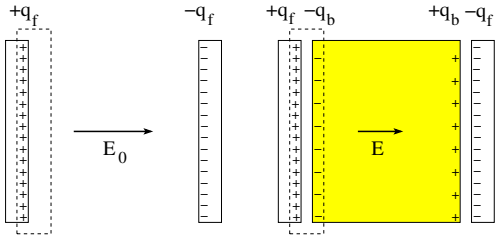
Parallel-Plate Capacitor with Dielectric (2)

Use Gauss' law to determine the electric fields $\vec{E}_0$ and $\vec{E}$.



- Field in vacuum: $E_0 A = \dfrac{q_f}{\epsilon_0} \quad \Rightarrow \quad E_0 = \dfrac{q_f}{\epsilon_0 A}$
- Field in dielectric: $EA = \dfrac{q_f - q_b}{\epsilon_0} \quad \Rightarrow \quad E = \dfrac{q_f - q_b}{\epsilon_0 A} < E_0$
- Voltage: $V_0 = E_0 d$ (vacuum), $\quad V = Ed = \dfrac{V_0}{\kappa} < V_0$ (dielectric)

Dielectric constant: $\kappa \equiv \dfrac{E_0}{E} = \dfrac{q_f}{q_f - q_b} > 1.$ Permittivity of dielectric: $\epsilon = \kappa \epsilon_0$.