

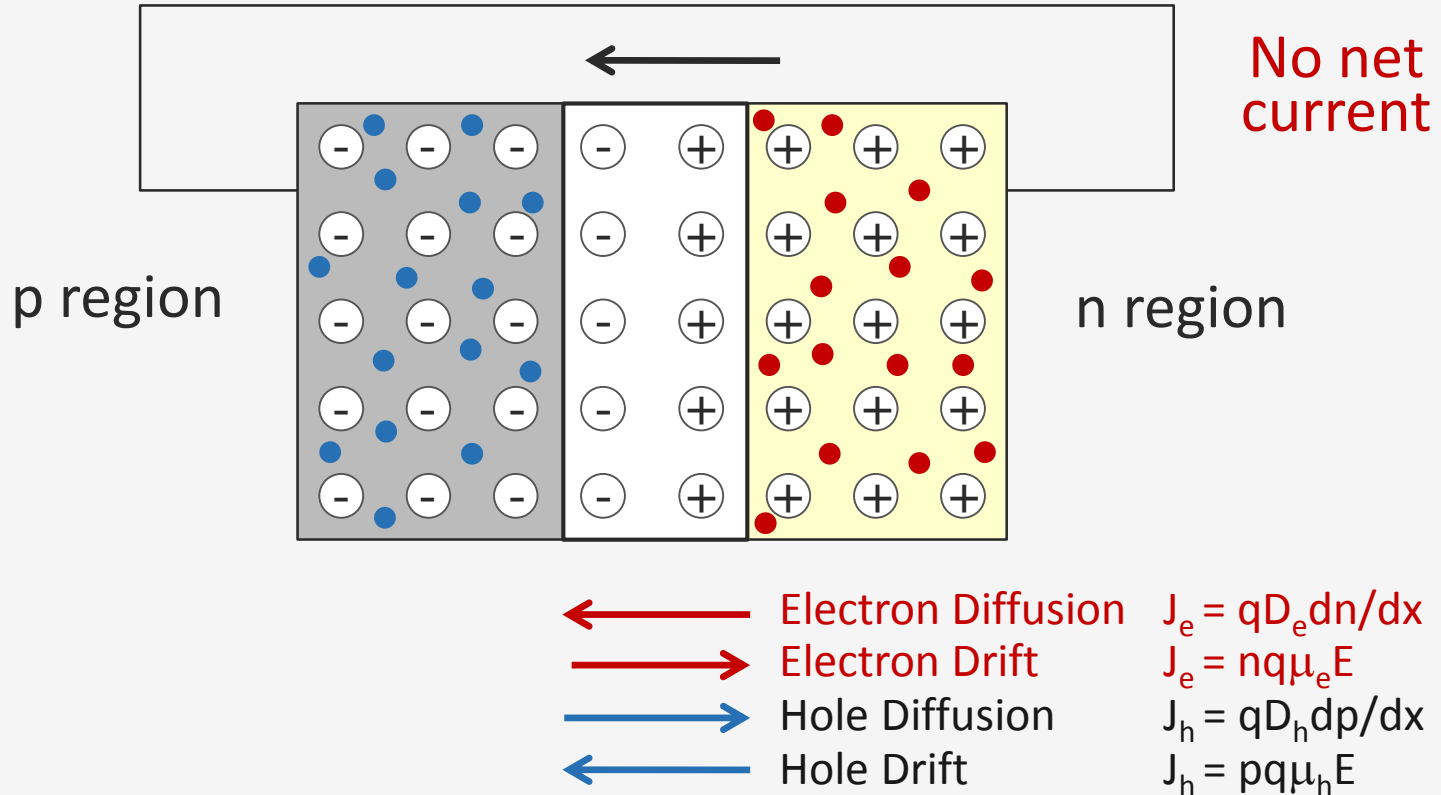
Working Principle of a Semiconductor Based Solar Cell

Semiconductor Junction II - The Solar Cell

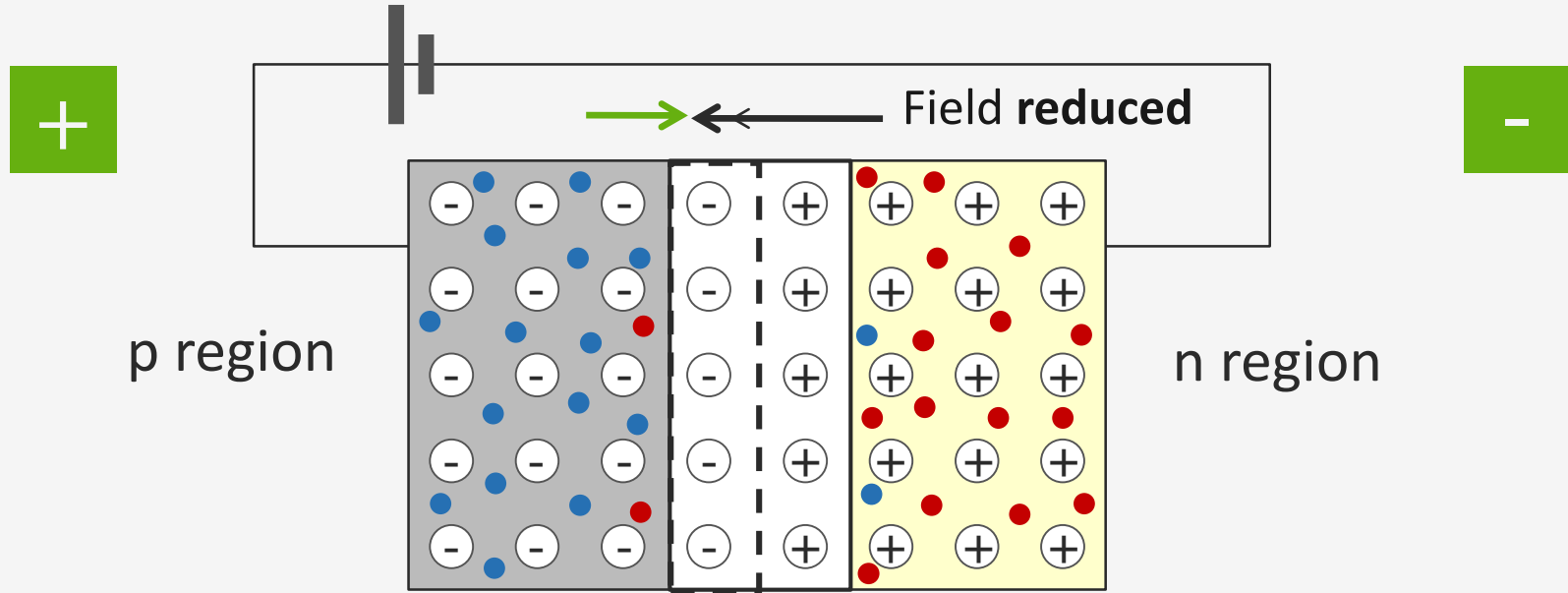
Week 2.4.2

Arno Smets

Semiconductor Junction – Thermal Equilibrium

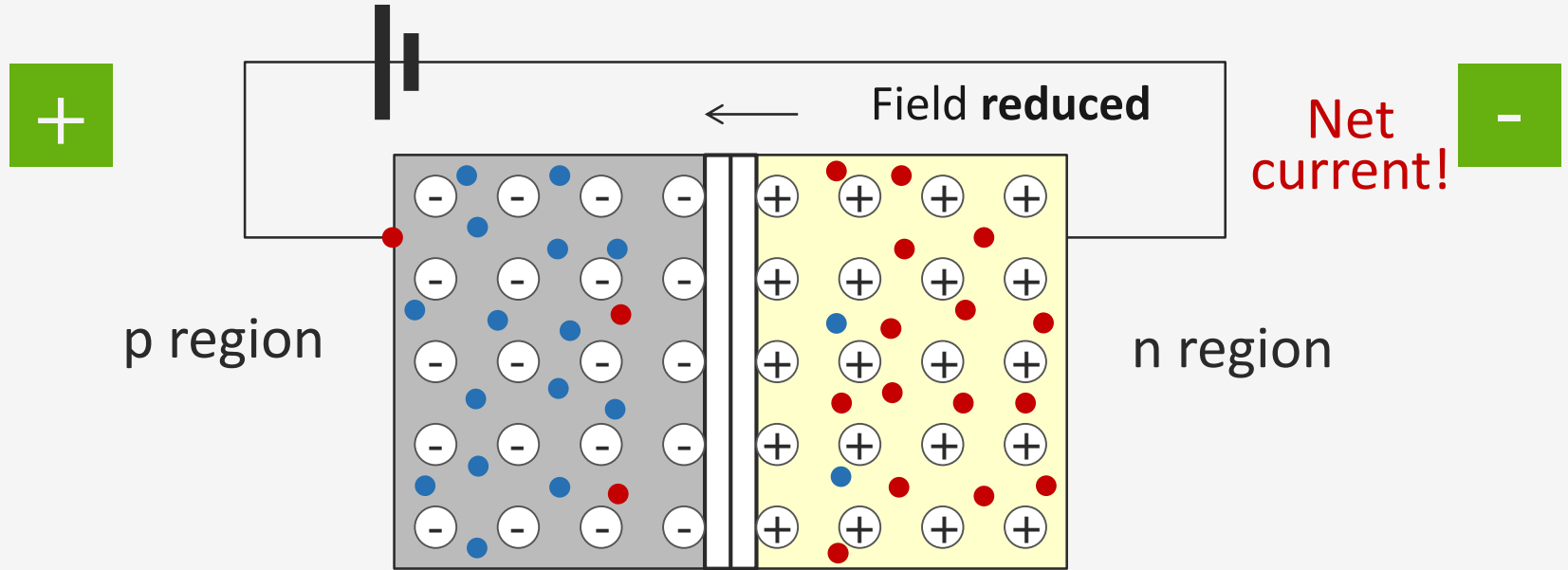


Semiconductor Junction – Forward Bias

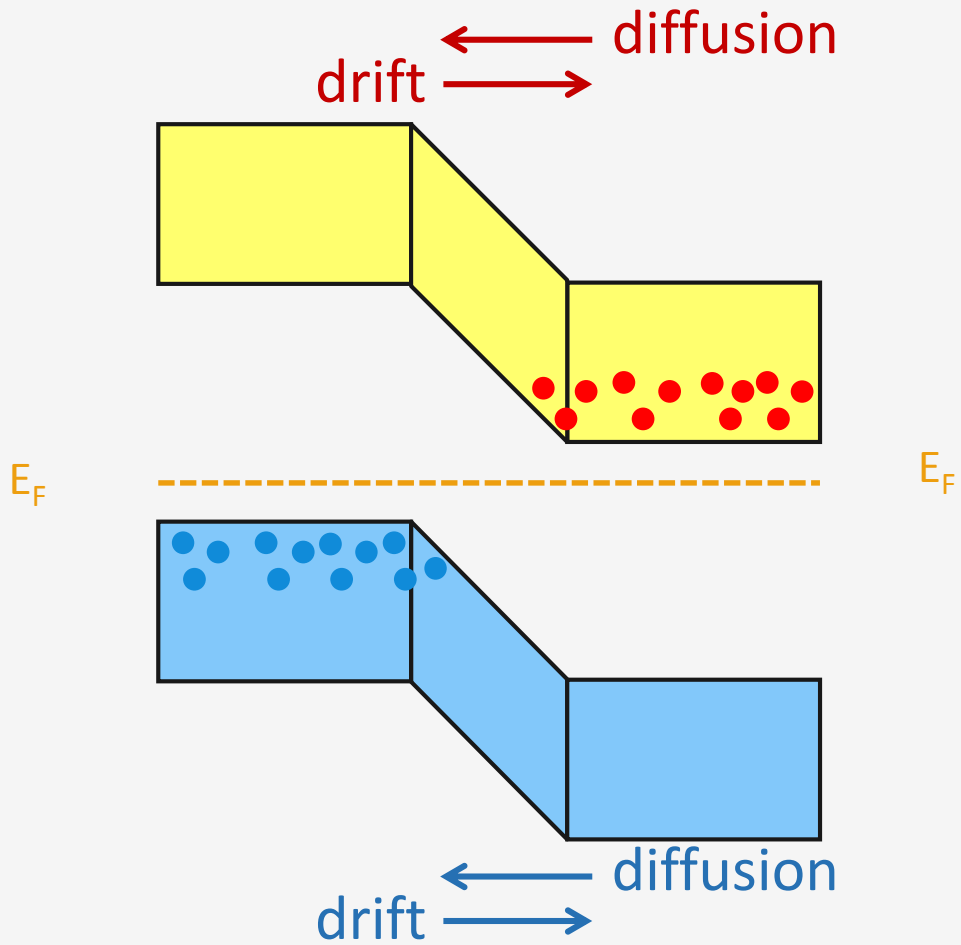


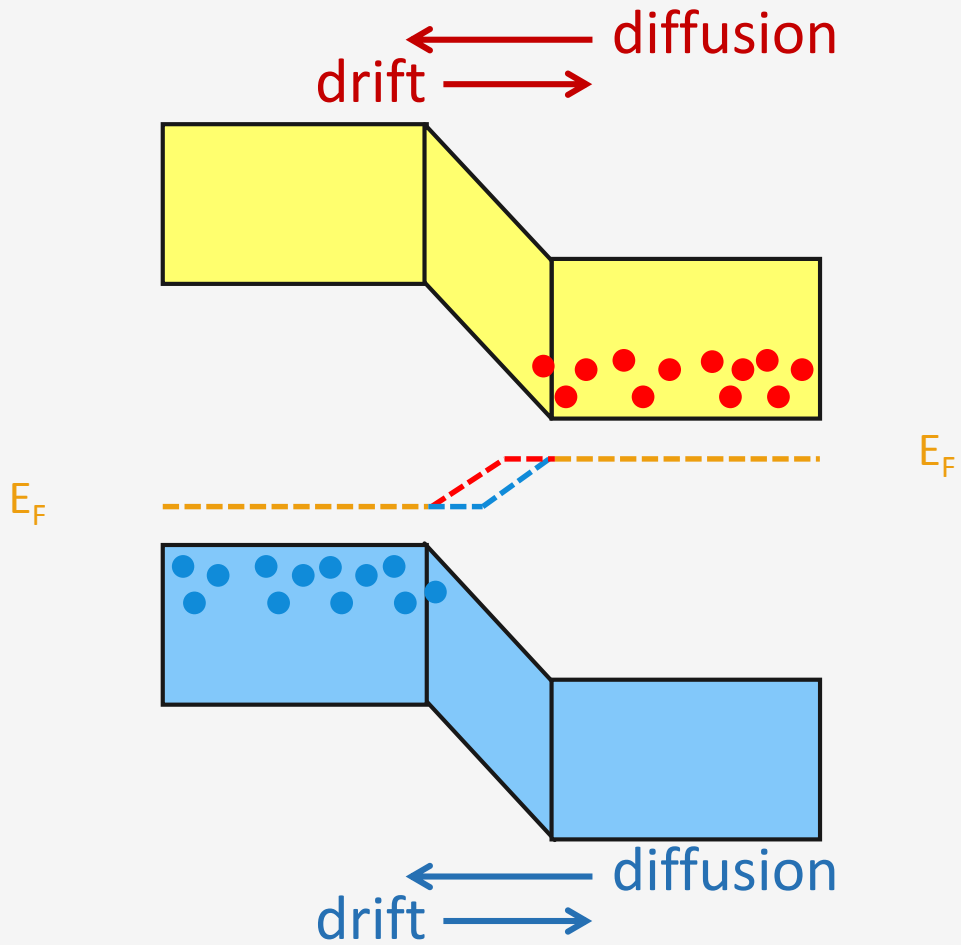
- | | | |
|--|--------------------|--------------------|
| | Electron Diffusion | $J_e = qD_e dn/dx$ |
| | Electron Drift | $J_e = nq\mu_e E$ |
| | Hole Diffusion | $J_h = qD_h dp/dx$ |
| | Hole Drift | $J_h = pq\mu_h E$ |

Semiconductor Junction – Forward Bias

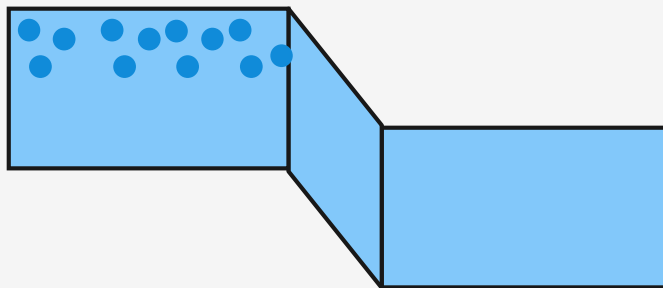
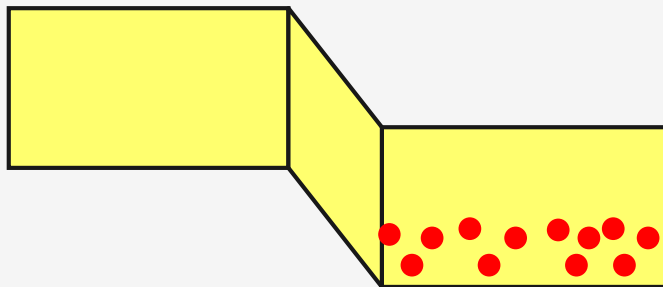


- ← Electron Diffusion $J_e = qD_e \frac{dn}{dx}$
- Electron Drift $J_e = nq\mu_e E$
- Hole Diffusion $J_h = qD_h \frac{dp}{dx}$
- ← Hole Drift $J_h = pq\mu_h E$



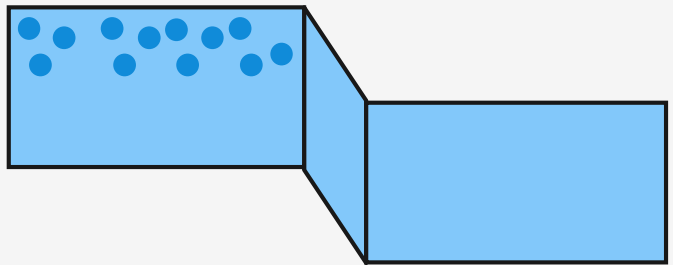
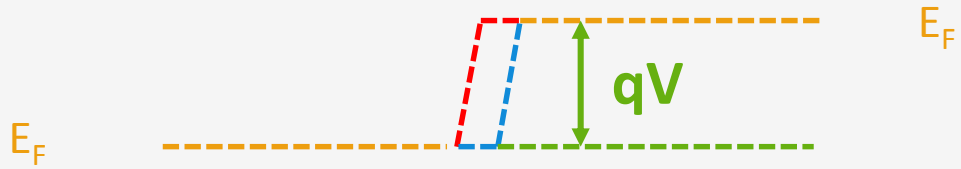
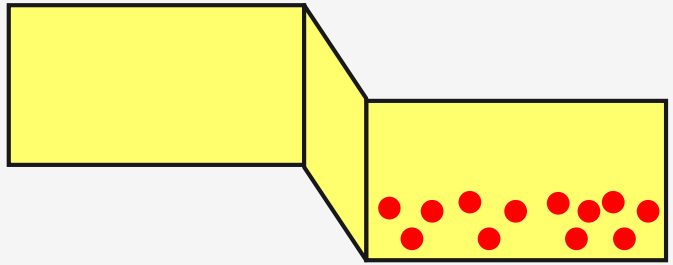


← drift → diffusion



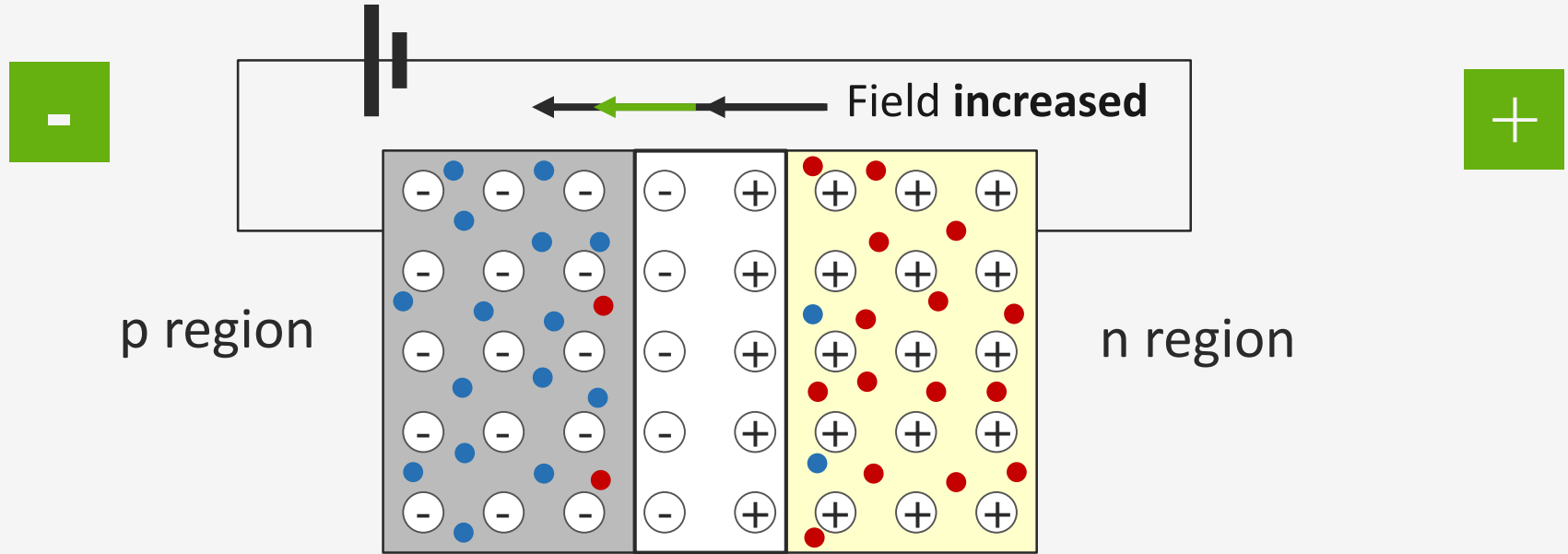
← drift → diffusion

← drift → diffusion
→



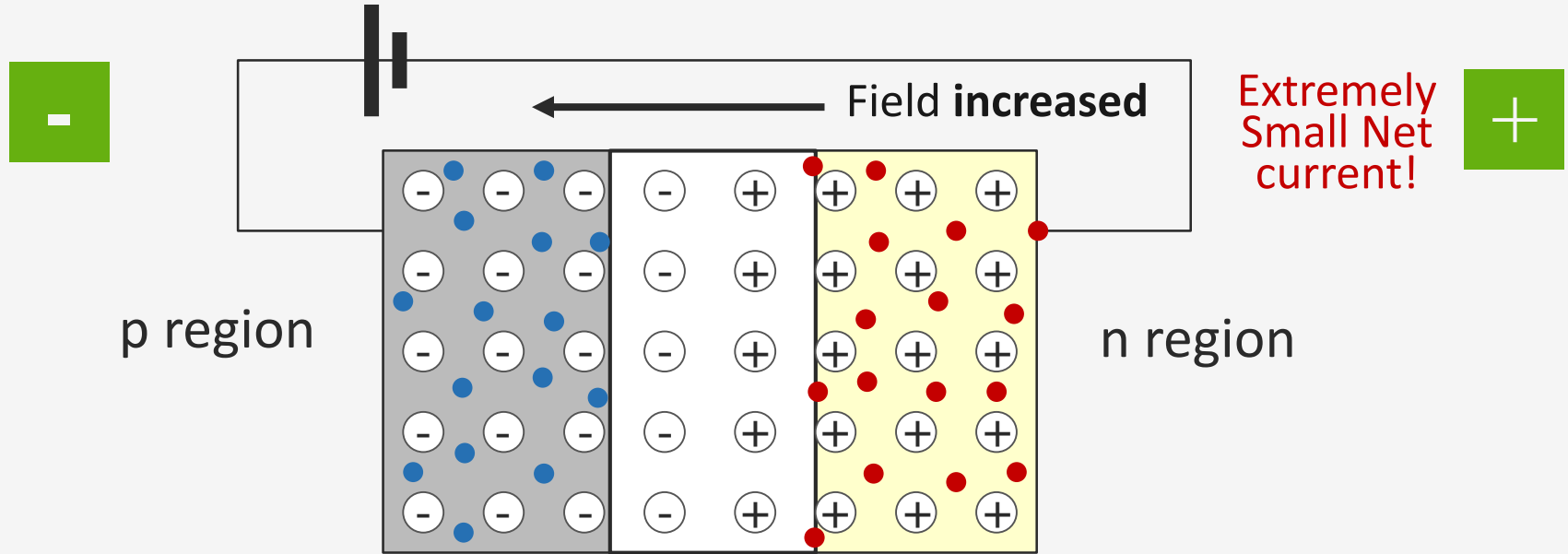
← drift → diffusion
→

Semiconductor Junction – Reverse Bias



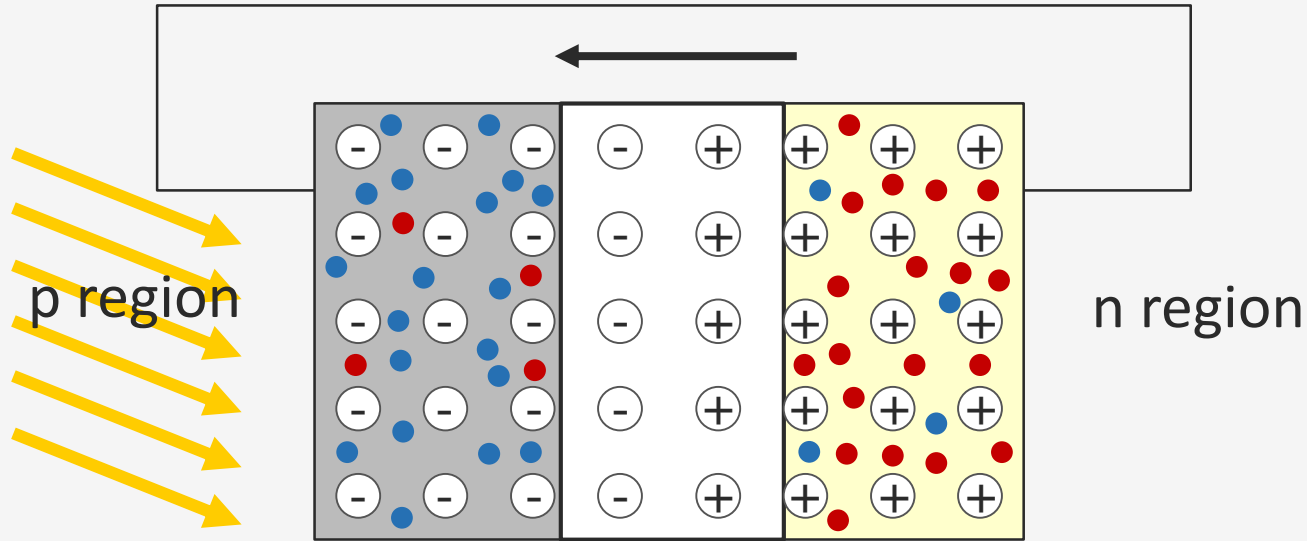
- ← Electron Diffusion $J_e = qD_e dn/dx$
- Electron Drift $J_e = nq\mu_e E$
- Hole Diffusion $J_h = qD_h dp/dx$
- ← Hole Drift $J_h = pq\mu_h E$

Semiconductor Junction – Reverse Bias



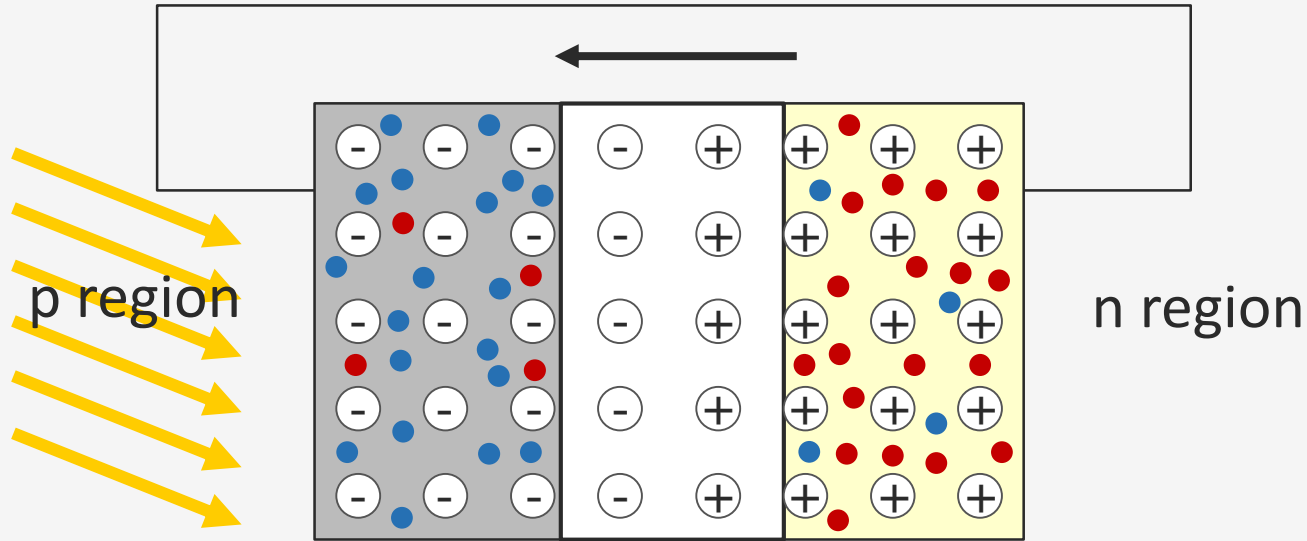
- ← Electron Diffusion $J_e = qD_e \frac{dn}{dx}$
- Electron Drift $J_e = nq\mu_e E$
- Hole Diffusion $J_h = qD_h \frac{dp}{dx}$
- ← Hole Drift $J_h = pq\mu_h E$

Semiconductor Junction – under illumination



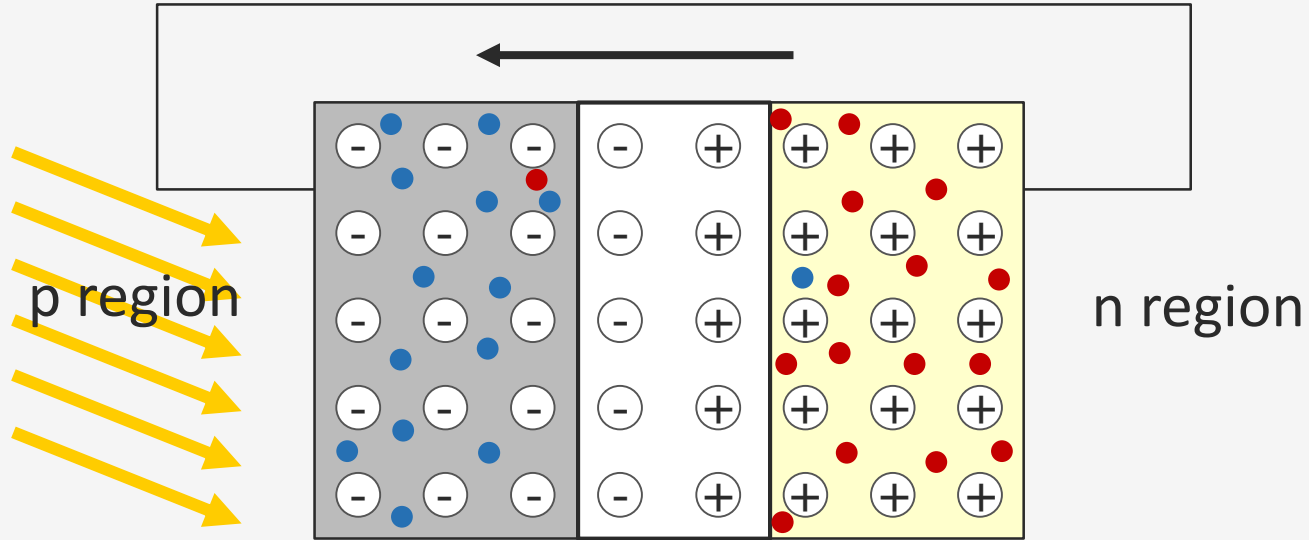
- | | | |
|--|--------------------|--------------------|
| | Electron Diffusion | $J_e = qD_e dn/dx$ |
| | Electron Drift | $J_e = nq\mu_e E$ |
| | Hole Diffusion | $J_h = qD_h dp/dx$ |
| | Hole Drift | $J_h = pq\mu_h E$ |

Semiconductor Junction – under illumination

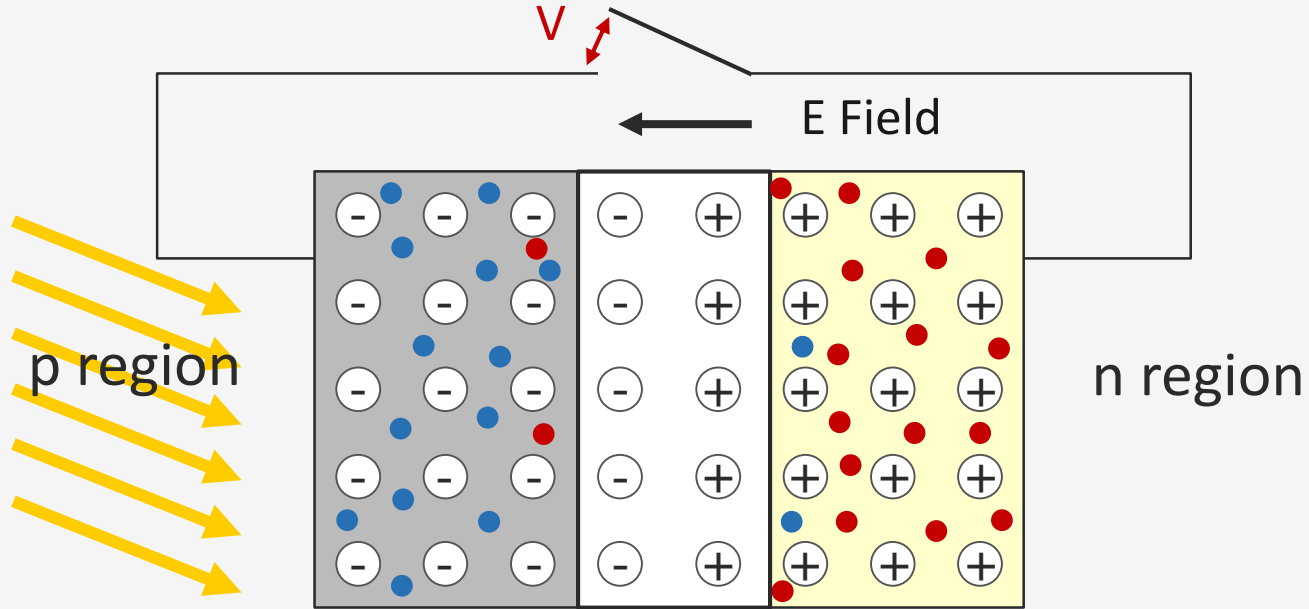


- ← Electron Diffusion $J_e = qD_e dn/dx$
- Electron Drift $J_e = nq\mu_e E$
- Hole Diffusion $J_h = qD_h dp/dx$
- ← Hole Drift $J_h = pq\mu_h E$

Short Circuit



Open Circuit



p-n junction Solar Cells

Three essential steps required for the operation of a solar cell:

1. Generation of electron-hole pairs in the cell
2. Separation of electron and hole at the junction
3. Collection of electrons and holes at the terminals

Thank you for your attention!