Total drift current:

$$J^{drift} = J_n^{drift} + J_p^{drift} = q(n\mu_n + p\mu_p)E$$

Has the shape of *Ohm's Law*:

$$J = \sigma E = \frac{E}{\rho}$$

Where:

$$\sigma \equiv conductiviy \; [\Omega^{-1} \cdot cm^{-1}]$$

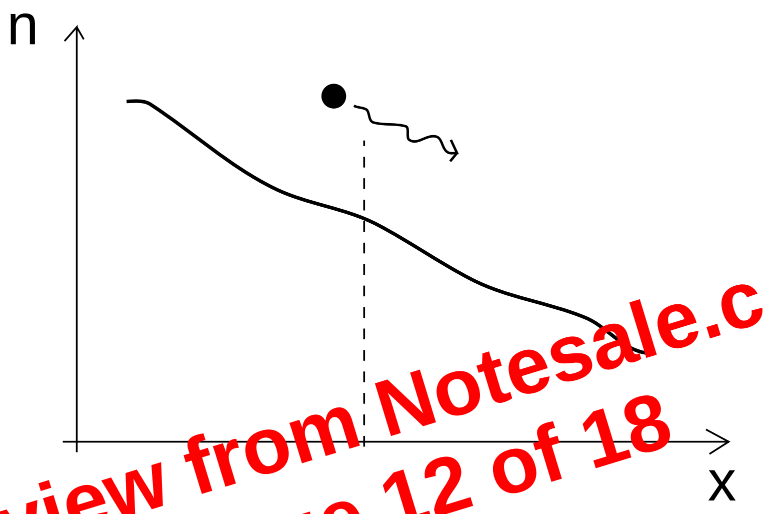
$$\rho \equiv resistiviy \; [\Omega \cdot cm]$$

Then:

$$\boxed{\rho = \frac{1}{\sigma} = \frac{1}{q(n\mu_n + p\mu_p)}}$$

3. Carrier diffusion

Diffusion: particle movement in response to concentration gradient.



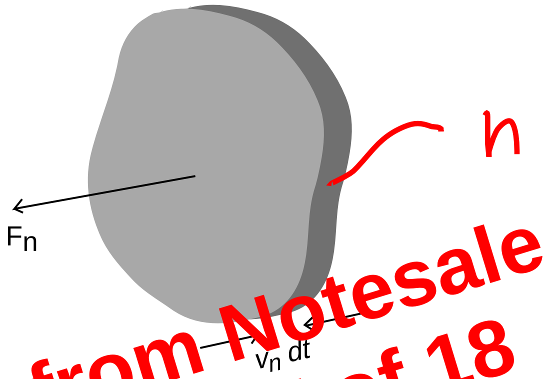
Elements of diffusion:

- a medium (*Si crystal*)
- a gradient of particles (*electrons and holes*) inside the medium
- collisions between particles and medium send particles off in random directions:
  → overall, particle movement down the gradient

Summary: relationship between v, F, and J

In semiconductors: charged particles move
$\Rightarrow$ particle flux $\Rightarrow$ electrical current density

Particle flux: number of particles that cross surface of unit area placed normal to particle flow every unit time



Relationship between particle flux and velocity:

$$F_n = nv_n \qquad F_p = pv_p$$

Current density: amount of charge that crosses surface of unit area placed normal to particle flow every unit time

$$\boxed{J_n = -qF_n = -qnv_n \qquad J_p = qF_p = qpv_p}$$

whether carriers move by drift or diffusion.