



**CALIFORNIA STATE SCIENCE FAIR  
2016 PROJECT SUMMARY**

<b>Name(s)</b> <b>Henry A. Mason</b>	<b>Project Number</b>  36048
<b>Project Title</b> <b>Make It or Break It, Now in Color: The Effects of Colorant on the Strength of PLA Polymer 3D Printed Objects</b>	
<b>Objectives/Goals</b> <b>Abstract</b> This study examines the effect of colorant on the strength of objects printed with poly lactic acid (PLA), a biodegradable plastic. Colored filament is made of this PLA blended with pigments such as organic azine dyes. Considering that pigment is an additive and can therefore make a difference in the mechanical properties of plastic, I chose to study the behaviors of different color plastics under stress and to note the differences.  Question: Does color affect filament strength? What effect does colorant have on the structure of plastic? Of colors used for PLA 3D printer filament, which color is strongest?  Hypothesis: Filament with no dye or added color (natural) will outperform the plastics with color in stress tests. <b>Methods/Materials</b> Using basic hardware from the hardware store, I built my test equipment at home for all but the compression tests. The equipment I built allowed me to test flexure, tension, torsion, and shear; while I ran my compression tests using the leg press machine at a local gym. I used a fish scale to measure the amount of weight being applied to each object up to its point of breaking (again, apart from the compression test, which was a matter of stacking weights on top of each test object). <b>Results</b> The study found that, contrary to my hypothesis, the natural or uncolored PLA was not the strongest in any of the tests, but rather the yellow was consistently the strongest. This does indicate that the colorant makes a difference in the strength of printed objects, as I discovered that each color of PLA behaved differently. <b>Conclusions/Discussion</b> The additives in filaments include more than just color and affect the mechanical structure of a 3D-printed object. My findings confirmed that color makes a difference in the mechanical properties of the printed objects. This research proved that color causes differences in the mechanical structure of the plastics; in fact the color sometimes serves to strengthen the plastic. Each individual color behaves differently. Other variables in the manufacturing process can change the properties of the plastic. These questions of manufacturing differences do not come into play in this specific study, as my PLA was all ordered at one time and of the same #Elephant# brand.	
<b>Summary Statement</b> This study tests for the effects of colorants on objects 3d printed using PLA plastic.	
<b>Help Received</b> My father for assisting in 3d printing and testing; Dr. Daniel Fernandez (CSUMB) for proposing the idea; Dr. Paul Stivers for hints about polymer chemistry; Mr. Thomas Shelby for reviewing my display and chemistry; Mr. James Arao for presentation coaching	