



Factors Affecting Bridge Strength

Developed by Linda Roberts

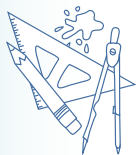
Grades 5-6



Objectives

Students will...

- Create two geometric shapes (square and triangle) to determine which is more stable.
- Relate examples of bridges they have seen.
- Describe the example, draw a picture of it, and learn the names of the three main types of bridges: beam, arch, and suspension.
- Learn that each of these types may be included in a complex bridge.
- Learn that a truss bridge is a form of beam bridge.
- Apply their knowledge of geometric shapes to design a truss bridge.
- Build a truss bridge from their design and test its weight bearing ability.
- Apply critical thinking to build their bridges.
- Experience team building and real world problem solving.



Materials

- Drilled Tongue Depressors (drill a hole near each end to put a brass fastener through) — Cat. No. 5500190M, box of 500
- Brass Fasteners (brads) — Cat. No. KI01662(P)M, pkg. of 25
- Pictures of Different Bridges
- Drawing Paper
- Pencils
- Crayons or Colored Pencils
- Rulers
- Graph Paper — Cat. No. 9706099M, pad of 50, 8 1/2" x 11" sheets
- Plastic Straws, straight, 30 per group
- Scissors
- Masking Tape
- Pennies or Metal Washers (at least 300 for weight)
- Paper or Plastic Cup
- Stacks of Books

Activity 1

Each student will use four tongue depressors and four brass fasteners to make a square. Students will apply pressure with their hand on the top of the square. The shape will collapse. Students will then build a triangle from three tongue depressors and three brass fasteners. Students will apply pressure to the triangle. The shape will not collapse. Ask students which shape is more stable. Ask students for examples of triangles used in construction. They may say bridges, cranes, cell towers, house roofs, tall buildings, etc.

Activity 2

Class discussion: Write the three main types of bridges (beam, arch, and suspension) on the board or chart paper. Show the students pictures of various bridges and have them classify them by type. Have students give examples of bridges they have seen and tell which type of bridge it is. Students will draw the bridge they have seen, write the type of bridge, and write several sentences to tell the purpose of the bridge and the materials from which it is made.

Activity 3

Students will be given a challenge to design and draw a truss bridge they will build and test according to specific instructions. Tape pictures of truss bridges on the board or chart paper. Explain that truss bridges are a form of beam bridge. Have the students notice the shapes used in building truss bridges, such as triangles and posts. Note that the trusses can be above or below the bridge deck.

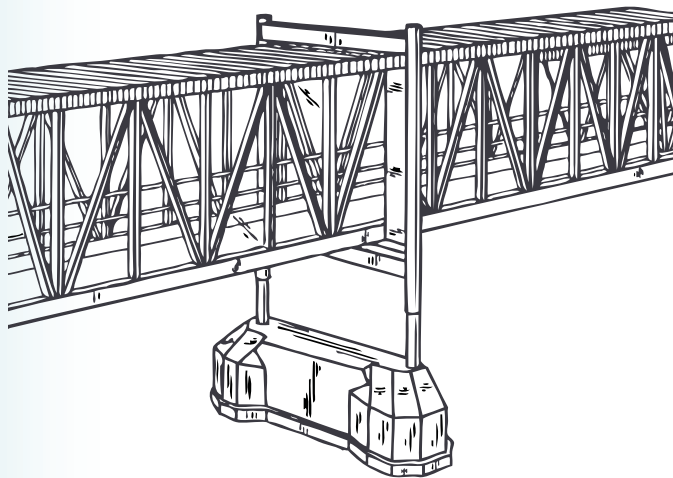
Divide students into groups of three or four. Give each group instructions for designing and building a truss bridge. The bridge must be free standing and span a gap of 13". The total bridge length cannot exceed 16". The straws can only be held together by small pieces of masking tape.

Each group will design a truss bridge to build and create a drawing on graph paper. Each group will use 30 plastic straws connected with small amounts of masking tape to create a truss bridge. After building the bridge, students will predict how many pennies or washers the bridge will hold, test the strength of their bridge by adding weight to it (pennies or washers), and record their results.

To test the strength of the bridge, place two stacks of books on a table with a 13" gap in between. The bridge will rest on top of the books. A paper or plastic cup will be placed in the center of the bridge. Weight will be added until the bridge fails. Alternately, the bridge can be placed on two chairs with a 13" gap between the chairs.

After all groups have tested their bridges, make a class chart showing the groups' prediction and the actual weight the bridge held. Have students discuss what they learned about bridge building and how they could have improved their design.

An alternate method of testing the strength of the bridge: Punch two holes in the side of a plastic cup with a paper punch. Attach string to the two holes to make a handle. Attach another piece of string to the handle to hang the cup. Tie a loop at the top of the string. Pass the loop through the bridge at the center and insert a popsicle stick through the loop on top of the bridge deck. Make sure the string is short enough so the cup won't touch the table between the stacks of books. Add weights to the cup until the bridge fails.



Student Instructions for Building a Truss Bridge

The bridge must span a gap of 13". The total length of the bridge may not exceed 16". Bridges must be free standing (not attached to anything). Each group will be given 30 straws and a small amount of masking tape to build the bridge. Before building the bridge, each group will make a drawing on graph paper to be used as the design of the bridge they will build. Make a prediction and write down how much weight you think your bridge will hold. Test the strength of the finished bridge using a cup and pennies or washers. Balance the bridge on the two stacks of books. Place the cup in the middle of the bridge. Count the number of pennies or washers as they are added to the cup. Stop counting when the bridge fails. Write down the amount of weight your bridge held. Share your drawings and findings with the class.

Assessment

Teacher observation, participation in activities, cooperation, handling materials, participation in oral discussions, completeness of projects, written work, and illustrations.