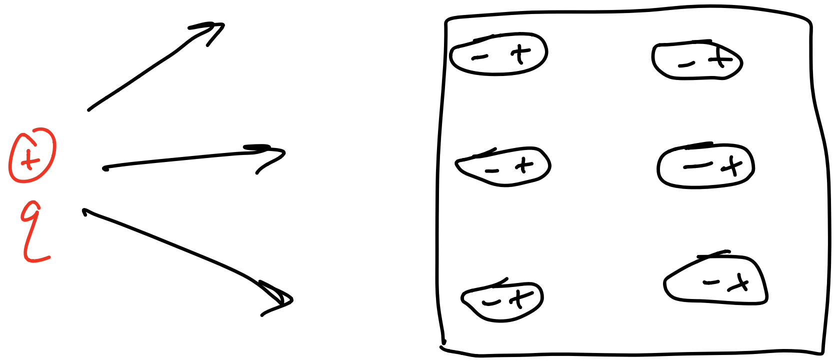
- On Friday:
  - We reviewed polarization
  - Behavior of charges and fields within matter depends upon the type of material
  - Insulators:
    - Tightly bound electrons, no mobile charges

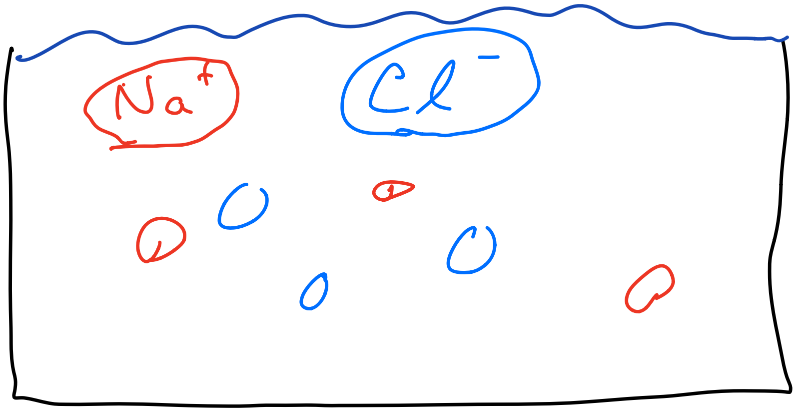
Polarized insulator



Conductors

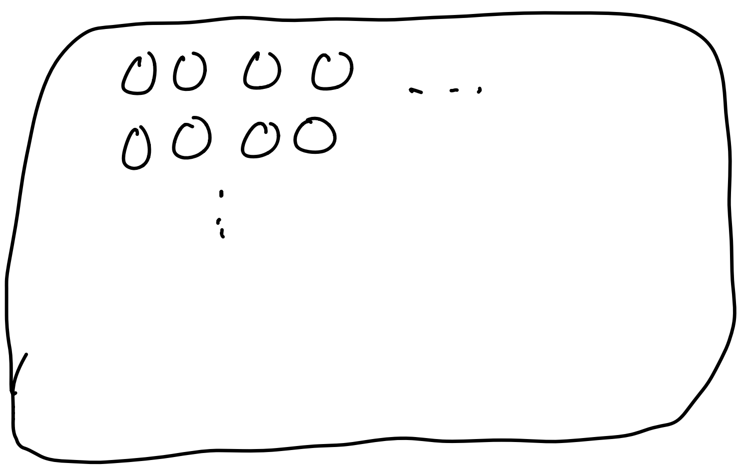
Many mobile charges

Ex: salt
water

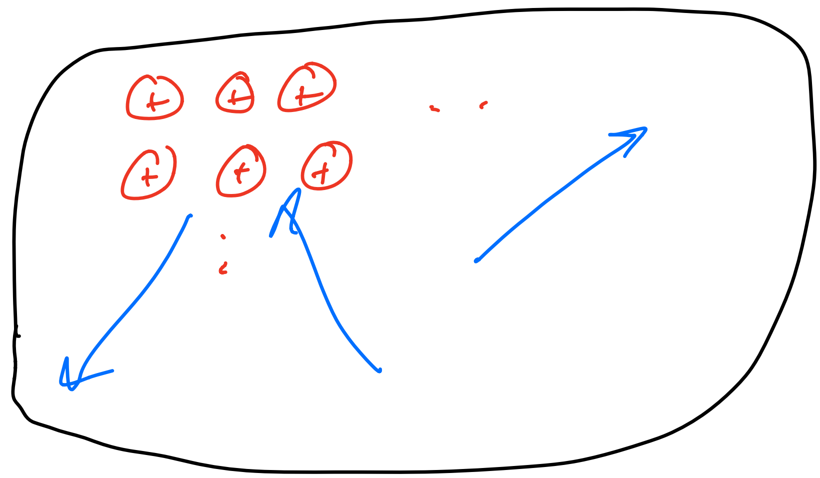


Mobile charges

Ex: Metals

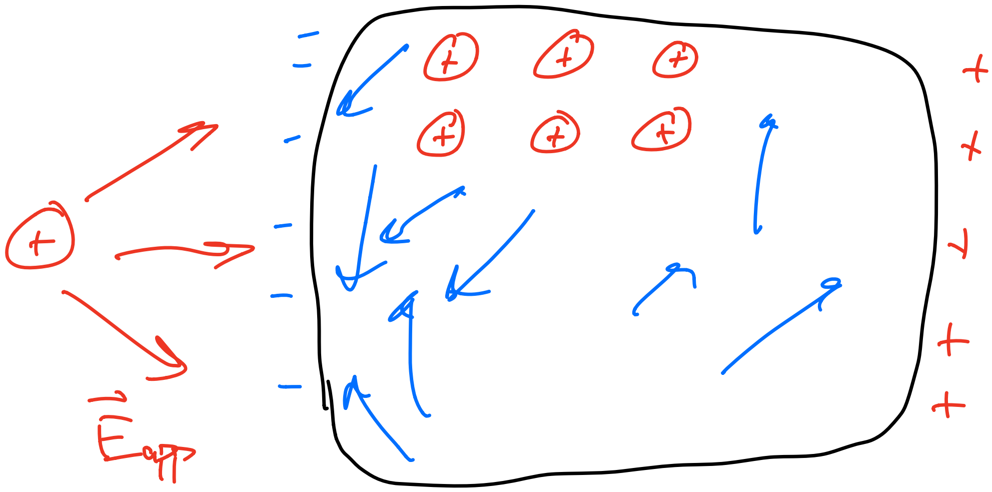


Each atom gives up
≥ 1 electron



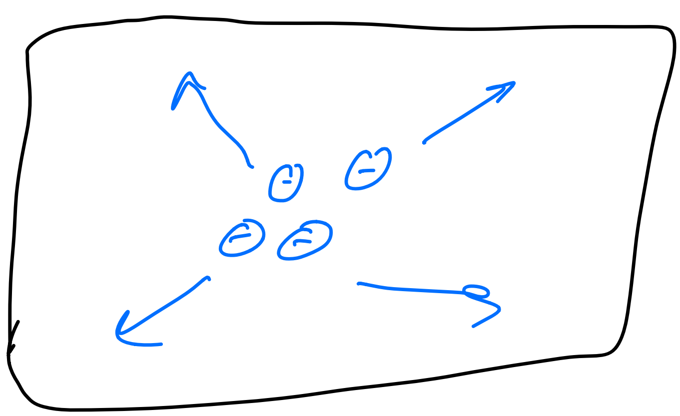
Atom lattice + electron sea
electron "gas"

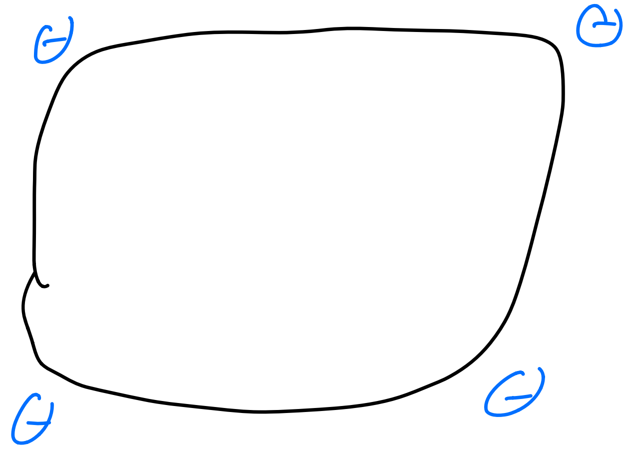
- Electrons move around randomly (thermal motion, like a gas)
- No net charge
- No net interactions with other electrons or nuclei
- Show first animation
- Now what happens when we apply an electric field near a conductor? (Next page)



- Electron sea or "gas" shifts towards the charge
  - Excess electrons on one side, deficit of electrons on the other
  - Show animation 2

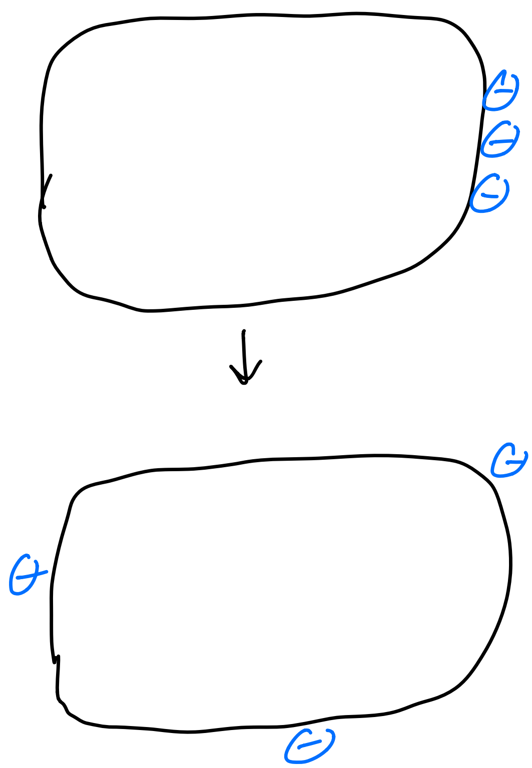
Excess Charge





No excess charge in interior of conductors.

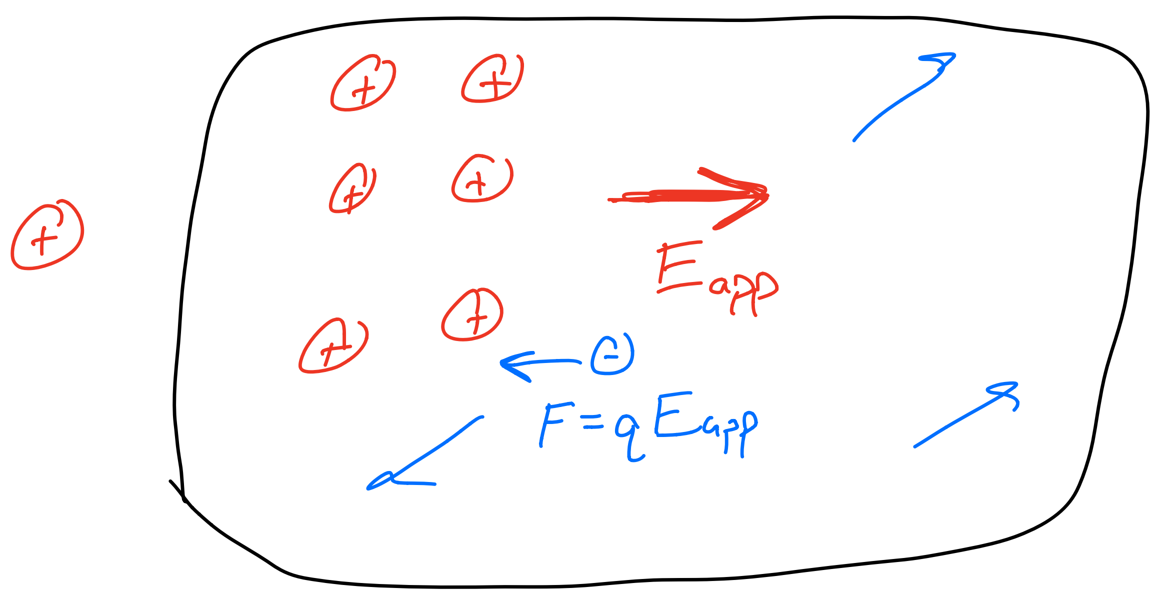
Alway on surface.

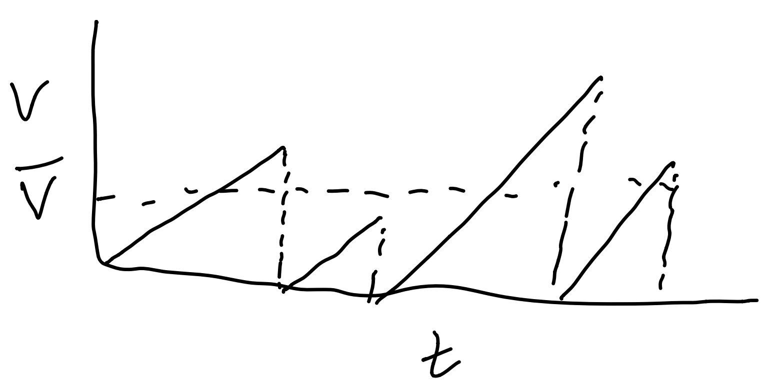


- Let's take a closer look at the motion of the electrons within a metal

Model of Metals:

Drude Model:

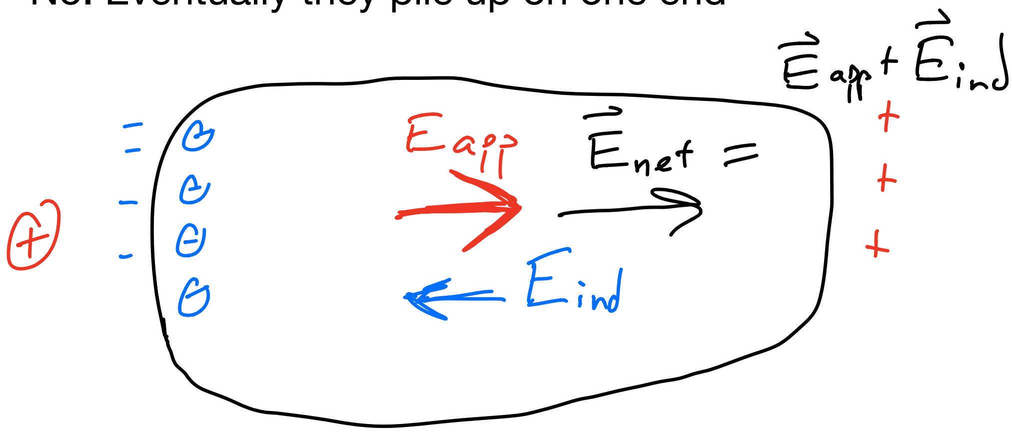




$$\bar{v} = u E_{app}$$

$$u = \text{mobility} \left[\frac{m/s}{N/C} \right]$$

- Do electrons move at speed vbar forever?
- No. Eventually they pile up on one end



Continue until

$$\vec{E}_{net} = 0$$

then: $\bar{v} = uE = u(0) = 0$

Static Equilibrium

is it possible?

V	E	
$\neq 0$	$\neq 0$	✓
$\neq 0$	$= 0$	✗
$= 0$	$\neq 0$	✗
$= 0$	$= 0$	✓

Static Eq

At static eq:

Net $\vec{E}$ inside a conductor is zero

Summary

	Insulator	Conductor
Mobile Charges?	No	Yes
Where is excess charge?	Inside OR Surface	Surface only
Does charge spread around?	No	Yes
E_{net} INSide (eq)	$\vert\vec{E}\vert$ can be $\neq 0$	$= 0$
Polarization	Induced Dipoles $p = \alpha E$	Moving charges $\bar{v} = uE$