Dear Members of Professional Engineers of California Government:

It is with upmost gratitude that I thank you for awarding me with the Marilyn Jorgensen Reece Award. It is a great honor to be bestowed the award, and I cannot thank you enough.

As you know, my name is Jane Whatley. I'm 13 years old and in seventh grade at Lorbeer Middle School. I did the science fair last year, and remembered how much I enjoyed it. Even though it's not required at my school to do a science project, I participated anyway, and I was the only one at my school.

While trying to come up with an idea for my project, I was playing with my pet chinchilla, Maggie. She was chewing on a toothpick, and it easily snapped. I thought about how weak they were, and thought it would be interesting to build something out of them. I worked from there, and soon I had my hypothesis: if three different polyhedrons (a rectangular prism, cube, and truncated pyramid) built out of toothpicks are stress tested under varying weights, then the cube will probably hold the most weight because its shape supports itself under force better than the other polyhedrons, or three dimensional polygons.

I started building my polyhedrons. It took about a day each to build. As soon as I was done, I started testing them.

I would test each polyhedron 3 times to get an average. Starting with four ounces, I would set the weight on top of the structure for two second before removing it. After observing, analyzing, and recording what happened, I would add four ounces and repeat the process until the structure broke. Then, I would rebuild it two more times following the same process, and repeat with the other two polyhedrons.

The average weight the rectangular prism could withstand was 201 ounces, the average for the cube was 184 ounces, and the average for the truncated pyramid was 129 ounces. My hypothesis was wrong; the rectangular prism was the strongest.

I noticed a few odd things in my experiments, and I wanted to discover why they happened.

For starters, I wondered why the rectangular prism did the best. When comparing the cube and rectangular prism to the truncated pyramid, you can see some obvious differences. The vertical format of the polyhedrons helped support the weight. The 90 degree angles of the two figures were more effective than the uneven angles of the truncated pyramid (60 degrees and 120 degrees) It prevented the structure from sagging inward as much, which could lead to an easier break. But while comparing the cube and the rectangular prism, they are very similar. What had caused such a significant difference in performance? I found that it was probably because the rectangular prism had all the positive attributes to it as the cube, but it was longer, therefore, giving it more room for support.

One strange aspect was that the rectangular prism became stronger after each test. It confused me at first; I had assumed that, since I was rebuilding the structure after the break, that it would become weaker. The opposite was true with the rectangular prism. Its weight limit gradually rose each time I tested it. I concluded that it was because each time it was tested and rebuilt, I was finding the weak spots and repairing them, making it stronger. However, when the truncated pyramid was tested, it did in fact become weaker, probably due to its weak angles and uneven sides making it difficult to repair. The cube didn’t necessarily get any better or worse. It did a little better because I found its weak spots, but repairing it doesn’t always work, similar to the rectangular prism and the truncated pyramid.

Some of the other things I analyzed were the types of toothpicks I used, the height of my weights, and how much force was put on the structures.

After doing this project, I discovered that I enjoyed engineering and structural design. I’m not sure yet what I’ll major in in college, but after this science fair, engineering might be an option.

Thanks again for granting me this award.

Sincerely,

Jane Whatley

Jane Whatley