CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
S1511

Project Title
2 + 2 = Less Than You Think

Abstract

Objectives/Goals
It has been said that the physical addition of two separate volumes of water and alcohol will result to less than the projected amount. However, could this merely be a fact lost in history through misunderstanding? Or could two plus two, or really any increment, add up to less than four?

Methods/Materials
To answer this question the long, but simple, task of measuring out individual increments of fluid and combining them within the 100ml graduated cylinder where they would again be measured, was begun. As the experiment proceeded new aspects of it were discovered, like the fact that it#s exothermic.

Results
The resulting data is illustrated through detailed graphs and charts. The results are categorized into four sections: combination, physical results, projected results, and % difference. For example, (respectively) 50 ml alcohol/50 ml water, 95.12 ml mixture, 100 ml mixture, 4.88% in clearly displayed in a chart. The experiment was run and recorded over one hundred times. Because the sample size ranged from a mere 10 ml to 100 ml, the data presents a broad spectrum of the results of hydrogen bonding on the mixing of water and alcohol.

Conclusions/Discussion
While the method is simple, its significance is everlasting. The experiment proved that the physical volume of mixing alcohol and water won#t equal its projected volume. All industries, even NASA, must understand the properties of alcohol and water. It is with this knowledge that they can be more efficient and accurate.

Summary Statement
What we have come to believe about the physical world may not be true, and two plus two may not equal four.

Help Received
My brother helped me come up with the idea.