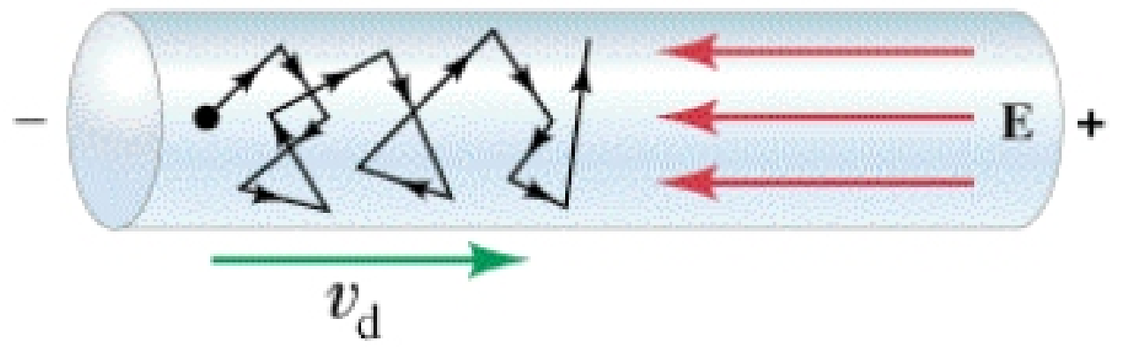
Electrons in the Wire

➔ If the electrons move so slowly through the wire, why does the light go on right away when we flip a switch?

1. Household wires have almost no resistance
2. The electric field inside the wire travels much faster
3. Light switches do not involve currents
4. None of the above



Think of what happens when you turn on a hose full of water. Water at end of hose comes out immediately because of push by pressure wave.

Electrons in the Wire, Part 2

➔ Okay, so the electric field in a wire travels quickly. But, didn't we just learn that E = 0 inside a conductor?

1. True, it can't be the electric field after all!!
2. The electric field travels along the outside of the conductor
3. E = 0 inside the conductor applies only to static charges
4. None of the above

Resistance and Ohm's Law

- Ohm's law is an empirical observation: *for most materials the current is proportional to the applied voltage*

$$I \propto \Delta V$$

- We write the constant of proportionality as R and call it the "resistance", measured in ohms (Ω)

$$\Delta V = IR$$

- Example, 120 V applied to a material gives I = 15 A.
  - R = 120/15 = 8Ω
- Most materials are "ohmic", i.e. obey Ohm's law over a very wide range of applied voltages
  - Common "nonohmic" materials are semiconductors such as silicon & germanium for which current rises exponentially with ΔV