



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

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| Name(s) Aurora L. Ostrom | Project Number S0514 |
| Project Title The Effect of Gravity and Counter Ions on Hydrogen Ion Diffusion | |
| Abstract Objectives/Goals This project investigates the effect of gravity and counter ions on the rate of hydrogen ion diffusion. This rate is determined by measuring the time it takes for hydrogen ions to travel a given distance. Solutions of hydrochloric, nitric, sulfuric, and phosphoric acid are used to supply the hydrogen ions. Replicate measurements are collected for each acid at a series of three different distances in a horizontal configuration. The results are plotted and a comparison of the rates for each acid is made to determine the effect of the anion (chloride, nitrate, sulfate, and phosphate) on the rate. All of these experiments (three replicate measurements of four acids at three different lengths) are repeated with the test stand in a vertical configuration. The results obtained horizontally are compared to those measured vertically to determine the effect of gravity. | |
| Methods/Materials A series of three, 1-inch PVC pipes (2-ft, 3-ft, and 4-ft) filled with 18 Megaohm deionized water were used as the test apparatus. 25-ml volumes of 10 Normal hydrochloric, nitric, sulfuric, and phosphoric acids were used as the test solutions. A pH electrode connected to a pH meter was used as the hydrogen ion sensing device. A stopwatch was used to measure the time in each experiment. | |
| Results A graph of the results collected in the horizontal configuration revealed a difference in the rate of hydrogen ion diffusion depending on the acid used. A graph of the results collected in the vertical configuration showed little difference in the rates of hydrogen ion diffusion measured for each acid. A significant increase in the times measured in the vertical configuration versus those measured horizontally was observed. | |
| Conclusions/Discussion Counter ions in the acids used did have an effect on hydrogen ion diffusion. However, the trend did not follow the mass of the anion as hypothesized. A change in the hydrogen ion diffusion was observed in the vertical configuration relative to that in the horizontal configuration. However, the rates did not increase due to gravity as hypothesized, but rather decreased significantly. Furthermore, the diffusion rates for the acids tested vertically were very similar. Since the first set of experiments showed that counter ions do effect hydrogen ion diffusion, it is proposed that another force is overriding any effect of gravity and equally controlling the hydrogen ion diffusion in all the acids. | |
| Summary Statement This project is designed to determine the effect of gravity and counter ions on hydrogen ion diffusion by measuring the diffusion rate of different acids in both horizontal and vertical configurations. | |
| Help Received Father completed the application and handled the acids during the experiments. | |