

Electric Circuits and Their Requirements

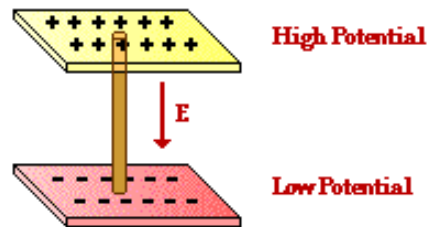
Lesson Notes

Learning Outcomes

- What is an electric circuit?
- What requirements must be met in order to establish an electric circuit?

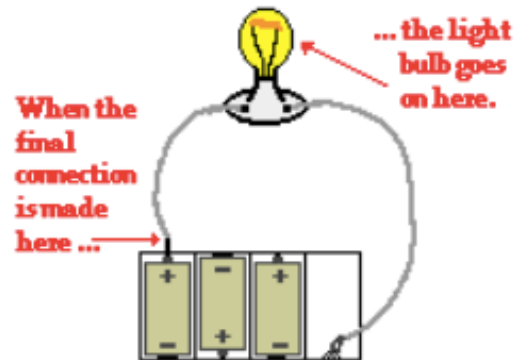
The Tale of the Two Plates

- Consider two charged *plates*: Charge on the + plate is at high potential (V). Charge on the - plate is at low potential (V).
- + charges will flow from the high V to the low V plate.
- Charge will continue flowing until the two plates reach the same electric potential.
- **Missing ingredient:** a means of looping the charge back up to the top plate to maintain the ΔV .



The Closed Circuit

- When the final connection is made of the last wire to the battery terminal, the light bulb lights ...
- ... and when disconnected, the bulb is immediately unlit.
- This highlights the importance of a **closed loop** extending from the + to the - terminal of the battery ... with no breaks or interruptions.

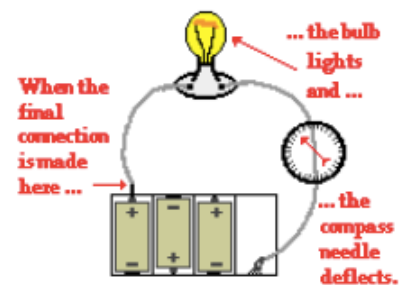


Something's Happening in the Wires

A compass needle placed under a wire will deflect whenever the last connection of a wire is made to the battery, indicating that charge is flowing through the wire

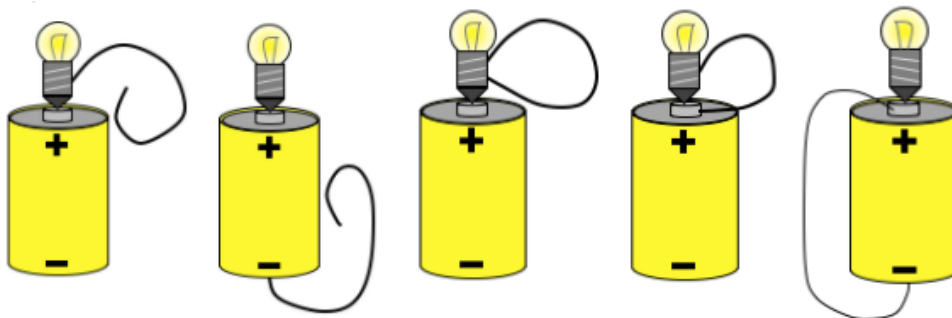
Closed circuit \Rightarrow lit bulb, deflected needle

Open circuit \Rightarrow unlit bulb, needle doesn't deflect



The D Cell, Wire and Bulb

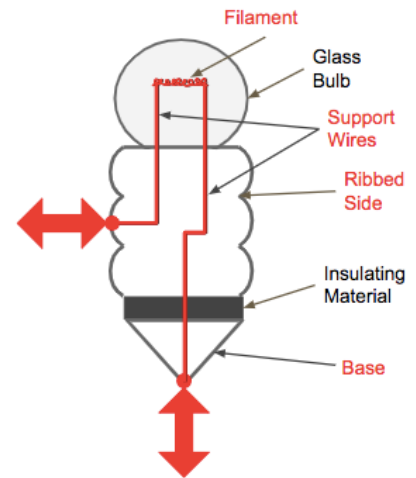
Lab Goal: using only a D-cell, a wire, and a bulb, find as many arrangements as possible that result in a lit bulb.



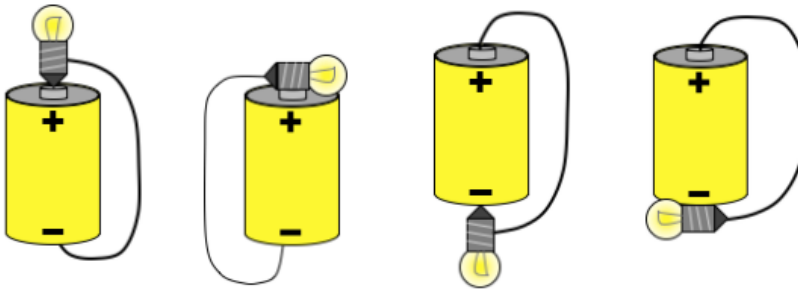
None of these result in a lit bulb because they lack the existence of a closed, conducting loop from + to - terminal ... with the bulb being part of the loop.

Light Bulb Anatomy

- For a light bulb to light, charge must pass through the filament.
- If two wires are touched to the ribbed edge, charge will flow from one wire to the other wire without passing through the filament.
- If one wire is touched to the ribbed side and the other to the base, the only way charge can flow from one wire to the other is the path through the filament.



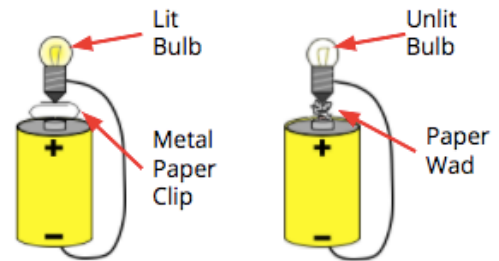
Successful Arrangements of D-Cell, Wire, and Bulb



Base \Rightarrow Support Wire \Rightarrow Filament \Rightarrow Support Wire \Rightarrow Ribbed Side
 Base \Leftarrow Support Wire \Leftarrow Filament \Leftarrow Support Wire \Leftarrow Ribbed Side

Requirement #1: Closed Conducting Loop

- There must be a closed, conducting pathway from + to - terminal of the energy source (cell, battery, etc.) in order for there to be an electric circuit.
- A break, interruption, or opening in the loop will stop the flow - whether it is charge flow, water flow, coaster car flow.



Requirement #2: Energy Source

- Two oppositely-charged plates connected by a wire will not allow for the permanent flow of charge.
- An energy source is required to pump the + charge against the E field back up to the + plate.
- The charge pump takes away from (subtracts, -) one terminal and adds to (+) the other terminal.
- An energy source (cell, battery, etc.) is required to maintain the difference in electric potential. A fluid will always flow when a ΔV is established.

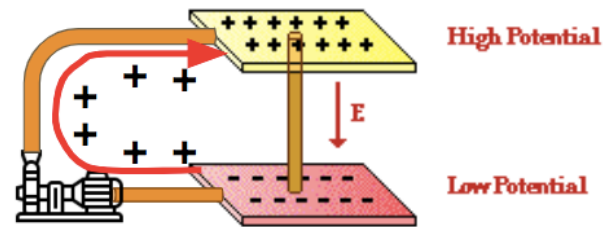


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