

“Voltage Sources”

- Electric field alone doesn't suffice
 - Due to imbalance in charges
 - Current flow will try to even out that imbalance
 - Eventually everything will come to a halt (no field inside conductor)
 - Analog: Water flowing between two reservoirs until both have same height
- => “Pump” = device that can move charges AGAINST an electric field and thereby maintain a voltage difference. Examples:
 - Batteries
 - Van de Graph generators
 - Fuel cells
 - Solar panels
 - Electromagnetic generators (later)

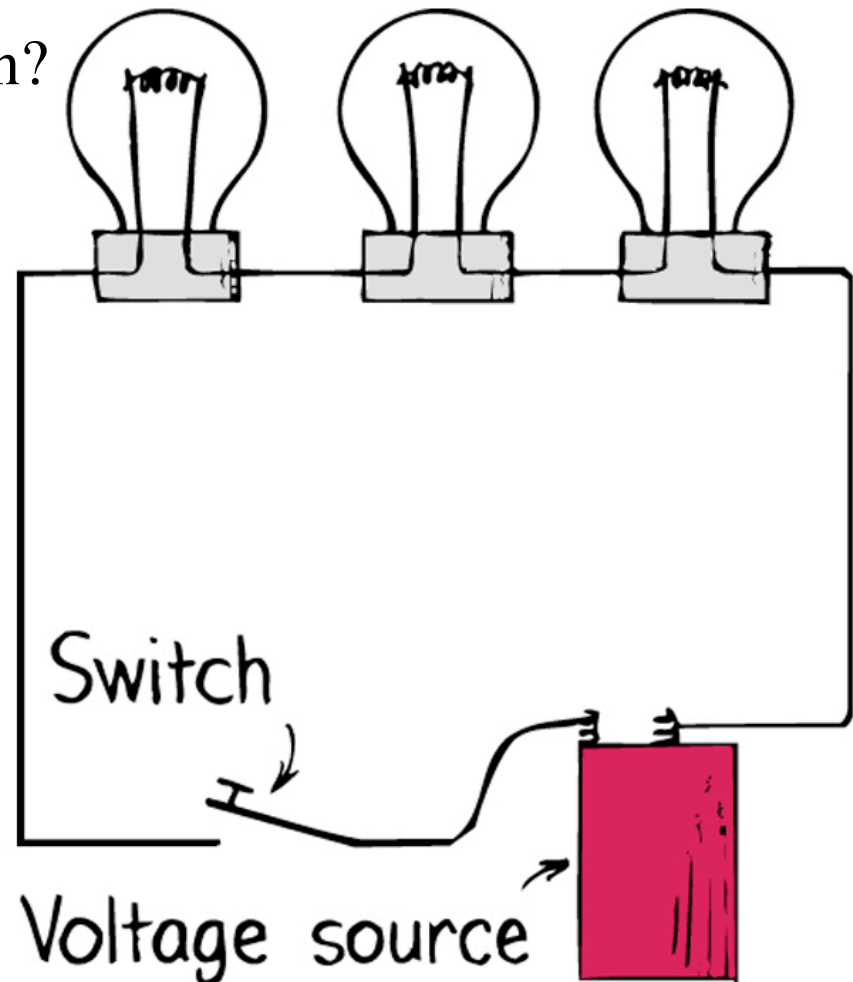
Circuits

- Water can flow out of a reservoir for a while, but then the reservoir has to be replenished
- Electric current cannot be maintained for any extended time without constantly replenishing the charge -> CIRCUITS! *)
- Simplest form: Closed loop
 - Battery, wire, lamp
 - Battery, wire, several lamps in series
 - Same current flows through all pieces, voltage changes in steps
- Can have several branches (like estuary) -> parallel circuit
 - Current splits up between different branches, nodes at fixed voltage

*) Example: charging capacitor - works only for a SHORT time

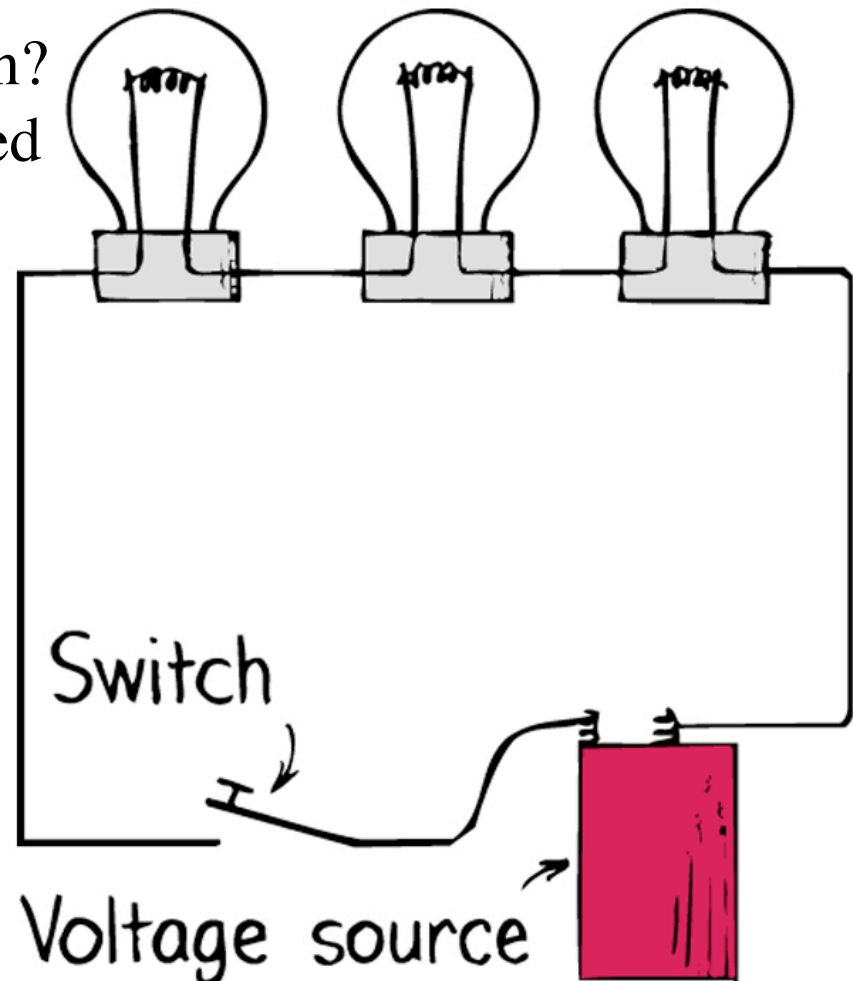
Series Circuit

- Q: What happens if switch is open?



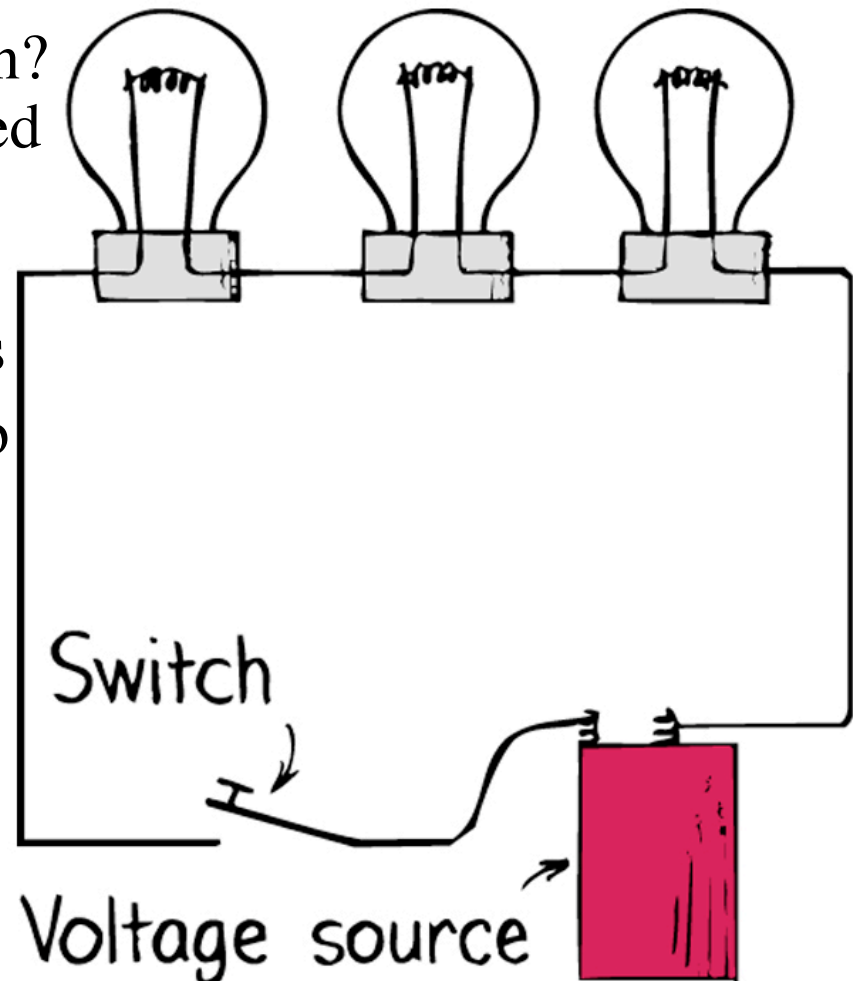
Series Circuit

- Q: What happens if switch is open?
A: Nothing - circuit must be closed
- Q: Which light bulb burns brightest?



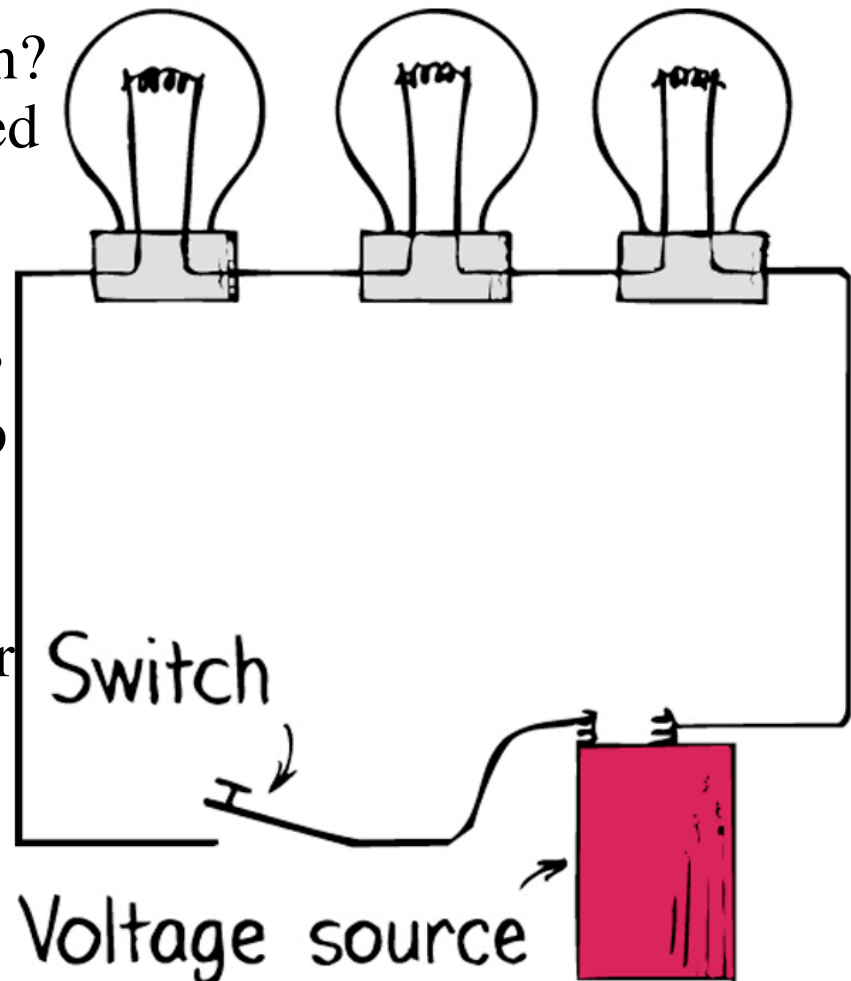
Series Circuit

- Q: What happens if switch is open?
A: Nothing - circuit must be closed
- Q: Which light bulb burns brightest?
A: All 3 have the same brightness
- Q: What happens if one light bulb burns out?



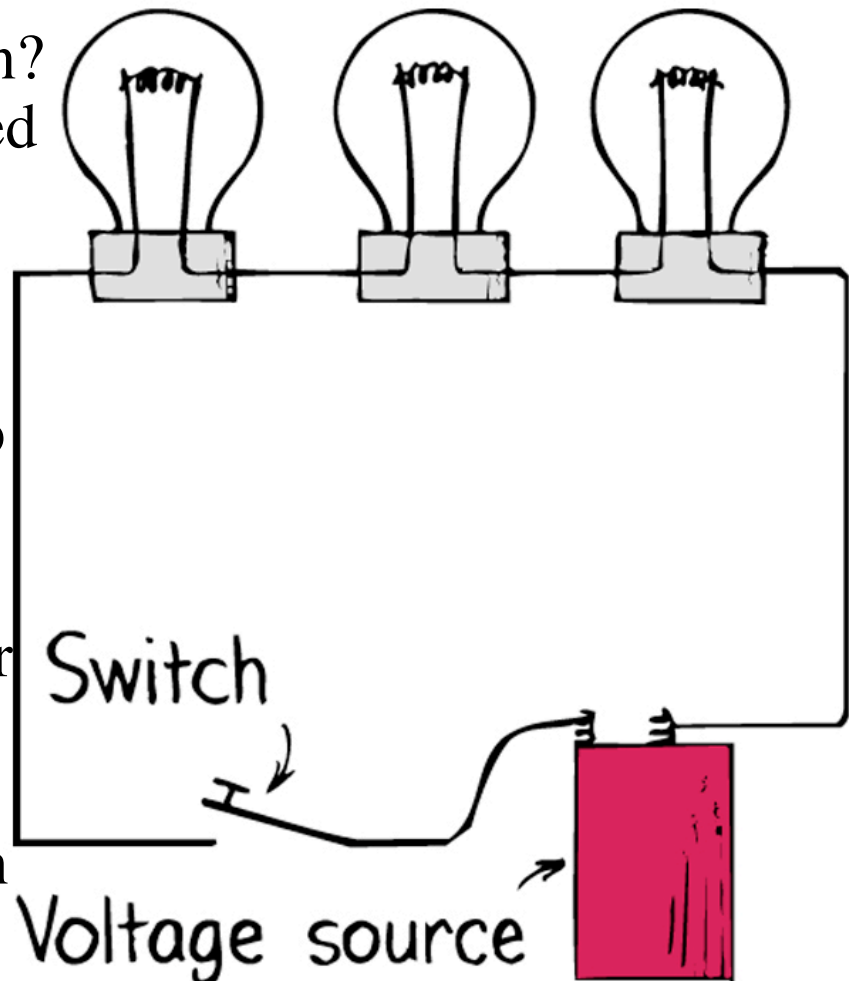
Series Circuit

- Q: What happens if switch is open?
A: Nothing - circuit must be closed
- Q: Which light bulb burns brightest?
A: All 3 have the same brightness
- Q: What happens if one light bulb burns out?
A: All 3 go dim
- Q: Would 2 bulbs burn brighter or dimmer than 3?



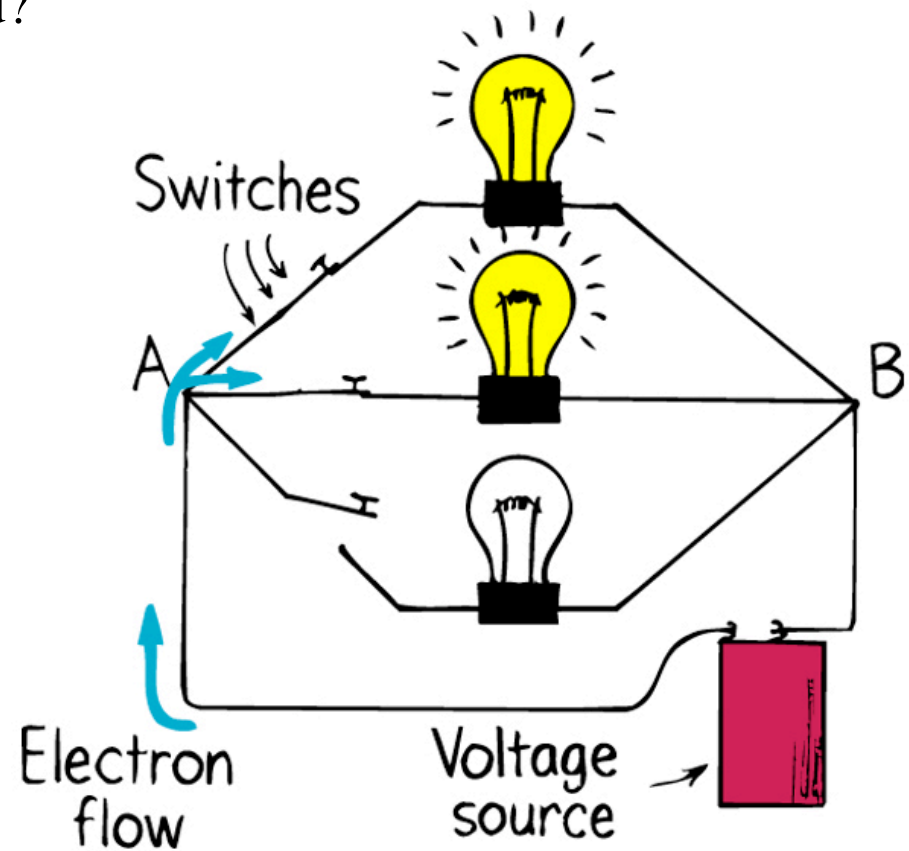
Series Circuit

- Q: What happens if switch is open?
A: Nothing - circuit must be closed
- Q: Which light bulb burns brightest?
A: All 3 have the same brightness
- Q: What happens if one light bulb burns out?
A: All 3 go dim
- Q: Would 2 bulbs burn brighter or dimmer than 3?
A: Brighter! Because the total R would be smaller, $I = V/R$ through each bulb would be larger.



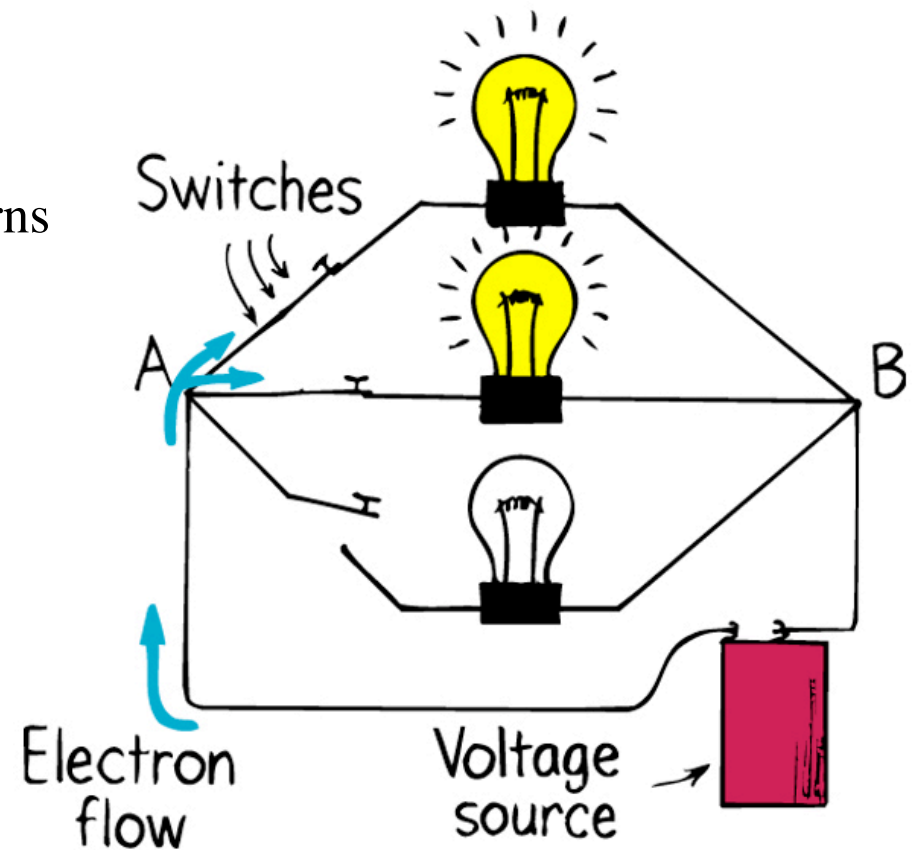
Parallel Circuit

- Q: What happens if switch is closed?



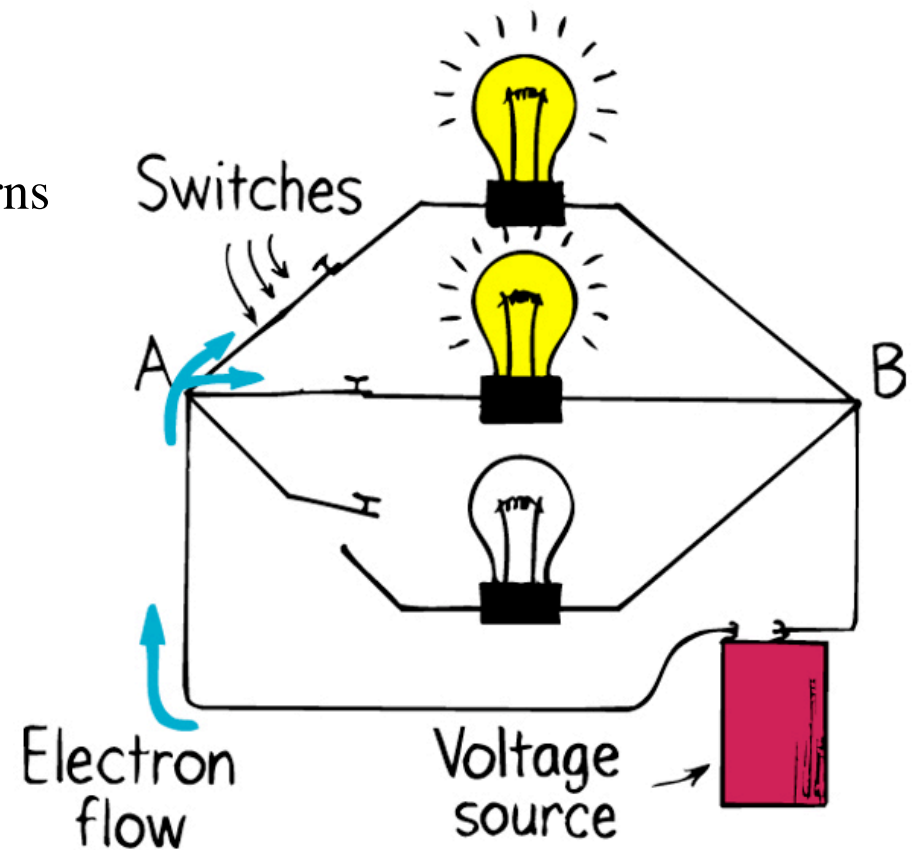
Parallel Circuit

- Q: What happens if switch is closed?
A: Third bulb goes on, the other two remain unchanged
- Q: What happens if one light bulb burns out?



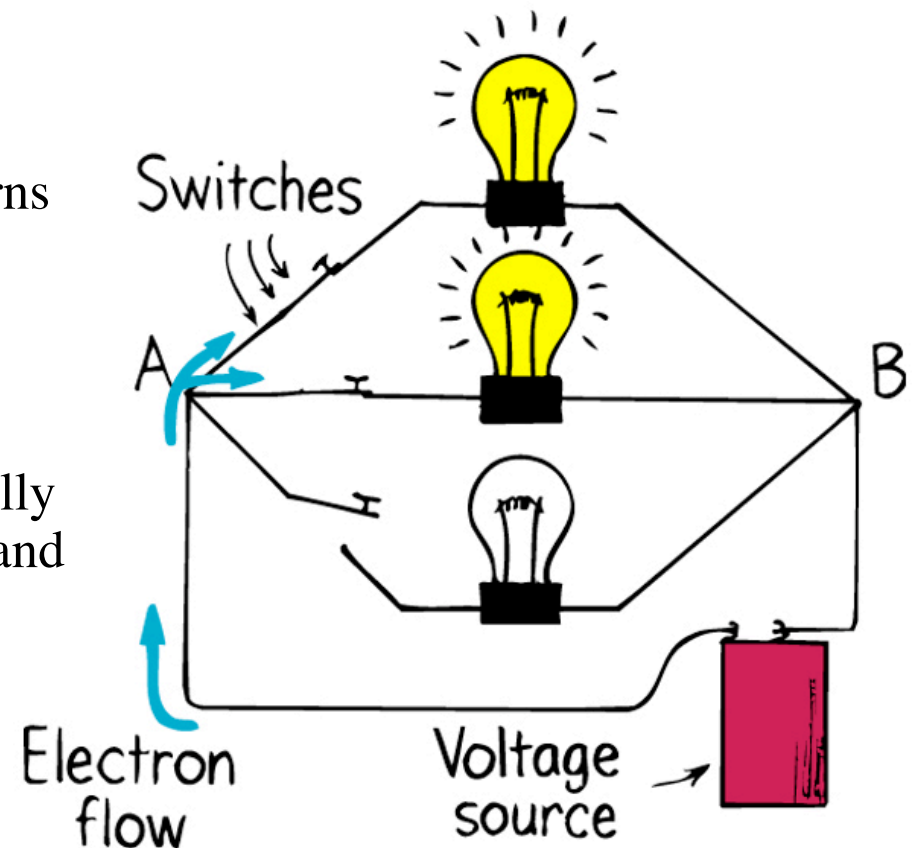
Parallel Circuit

- Q: What happens if switch is closed?
A: Third bulb goes on, the other two remain unchanged
- Q: What happens if one light bulb burns out?
A: Nothing happens to the other two
- Q: Are 3 bulbs in series brighter or 3 bulbs in parallel?



Parallel Circuit

- Q: What happens if switch is closed?
A: Third bulb goes on, the other two remain unchanged
- Q: What happens if one light bulb burns out?
A: Nothing happens to the other two
- Q: Are 3 bulbs in series brighter or 3 bulbs in parallel?
A: 3 bulbs in parallel - each individually sees the full voltage from the battery and can draw a larger current.
- Q: How much more current does the battery have to supply for 3 parallel bulbs vs. 3 bulbs in series?



Parallel Circuit

- Q: What happens if switch is closed?
A: Third bulb goes on, the other two remain unchanged
- Q: What happens if one light bulb burns out?
A: Nothing happens to the other two
- Q: Are 3 bulbs in series brighter or 3 bulbs in parallel?
A: 3 bulbs in parallel - each individually sees the full voltage from the battery and can draw a larger current.
- Q: How much more current does the battery have to supply for 3 parallel bulbs vs. 3 bulbs in series?
A: 9 times!

