



**CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY**

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Project Title Gone in a Flash: Solubility and Burn Rate of Nitrocellulose as a Function of Nitration Time	
Objectives/Goals I have seen many recommended nitration times for nitrocellulose. I would like to find out how the nitration time effects its solubility in acetone and its burn rate.	
Abstract Methods/Materials To nitrate cellulose, I soaked 1 gram samples of cotton in a 2:1 chilled mixture of sulfuric acid and nitric acid for different times. Adding sulfuric acid to nitric acid acts as an acid base reaction where the sulfuric acid acts as an acid and nitric acid acts as a base, although it is strongly acidic. This generates the nitronium ion, which attacks the cellulose structure by replacing hydroxyl groups with nitronium groups. The excess hydroxyl groups combine with an extra hydrogen ion from the nitric acid and create water. When I took the cellulose out of the acid, I neutralized it in a saturated sodium carbonate solution, then put it in a different bucket of water to wash out the created sodium salts. I then dried the nitrocellulose by sunlight and divided the samples in half. The first half of each sample I burned while filming. I played back the video in slow motion and recorded the time it took to burn. The second half I dissolved in acetone, filtered, and dried. I weighed the residue and recorded the weight.	
Results All of the nitrated samples burned very rapidly. An un-nitrated cotton ball used as a control burned so long that it was not included on the chart (greater than 20 seconds). Plots of burn time as a function of nitration time show a steady decrease. The 10 minute nitrated sample showed a longer burn time and lower solubility than the trend shown by the other data points. I believe that this is because the cotton that I nitrated was not pulled apart and did not get evenly soaked in the acid mixture. The solubility showed an increase as a function of nitration time except for the same problem with the 10 minute sample. I was surprised that the size of a sample of cottony nitrocellulose barely effected the burn time. However, this wasn't true for the plasticized samples.	
Conclusions/Discussion The results of this project show that a 15 minute nitration time is the most desirable of the soak times tested as commercial nitrocellulose. If it were nitrated longer, it may become unstable and sensitive to static electricity, making it a fire hazard. For future work, I would try dissolving nitrocellulose in other solvents, probably other ketones and ethers, to see if they could dissolve it better.	
Summary Statement I am measuring the solubility in acetone and burn rate of nitrocellulose as a function of nitration time.	
Help Received My mother supervised use of chemicals and fire, and filmed the burning nitrocellulose.	