Lesson Title: Popsicle Stick Bridge

<table>
<thead>
<tr>
<th>Length of time:</th>
<th>Subject area being addressed:</th>
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<tr>
<td>60 minutes</td>
<td>Engineering/Teamwork</td>
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Objective of the lesson (what is the point):
- Planning, teamwork, engineering design/civil engineering
- Learn how bridges are engineered to withstand weight, while being durable and (sometimes) aesthetically pleasing. Work in teams to design and build a popsicle stick bridge that can withstand 10-20lbs of weight.

List of materials:
- A copy of the lesson plan
- Enough popsicles for your site
- Copies of the Planning Phase worksheet
- Copies of the Bridge Designs sheet (one for each group)
- 1 hot glue gun for each group
- 200 popsicle sticks for each group
- Standard 10-20 pound weight (a few large books, a box of sugar, a workout weight, etc)
- Rulers
- Dice or numbers 1-5 written on paper

1. Hook (Something fun and cool to “hook” students’ interest):
   - Pass out popsicles 😊
     - We can bring these to you, or you can buy them for your site and get reimbursed. They have inexpensive large packages just about anywhere.
     - You can start the lesson while students are still eating their popsicles, to save time

2. Get Background Knowledge. Indicate what questions you will ask. Choose a Questioning Strategy from the list called “Questioning Strategies”

1) Break the class up into the groups of 3-4. They will stay in these groups throughout the rest of the lesson.
2) Explain to the class: “Today we are a part of a team of engineers who have been given the challenge to design a bridge out of 200 popsicle sticks and glue. Bridges must be able to hold a specific weight. It must be at least 14 inches in length. It should also be aesthetically pleasing (look good). We are going to review a few different bridge designs to get your creative juices flowing before we start to plan!”
1. Lesson (describe and include all materials needed): (5–10 minutes)

2. Explain to the class: “All major bridges are built with the public's money (taxes). Therefore, bridge design serves the public. It has three main goals: to be as efficient, inexpensive and as stylish as safely possible.
   a. There are four main types of bridges: arch, beam, cantilever, and truss.”

3. Choose four different groups to read the brief description of each bridge. Ask them to show the photo to the rest of the group or draw a simple diagram of the bridge on the board.

4. Arch

   a. The natural curve of the arch reduces the effects of tension on the underside of the arch. This is one of the oldest bridge design, used for more than $2,000 years.

5. Beam

   a. This is the simplest kind of bridge. It needs to be stiff, and usually consists of a horizontal beam that is supported at each end by piers.
6. Cantilever

   a. 
   
   b. These bridges are usually used to carry heavy loads over water. They are generally made with three spans (triangles)

7. Truss

   a. 
   
   b. Truss bridges are composed of connected elements. This type of bridge is usually more rigid than a single beam. The trusses (usually in the shape of a triangle) help to absorb load and tension. These bridges became very popular during the Industrial Revolution!
3. Extended activity students will work on once they have the new information you’ve presented. Describe activity, list all materials needed.

1. Explain again that students must develop their own bridge out of (at most) 200 popsicle sticks & glue.
   a. Students will be encouraged to use the fewest number of popsicle sticks possible to achieve their goal (give them a limit – remember, bridges need to also be inexpensive).
   b. Bridges must be able to hold a 10-20 pound weight.
   c. The bridge must be at least 14 inches long,
   d. When the bridge has been constructed, it will be placed at least one foot above the floor (place it between two chairs or stack of books, for example) and tested with the weight.
   e. In addition to meeting structural/weight-bearing requirements, you can choose to judge the bride on its aesthetics, so students should be creative.

2. Students first meet and develop a plan for their bridge (5-10 minutes recommended).
   a. Pass out the planning phase worksheet.
   b. After drawing their plan, ask each group to briefly share with the class.

3. Next, students execute their plans and start building (give them a time limit: 15-20 minutes).
   a. They may need to rethink their design, or ever start over.
   b. Distribute the popsicle sticks and hot glue guns (ask Peer Mentors and teens to be very respectful when using this — it’s hot)

4. Once finished, students test their bridge’s weight capacity by placing it at least one foot above the floor. Try using blocks or a chair supporting each end of the bridge (5-10 minutes)
   a. The bridge must be able to bear the assigned weight for at least 30 seconds.
   b. Ask groups to stay together for the debrief activity.

4. Debrief
1) Once the groups are back together after the testing phase, have teams number off each person in their group (if there are 5 people in the group, one person will be #1, another person will be #2, etc.)
2) You will ask a question to all of the groups, then roll a dice or pick a number out of a bucket to see which person from each group will answer.
3) Questions:
   a) What was the point of our lesson today? Why did we do it?
      i) Answers: Teamwork, engineering, design, etc.
   b) If you had to do it again, how would your design plan change?
   c) What was the best part about working in a team?