



# CALIFORNIA STATE SCIENCE FAIR 2005 PROJECT SUMMARY

<b>Name(s)</b> A. Si-Si Hensley	<b>Project Number</b> <b>J1513</b>
<b>Project Title</b> <b>Does the Rate of Heating Have an Affinity for Salinity?</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of my project was to determine how salinity and initial temperature affect the rate of heating and cooling of water.</p> <p><b>Methods/Materials</b> To test this hypothesis, a measured amount of table or sea salt is added to 200ml of distilled water to reach a desired level of salinity. Then, heat is applied using a heat lamp to the water for 15 minutes and removed to cool the water for 15 minutes. An aquarium pump connected to an aerating stone is used to continually mix the water during the heating process to maintain a uniform temperature. A digital thermometer (Extech DTD) records the data every 5 seconds and is then transferred to a laptop computer and plotted onto a graph in Excel. The slope of the temperature versus time is computed using a linear least squares tool in Excel to provide my rate of heating or cooling. Four measurements are made and the standard deviation is used to estimate the error in the heating or cooling rate. Five salinity levels (0, 17.5, 35, 87.5, 175) parts per thousand corresponding to (0, 0.5, 1.0, 2.5, 5.0) times the normal sea salinity level (35 parts per thousand) were tested for both table salt and sea salt for an initial temperature of 20 C. Also, the heating rate was measured for three salinity levels, 0, 1.0, and 5.0 times the normal sea salinity, of both table and sea salt with an initial temperature of 4 C.</p> <p><b>Results</b> After analyzing the measured heating/cooling rates, only a couple of the experiments showed a possible trend with salinity level. The experiments with the largest trend (least squares linear fit of the heating rate as a function of salinity) with salinity were the 20 C ocean salt heating and the 4C heating for table and sea salt. These trends were smaller than the error bars on the measurements and thus could not definitely establish a trend. The trend for heating that was observed with the 20 C sea salt heating and the 4 C heating was shown to be in rough agreement the heating rates predicted using a model for the predicted rate of temperature increase.</p> <p><b>Conclusions/Discussion</b> My analysis indicated there maybe a heating rate increase with salinity in some cases. It was not possible to establish a definite trend of the heating or cooling rates with salinity because the error bars on the measurements were larger than the trends determined by linear least squares fits of the heating rates as a function of salinity.</p>	
<b>Summary Statement</b> The objective of my project was to determine how salinity and initial temperature affect the rate of heating and cooling of water.	
<b>Help Received</b> Mother helped transferring data from Extech DTD to computer and formatting Excel plots, father helped understanding least squares and the density and heating equations.	