



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Nilesh Tripuraneni	Project Number S1699
Project Title Novel Characterizations of the Static and Kinetic Behavior of Liquid Marbles: A Potential Utility in Microfluidics?	
Abstract Objectives/Goals Liquid marbles, first created in 2001, are formed when a liquid such as water, is encapsulated within a skin of super-hydrophobic powder; this protective skin results in the droplet's complete non-wetting of its substrate. My primary aim was to develop a more complete understanding of the static and kinetic behavior of these liquid marbles in addition to investigating their applications in digital microfluidics. Methods/Materials Mathematically, I derive a novel geometric description of liquid marbles in their static state by using an energetics framework. A physical model of their kinetic behavior is obtained by using a non-slip rotational model to describe their movement and a simple scaling law to account for viscous dissipation. Liquid marbles, used in experimentation to corroborate the theoretical calculations, were created using water and micronized Teflon. High-resolution pictures of the marbles were analyzed to verify the geometric predictions obtained from the static model. Similarly, the kinematics of these liquid marbles were experimentally verified by monitoring how liquid marbles behaved on inclined planes. Results Less than 5% deviation was found to exist between the theoretically-predicted values and the actual values for both the static and kinetic models. Correspondingly, the derived theory predicts that droplet velocity should scale hyperbolically with size, which appears to explain some of the unusual movement patterns of liquid marbles. Conclusions/Discussion It appears that this study has brought a more precise and broad understanding of the static and kinetic behavior of liquid marbles. Additionally, liquid marbles' applications to the field of digital microfluidics have also been hitherto unexplored; a proof-of-principle demonstration seems to suggest that liquid marbles would form-fit the needs digital microfluidics - efficiently transporting discrete packets of liquid - and perhaps remedy a few of its problems.	
Summary Statement My project seeks to experimentally and theoretically describe the unusual physics of liquid marbles, in addition to investigating their application in digital microfluidics.	
Help Received Father helped to take pictures; Teacher provided materials.	