



**CALIFORNIA STATE SCIENCE FAIR  
2016 PROJECT SUMMARY**

<b>Name(s)</b> <b>Lauren Lum; Victoria Vo</b>	<b>Project Number</b>  36864
<b>Project Title</b> <b>The Effect of the Addition of Acetic and Nitric Acids to Natural Dyes on the Electrical Output of a DSSC</b>	
<b>Objectives/Goals</b> The purpose of this experiment was to determine the effect of the addition of acetic and nitric acid to two natural dyes, raspberry and azalea, on the electrical output of a dye sensitized solar cell (DSSC). It was hypothesized that DSSCs using dyes treated with acetic acid, rather than nitric acid, would produce a higher electrical output. <b>Abstract</b> <b>Methods/Materials</b> Major equipment used in the project include raspberry dye, azalea dye, 0.01 M nitric acid, 0.87 M acetic acid, pH meter, hot plate, halogen lamp, and a voltmeter, TiO <sub>2</sub> paste and iodine electrolyte. A total of 18 DSSCs were constructed, 6 tested for each of the 3 trials. Each DSSC tested a different type of dye (raspberry control, raspberry-acetic, raspberry-nitric, azalea control, azalea-acetic, azalea-nitric). DSSCs were built using two glass slides acting as the electrodes, one coated with titanium dioxide paste and soaked in the natural dye and the other coated with carbon. The DSSC was placed under the halogen lamp and its maximum voltage (in mV) and maximum current (in mA) were measured and recorded after 5 seconds using a voltmeter. <b>Results</b> The experimental mean for the azalea control was 212.1 +/- 53.4 mV, the azalea acetic was 265.1 +/- 38.1 mV, and the azalea nitric was 107.1 +/- 48.8 mV. The experimental mean for the raspberry control was 370.9 +/- 11.2 mV, the raspberry acetic was 402.7 +/- 20.3 mV, and the raspberry nitric was 312.3 +/- 39.3 mV. <b>Conclusions/Discussion</b> Overall, the hypothesis was determined to be inconclusive due to insufficient data, high deviations, and small sample size. Though the data showed that the DSSCs using dyes treated with acetic acid produced the most energy, the difference between electrical output of acetic DSSCs and the electrical output of the control (unmodified) DSSCs was not very significant. The nitric acid DSSCs produced significantly less energy. Flaws in experimental design, such as the dilution of the acetic and nitric dyes through the addition of acidic solution or the cracks in the TiO <sub>2</sub> paste could have contributed to the inconclusive results.	
<b>Summary Statement</b> Though the data was determined to be inconclusive, the results showed the addition of acetic acid to the natural dyes of the DSSCs produced the most energy.	
<b>Help Received</b> Our chemistry teacher assisted us in our studies of DSSCs. Throughout experimentation, we constructed the the DSSCs and carried out the experiment on our own; however, Mr. Lum helped us when heating the DSSC anodes on hotplates.	