CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J0214

Project Title
Which Web Withstands Weights? The Application of Force Decomposition to Spider Webs

Abstract

Objectives/Goals
The purpose of my project is to determine the strength of two different spider web designs: an orb web, and a triangle web, using weights. My hypothesis was that the orb spider web would be stronger because it is attached in more places than the triangle web so the stress is distributed along more strands.

Methods/Materials
Twenty square frames, one foot by one foot were made. A basic orb spider web design was strung onto ten of the frames and a basic triangle spider web design was strung on the other ten frames using tacks and silk thread. The spider web frames were set on a Styrofoam stand with a piece of yarn going from the web to the bottom of the stand. The increase in length of the yarn laying on the bottom was used to measure the amount that the web stretched. For the Orb web the starting weight was 1 kg and smaller weights were added incrementally until the orb web broke. For the triangle web the starting weight was 200 g and smaller weights were added incrementally until the triangle web broke. Every time a weight was added the total weight hanging on the web and the web stretch was noted. The stretch was measured by measuring the length of the yarn laying on the bottom of the stand. This procedure was repeated over and over again until all of the webs were broken.

Results
The results of my project indicated the average maximum weight the orb web could withstand before breaking was 1 kg 404 g vs. 440 g for the triangle web. The average tensile stretch of the orb web was 5.5 cm vs. 4.2 cm for the triangle web.

Conclusions/Discussion
My hypothesis was proven correct. In every single case the orb web held more weight than the triangle web. On the average the orb web withstood three times more weight than the triangle web. I used the principles of force decomposition to prove that that the orb web was stronger because the stress was distributed across eight strands in the orb web, as opposed to three strands in the triangle web. Using Young#s Modulus of Elasticity I documented the relationship between the stretch (strain) and the weight (stress). I determined the tensile strength of each web thus predicting the amount of weight each web could withstand before breaking.

Summary Statement
My project was to determine whether an orb web or a triangle web design was stronger applying the principles of force decomposition, graphing a modified version of Young#s Modulus of Elasticity and measuring the tensile strength of the webs

Help Received
Professor Emeritus Bill Purves of Harvey Mudd College helped me come up with the project and understand the physics in it; my parents helped me with "another pair of hands" while running the experiment; my dad nailed down the 20 frames