



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Callie M. McCaffery	Project Number S0314
Project Title The Shape of Strength: Geometric Shape Impact on Truss Design	
Abstract Objectives/Goals My goal is to understand how different geometric shapes affect the strength of a truss. Specific Test: Does a truss composed of right triangles support more, less, or an equal amount of weight than a truss composed of equilateral triangles? My hypothesis is that a truss made up of equilateral triangles will hold more weight than a truss made up of right triangles. Methods/Materials After experimenting with prototypes made out of Legos and discovering what went wrong with them, I built two styles of trusses out of bass wood that have equal lengths of horizontal members; one set of trusses was made up of equilateral triangles and the other set was made up of right triangles. I then added weights to the center of each truss and found the amount of weight that caused the truss to fail or break. I supported my data with free body diagrams and mathematical calculations. Results The equilateral triangle trusses held more weight than the right triangle trusses: The equilateral triangle trusses started to noticeably bow and bend at an average of 28 pounds, and broke at an average of 36 pounds. The right triangle trusses started to noticeably bow and bend at an average of 22 pounds, and failed at an average of 28 pounds. Conclusions/Discussion My data showed that my hypothesis was correct; the equilateral trusses held more weight. I wanted to validate this mathematically if possible, so I drew free body diagrams applying Newton's Third Law, along with trigonometry to find which members of each truss had the most force applied to them. The member that had the most force applied to it was the breaking point of the truss. By looking at the different calculated mathematical highs, I verified my hypothesis showing that the equilateral triangle trusses better distributed the force than the right triangle trusses. In addition to some trigonometry and physics, I discovered a number of various applications of truss construction concepts.	
Summary Statement Determined how changing the shape of a truss (specifically equilateral vs right triangle construction) affects the deflection or strength of the truss.	
Help Received I designed the prototypes and planned the experimental set up. My father helped me with construction of the set up and verified the calculations. My mother helped me with data collection.	