



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

Name(s) Amy F. Domae	Project Number J0304
Project Title Designing Stronger Lightweight Support Columns	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The choice of regular polygon shape for the perimeter of a short hollow structural support column can increase a column's compression strength by several times. The objective is to determine why shape causes a significant difference in strength so that stronger lightweight support columns can be made.</p> <p>Methods/Materials Method: (1) Make 10 columns for each regular polygon- PART 1 (constant perimeter): triangle, square, pentagon, hexagon, octagon, 16-gon, 20-gon, circle; PART 2 (constant area): square, hexagon, octagon, circle; PART 3: constant perimeter rectangles of 4 different sizes including square. (2) Place flat cardboard and container on top of each column. (3) Add incremental weights until column collapse. Video, photo, observe changes. (6) Measure total weight on the column at collapse. (7) Calculate average collapse weight for each set of trials; analyze. Materials: 110 lb. cardstock, hot glue sticks, hot glue gun, cardboard, paper cutter, weights-penny rolls, digital postal scale</p> <p>Results PARTS 1 and 2: A short hollow column shaped as a regular polygon has increasing compression strength as the number of polygon sides is increased, and this relationship holds even when decreasing the amount of material to make shapes of identical area. In Part 1, circles had 4.7 times the compression strength of triangles. PART 3: Corners fail first and rectangles that better fit the size and shape of the load are stronger.</p> <p>Conclusions/Discussion My results show that compression strength is determined by a column's ability to balance its load. A column collapses when its weakest parts - faces or vertices - begin to fail and the column cannot maintain balance. Stronger shapes have more faces/vertices to share the load after weak parts buckle. Circles, with an infinite number of sides, are strongest. Hexagons are often used for high compression strength lightweight columns, but circular columns could be lighter and stronger with less material.</p>	
Summary Statement My project shows that significantly different compression strengths result from different regular polygon shapes and analyzes why this happens.	
Help Received My mom took photos and videos of the experiments and helped to edit the report. Science teacher, Mr. Briner, reviewed project progress.	