



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Casey J. Mansfield	Project Number J1811
Project Title Does the Degree of Curvature Affect the Strength of Wooden Arches?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to determine how a wooden arch's curvature affects its strength. My hypothesis was that the greater the curvature of an arch, the stronger it would be because of the greater effect of tension on the underside of the arch.</p> <p>Methods/Materials I cut 1/8" X 15/16" strips ripped from two 2x8 basswood boards into five different lengths: 42", 48", 54", 60", and 66", then bent each strip into arch supports (abutments) placed 38" apart. I attached a 5 gallon plastic bucket with a carabiner to the middle of each arch and filled the bucket with sand until the arch broke. I repeated the experiment for a total of 5 trials. I calculated the arc angle for each arch with a construction calculator, using each arch's dimensions from tracings.</p> <p>Results On average, the middle length arch, 99 degrees, supported slightly more weight than either the two steeper or the two shallower arches. However, all five arches were fairly close in their ability to hold weight. On average, the 99 degree arch supported 9% more weight than the 51 degree arch, 11% more weight than the 73 degree arch, 19% more weight than the 112 degree arch, and 7% more weight than the 118 degree arch.</p> <p>Conclusions/Discussion I originally thought that the steeper arch would create the strongest arch. My results indicated that while all my arches effectively dissipated the weight from the center of the arch to the abutments, a medium arch of about 100 degrees created a slightly stronger arch than ones either substantially shallower or steeper. The steeper arches tended to buckle with increased weight, the result of compression overcoming the wood's ability to handle compression. Their breaks were usually off center, at a buckle. I feel this buckling negatively affected the arch's strength. The shallower arches tended to snap in the middle. My results were more varied than I expected, which caused my average results to be closer than I expected, possibly due to the inconsistent nature of my wooden strips, despite my efforts to make them as consistent as possible. I would like to repeat this experiment using different materials, such as thin strips of plastic, and possibly add stabilizing structures to the steeper arches to help prevent buckling.</p>	
Summary Statement My project tested how the degree of curvature affected the strength of wooden arches.	
Help Received My dad helped me with the power saws, and my mom drove me to the lumberyards and helped me edit.	