



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Hailey C. Loehde-Woolard	Project Number 31148
Project Title Saccharification of Cellulose to Produce Ethanol, a Sustainable Liquid Fuel, Year Two: Next Gen. Enzymes & Pretreatment	
Objectives/Goals Cellulose is one of the main components of the paper waste stream. Ethanol can be used as a fuel. Last year I developed a pretreatment process using pressure cooking and microwave digestion with sulfuric acid to produce cellulosic ethanol. The purpose of my experiment this year is to investigate next generation cellulase enzymes and pretreatment of paper products in order to achieve an efficient yield of glucose. Abstract Cellulose is one of the main components of the paper waste stream. Ethanol can be used as a fuel. Last year I developed a pretreatment process using pressure cooking and microwave digestion with sulfuric acid to produce cellulosic ethanol. The purpose of my experiment this year is to investigate next generation cellulase enzymes and pretreatment of paper products in order to achieve an efficient yield of glucose. Methods/Materials Materials: newsprint, sulfuric acid, sodium bicarbonate, Novozymes NS22074 Cellulase Colmplex, Genencor ACCELLERASE 1500, pH meter, glucose meter, paper shredder, 1/2 gal. Jars\quart jars, distilled water, large graduated cylinder, small graduated cylinder, pipette, safety equipment. Methods: Non Pretreatment: Fill jars with shredded paper and water. Adjust pH. Heat jars to 50C. Add (0.1-0.5mL per gram cellulose) ACCELLERASE 1500 to 3 jars. Add (1-5% w/w) NS22074 to 3 jars. Place all jars in oven and maintain for 24 hours. Check sugar level with glucose meter and record. Measure fluid and record volume. Pretreatment: Fill jars with shredded paper. Add distilled H ₂ O and H ₂ SO ₄ to get a pH below 2. Place jars in pressure cooker. Heat for 45min. at 15psi. Transfer jars to microwave oven and microwave on high for 10 1min increments, stirring between each increment. Cool and repeat the steps from the non pretreatment method starting from the pH adjustment step. Results Starting with 50 grams of paper and no pretreatment I produced 18.5 g +/- 0.5 g of glucose using Novozymes NS20774 and 22.7 g +/- 1g of glucose using Genencore Accellerase 1500. Starting with 50 grams of paper and pretreatment I produced 18 g +/- 1.2 g of glucose using Novozymes NS20774 and 27.7 g +/- 3.5 g of glucose using Genencore Accellerase 1500. Conclusions/Discussion My result for last year was to produce about 4.2g of glucose from 50 grams of newsprint. This year I produced up to 8 fold as much glucose from the same amount of newsprint. I was surprised by the differences between the two enzymes. I expected them to perform about equal. Pretreatment was not statistically different from non pretreatment for Novozymes but was for Genencor.	
Summary Statement Investigating next generation enzymes with and without pretreatment to produce cellulosic ethanol.	
Help Received I received help from my mother and father in preparing my poster and with chemicals during the experiment.	