

# Bold Bridges

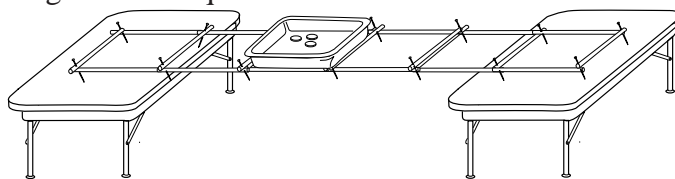
**Concept:** *strength of geometric shapes*

**Materials:** straws, straight pins, scissors, fishing line, pennies, small Styrofoam tray

**Optional:** large paper clips, string

## The Basic Bridge

1. Use straws and straight pins to construct a flat bridge between two desks like the bridge pictured here. It should be constructed with squares and be three feet (91 cm) long. It should extend onto each desk about the length of one square.

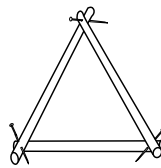
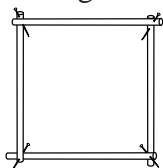


2. Press your hand on the bridge. Push on one side and then the other. Notice how easily the bridge bends and the sides slide toward each other.
3. Place a small, flat Styrofoam plate on the center of the bridge and place pennies (or large paper clips) in the tray. Add as many pennies as you can until the bridge collapses. Record the result.

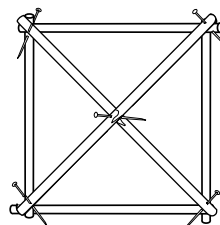
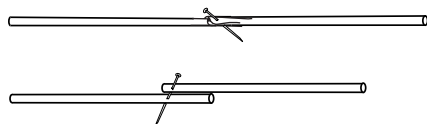
## The Superior Triangle

Make a square with four straws and four pins. Hold it upright and press down on it. What happens?

Make a triangle with three straws and three pins. Hold it upright and press down on it. Can you determine that the triangle is stronger?



Remove and replace any broken straws in your bridge. Add diagonal reinforcements as shown in the illustration. You can make the diagonal straws long enough by slitting the end of one straw with scissors and fitting the slit end inside another straw or by pinning two straws together. Pin the diagonal reinforcements at the four corners of the square and in the middle. This creates four triangles within each square.

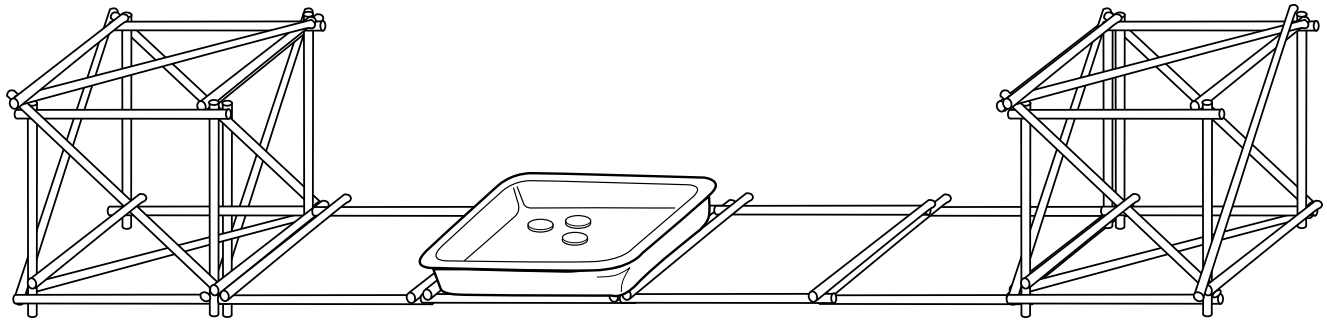


Place the Styrofoam plate on the center of the bridge again and add pennies. Add as many as you can until the bridge collapses. How many more pennies did the bridge hold this time? Record the result.

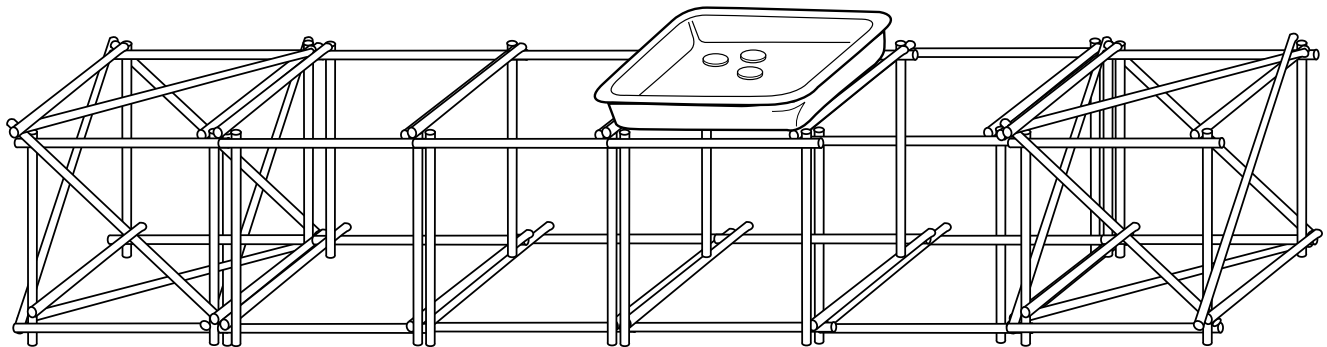
# Bold Bridges *(cont.)*

## Beam It Up

Build one cube made of straws on each side of the bridge. Use diagonal reinforcements on all faces of each cube. Test the strength of this beam bridge with the weights.



Use squares to build up each side of the bridge. Connect the tops of the squares with straws so that a series of cubes are formed.



Place the small Styrofoam tray on the center of the bridge as before. Place as many pennies as you can on the tray. Determine how many pennies the bridge will hold before it collapses.

## Building a Better Beam Bridge

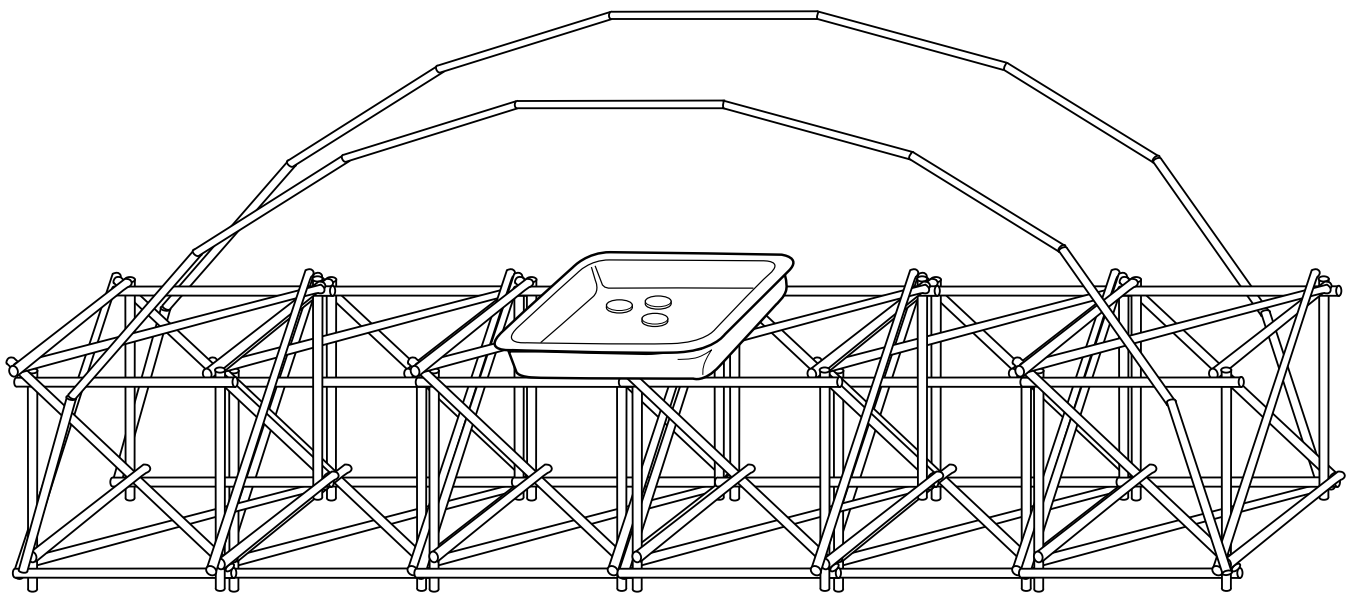
1. Replace any broken or damaged straws in your bridge.
2. Insert diagonal reinforcements along the sides of your bridge just as you did on the base.
3. Use the small Styrofoam tray at the center of the bridge and pennies to test how much your bridge will hold before falling.
4. Add the same type of reinforcement along the top of your bridge and retest it to determine how much weight it will now hold.
5. Record your final total and make a graph to illustrate the number of weights held by the structures each of your classmates made.

# Bold Bridges *(cont.)*

## An Arch Bridge

In an arch bridge, the curve of the arch shifts the weight to the supports at each end.

1. Thread about four or five straws firmly together with the ends slit and inserted into the next straw so that you have one long “straw” about 35 inches (88 cm) long.
2. Bend this long straw into an arch shape and pin it to the support towers and the underside of the bridge as shown in the illustration.
3. Make a second long “straw” in the same way and pin it to the other side of the supports and the bridge.
4. Make two more shorter arches in the same way.



5. Use reinforcing straws to attach each long, curved “straw” to the structure of the bridge as shown in the illustration.
6. Use the tray of pennies to test the strength of your bridge. Remember to place them in the center of the bridge.
7. Do several trials and replace any broken straws. Record your best trial.
8. Make a graph or chart to record the results for your class. Compare the bridges to see why some held more weight than others.

## Suspension Bridge

In a suspension bridge, the suspending cables exert an upward force which, along with the towers, supports the weight. Use fishing line (or string), straws, and pins to make a bridge like the Golden Gate on page 33. Use a pin to make in the upright straws a hole large enough to thread the fishing line cable through the top of each straw.