SNS COLLEGE OF TECHNOLOGY

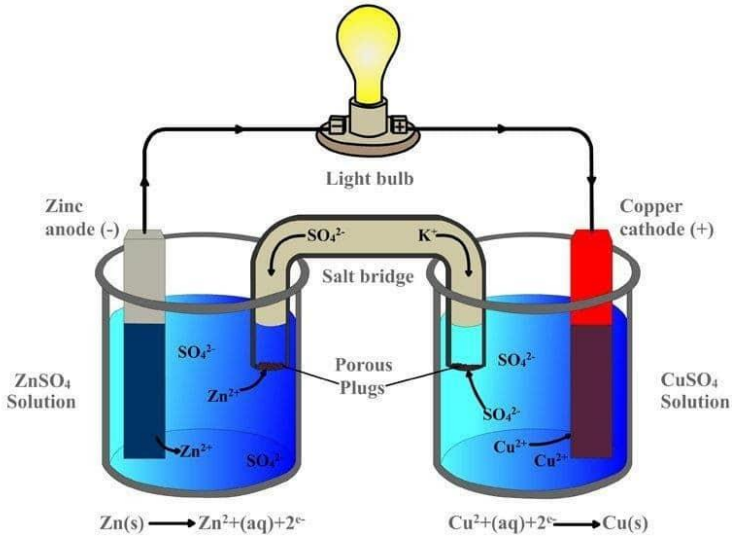
AN AUTONOMOUS INSTITUTION

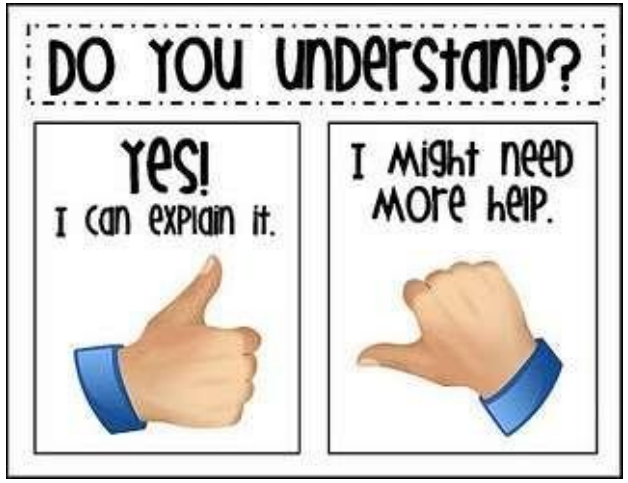
Coimbatore – 641035

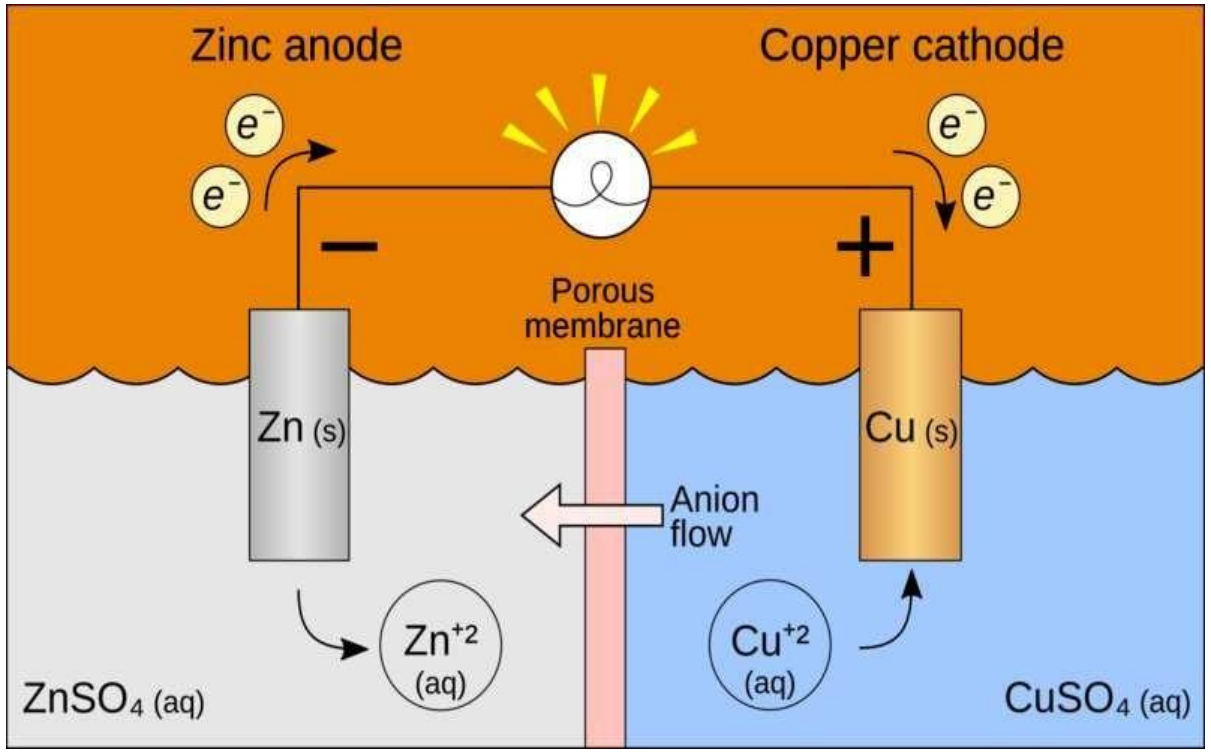
23CHT101-ENGINEERING CHEMISTRY

UNIT -1 - ELECTROCHEMISTRY

1.8 Galvanic Cell

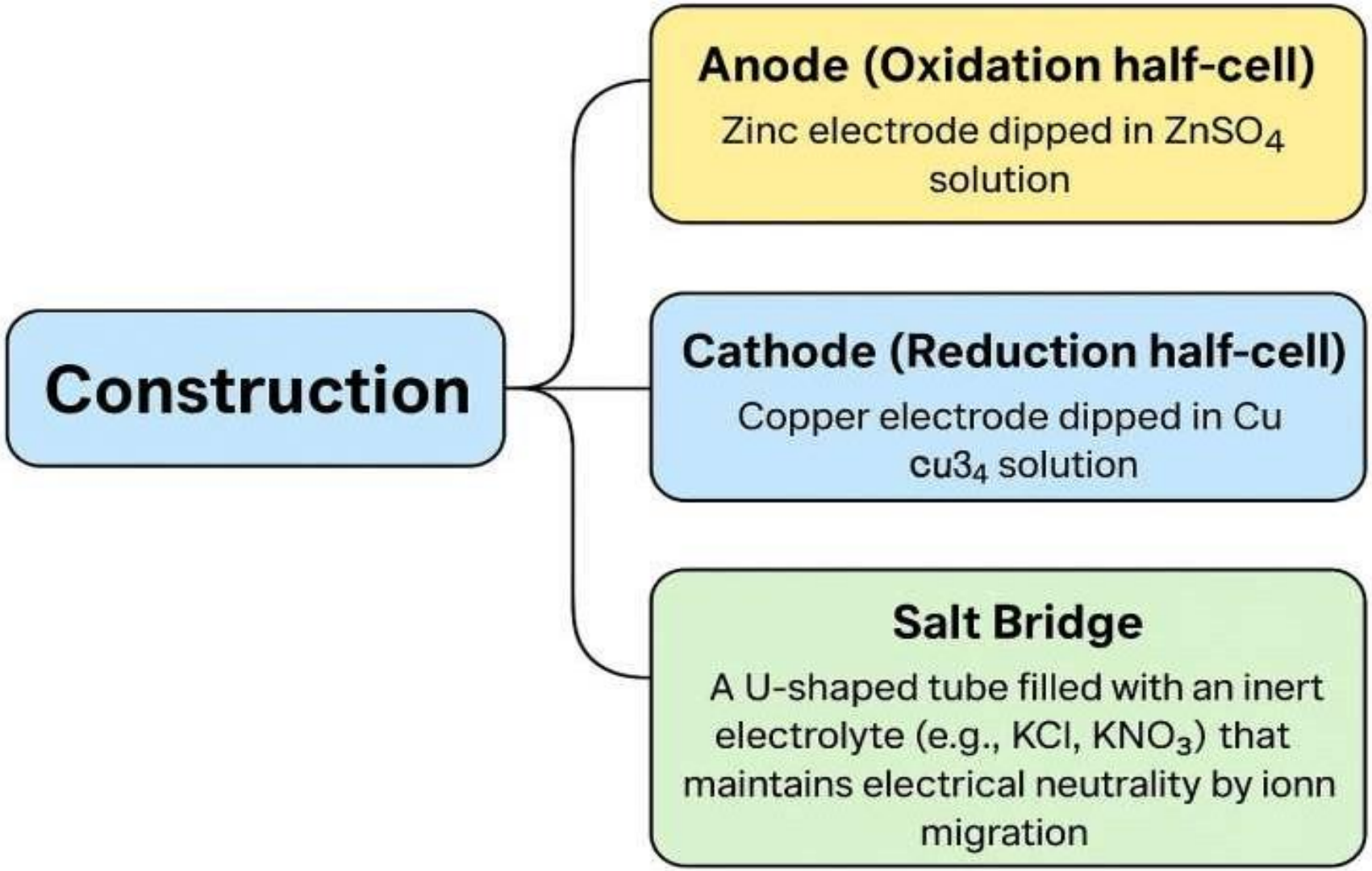


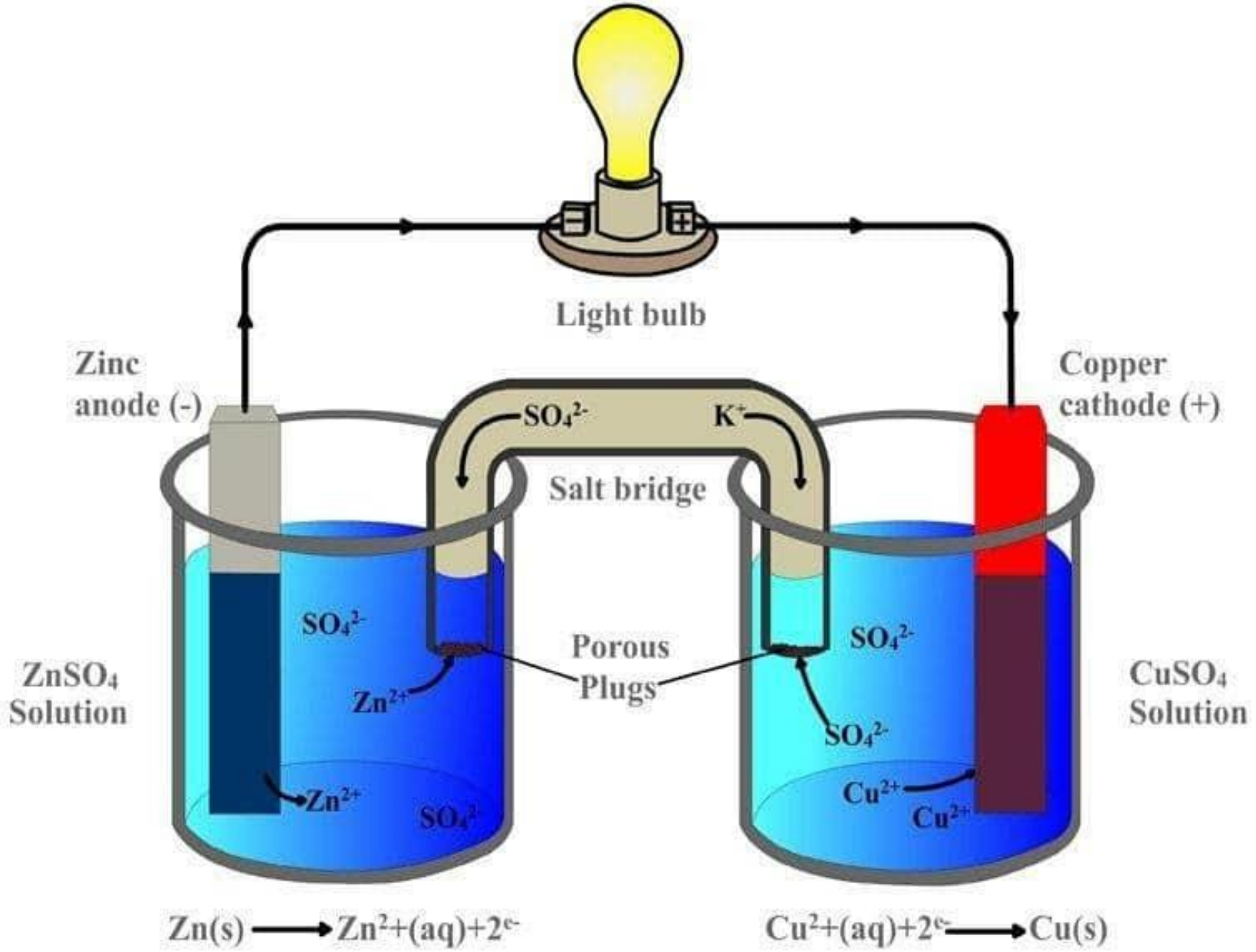

DO YOU UNDERSTAND?
YES!
I can explain it.
I might need more help.

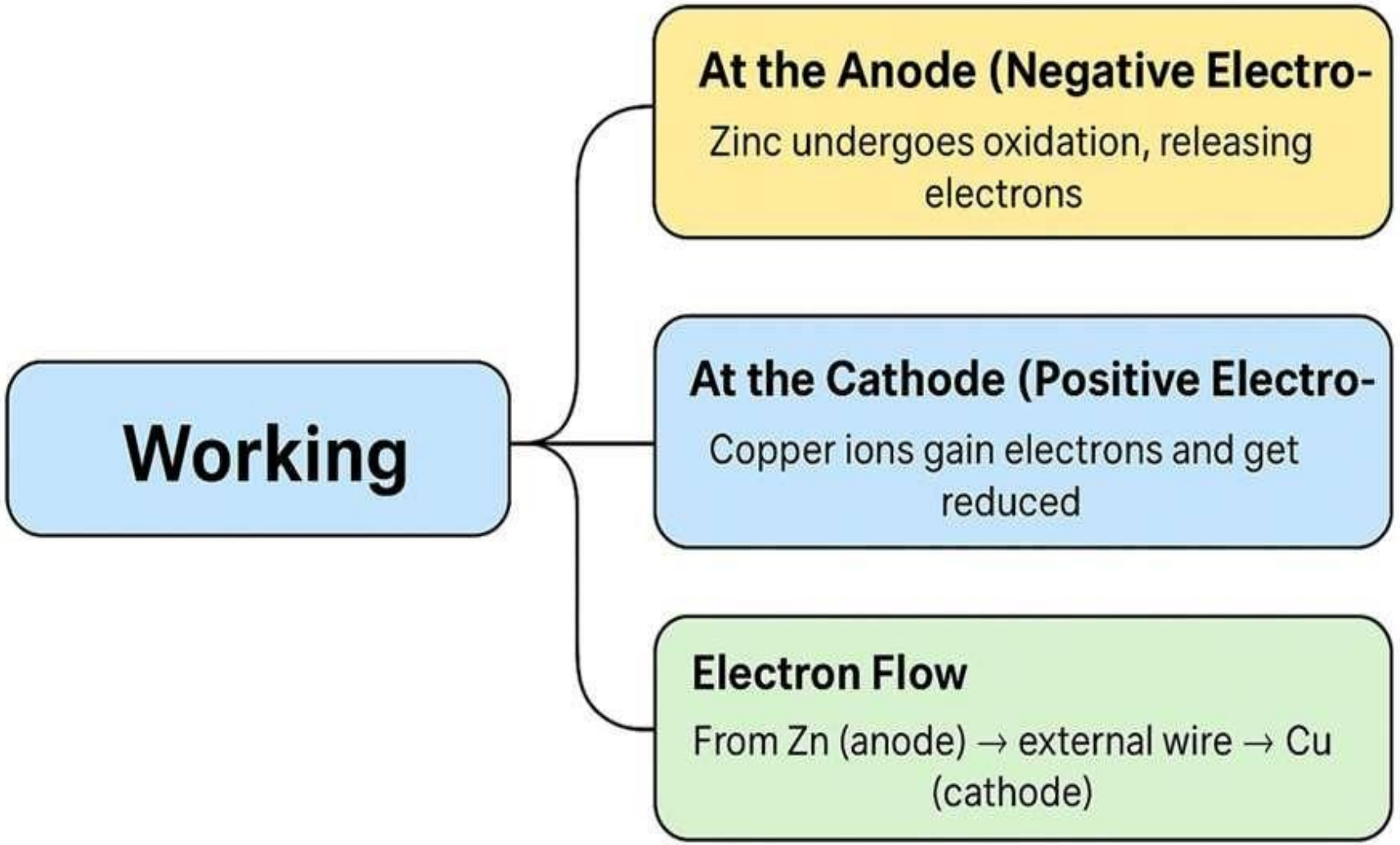

Zinc anode
Copper cathode
e⁻
e⁻
e⁻
e⁻
−
+
Porous membrane
Zn (s)
Cu (s)
Anion flow
Zn+2 (aq)
Cu+2 (aq)
ZnSO4 (aq)
CuSO4 (aq)

GALVANIC CELL

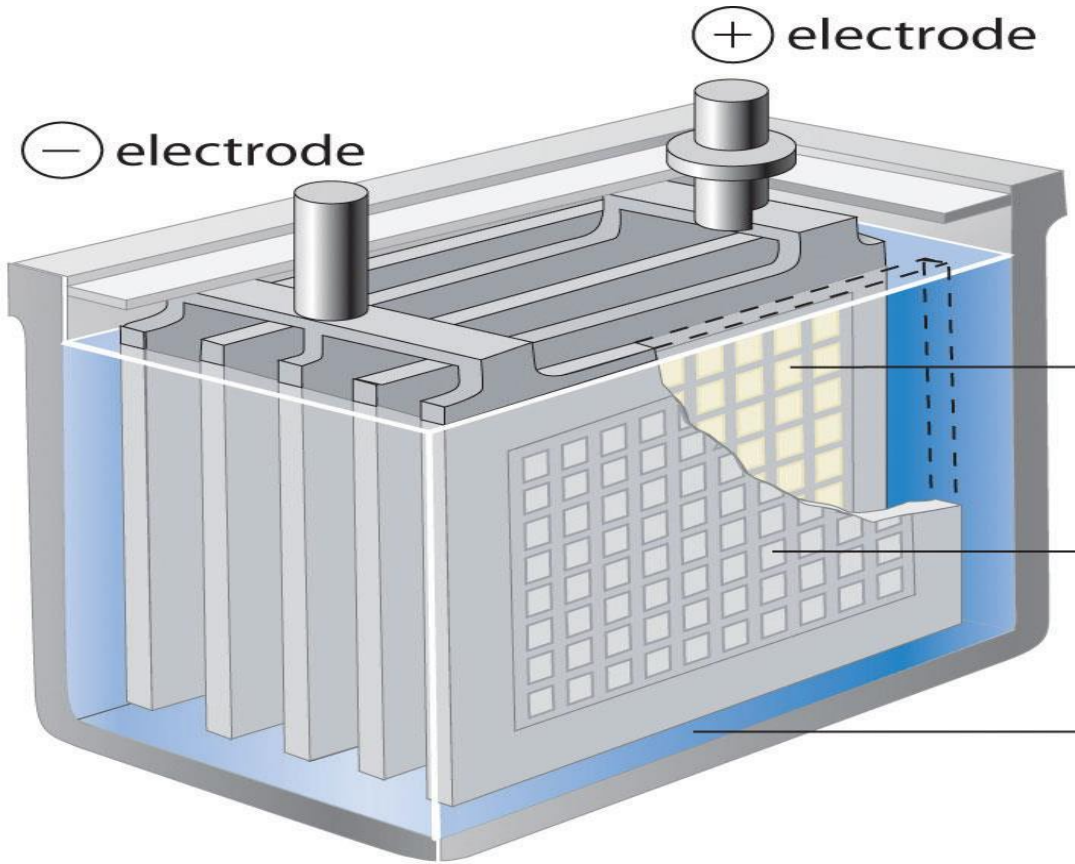
Parameter	Standard Condition
Nature of Electrodes	Zn acts as anode Cu as cathode
Concentration of Electrolytes	As concentration changes, electrode potential shifts according to the Nernst equation.
Temperature	Decreases with rise in temperature
Surface Area of Electrodes	Larger surface area allows more active sites for redox reactions


Construction
Anode (Oxidation half-cell)
Zinc electrode dipped in $ZnSO_4$ solution
Cathode (Reduction half-cell)
Copper electrode dipped in Cu $cu3_4$ solution
Salt Bridge
A U-shaped tube filled with an inert electrolyte (e.g., KCl, KNO_3) that maintains electrical neutrality by ionn migration


Light bulb
Zinc anode (-)
Copper cathode (+)
SO_4^{2-}
K^+
Salt bridge
SO_4^{2-}
Zn^{2+}
Porous Plugs
$ZnSO_4$ Solution
SO_4^{2-}
SO_4^{2-}
Zn^{2+}
SO_4^{2-}
Cu^{2+}
Cu^{2+}
$CuSO_4$ Solution
$Zn(s) \rightarrow Zn^{2+}(aq)+2e^-$
$Cu^{2+}(aq)+2e^- \rightarrow Cu(s)$


Working
At the Anode (Negative Electro-
Zinc undergoes oxidation, releasing electrons
At the Cathode (Positive Electro-
Copper ions gain electrons and get reduced
Electron Flow
From Zn (anode) → external wire → Cu (cathode)

Ex: Galvanic cell-based battery



cathode (+):
lead grid filled with PbO_2

anode (−):
lead grid filled with spongy lead

electrolyte:
solution of sulfuric acid

cell reaction:

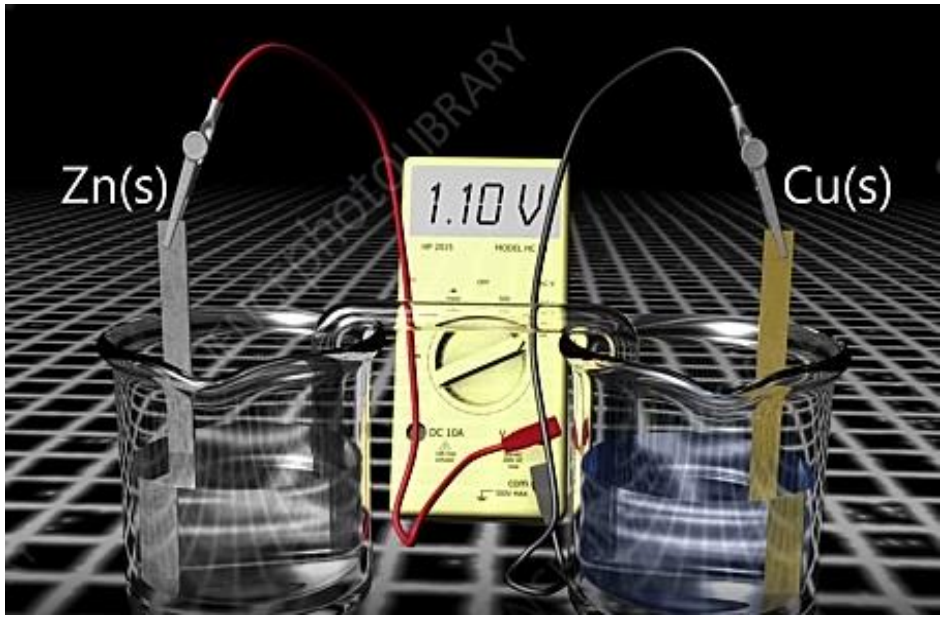
$$Pb(s) + PbO_2(s) + 2HSO_4^-(aq) + 2H^+(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$$

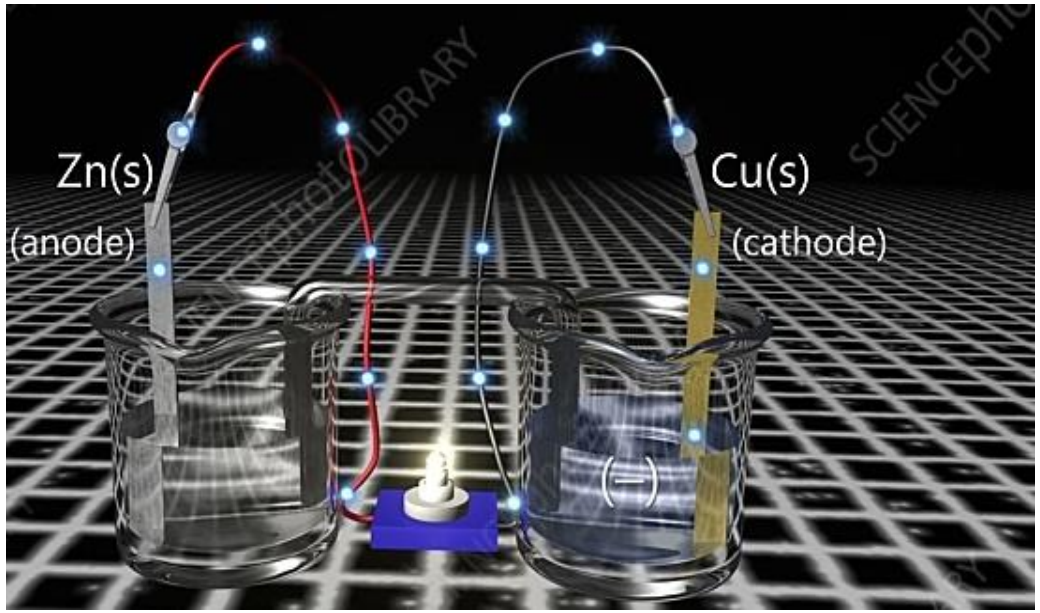
Ion Flow (in salt bridge)

Anions → anode, cations → cathode

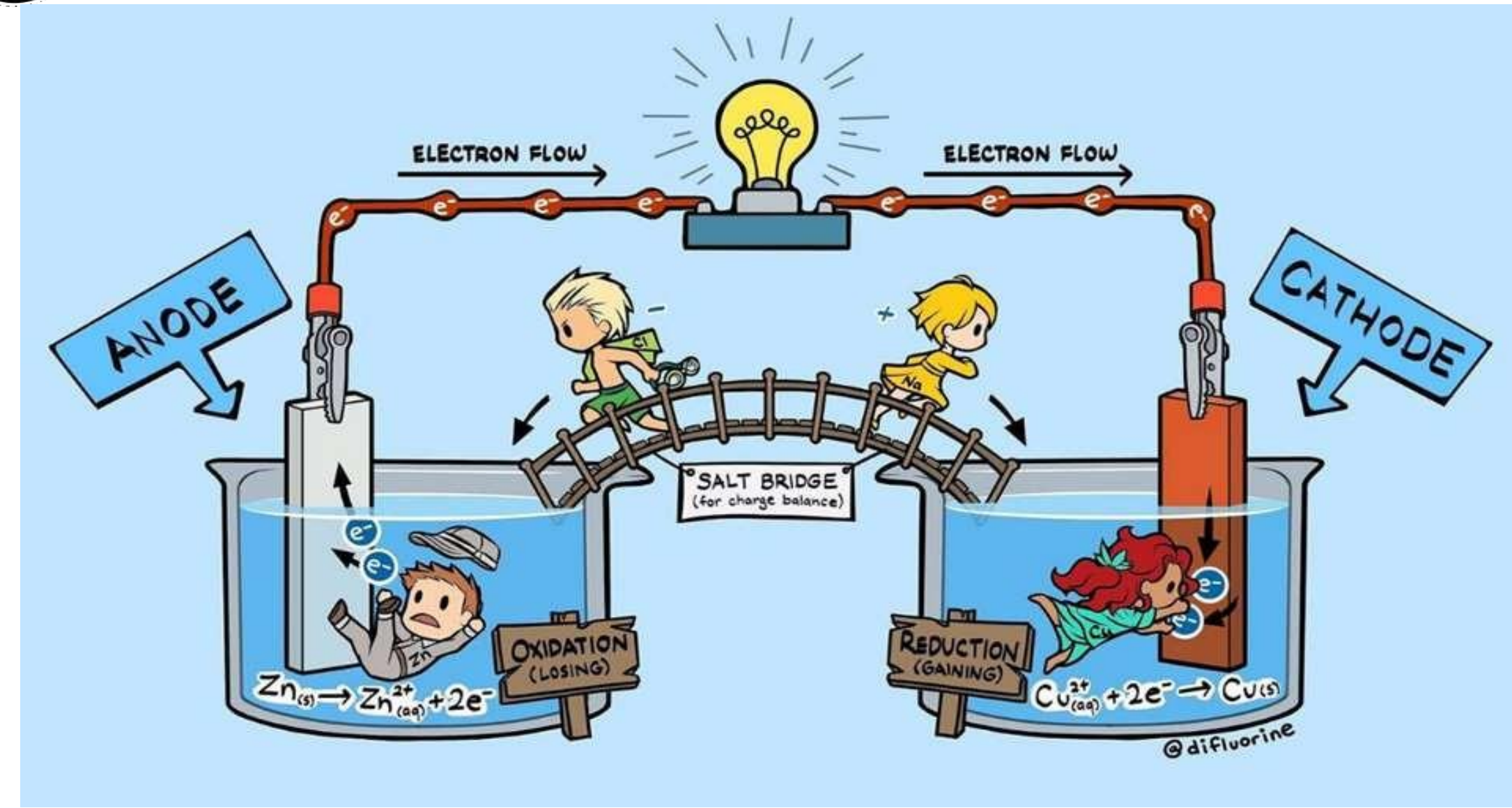
NO_3^- → Zn side, K^+ → Cu side

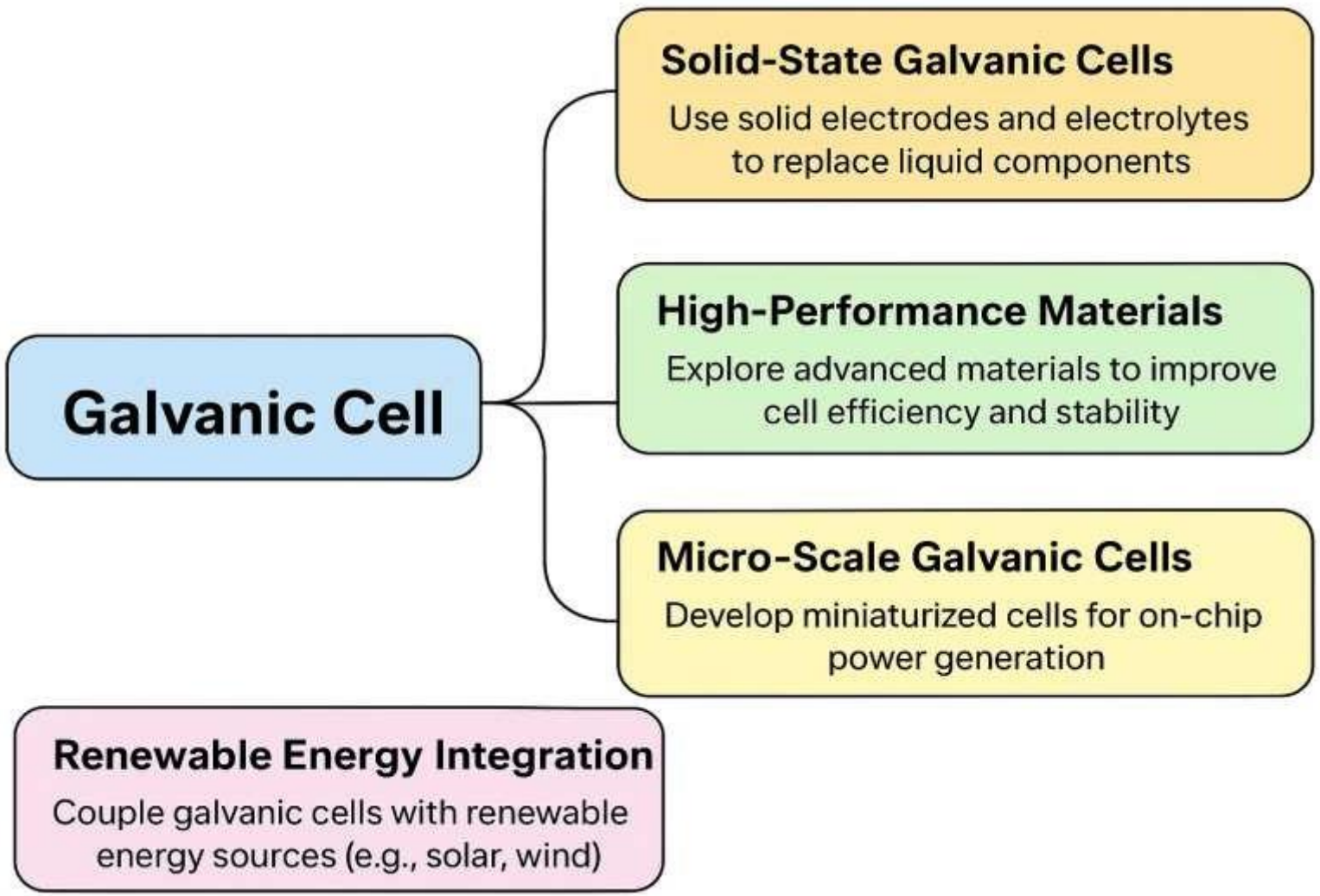
Overall Cell Reaction:	$Zn\ (s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu\ (s)$
Cell Representation:	$Zn\ (s)\|Zn^{2+}(1M)\|\|Cu^{2+}(1M)\|Cu\ (s)$

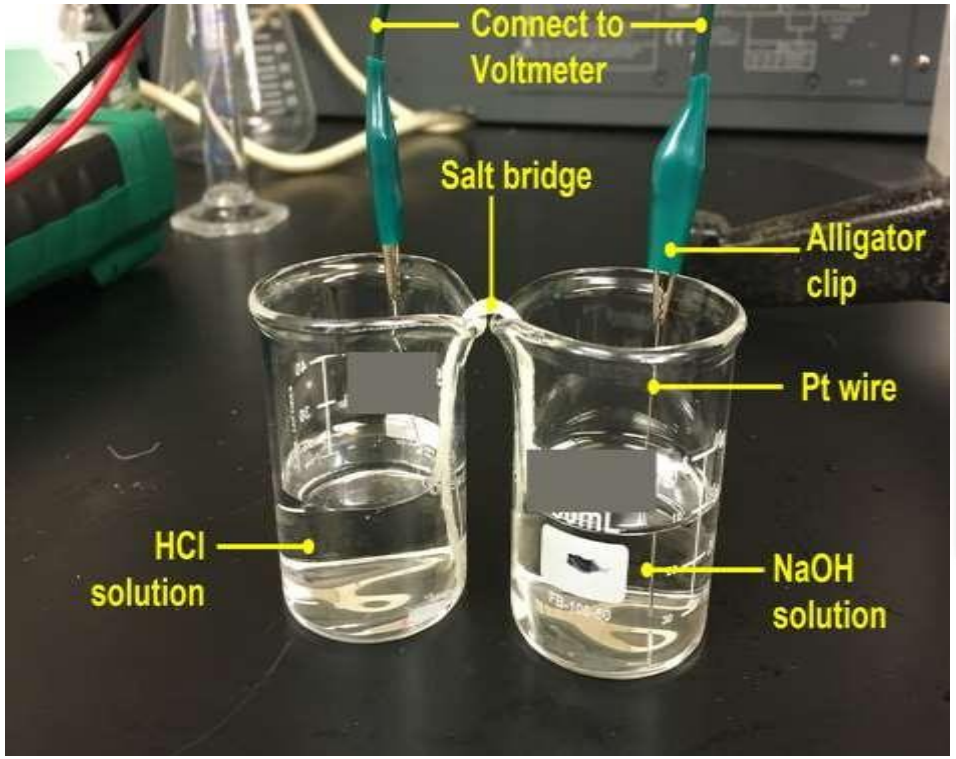




Link:
https://media.sciencephoto.com/image/k0053166/preview/K0053166-Galvanic_cell_chemistry,_animation.mp4


ELECTRON FLOW
ELECTRON FLOW
ANODE
CATHODE
SALT BRIDGE
(for charge balance)
OXIDATION
(LOSING)
REDUCTION
(GAINING)
$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$
$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$
@difluorine


Galvanic Cell
Solid-State Galvanic Cells
Use solid electrodes and electrolytes to replace liquid components
High-Performance Materials
Explore advanced materials to improve cell efficiency and stability
Micro-Scale Galvanic Cells
Develop miniaturized cells for on-chip power generation
Renewable Energy Integration
Couple galvanic cells with renewable energy sources (e.g., solar, wind)


Connect to Voltmeter
Salt bridge
Alligator clip
Pt wire
HCl solution
NaOH solution


WHAT
WILL
YOU DO
NEXT?


1.08

References

https://en.wikipedia.org/wiki/Galvanic_cell

https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry/Basics_of_Electrochemistry/Electrochemistry/Galvanic_Cells