



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

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Project Title Measurement of Diffusion Coefficient in Liquids using Digital Video Technique	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this experiment is to measure the rate of diffusion of liquids using digital video technique. The technique is applied to determine the effect of temperature and viscosity on the diffusion coefficient in corn syrup. The hypothesis is that if a liquid is thinner or if its temperature is higher, then its rate of diffusion will be faster.</p> <p>Methods/Materials In this experiment, the diffusion distance versus time (response variable) of a liquid is recorded while the temperature or viscosity (manipulated variable) is changed. The experimental data is compared against a theoretical model based on Fick's Second Law of Diffusion. The model is simulated using Excel for various relative diffusion coefficients. By comparing the experimental curves to the theoretical values, the dependences of the diffusion coefficient on temperature and viscosity are obtained. The diffusion takes place in a clear plastic tube mounted parallel to the ground to minimize the effect of gravity. The diameter of the tube is selected to be 3/8 inch to keep the diffusion one dimensional but at the same time is large enough to avoid air bubbles that can block the flow. Food coloring is used to help distinguish the diffusing liquid against the background liquid. A ruler is placed next to the tube to help mark off the distance. A video camera is placed three feet away to film the diffusion process. Finally, Sony Vegas software is used to read off the diffusion distance versus time from the video tape.</p> <p>Results The experimental data is organized into two types of graphs consisting of distance vs. time vs. temperature and distance vs. time vs. formula. A corresponding set of theoretical diffusion distance vs. time curves are made to match the experimental data by varying the diffusion coefficient in the model. The results show that by altering the viscosity of corn syrup through thinning by 90%, the diffusion coefficient increased three times. While altering temperature by 27 degrees, there is hardly any change in the diffusion coefficient.</p> <p>Conclusions/Discussion The experimental technique of using a camcorder to capture the diffusion process in liquids and subsequent analysis using digital video editing software was shown to give very accurate measurements. Using the measured data, the hypothesis that if a liquid's temperature is higher or if it is thinner, then its rate of diffusion will be faster is confirmed.</p>	
Summary Statement A digital video technique to measure diffusion coefficient in liquids is used to show the effect of temperature and viscosity	
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