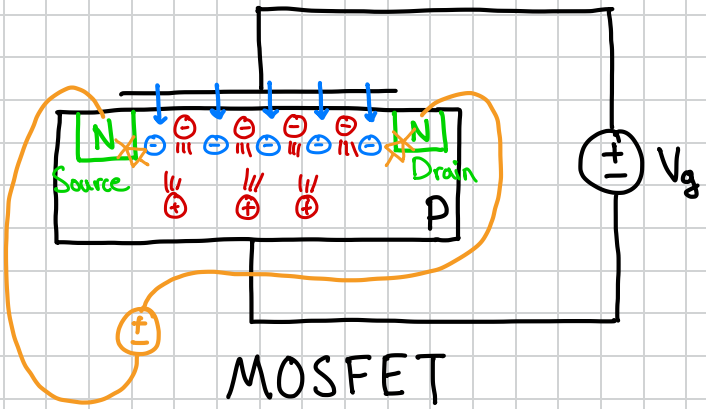
P-type CAPACITOR

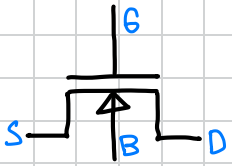


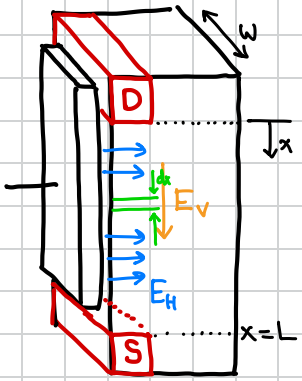
$V_g < V_{TH}$ Pushing Holes Away

$V_g = V_{TH}$ All Holes Pushed Away

$V_g > V_{TH}$ Bring in Mobile e^-

★ Inversion





$$i = \frac{dq}{dt} = \frac{dq}{dx} \times \frac{dx}{dt}$$

$\frac{dq}{dx}$: linear charge density

$\frac{dx}{dt}$: velocity $= -\mu_e E_V$ ← voltage $\mu_e \frac{dV}{dx}$

$$\oint \epsilon E \, dA = dq = -\epsilon_{ox} E_H W dx$$

$$\frac{dq}{dx} = -\epsilon_{ox} E_H W$$

$$E_H = \frac{V_g - V(x)}{t_{ox}}$$

$$\frac{dq}{dx} = -\frac{\epsilon_{ox}}{t_{ox}} W \left[V_g - V(x) - V_{TH}\right] \mu_e \frac{dV}{dx}$$

$$\int_0^L i \, dx = \int_{V_{DS}}^{0} -\frac{\epsilon_{ox}}{t_{ox}} W \left[V_g - V(x) - V_{TH}\right] \mu_e \, dV$$

$$iL = -\mu_e \frac{\epsilon_{ox}}{t_{ox}} W \left[(V_g - V_{TH}) \times (-V_{DS}) - \tfrac{1}{2}(-V_{DS})^2\right]$$

$$\boxed{i = \mu_e \frac{\epsilon_{ox}}{t_{ox}} \frac{W}{L} \left[(V_g - V_{TH}) V_{DS} - \tfrac{1}{2} V_{DS}^2\right]}$$

$\frac{\epsilon_{ox}}{t_{ox}} = C_{ox}$ NOT Capacitance

Near $V_{DS} = 0$
Linear Approx