# Gumdrop Structure Challenge Teacher Lesson Plans

## The Challenge:

Using 10 gumdrops and 20 toothpicks, design a structure that can hold the weight of a large textbook.

## STEM Connections

Science & math = physics & shape comparison
Engineering & technology = load distribution & building structures

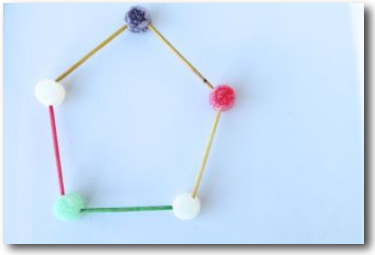
## The Big Ideas

Triangles are strong.
Large bases support more weight.

**Materials:** For each student (or pair of students):

- 10 gumdrops
- 20 toothpicks
- 1 ruler
- Disposable surface on which to work; small paper plate, or paper towels (optional, but sugar from the gumdrops gets a little messy.)

## Inquiry Leveling Options



### Non-Inquiry

Provide students with step-by-step directions on how to build a gumdrop structure. (Like the"Gumdrop Dome" from Teacher's Domain)

### Low-Level Inquiry

Introduce the importance of shapes when building structures
Have students predict which shape they think will do the best

### Mid-Level Inquiry

Introduce the challenge, explain how the houses will be tested (show the book), and then have them begin. No additional talk or help! Failure is an option! Encourage students to rebuild.

## Construction Time!

**Questions that provide hints/guidance during the building process:** (Use at your discretion)

- How will your roof affect the home's ability to be tested?
- How could you strengthen the joints?
- Since you found that one triangle is good, would two be even better?

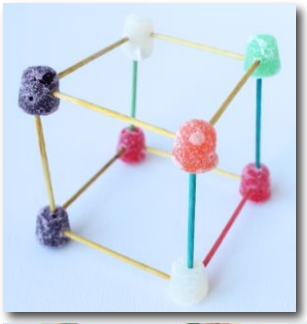
- How could you broaden the base to give the house more support?
- How does the number of toothpicks stuck into one gumdrop affect the strength of the joint?
- It looks like the length of a toothpick limits you. Is a solution to that problem worth exploring?

**You Decide:** It is up to you whether or not you want to provide replacements for broken toothpicks or gumdrops that have been speared too many times. When students know they have limited resources, they may plan a bit more before beginning to build.

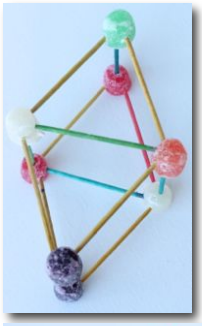
**Encourage collaboration and celebrate failure.** Consider having students listing their attempts and failures on the board so everyone can learn from one another.

**Lab Notebook:** When ever possible, have students record the process of what they are doing and learning in a lab notebook. Encourage them to draw sketches, take measurements, and describe what happens during their testing sessions. If digital cameras and/or video cameras are available, use these to help record the process. Included in this file are two 2 student labs; one for lower elementary that is low-level inquiry and one for upper elementary that is mid-level inquiry. Both are

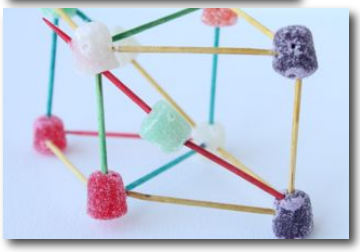
## Sample Gumdrop Houses



The cube is the first structure that students usually build. Squares are notoriously weak and will fall under the book's weight.



Diamonds can be made from the cube by pushing in the sides and adding toothpicks to the center. While the home now has triangles, it still is not very strong.



Extending a toothpick's range by adding a joint may also be a student's attempt at firming up an existing structure.

The base of this structure is a pentagon, with alternating triangles. It uses all the toothpicks, creates a solid base, and holds up to testing. But this is NOT the "answer!"

## Testing the Structures

Name _____ Date _____

# Gumdrop House

Using 10 gumdrops and 20 toothpicks make a house-like structure that can hold the weight of a heavy book.

Build a gumdrop house using the following shapes. Record the house's height and width in the measurement column. Then describe what happened to the house after testing.

I predict that the _____-shaped house will be able to hold the weight of a book.

| Shape | Measurements | Testing Results |
|---|---|---|
| square | | |
| triangle | | |
| diamond | | |
| (your choice) | | |

1. What shape made the weakest home?

2. What shape made the strongest home?

3. If you had more gumdrops and toothpicks how would you make your home stronger?

Name Date

# Gumdrop Structure Challenge

Your challenge: Using 10 gumdrops and 20 toothpicks, design a structure that can hold the weight of a large textbook.

***Check-in Questions***

1. What structures or methods of construction have you tried that aren't working? Draw a sketch to help explain. Why do you think this structure doesn't work well? Can you modify it, or will you abandon this structure all together?

2. What structures or method of construction are you planning to include in your final design? What have you found about this structure that will help your design meet the challenge?

***Testing Your Design***

3. Draw a sketch of the Gumdrop structure you will test. Take measurements and label these on your drawing.

4. Did your gumdrop structure hold up under testing? If so, why was the design successful? If not, what aspect of your design could be improved?

5. Whether or not your design was able to meet the challenge, what did you learn while completing this activity?

***Going Deeper***

6. Describe a way in which the gumdrop homes could be tested to show varying results so that the structures could actually be "measured" for their strength.
7. With more toothpicks and gumdrops, what modifications would you make to test for strength?
8. As you consider what made your design both weak and strong, provide a few engineering elements that you might be able to observe in structures in your own environment (both indoor and outdoor).