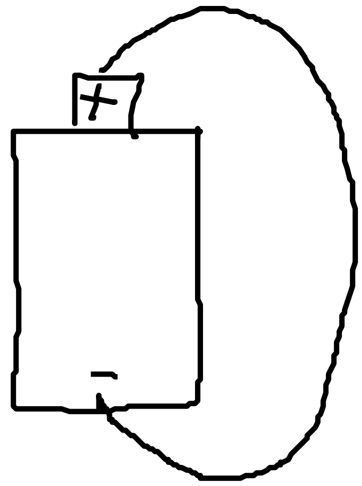
Conductor in Electrostatic Equilibrium: $E = 0$ inside

$\Delta V = 0$ inside

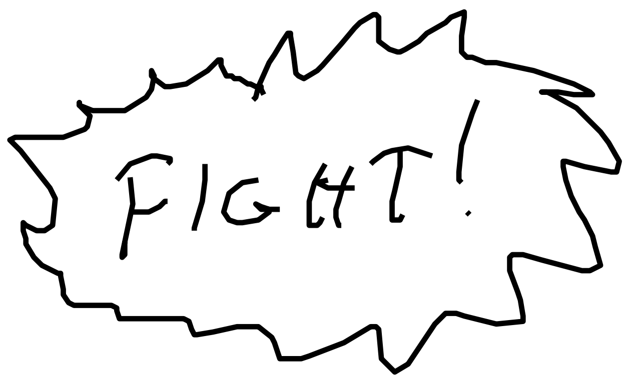
constant V

Current: steady flow of charge

Electrostatic equilibrium means no current battery: maintains a constant $\Delta V \neq 0$



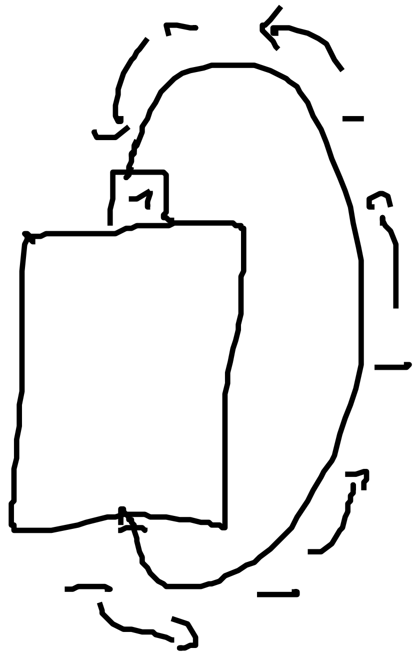
metal wire maintains a $\Delta V = 0$



which wins?

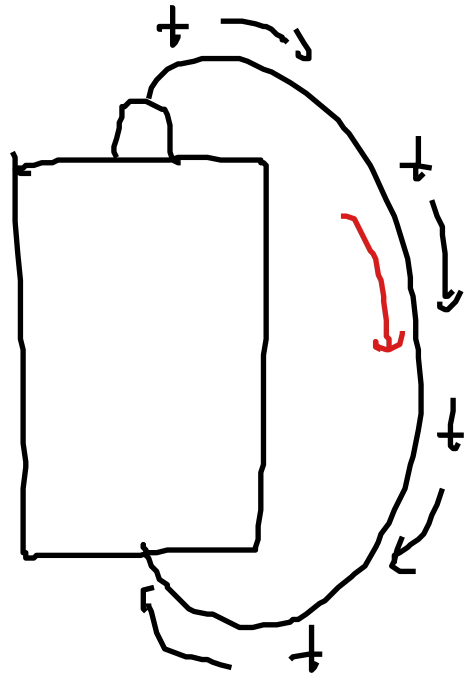
battery (in the short term)

there is $\Delta V > 0$ across the wire $\rightarrow$ current in the wire



what really happens

negative charge carriers



conventional current

positive charge carriers

Current is defined to point in direction positive charge carriers would flow from higher potential to lower potential "downhill"

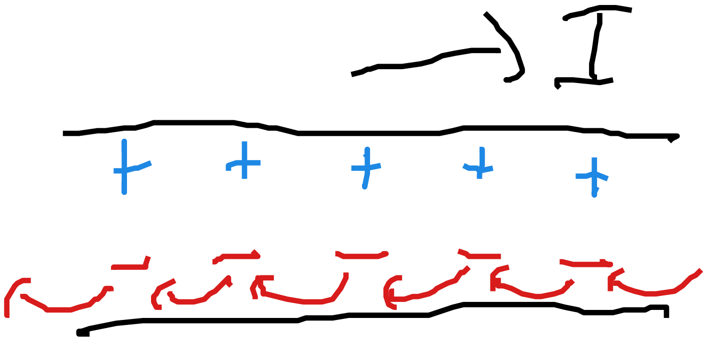
$$\text{Current} = \frac{\text{charge that flows past}}{\text{second}}$$

in physics: I

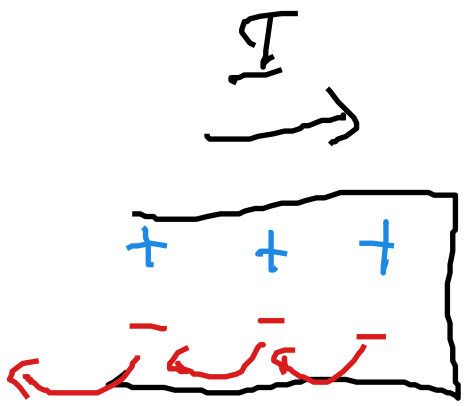
units: $\dfrac{\text{coulomb}}{\text{second}}$ = Ampere or Amp

(1A)

I is proportional to # of charge carriers and their speed



Wire has no net charge



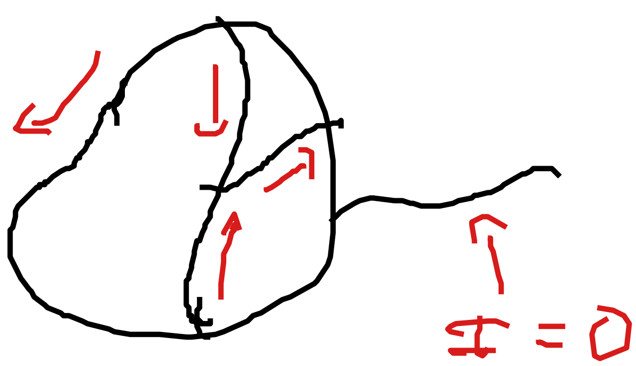
becomes + charged -

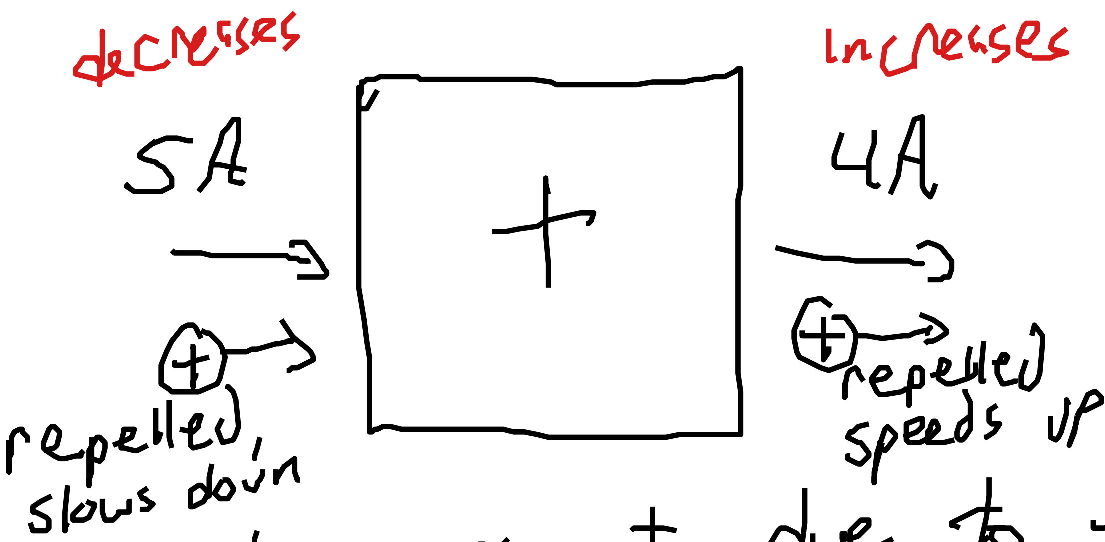
pulls electrons back

break in the wire:

no steady current flows

Current flows in closed circuits





becomes + due to the mismatch of the currents

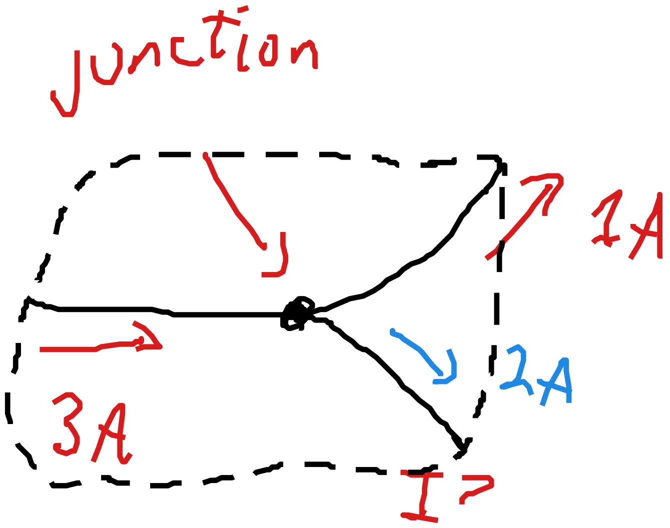
currents even out quickly

Steady Current

current in = current out

"Conservation of Current"

"Kirchhoff's Junction Law"



IN: 3A

OUT: 1A + 2A

Current flows downhill

Which one has the larger current?

A: steeper drop, more current

$$I \sim \Delta V$$

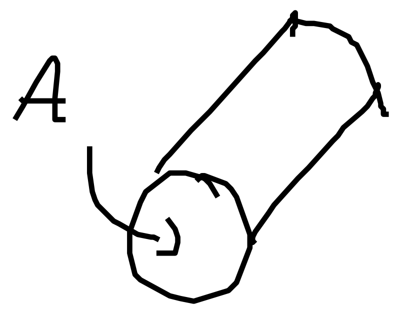
$$I = G \Delta V$$

G: "conductance" of wire

how well electricity flows

for a wire,

$$G = \sigma \frac{A}{L}$$



A: cross-sectional area of wire (m^2)

L: length of wire (m)

σ: conductivity of material

metal $\sigma = 10^{8}$

glass $\sigma = 10^{-12}$

$$\frac{1}{G} \equiv R$$

resistance of wire
how badly electricity flows

$$I = \frac{1}{R}\Delta V$$

$$I = G\Delta V \qquad \Delta V = IR$$

Ohm's Law