



**CALIFORNIA STATE SCIENCE FAIR  
2002 PROJECT SUMMARY**

<b>Name(s)</b> <b>Anirban Mazumdar</b>	<b>Project Number</b>  22608
<b>Project Title</b> <b>Microwave Superheating through Attempts at Chemical and Physical Facilitation of Nucleation</b>	
<b>Objectives/Goals</b> The objective of this study was to understand how different physical properties and chemical agents affect microwave superheating of water. Since scientific literature has not fully addressed the interactions and dynamics of this phenomenon, and microwave superheating is not well understood, the hope is that this study will contribute towards better understanding of this phenomenon <b>Abstract</b> <b>Methods/Materials</b> Using the same domestic microwave oven set to "normal" power, several samples in 125ml of tap water at 23°C were subjected to microwave radiation for 7 minutes and 30 seconds, and observed for evidence of boiling (nucleation) and superheating (an abrupt stop in nucleation followed by an eruption). The tests were repeated using distilled water at 23°C. The variables included changes in physical properties (different shaped containers, an artificially roughened container, the presence of a smooth probe, the presence of a boiling tab, the presence of an oily layer, and the presence of tea-leaf fragments) and chemical agents (additions of salt, sugar, and detergent to create solutions). <b>Results</b> Superheating was prevented physically by the presence of tea leaf fragments, the use of artificially roughened container, and boiling tab. Superheating was prevented chemically by the use of a detergent solution. Superheating occurred with the standard beaker, the wide container, the narrow container, the presence of a smooth probe, the presence of an oily layer, the use of an electrolytic (salt) solution, and the use of a sugar solution <b>Conclusions/Discussion</b> By preventing superheating physically, the artificially roughened container, the boiling tab, and the tea leaf fragments all physically facilitated nucleation. Similarly, by preventing superheating chemically, the detergent solution chemically facilitated nucleation. The other variables did not facilitate nucleation significantly. Nucleation therefore is the primary factor in the ability of water to superheat. Analysis of the data also illustrates the potential of chemical agents to alter the ability of water to nucleate, providing implications for the field of chemistry. The data also illustrates the viability of artificial roughening as a practical solution to enhance public safety.	
<b>Summary Statement</b> This project studied the dynamics of superheating of water through attempts to facilitate nucleation by altering various chemical and physical properties and subjecting the samples to microwave radiation using a domestic microwave oven.	
<b>Help Received</b> Used the Microwave Oven of a Neighbor, Mr. Ferazzi helped provide the measurement equipment, parents helped purchase equipment and provided encouragement	