CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
J0225

Project Title
Does Structure Affect Strength?

Abstract

Objectives/Goals
My goal was to explore the relationship between the structure of a material and its strength. I answered the question: Will changing the structure (or the form: flat, rolled, twisted, and braided) of a material affect its strength? My hypothesis was: The braided structure of the materials will be the strongest.

Methods/Materials
I created four different bridge structures, flat, rolled, twisted and braided, for each of three different materials, cotton, fabric, plastic and paper. I used four 21.65 cm x 14 cm pieces of each material for each structure. Within material, all of the 4 structures were of similar mass. Overturned yogurt containers secured with tape were the bridge supports. To measure the strength of the structures, I placed each across the supports to form a bridge, placed weights on top until the structure broke, then measured and recorded the mass of the weights. I repeated three trials for each structure.

Results
For each material, changing the structure changed its strength. Across the three materials, the strength of the types of structures varied similarly: The rolled structures were the strongest supporting the most mass by far (ranging from 15.73g to 7500.00g), the twisted structures were the second strongest (ranging from 5.70g to 189.97g), the braided structures were the third strongest for paper and fabric (ranging from to 8.00g to 93.33g), the flat structures were the weakest for paper and fabric (ranging from 1.00g to 9.00g). The braided and flat plastic structures were both very weak supporting only 1g of mass. A secondary finding was that the paper was stronger than the fabric, and the fabric was stronger than the plastic.

Conclusions/Discussion
Structure affected strength across all materials. The data did not support my hypothesis, which stated that the braided structure would be the strongest. My project attempted to model and demonstrate the process of changing a materials# structure to change its strength. Scientists have used this idea in nanotechnology. Carbon nanotubes, a new form of carbon that scientists have made using nanotechnology, are 50 times stronger than steel and have a diameter of only 1 to 10 nanometers.

Summary Statement
My project explores the relation between the structure of a material and its strength.

Help Received
Mrs. Kilkenny helped me specify my hypothesis. Peggy Estrada helped me refine my braiding techniques and taught me how to iron.