



**CALIFORNIA STATE SCIENCE FAIR  
2004 PROJECT SUMMARY**

<b>Name(s)</b> <b>Nitish Lakhanpal</b>	<b>Project Number</b> <b>J1810</b>
<b>Project Title</b> <b>Strength in Numbers? A Study of Change in Cable Tensile Strength Due to the Number of Wires and Their Arrangement</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> My objective is to examine whether the ultimate tensile strength (UTS) of a cable is affected by the number of wires in the cable and the manner in which they are arranged. I explored two questions: When a wire is added to a cable, will the change in its UTS be greater than the UTS of a single wire, i.e., will there be a synergy effect? Will the manner in which the wires are arranged, e.g. through braiding, increase the cable's UTS? Correspondingly, the two hypotheses for this experiment are: Hypothesis 1: The UTS of an n-wire unbraided cable will be more than n times the UTS of a single wire. Hypothesis 2: For the same number of wires, braiding will result in higher UTS.</p> <p><b>Methods/Materials</b> Materials: Ring Stand with single-burette clamp; Calibrated gram weights; 16" lengths of 32-gauge wire cut from the same spool; S hook; String; Cookie tin; Nail. Procedure: For hypothesis 1, a container to hold weights was first prepared using a cookie tin and string. One end of a 16" length of 32 gauge wire was then tied to the burette clamp attached to the ring stand; the other end was tied to a S hook. The container was attached to the hook and weights were gradually added to the container, waiting a few minutes between each addition. Weights were added till the wire snapped and this weight was recorded. 9 more trials were conducted in the same manner. Measurements from these 10 trials were then averaged. These steps were repeated for 2, 3, and 4 wires. For hypothesis 2, the above procedure was repeated for 2 wires braided together and the weight at which the cable snapped was recorded for 10 trials and averaged. These steps were repeated with 3 and 4 wire braided cables.</p> <p><b>Results</b> For the unbraided case, the increase in cable UTS due to each additional wire was equal to the UTS of a single wire. Further, the UTS of braided cables was greater than the UTS of corresponding unbraided cables with the same number of wires. Error bars of one standard deviation were used for analysis.</p> <p><b>Conclusions/Discussion</b> The observations did not support hypothesis 1. As more wires were added, the UTS of the unbraided cable increased in proportion to the number wires; no synergy effect was found. Hypothesis 2, however, was supported. The UTS of a 2 wire braided cable was greater than the UTS of a 2 wire unbraided cable - with similar results for 3 wire and 4 wire cables as well.</p>	
<b>Summary Statement</b> This project examined the change in the ultimate tensile strength of a cable due to the number of wires in the cable and the manner in which they are arranged.	
<b>Help Received</b> Parents provided transportation and help with buying materials.	