CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Amy F. Domae

Project Number
J0311

Project Title
Cell Shape in a Honeycomb Structure vs. Structure Strength

Abstract

Objectives/Goals
The objective is to determine which basic shape among triangular, square, hexagonal, or circular cells in a honeycomb structure has the strongest compressive strength.

Methods/Materials
Method: 1. Create Columns: a) Make 288 half-sheets of cardstock. b) Create a pattern for various columns so that all columns of a given shape are as uniform as possible. c) Build 72 columns for 3 honeycomb structures for each shape. 2. Test Setup: a) Arrange 24 identical columns into 4 rows of 6 as a parallelogram in a honeycomb structure that minimizes space between columns. b) Put each honeycomb between two identical cardboard pieces. 3. Test: a) Incrementally place known weights on top of each of the twelve honeycomb structures until each structure fails. b) Record the weight at which the structure fails. 4. Analyze the data.

Materials/equipment: 110 lb. 8.5" x 11" cardstock, Mini round "High-Temp" hot glue sticks, Bostik 6-g hot glue gun, Artskills Project Board cardboard, Paper cutter, Known weights, Scale

Results
The strongest column shape is the cylinder (circular cell). The weakest shape is a triangular column. For each of the three honeycomb structures of each column shape, the weight causing each structure to fail are: Cylinder: 147.9 kg, 177.8 kg, 168.7 kg; Hexagon: 113.4 kg, 142.9 kg, 154.2 kg; Square: 129.3 kg, 133.8 kg, 117.9 kg; Triangle: 86.2 kg, 79.4 kg, 102.1 kg

Conclusions/Discussion
While hexagonal cells are used in beehive honeycombs and some packing materials because of their strength and dense packing, this study shows that circular columns can make a stronger structure. The list of structures from strongest to weakest are: (1) cylinder (averaging 164.8 kg of load at crushing weight), (2) hexagon (averaging 136.8 kg of load at crushing weight), (3) square (averaging 127 kg of load at crushing weight), (4) triangle (averaging 89.2 kg of load at crushing weight). The results suggest that the larger number of sides of the shape (smaller the flat faces on the column sides), the higher amount of weight that it will support. Cylinders may be the strongest because there are no flat faces. Further testing is needed to study this.

Summary Statement
Honeycomb structures are lightweight and do not crush downward easily; this project studies which honeycomb cell shape among triangular, square, hexagonal and circular columns will provide a structure with the highest compressive strength.

Help Received
Parents helped with lifting of the weights and with photography. Mother helped to edit the report. Science teacher, Mr. Briner, reviewed project progress and gave advice.