



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

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Project Title Knot Theory: The Effects of Different String Sizes on the Probability that Complex Knots Will Form	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this research project was to determine if the size of a string affected the probability that a complex knot would form when the string went through a tumbling process, and to be able to apply this principle to the knots formed by DNA in cells</p> <p>Methods/Materials The 5 different widths of string (0.5 mm, 1.0mm, 1.5 mm, 2.0mm, and 3.0 mm) were gathered and out of each, three sets of strings of three different lengths (20 cm, 35 cm, and 45 cm) were cut. For each trial, 1 piece of each length of a certain width string was placed in one of 3 Ziploc containers. The three containers were placed in a machine dryer. The dryer was set to #air dry# (no heat used) and ran for 10 minutes. The knots formed by the strings were analyzed by counting the number of crossings and recording it. The knots were placed on a table to be compared to the other knots formed. A total of 45 knots formed after 3 trials.</p> <p>Results The 20 cm string with a 0.5mm width had an average crossing number of 0.33. The rest of the widths for the 20 cm string did not cross to form knots. For the 35 cm string, the 0.5 mm, 1.0 mm, 1.5mm, 2.0mm, and the 3.0 mm width strings had average numbers of crossings of 1.00, 0.67, 2.33, 1.67, and 1.33, respectively. The 50 cm strings of widths 0.5 mm, 1.0 mm, 1.5mm, 2.0mm, and 3.0 mm had average numbers of crossings of 2.67, 1.67, 3.33, 2.67, and 0.33, respectively. The percent deviations for each trial ranged from 0% to 133%.</p> <p>Conclusions/Discussion The data collected did not allow a definite conclusion to be reached. Although some of the deviations were high, it was apparent that as both the string width and length decreased, the ability to form a knot decreased. By the same token, it appeared that as the string became too long and too wide, the ability to form a knot also decreased. Yet, this cannot be concluded with confidence because of the deviations in the trials and the small range of the string sizes that were used. In order to obtain more accurate and conclusive results, longer string lengths and widths would need to be tested because it appears that a trend does exist, but cannot be seen clearly through the range of string sizes tested. Furthermore, to obtain better results, more trials would need to be conducted, and only one variable should be tested at a time. The size of the containers used should also be a factor considered in future testing.</p>	
Summary Statement Different string sizes were tested to find out what length and width combination formed the most complex knots, but due to flaws in the experimental design, more testing is needed to reach a conclusion.	
Help Received Parents helped take pictures, allowed for the use of dryer, provided funds for materials.	