractive net force toward the external charge.



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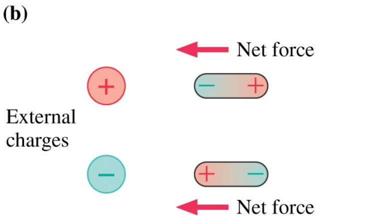

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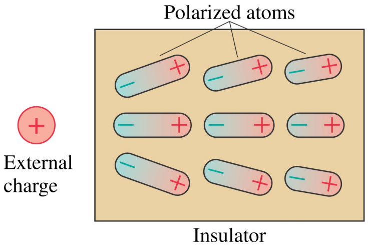
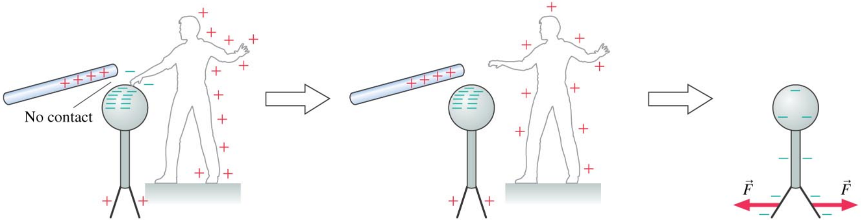


- So, an insulating medium can be polarized.
- Each individual atom is polarized leading to a net force of attraction.

Charging by Induction

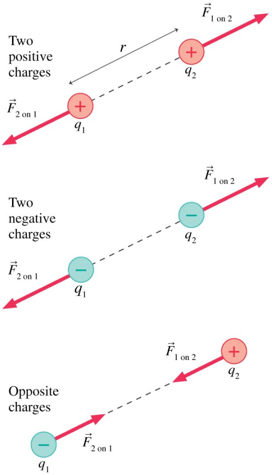


1. The charged rod polarizes the electroscope + person conductor. The leaves repel slightly due to polarization, but overall the electroscope has an excess of electrons and the person has a deficit of electrons.

2. The negative charge on the electroscope is isolated when contact is broken.

3. When the rod is removed, the leaves first collapse as the polarization vanishes, then repel as the excess negative charge spreads out. The electroscope has been *negatively* charged.

Coulomb's Law (26.4)



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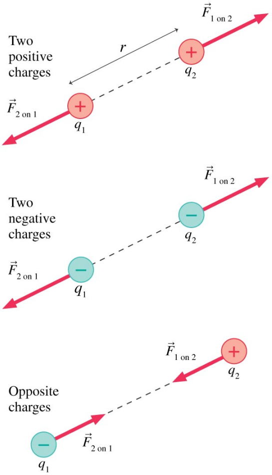

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- Coulomb's Law states

$$F_{1\text{ on }2} = F_{2\text{ on }1} = \frac{K|q_1||q_2|}{r^2}$$

Where the direction of F is along the line connecting the two particles, like particles repel and opposites attract.

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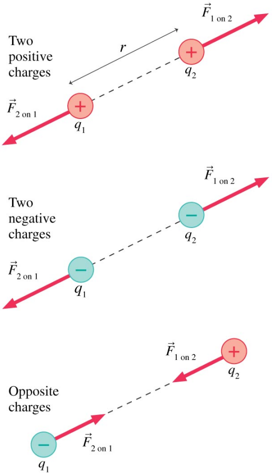

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- K is the electrostatic constant and is

$$K = 9.0 \times 10^9 \ \ \text{Nm}^2/\text{C}^2$$

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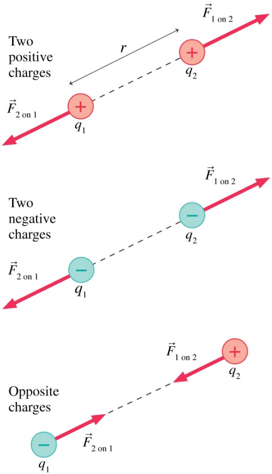

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$$\epsilon_0 = \frac{1}{4\pi K} = 8.85 \times 10^{-12}\ \text{C}^2/\text{Nm}^2$$

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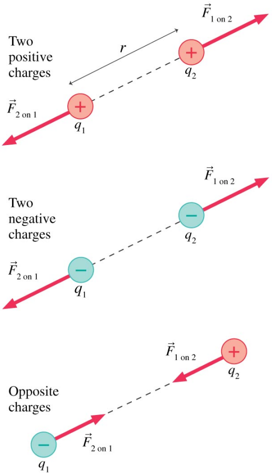

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$$\epsilon_0 = \frac{1}{4\pi K} = 8.85 \times 10^{-12}\ \mathrm{C^2/Nm^2}$$

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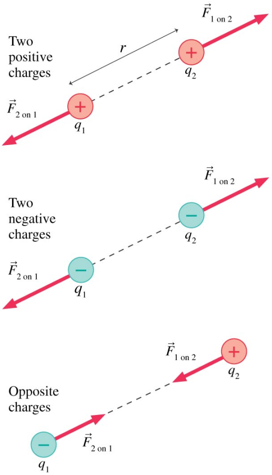

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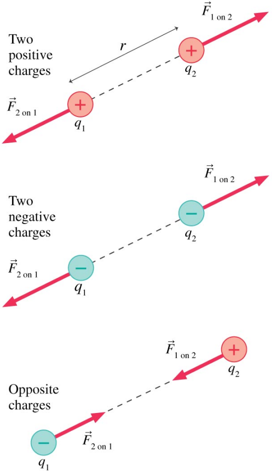

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- In vector form:

$$\vec{F}_{1\text{ on }2} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}_{1\text{ to }2}$$

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3. Electric forces, like other forces, can be superimposed

$$\vec{F}_{\text{net on j}} = \vec{F}_{\text{1 on j}} + \vec{F}_{\text{2 on j}} + \vec{F}_{\text{3 on j}} + \cdots$$