Robogals
Science Challenge

Minor Challenge Set #4
STEM Field: Civil Engineering
Level: Junior
Challenge Name: Build Your Own Geodesic Dome
Project Cost: 0-20 USD
Materials Required:

- 25 toothpicks, or 25 pieces of spaghetti (you can cut pieces of spaghetti to smaller pieces of the same size)
- 11 pieces of marshmallows, jelly beans or any types of chewy candies, or pieces of play dough of the same size

Duration:

- The challenge takes approximately 1 hour to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

In this challenge, we will build a very simple geodesic dome from chewy candies (marshmallows, jelly beans – your choice!) and toothpicks (or pieces of spaghetti).

Have you ever seen a **geodesic dome**? They are structures that look like a sphere, and are made up of triangles. Some real life examples are shown in the pictures below.

Figure 1 - Spaceship Earth at EPCOT in Walt Disney World, Florida, USA

Figure 2 - Science World in Vancouver, Canada

In real life, a geodesic dome uses very little building materials, however can still create roomy space inside. The structure of a geodesic dome allows a large amount of mass. This means you would need to apply a lot of pressure before the dome would fail. This is because its structure is made up of triangles. Triangles are used in many structures' designs as they make the structures more stable and rigid.

Instructions:

1. Start by using 3 toothpicks or spaghetti pieces and candies to make a triangle shape.

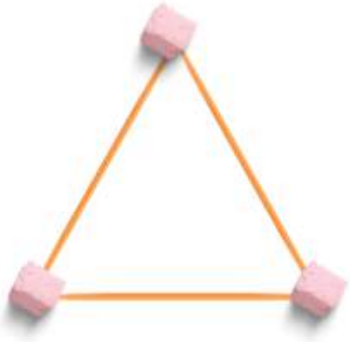

Figure 3 - Make a triangle shape

2. Make four more triangles (similar to figure 3). When you have five triangles, join them together as shown in figure 4.

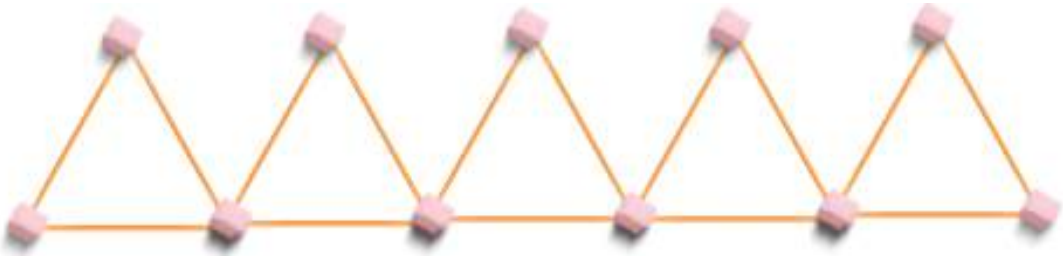

Figure 4 - Join five triangle shapes together

3. Join these triangles together at the top by inserting toothpicks or spaghetti pieces into the candies. This is shown in figure 5.

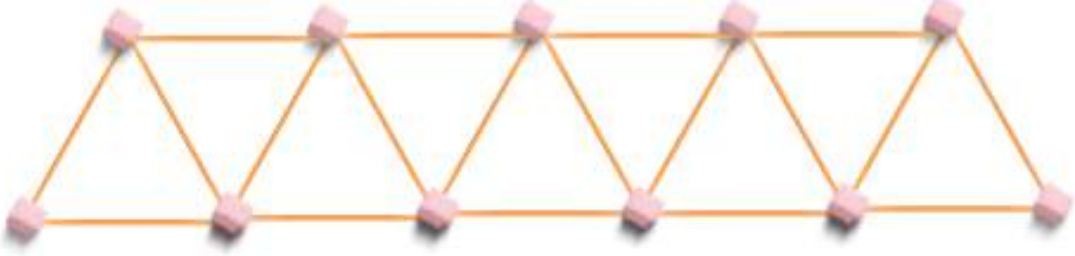

Figure 5 - Join five triangles at the top

4. Add one extra toothpick or spaghetti piece at the end, as shown in figure 6.

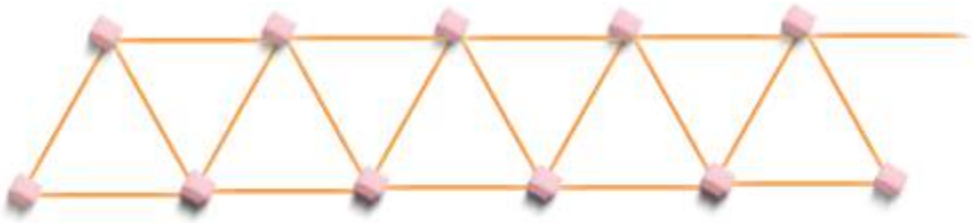

Figure 6 - Add an extra toothpick at the end

5. Lift the triangles up and connect them together so that you have a pentagon shape at the top and bottom. In the place where two candies are joined together, you can remove one, then connect the toothpicks at the bottom of the structure.

   A **pentagon** is a shape that has five sides, like figure 7. In figure 8, the black lines show the pentagon shape you make from joining triangles together.

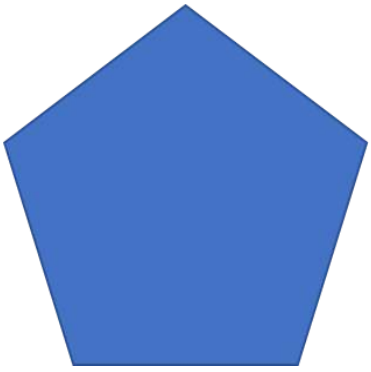

Figure 7 - Pentagon shape

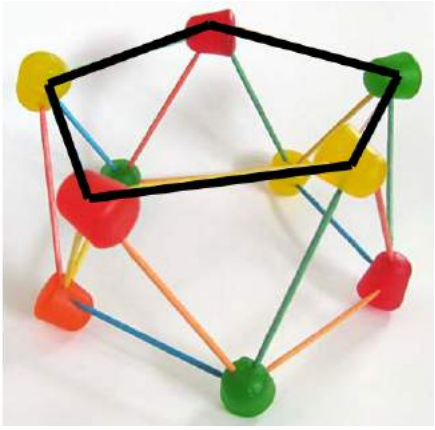

Figure 8 - Pentagon shape in the candy dome

6. After step 5, you should get a design which looks like figure 9.

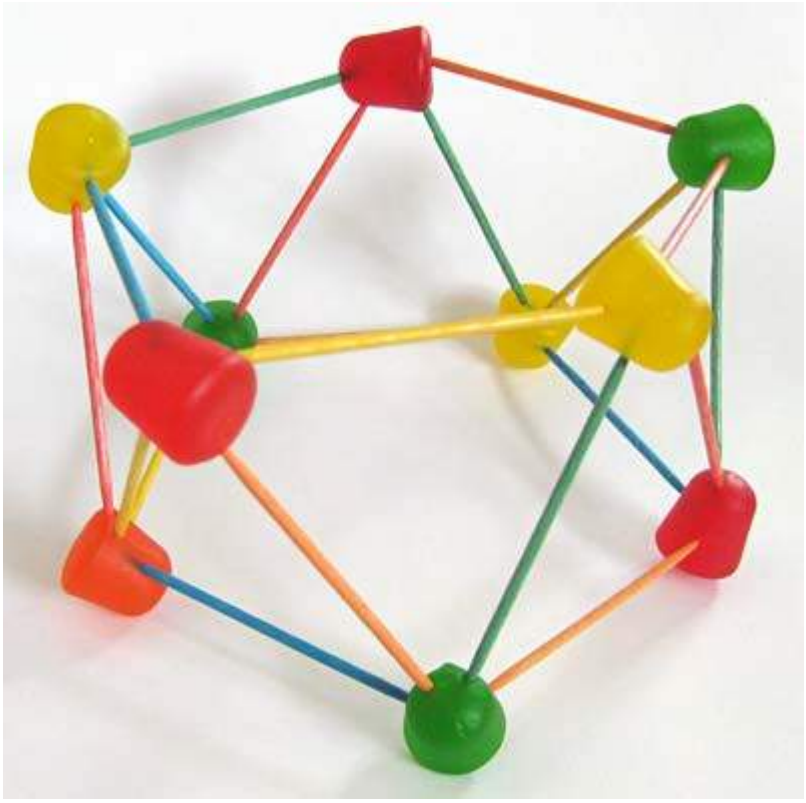

Figure 9 - Geodesic dome from step 5

7. Use the remaining toothpicks and candy to make a star shape, similar to figure 10.

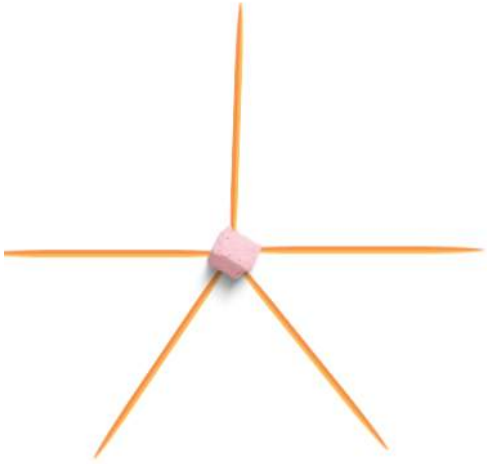

Figure 10 - Make a star shape for the top of your dome

8. Join each toothpick to one of the five points at the top of your dome. Your final design should look like figure 11 below.

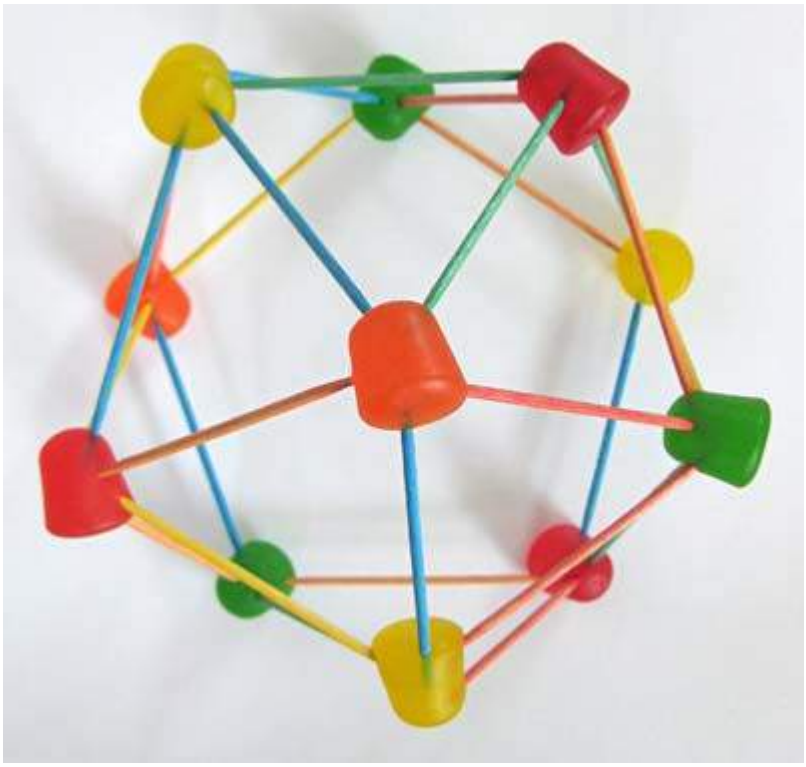

Figure 11 - Your final dome design

9. Gently press down on the top of your geodesic dome. If it does not break, carefully pressing down on it a little more.

Extension - Triangles in Structures

Learn more about how architects use triangles in their designs with this Google Earth activity. This is a presentation on Google Earth, featuring how triangles are incorporated in designs of buildings around the world.

Google Earth - Triangular Structures

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What are the key science and engineering concepts that relate to this challenge?
- Can you find other examples of geodesic dome designs in real life?

- How strong is your dome?
- (Take a photo of your complete dome before trying this!) Try adding some mass on the top of your dome. How much mass can your dome support before failing?
- Will the dome design look rounder if we add more triangular shapes?

Submission Guidelines:

- Submit a photo of the experiment setup/picture of your screen. Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- You can learn more about the building of domes here: http://www.pbs.org/wgbh/buildingbig/dome/index.html

Bibliography:

- Lasher, D., 2020. *Kids Building Big: A Geodesic Dome in Less than an Hour!*. [online] Bigideas4littlescholars.com. Available at: <https://www.bigideas4littlescholars.com/kids-building-big-a-geodesic-dome-in-less-than-an-hour/> [Accessed 8 April 2022].

- Rowland, T., n.d. *Build a Gumdrop Geodesic Dome | STEM Activity*. [online] Science Buddies. Available at: <https://www.sciencebuddies.org/stem-activities/geodesic-domes-gumdrops?from=Blog> [Accessed 8 April 2022].
- 2007. *Spaceship Earth at Epcot*. [image] Available at: <https://en.wikipedia.org/wiki/Geodesic_dome#/media/File:Epcot07.jpg> [Accessed 8 April 2022].