Fernbank Science Center

Title: STRUCTURES AND BRIDGES (4458) **Type:** Outreach
Level: 4th **Length:** 50 Minutes
Location: Local School **Limit:** 28 students 5 Classes

Program Description

Students will explore the process of designing and building bridges. The types of bridges explored will include arch, beam and truss bridges. They will use materials provided to test various bridge designs including the strength of triangles versus rectangles. This class is an introduction to the Toothpick Bridge Breaking event that will be held at Fernbank Science Center on Saturday, February 26 in celebration of National Engineering Week.

Georgia Performance Standards Addressed

The students will be able to:

1) S45CS7: be familiar with the character of scientific knowledge and how it is achieved;
2) S45CS2: use appropriate tools to collect and analyze data and solve problems;
3) S45CS4: use ideas of system, model, change, and scale in exploring scientific and technological matters.
4) S4P3: demonstrate the relationship between the application of a force and the resulting change in position and motion on an object.

Vocabulary

arch	beam	bridge	compression
force	span	tension	transfer
truss	weight		

Pre-Visit Activities

1) Review the glossary with the students.
2) If possible, preview the online resources listed below.

Post-Visit Activities

1) The activities in this program are designed to introduce the students to various types of bridge design and the forces acting on each.
2) After completing the activities the students may choose to participate in the Toothpick Bridge Breaking event at Fernbank Science Center on February 21, in support of National Engineering Week.

Resources

1) www.atlantatoothpickbridge.org
2) http://bridgecontest.usma.edu/
3) http://www.manufacturingiscool.com/
4) http://www.geocities.com/tech_ed_2000/units/wadd/bridgebuilding.htm
5) http://www.pbs.org/flw/resources/index.html
6) http://42explore.com/bridge.htm
7) http://www.pbs.org/wgbh/buildingbig/lab/forces.html

STRUCTURES AND BRIDGES (4458 Post-Visit Activities)

Objectives

The students will be able to:

5) **S45CS7: be familiar with the character of scientific knowledge and how it is achieved;**
6) **S45CS2: use appropriate tools to collect and analyze data and solve problems;**
7) **S45CS4: use ideas of system, model, change, and scale in exploring scientific and technological matters;**
8) **S4P3: demonstrate the relationship between the application of a force and the resulting change in position and motion on an object;**

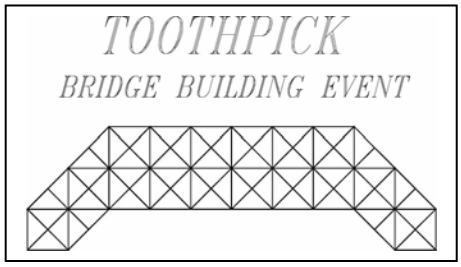
Post-Visit Activity

TOOTHPICK BRIDGE CONSTRUCTION

Students will measure, design, construct and test the strength of their bridges made with toothpicks and white glue. The students may bring their bridges to Fernbank Science Center on Saturday, February 21, during National Engineering Week, to test the strength of their bridges.

Use the activity below to construct a bridge that meets the required dimensions for the Atlanta Toothpick Bridge Breaking event.

Toothpick Bridge Construction



Materials:
wax paper
cardboard
flat or round wooden toothpicks (2 boxes/team)
white glue
empty film canisters
modeling clay

1. Review the design and engineering process with the students. Discuss what they learned about the strength of triangles and squares, as well as one span vs. several spans. Have the students bring in pictures of different types of bridges.

2. The final bridge must span a gap of 42.23 cm or 16 $^{5}/_{8}$ inches; maximum length is 64.77 cm or 17 ¾ inches; maximum width is 25.5 cm or 7 inches; maximum height os 45.72 cm or 18 inches, maximum weight is 121 g or 4.25 oz.

3. Have students work in pairs to design a blueprint for a single span. Their designs should be the actual size for length and height. Use actual lengths of toothpicks for the blueprint designs.

4. Tape individual span blueprints to cardboard and cover them with wax paper taped lightly to the cardboard. Be sure to have students put their names on the blueprints before covering with wax paper.

5. Give each team a film canister that contains white glue. They may glue the toothpicks directly to the wax paper. Simply dip ends of the toothpicks into the glue and place them directly on the blueprint. Overlap the toothpicks and make good connections between them. Careful design and attention to detail will determine success!

6. When spans are complete, carefully remove them from the cardboard, on the wax paper, and transfer them to a safe, flat location to finish drying. Put new wax paper on the cardboard/blueprint and build the next identical span. Continue this process until at least three spans are completed. If weight limits are not exceeded, they may want to make a fourth span.

7. To join the spans, carefully peel the wax paper away from the structures. Use common materials to support the spans as they support them and join them together. They may make small marbles of modeling clay to hold the spans to the wax paper, spaced one toothpick distance apart. Use items to maintain equal distances. Begin gluing and placing toothpicks across the spans. Let them dry overnight.

8. Carefully pull the dry, connected spans off the wax paper, flip over and begin gluing toothpicks across the bottom for connection, being careful not to glue spacers to the bridge!

9. Do a final weight check on the bridges. Students may bring their bridges to Fernbank on February 26 to test their strength!

Resources:

8) www.atlantatoothpickbridge.org
9) http://bridgecontest.usma.edu/
10) http://www.manufacturingiscool.com/
11) http://www.geocities.com/tech_ed_2000/units/wadd/bridgebuilding.htm
12) http://www.pbs.org/flw/resources/index.html
13) http://42explore.com/bridge.htm
14) http://www.pbs.org/wgbh/buildingbig/lab/forces.html