CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
31163

Project Title
How Strong Is the Molecular Force in a Drop of Liquid?

Abstract

Objectives/Goals
I mainly want to find out the strength of intermolecular forces in a drop of water and other liquids, look for a simple way to observe and estimate those intermolecular forces, and see what factors could affect the force strength in a drop of liquid molecules.

Methods/Materials
Samples of liquids include water, ethanol, red wine, red tea, NaCl/water, and sugar/water. The method in the following I called block-separation method:
1. Make two copper cylindrical blocks with the same diameter
2. Hang the top block on a block holder with the flat surface facing down
3. Put a drop of water on the flat surface of the bottom block
4. Align the bottom block to the top one, with the drop of water in between
5. Stick the two blocks together vertically. They will attach to each other
6. Put a small weight on the string that is fastened tightly to bottom block.
7. Add more weights until the bottom block separates from the top block
8. Record the total weight that caused the separation
9. Repeat the same procedures (steps 2-8) with different liquids

Results
The intermolecular forces in drops of liquids were measured by using the block-separation method. The strength of intermolecular force between two water molecules was around 2.5E-16 Newton. The intermolecular forces of ethanol solution in various concentrations diluted with pure water were also measured. When those samples of liquids were compared, the results are that the sugar solution has the strongest intermolecular forces, and ethanol has the weakest intermolecular forces.

Conclusions/Discussion
My experiments demonstrate that the intermolecular forces of liquids are quantitatively measureable by using the block-separation method. The intermolecular forces of water molecules are around 2.5E-16 Newton per molecule in force. The measurement results also reveal that the intermolecular forces do not totally depend on the size or complexity of the liquid molecules. They seem to be more influenced by polar strength of liquid molecules. That does make sense since the intermolecular forces are actually electrostatic forces between positive and negative electric charges.

Summary Statement
I want to find out a simple way to measure the strength of intermolecular forces in a drop of liquid.

Help Received
My dad helped to make the metal blocks; my mom helped to record data while I was conducting the experiment. Both of them helped me with building the board.