Toothpick Bridges - Engineers Week

Objective
Work together in teams to build a bridge made of toothpicks and marshmallows.

Tips:
- Open the bag of marshmallows a couple days before the activity is to be done. Dry marshmallows provide a more stable link between toothpicks (and less sticky) than moist ones.
- Plan to allow 20 minutes of discussion and building time. As the teams begin to build, notice the shapes they are using. Many will begin with squares, a weak shape.
- Bring up the concept of triangles and their inherent strength, and encourage them to start again using triangles. Or they may want to keep the existing structure but strengthen it by cross-bracing existing squares (which will sub-divide the squares into triangles). Or, they may want to add stabilizing "legs."

Materials Needed:
- ½ bag of mini marshmallows per group
- 1 box of toothpicks per group
- Two heavy chairs or tables, placed about 1 ft apart
- Lightweight cup with string attached
- Glass marbles or pennies

Procedure:
Divide the class into teams of 4-5 students each. Distribute the materials and have the students talk about how the bridge should be designed. Which shape lends the most strength? Have them sketch a few ideas and talk about how strong each might be. Have them choose the one that they think will be the strongest.

Using marshmallows and toothpicks, have the students construct a bridge about one foot long. Encourage them to try a few different approaches and start over, if they like.

Once it is done, allow it to sit undisturbed for a few minutes to set. Ask them: does it resemble real bridges you've seen? How much weight do you think it would hold?

When all teams are ready, place the two chairs or tables a little less than a foot apart. The chairs represent the shorelines that the bridge must span. Place the bridge across the span. Ask the students to observe. Does it buckle under the force of gravity? Try pressing down a bit on the top of the bridge. Does it hold? What forces is the bridge experiencing?

If the bridge holds steady, try testing its strength. Loop the string over the bridge with the cup empty. If it holds, add a glass marble (or penny), one at a time, and see how many the bridge will hold.

When the bridge begins to buckle, the students will know its load limit. Ask the class: Whose bridge holds the most weight? Compare the bridges by measuring the number of pennies in each bucket.

Reflection Questions for the Students:
- What new things did you learn about bridges?
- What is the force?
- What is the difference between compression and tension?
- What other types of structures have you seen that use triangles or trusses?
- What did the strongest bridges have in common? What did the weakest have in common?
- Did you final design look like your initial design? If not, what changes did you make and why?