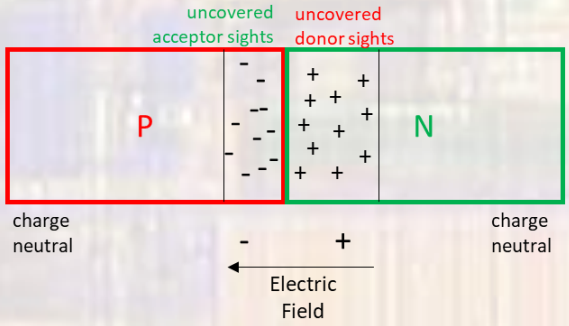
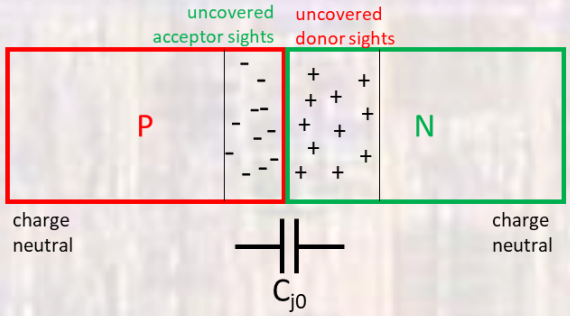
PN Junction Forward Bias

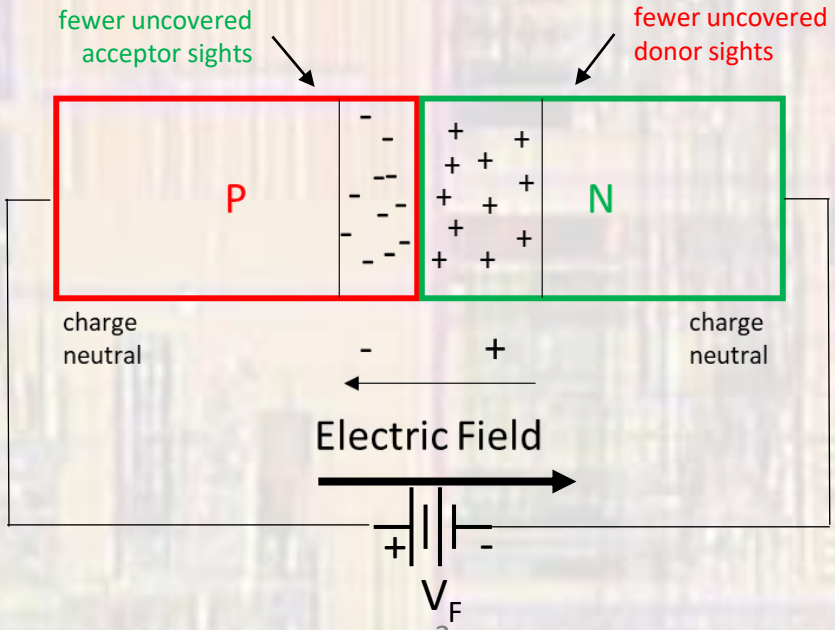
Last updated 2/10/22

PN Junction – Forward Bias

- Forward bias
  - P side at a higher voltage than the N side







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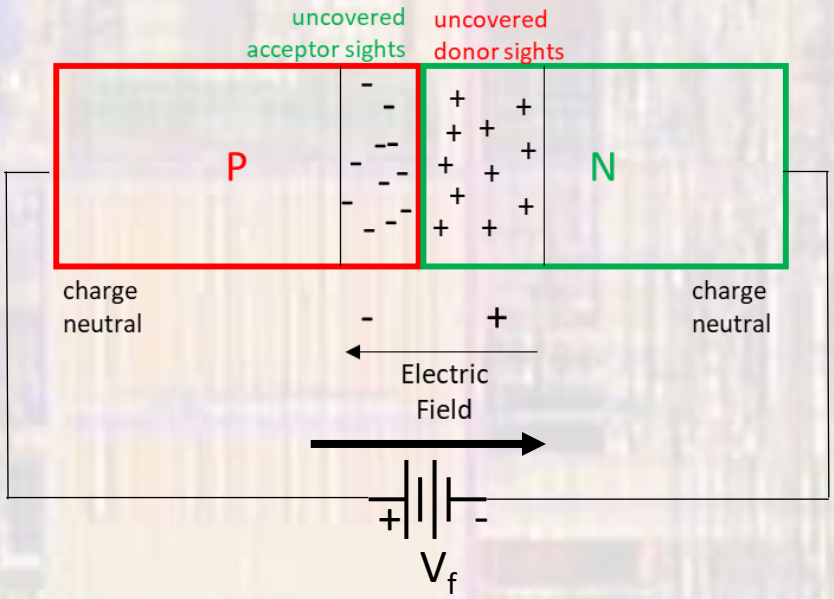
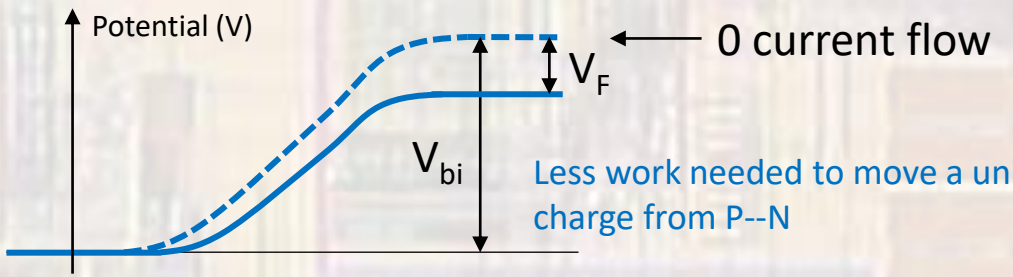


Smaller depletion regions on both sides

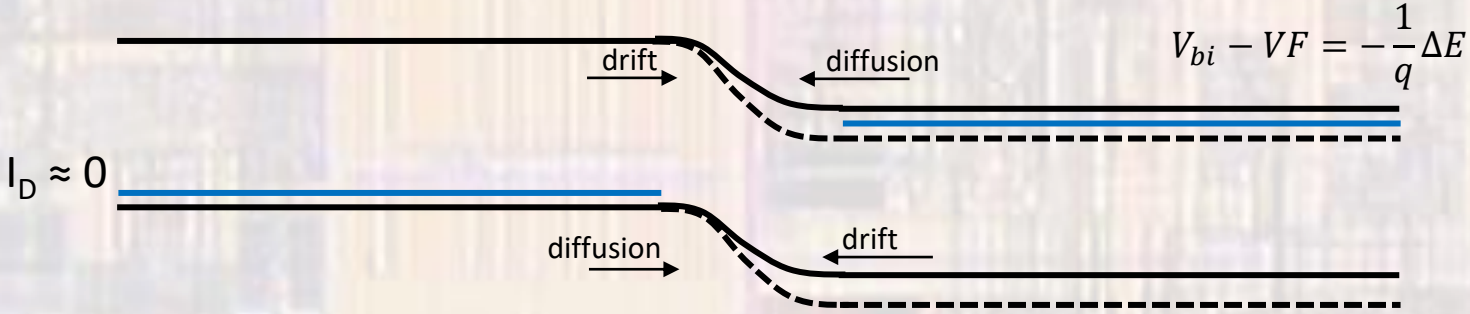


0 current flow

Less work needed to move a unit charge from P--N

PN Junction – Forward Bias

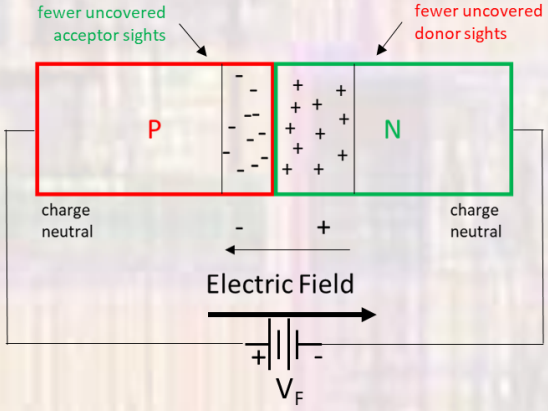
- Forward Bias
  - The forward bias shifts the energy bands relative to the P and N side
    - No impact on the drift current
    - Increases the number of carriers that have sufficient energy to diffuse (exponentially)



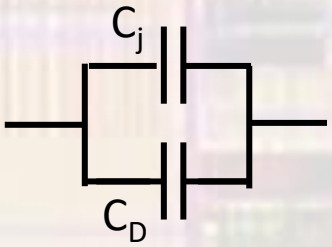
  - Resulting net current can be large and positive (P → N)
    - additional forward bias leads to exponential increases in current

PN Junction – Forward Bias

- Forward Bias – Junction Capacitance



smaller depletion region (W) → additional capacitance



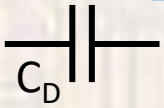
Small voltage changes → changes in diffusion charge

Note: this is a Majority Carrier phenomena and can be very fast → small capacitance

Note: this is a Minority Carrier phenomena and is relatively slow → large (relative) capacitance

$$C_j = C_{j0}\left(1 - \frac{V_A}{V_{bi}}\right)^{-1/2}$$

$V_A = V_F$



$$C_D \approx e^{V_A/V_T}$$

$V_A = V_F$