Teetering Toothpick Towers: Creative building challenge to design the tallest toothpick tower

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Level: All Grades

Concepts: Geometry and Measurement, Problem Solving

Downloadable/Viewable PowerPoint: http://bit.ly/toothpicktowers

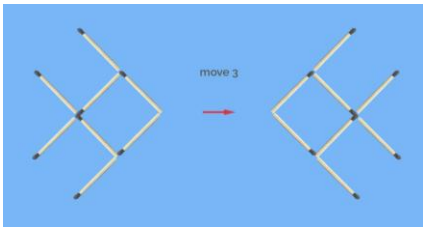
Objective: A creative building challenge to design the tallest toothpick tower. What geometric shape supports, stabilizes, and stiffens structures?

Materials: 30 Toothpicks, Play-Doh (or sticky tack, tape, etc.), measuring tape or ruler (needs to include cm).

Background Information: This activity integrates design components of STEM and the application of math concepts (geometry and measurement). Students have the opportunity to exercise creative thinking skills by designing a free-standing structure from toothpicks, critically assess real-life structures, and then analyze the similarities and differences of buildings in real life to their own designs. Last but not least, they are encouraged to reflect on ways to improve their design and to make observations in their local communities.

Starter/ Warm-Up Activity: Toothpick Fish

Build the toothpick fish and try to determine how the fish can change direction by simply moving only 3 toothpicks.



Adapted from: Chaudhuri, Atunu (2017). "Matchstick Puzzle: Turn around the fish by 3 moves". SureSolv. https://suresolv.com/brain-teaser/ matchstick- puzzle-turn-around-fish-3-moves

Teetering Toothpick Tower Challenge: Using only 30 toothpicks, build the tallest free-standing structure. Play-Doh is used as a connector between the toothpicks. Students are given 10 minutes to build (this can be adjusted depending on the total time allotment). When completed, measure the total height in centimeters to the nearest tenths (1 decimal place).

Discussion Question: Be a detective! Review the following images, what geometric shape(s) stand out? What shapes do you notice in all of the structures? *NOTE: Images below are for reference only. Please see PowerPoint/Google Slides for more detailed versions.*

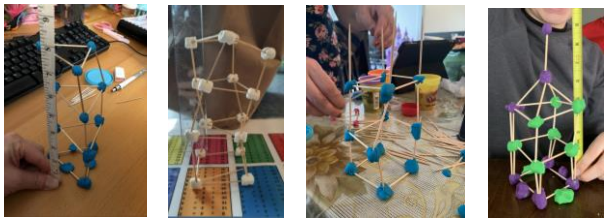
Solution: Triangles

Explanation: Triangles are the strongest geometry shape when it comes to architecture and are commonly used in the design of buildings (Ramos). They stabilize, stiffen and support structures (Design Squad Global). When building materials are used to form a triangle, the design has a heavy base and the vertex (or apex) on the top is capable of handling weight because of how the energy is distributed throughout the triangle. The three legs of a triangle define one and only one triangle. If all three sides are made of a rigid material, the angles are fixed and cannot get larger or smaller without breaking at the joints, unlike a rectangle, for example, which can turn into a parallelogram and even collapse totally (Ramos).

Reflection: Does your own building structure contain triangles? Are there parts that could have had toothpicks added to form a triangle? How would you have done this activity differently now knowing what you know about triangles?

Extension: Explore structures and architects in your local community. What other geometric shapes do you see? Which type of triangles are more commonly seen?

Examples:



Images are submitted by participants during the February 20th Virtual Math Fair.

Resources:

Design Squad Global. 2017. "Strong Structures with Triangles". *WGBH Boston.* YouTube. https://www.youtube.com/watch?v=mBHJtWbsiaA&feature=emb_logo

Lekcyje. "Shapes: How Do Shapes Affect Architecture?" Stadium Jezykow Obcych. https://www.sjo.pw.edu.pl/biuro1/LekcjeTechn/Shapes.doc#:~:text=The%20equilateral%20triangle%20is%20by,Complex%20of%20Giza%20in%20Egypt.

Ramos, Nicholas. 2018. *Triangles Used in Architecture.* Sciencing. https://sciencing.com/triangles -used-in-architecture-12084289.html