Tower of Pasta

Summary

Using spaghetti and marshmallows, students experiment with different structures to determine which ones are able to handle the greatest amount of load. Their experiments help them to further understand the effects that compression and tension forces have with respect to the strength of structures. Spaghetti cannot hold much tension or compression; therefore, it breaks very easily. Marshmallows handle compression well, but do not hold up to tension.

Engineering Connection

Engineers consider tension and compression forces when designing a building or structure, and choosing the materials to build it. All structures must be able to handle the forces that act upon them so they will not fail and injure people, wildlife or the environment. Like all structures, the foundation, frame and joints of a skyscraper must be able to withstand enormous tension and compression forces from the weight of its own materials, the load of people and equipment it holds and the impact of natural forces such as wind, snow and earthquakes.

Learning Objectives

After this activity, students should be able to:

Understand that compression and tension affect the stability of a structure.
Recognize components of their structure that are experiencing tension, and other components that are experiencing compression.
Suggest materials that would make their structure stronger.
Use number sense to correlate the strength of a structure to the amount of weight it holds.
Identify shapes that are better at supporting loads.
Understand that geometry is a significant factor in the amount of weight a building can support.
Compare their model to others to understand why some models are stronger than others.
Collect data by measuring the height of their structure and how much weight it can hold.
Use different building models to predict how much weight a building can hold.

Materials List

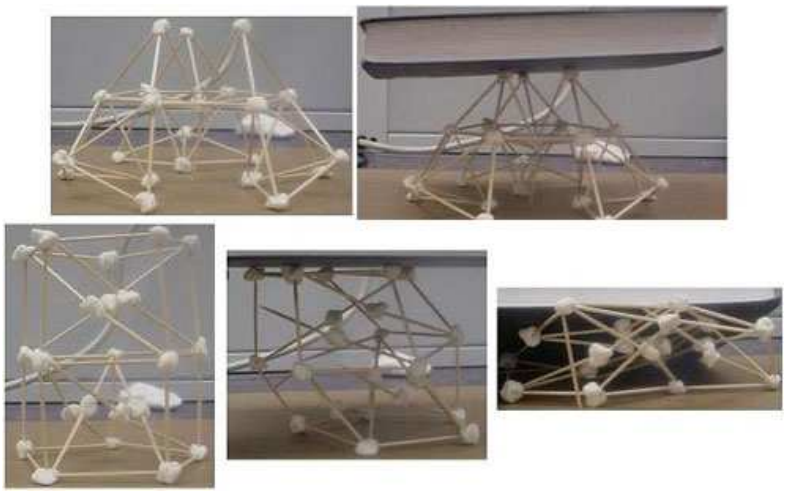
Each group needs:

20 unbroken pieces of uncooked, long pasta, such as spaghetti, linguine or fettuccini
30 small marshmallows
Measuring tape or ruler
Weights or small books

Introduction

Have you ever wondered how really tall buildings stay up? Why do skyscrapers not fall down when strong wind hits them? Engineers work with architects and scientists to understand what makes materials break, and then use what they learn to design strong structures. Today, you will have the opportunity to figure out how to make a strong structure, too. Sometimes, engineers may be able to find very strong materials, but they cannot use them in a structure because the materials are too expensive. Sometimes, engineers cannot use as much material as they might like due to budget or supply limitations. Just like an engineer, today you will be constrained; you can only use a limited amount of materials. Your job is to design and build a structure that is as tall and strong as possible, using only marshmallows and spaghetti.

As you build, think about what forces will be acting upon your structure. Which parts will be pushed together (that is, which will experience compression) and which parts will be pulled apart (that is, which will be under tension). Is it better to have a piece of spaghetti or a marshmallow under tension? Under compression? How will you design the tallest, strongest structure using limited resources?



Procedure

The object of this activity is to build a tower as high AND strong as you can using only a limited supply of spaghetti (or linguine or fettuccini) and marshmallows. There are no step-by-step instructions for this project, only the constraints of limited resources! Students can do whatever they want with the materials to try to build a structure as tall, stable and strong as possible.

The project can be made more difficult by adding more constraints such as fewer materials, a minimum height requirement, or a requirement to support at least a minimum weight for a given time. Let the student teams' imagination, creativity and ingenuity run wild.

Hold a competition and give points for how tall the structure is as well as how much weight it can hold. A good way to comparatively measure the effectiveness of each structure is by having students take the load the structure can support and divide it by the weight of the structure. The higher this number, the more effective the structure. For example, 30g (maximum weight structure could hold) divided by 10g (weight of structure alone) = 3.

Before testing the structures, have students measure and record the height and weight of their structure. How much weight does the structure support? Five grams? 10 grams? 20 grams? 30 grams? Have students record their structure's maximum weight held on the worksheet, and calculate the load to weight ratio for comparison purposes.

After the competition, hold a class discussion:

- Discuss which structure was the tallest and held the most weight. Which structures had the highest ratio of load to structure weight? Which structures held the most weight, regardless of height, and why.

- Discuss the success or failure of the materials used. Spaghetti cannot hold much tension or compression; therefore, it breaks very easily. Marshmallows handle compression well, but do not hold up to tension (the spaghetti can slip out of them).

- Which geometric shapes seemed the strongest for holding weight … triangles, squares, or circles?