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**Topic:** Capacitors
**Code:** HF60211

This equation indicates that the capacitance of a sphere increases as the size of the sphere increases. Because Earth is so large, it has an extremely large capacitance. Thus, Earth can provide or accept a large amount of charge without its electric potential changing too much. This is the reason why Earth is often used as a reference point for measuring potential differences in electric circuits.

### The material between a capacitor's plates can change its capacitance

So far, we have assumed that the space between the plates of a parallel-plate capacitor is a vacuum. However, in many parallel-plate capacitors, the space is filled with a material called a *dielectric.* A dielectric is an insulating material, such as air, rubber, glass, or waxed paper. When a dielectric is inserted between the plates of a capacitor, the capacitance increases. The capacitance increases because the molecules in a dielectric can align with the applied electric field, causing an excess negative charge near the surface of the dielectric at the positive plate and an excess positive charge near the surface of the dielectric at the negative plate. The surface charge on the dielectric effectively reduces the charge on the capacitor plates, as shown in **Figure 6.** Thus, the plates can store more charge for a given potential difference. According to the expression $Q = C\Delta V$, if the charge increases and the potential difference is constant, the capacitance must increase. A capacitor with a dielectric can store more charge and energy for a given potential difference than can the same capacitor without a dielectric. In this book, problems will assume that capacitors are in a vacuum, with no dielectrics.

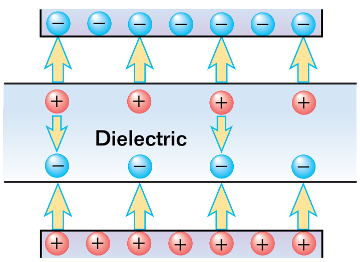


**Figure 6**
The effect of a dielectric is to reduce the strength of the electric field in a capacitor.

### Discharging a capacitor releases its charge

Once a capacitor is charged, the battery or other source of potential difference that charged it can be removed from the circuit. The two plates of the capacitor will remain charged unless they are connected with a material that conducts. Once the plates are connected, the capacitor will *discharge.* This process

**Why it Matters**

## Conceptual Challenge

### 1. Charge on a Capacitor Plate

A certain capacitor is designed so that one plate is large and the other is small. Do the plates have the same magnitude of charge when connected to a battery?

### 2. Capacitor Storage

What does a capacitor store, given that the net charge in a parallel-plate capacitor is always zero?