Mariana King
Harrison-Morton Middle School
8th Grade

Salt Bridge Over Electrified Waters

Question

What will happen to the pH of two salt solutions(Cu(NO3)2, $Zn(NO_3)_2$), connected by a salt bridge when an electrical current is generated?

Hypothesis

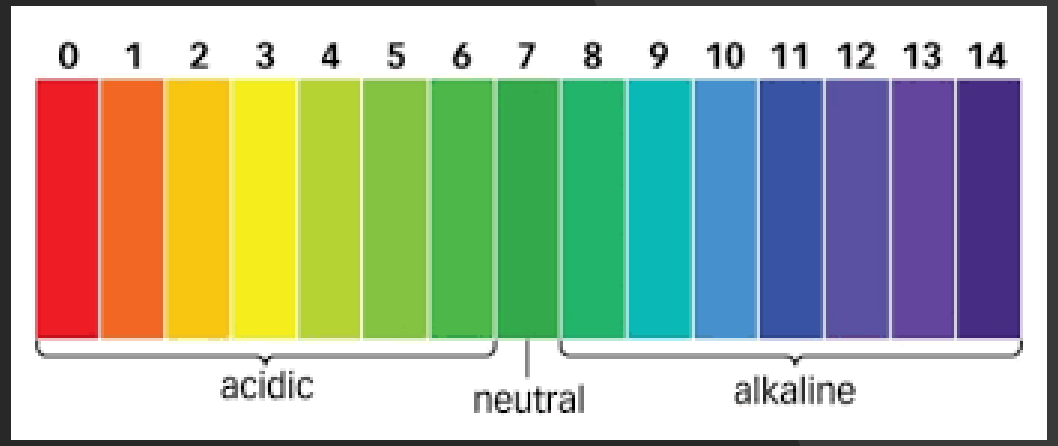
Will the pH become more basic because of the flow of electrons generated within the salt bridge?

Rationale

I selected this experiment because electrons pass through water because they are generated at the anode, but I wanted to know if it changes the pH of the water; or the physical makeup of the salt bridge.

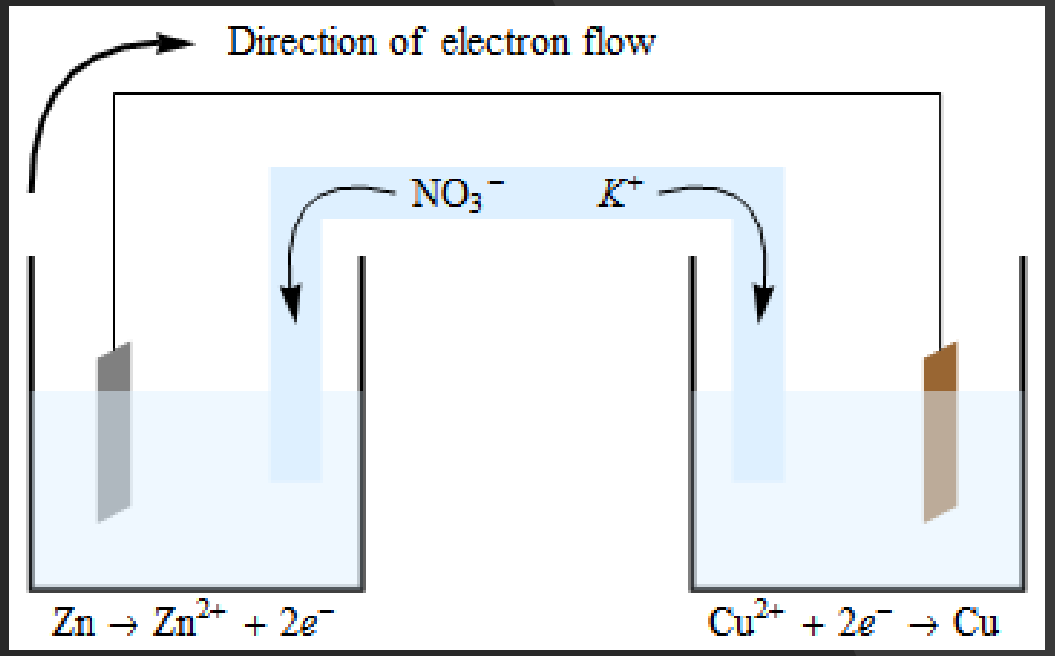
Background Research

A pH scale ranges from one to fourteen one being the most acidic, seven being neutral, and fourteen is alkaline. pH stands for potential of hydrogen, referring to the hydrogen ion concentration in a solution.



Background Research

In electrochemistry, a salt bridge is used to generate and maintain an electric neutrality by keeping the electrons moving from one half cell to another.



Materials

- Glass salt bridge
- Huggies 10x3 Diaper Strip
- Porous cup
- 10x3 paper towel strip
- 1.2 volt light bulb
- Distilled water
- Zinc Nitrate
- Cupric Nitrate
- Magnesium Sulfate
- Multimeter
- 2 Alligator Clips
- Universal pH Indicator Strips
- Bromothyml Blue pH Indicator
- Digital pH Meter
- Copper Bar
- Zinc Bar

Variables

Independent Variable: Kind of salt bridge

Dependent Variable: Voltage measure

Constants:

Copper Anode

Zinc Cathode

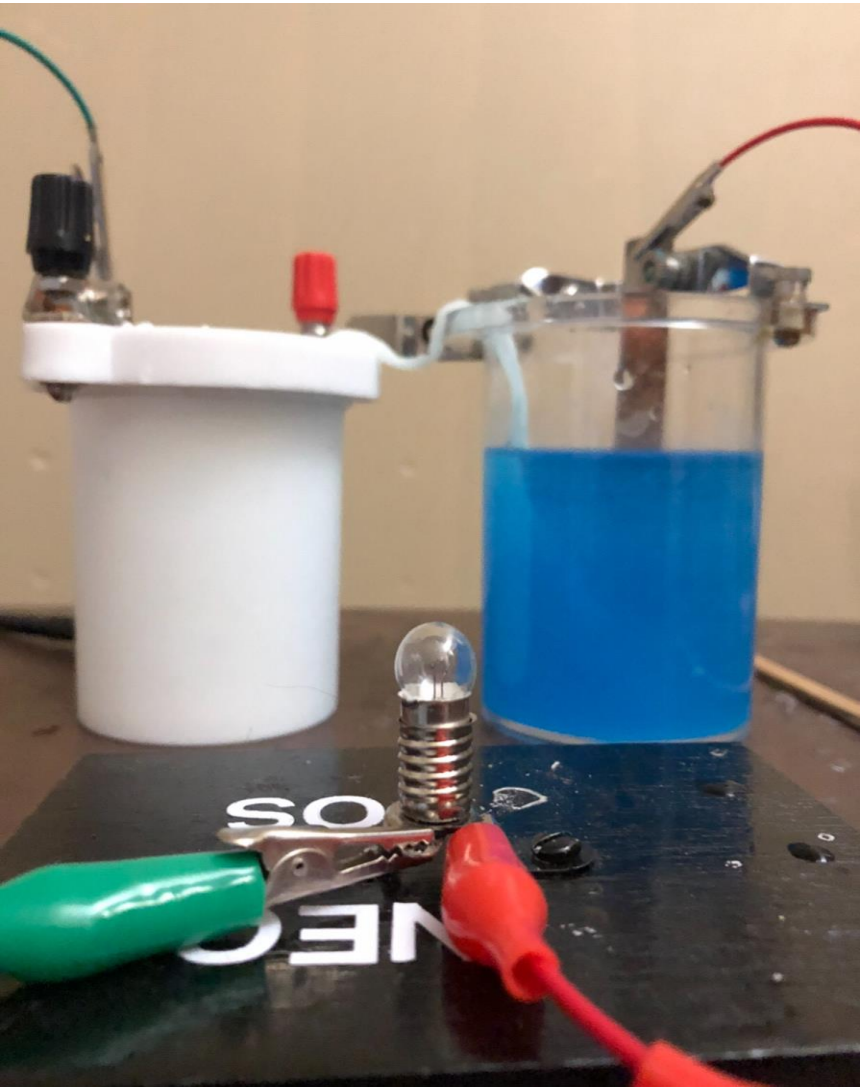
Procedure (Paper Diaper Glass)

- Pour 200 mL of Zinc Nitrate Solution into the Cathode and 200 mL of Cupric Nitrate Solution in the Anode.
- Measure pH with pH strips, roll and meter and record data.
- For Paper and Diaper; pour 200 mL of Magnesium Sulfate Solution onto Salt Bridge. For Glass Salt Bridge; drop 200 mL of Magnesium Sulfate Solution into both sides of glass using dropper.
- Measure pH with pH strips, roll and meter and record data.
- Put Zinc Bar Cathode and Copper Bar into Anode.
- Measure Voltage with Multimeter and record data.
- Connect Zinc and Copper to lightbulb with alligator clips.
- Let light bulb sit for 5 minutes and record data.
- Measure pH with pH strips, roll and meter and record data.

Procedure (Porous Cup)

- Pour 100 mL of Zinc Nitrate Solution into the Cathode and 100 mL of Cupric Nitrate into the Porous Cup.
- Place Porous Cup inside the Cathode.
- Measure pH with pH strips, roll and meter and record data.
- Place Zinc Bar in Cathode and Cupric Bar in Porous Cup.
- Measure Voltage on Multimeter.
- Measure pH with pH strips, roll and meter and record data.
- Connect Zinc and Copper to lightbulb with alligator clips.
- Let light bulb sit for 5 minutes and record data.
- Measure pH with pH strips, roll and meter and record data.
- Compare results.

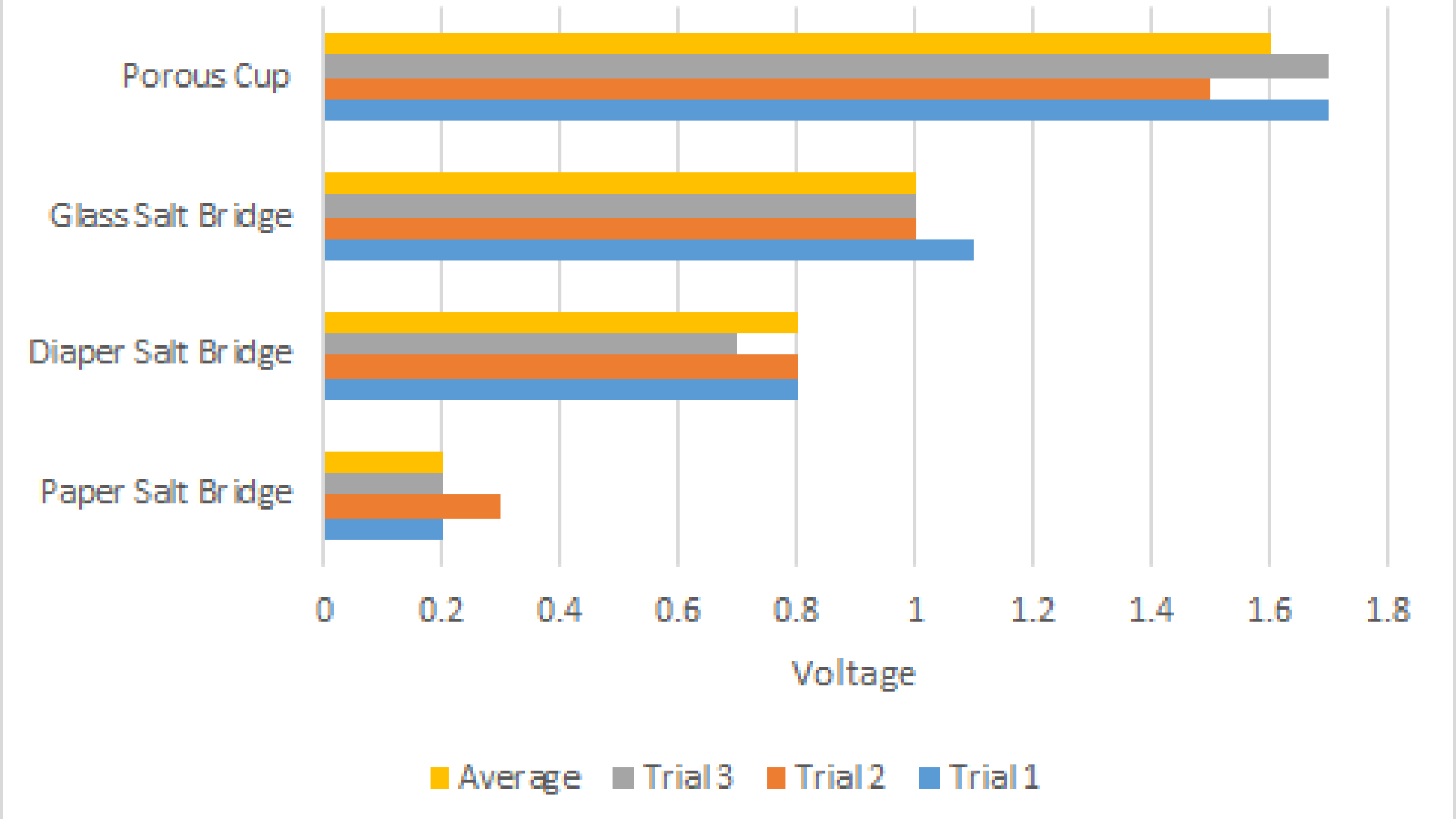
Experimental Setup

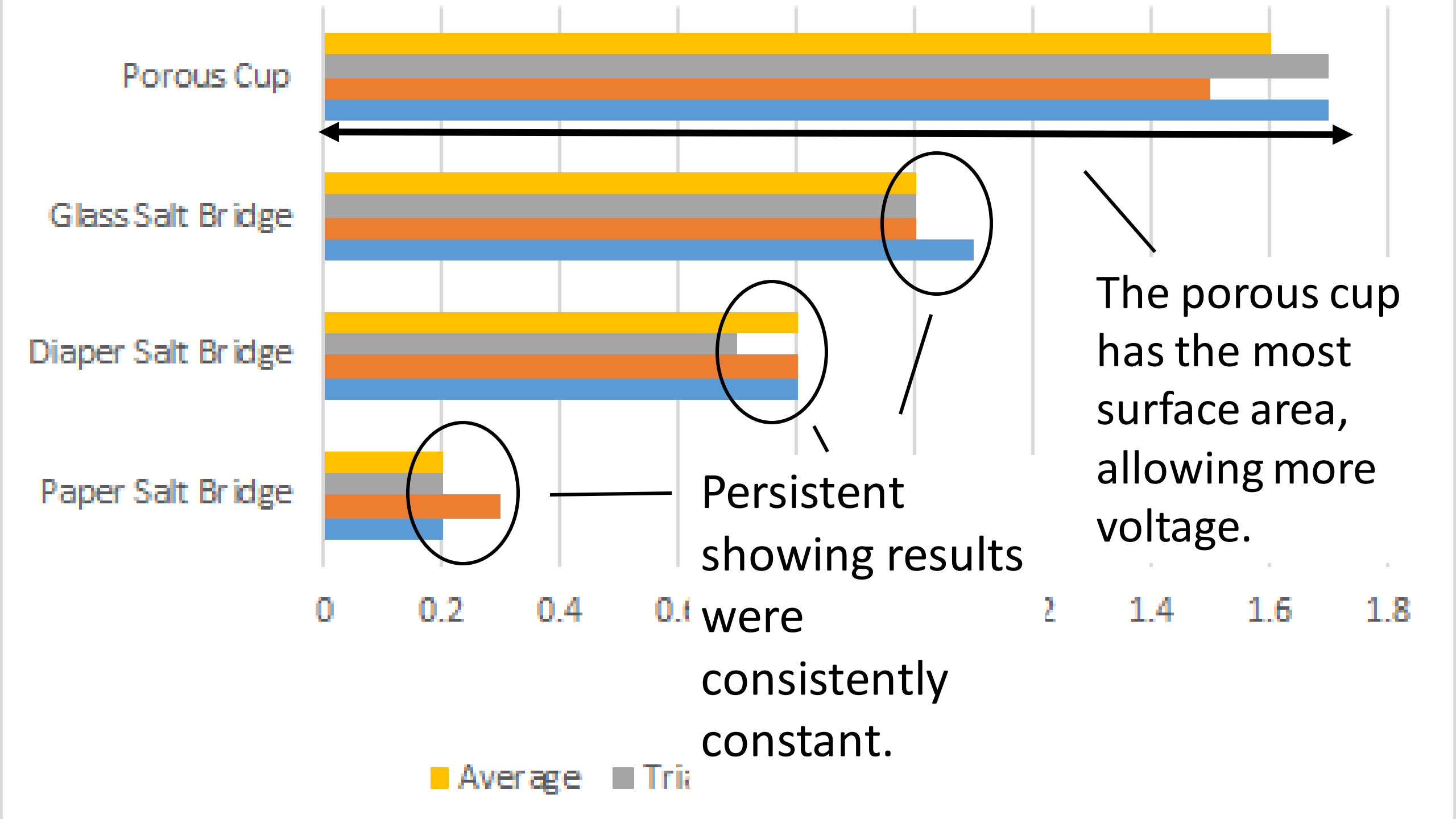


This was the setup for my paper salt bridge, diaper salt bridge, and glass salt bridge, since they are almost the same physical setup.

This was the setup for my porous since the porous cup is built differently.

	Trial 1	Trial 2	Trial 3	Average	Did It Light The Light Bulb?	How Long Did The Light Last For?
Paper Salt Bridge	.2 Volts	.3 Volts	.2 Volts	.2 Volts	No	0 Seconds
Diaper Salt Bridge	.8 Volts	.8 Volts	.7 Volts	.8 Volts	No	0 Seconds
Glass Salt Bridge	1.1 Volts	1.0 Volts	1.0 Volts	1.0 Volts	Yes	47 Seconds
Porous Cup	1.7 Volts	1.5 Volts	1.7 Volts	1.6 Volts	Yes	79 Seconds


Porous Cup
Glass Salt Bridge
Diaper Salt Bridge
Paper Salt Bridge
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Voltage
Average
Trial 3
Trial 2
Trial 1


Porous Cup
Glass Salt Bridge
Diaper Salt Bridge
Paper Salt Bridge
0
0.2
0.4
1.4
1.6
1.8
Average
The porous cup has the most surface area, allowing more voltage.
Persistent showing results were consistently constant.

	Beginning of Experiment pH	Middle of Experiment pH	End of Experiment pH
Diaper Salt Bridge	6.5	6.7	6.7
Paper Salt Bridge	6.5	6.8	6.9
Glass Salt Bridge	6.5	7.1	7.8
Porous Cup	6.5	7.7	8.2

The porous cup had the greatest pH change because it can reach equilibrium the fastest.

Data Analysis

My data shows the porous cup was the most efficient in lighting the light bulb having the highest pH change. It lit the lightbulb up for the longest and the brightest, had the highest voltage by far, and made the pH the most basic.

Conclusion

In conclusion, my hypothesis was verified since the pH from the beginning of the project to the end became more basic. The porous cup was the most efficient like I predicted in the hypothesis, in all the different measures.

Bibliography

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Acknowledgements

Acknowledgements go out to:
Dr. Frank Schweighardt

Thank you for your time.

Any questions?