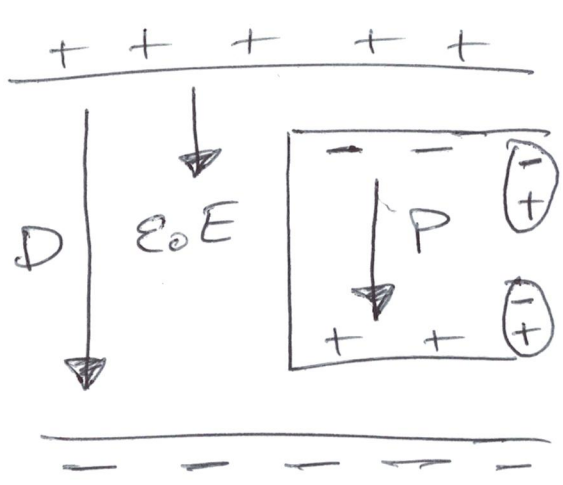
Dielectrics Ala Griffiths +ooo

$\rho = \varepsilon_0 \nabla \cdot E$

$\rho_B = -\nabla \cdot P$

$\rho_F = \nabla \cdot D$



Free charge

bound charge

$$D = \varepsilon_0 E + P$$

$$\rho = \rho_B + \rho_F$$

$$\varepsilon_0 \nabla \cdot E = -\nabla \cdot P + \nabla \cdot D$$

$$\varepsilon_0 E = -P + D$$

$$D = \varepsilon_0 E + P$$

* Note: Direction of $\vec{P}$

Linear Dielectrics

$$P = \chi \varepsilon_0 E$$

$$D = \varepsilon_0 E + P = (1+\chi)\varepsilon_0 E \equiv \varepsilon E$$

No subscript

Thus $(1+\chi) = \frac{\varepsilon}{\varepsilon_0} = \varepsilon_r \equiv K$

relative perm. ≡ dielectric constant

Note $\chi \geq 0 \Rightarrow K \geq 1$

$$D = \varepsilon E = K(\varepsilon_0 E)$$

Since $K \geq 1 \Rightarrow D \geq \varepsilon_0 E$

dielectric reduces Field

Capacitors

$$E \to \frac{E}{K} \Rightarrow V \to \frac{V}{K}$$

$$C = \frac{Q}{V} \to \frac{Q}{V/K} = K\frac{Q}{V} = K C_0$$

dielectrics improve capacitors !!!