CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
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Project Number
J0606

Project Title
Surface Tension of Different Liquids

Abstract

Objectives/Goals
An experiment is conducted to measure the surface tension of four different liquids, specifically: water, cooking oil, isopropanol (rubbing alcohol), and a solution of dish soap in water. Which one will have the highest and which one will have the lowest surface tension? My hypothesis is that water will have the highest surface tension, followed by soapy water, isopropanol, and lastly cooking oil, based on the degree of hydrogen bonding in each liquid.

Methods/Materials
A weight balance is used to measure the force required to lift a needle off the surface of each liquid. To construct the balance, a fulcrum is drilled into the center of a beam, that is then placed on two supports. A needle is tied on one end of the beam with string, and a cup is tied on the other. The needle is placed horizontally on top of each liquid, and small weights are placed inside the cup until the needle is lifted off the liquid. Surface tension is defined by the following equation: $s = F/2d$. F is the force in newtons, which is derived from weight (in grams) required to lift off the needle, the factor of 2 is because the film of water pulled up by the needle has 2 surfaces, d is the length of the needle in meters, and s is the surface tension. First, the weight in grams is converted to the force in newtons. Then the formula, $s = F/2d$, is used to calculate the surface tension.

Results
Out of all the tests I conducted for my science project, I confirmed that water did have the highest surface tension out of all the liquids that I tested. Following water, the rank order of surface tension from highest to lowest was cooking oil > rubbing alcohol > solution of water with soap.

Conclusions/Discussion
I further researched to find out why the results were different from my hypothesis. I learned that the degree of hydrogen bonding in each liquid is what affected the surface tension the most, but it was also the other elements in different liquid molecules that prevented hydrogen bonding. For example, the soap in the solution have fatty acids that separates the hydrogen atoms from the oxygen atoms. This separation between the hydrogen and oxygen atoms is what prevented some of the liquids I tested to have a high degree of hydrogen bonding, which is the cause of lower degrees of surface tension.

Summary Statement
I conducted tests to measure the degree of surface tension in different liquids to demonstrate the principle of hydrogen bonding, and accomplished this by determining the force required to lift a needle off the surface of each liquid.

Help Received
I got help in understanding hydrogen bonding from my mom, and my dad assisted me with the power tools I used to build my balance. I conducted my experiments myself.