

Electrostatic Induction

These activities will improve your conceptual understanding if you predict the outcome you expect at each step below BEFORE performing the activities.

Go to the Physics Exploration Center. Enter through the resource room in 311/312 Thaw Hall. Go to the electrostatic setup which consists of a metal sphere on an insulating stand and an electrophorus (which consists of a metal plate with an insulating handle and an insulating surface).

(a) Rub the insulating surface with the blue cloth. If positive charges appear on the blue cloth, what kind of charges appear on the insulating surface. Now put the metal plate (which has an insulating handle) on the insulating surface that you just "charged" by rubbing with the cloth. Charge separation will take place on the surface of the metal plate by induction due to its proximity with the insulating surface (Note that insulating surface does not readily transfer charge to another object due to contact unless rubbed vigorously). Draw a diagram with the metal plate on top of the insulating surface showing the charge on the insulating surface and the induced charges on the two surfaces of the metal plate that are close and far from the insulating surface.

(b) Now touch the surface of the metal plate with your fingers while the plate is still on the insulating surface (then remove your fingers). Your body acts as a grounding wire. Draw a diagram similar to that in part (a) showing what happens after you touch the metal plate to the charges on the insulating surface and the metal plate.

(c) Now lift the metal plate by holding it with the insulating handle. Is there a net charge on the metal plate? Explain. Does the charge distribution on the metal plate change after you lift it from the insulating surface? Draw a rough diagram showing how it changes and explain the change in words. If you had lifted the metal plate before touching it with your fingers, would the results be different from the results obtained in the reverse order as in parts (b) and (c)? Explain.

(d) Now bring the "charged" metal plate with insulating handle close to (but not touching) a metal sphere on an insulating stand. Draw a diagram showing the charge separation on the metal sphere. Now touch the metal sphere with your fingers while still holding the metal plate close to it. Then, remove your fingers and then the metal plate. Redraw the charge distribution on the metal sphere. Is there a net charge on the metal sphere?

(e) What would have happened if in part (d) you had first removed the metal plate from the vicinity of the metal sphere and then removed your fingers? Explain.