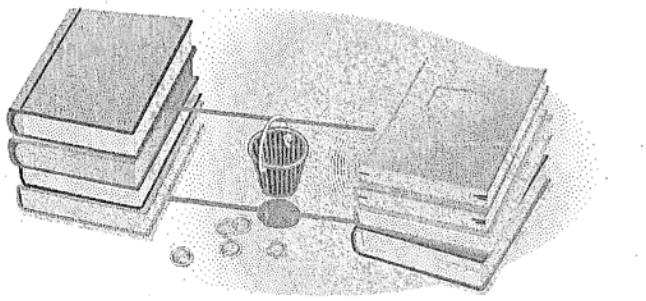
Investigating beam strength for bridges

How strong do the beams in bridges need to be? How do bridge engineers select beams to support traffic? Engineers must make decisions about how strong is strong enough by considering architectural, financial, and political factors as well as structural ones. All bridges and buildings could be built ten times as strong as they presently are, but at a tremendous increase in cost. One of the most important calculations of an engineer is the one that predicts how long it will take before cracks occur or the structure starts to fail. The process of engineering design may be considered a succession of hypotheses that such and such an arrangement of parts will perform a desired function *without fail.* A design is never perfect, but it must be determined when it is good enough to meet the needs, stresses, and requirements to be successful.

In this investigation you will collect data and find a model to determine the strength of various "beams" made of spaghetti.

Make two stacks of books of equal height or you can use two tables with a gap between them. Punch holes on opposite sides of the cup and tie the string through the holes.

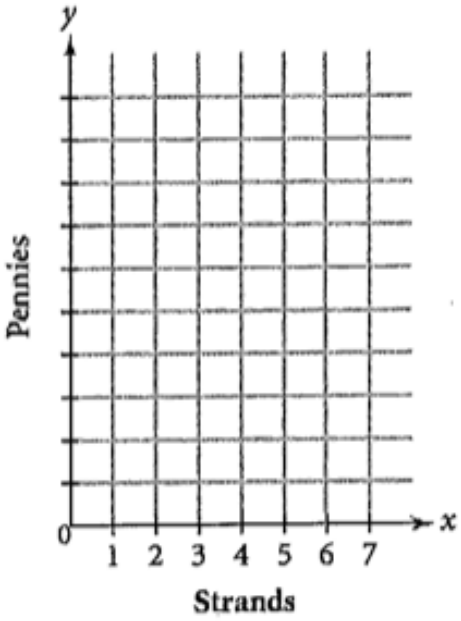
Hang your cup at the center of your spaghetti beam. Support the beam between the stacks of books or table so that it overlaps each stack by about 1 inch. Hold each side of the spaghetti or place a book on each end.



Put the pennies in the cup, one at a time, until the beam breaks. Record the number of pennies in the table and repeat for beams made from three, five, and six strands of spaghetti. Two and four strands of spaghetti are being skipped because tests cost money and engineers are often working with a budget. After collecting the data you will come up with a model to determine the number of pennies that would break 2 and 4 strands of spaghetti.

Number of strands	Number of pennies
1	
3	
5	
6	

1. Plot your data on the grid below.



2. Use a strand of spaghetti to visualize a line that you think fits the data on your sketch. Calculate the slope of this line.

3. Using the spaghetti strand on your sketch, estimate the y-intercept.

4. Write out the equation of the line based on the slope and y-intercept above.
a)Explain the real-world meaning of the slope of your line for this problem
b) Explain the real-world meaning of the y-intercept for this problem

5. Use the equation or the table feature on the graphing calculator to predict the maximum loads of pennies for beams made of 2 and 4 strands of spaghetti.

6. Use the equation or the graphing calculator to predict the number of spaghetti strands needed to support $5 worth of pennies.