**Determining Beam Length and Orientation**

In this activity you will determine the relationship between the length of a wooden stick and the *static shear force* that can be applied to the stick without it breaking. You will also examine if there is a relationship between the orientation of the stick and its response to a shear force.

The outcome of this activity should help you answer 2 questions related to the design of a structure:

A) What is better at supporting vertical loads, narrow and tall beams or wide and low beams?

B) How far apart can you place the pillars that support the beams without having the roof sag too much?

**Materials**
- 2 metersticks
- A set of weights
- rope

**Part A**
In this activity you will measure how a support structure, a beam, responds to different static tension and compression forces.

1. Break up into groups of 4. Each team will be assigned a *span* to work with of 80, 70, 60, or 50 cm.

2. Create a data table that has five columns and 7 rows. Label the first column span length, the second is labeled weight, the third is labeled initial height, the forth is final height, and the fifth is bend distance. Be sure to include your units in all columns.

3. Move two tables (or desks) close together so that the distance between them equals your assigned span. Place a
meterstick between the tables so that at least 10cm of either end of the meterstick is on the tables.

4. Cut 20cm of the rope and tie it into a loop. Fit the loop over the suspended meterstick and locate it at the middle of the meterstick.

5. Position the other meterstick vertically so that you can use it to measure the height of the suspended meterstick above the floor. This is your initial height.

6. While two students keep the ends of the suspended meterstick from moving, hang 200gr from the loop. This mass should cause the stick to bend as a result of the static force it applies to it. Measure the new height of the suspended stick. This is the final height. Calculate the deflection from your two height values.

7. Consecutively increase the hanging mass by 200gr and each time record the meterstick’s height. Be sure not to break the meterstick!!

Part B
8. Repeat your experiment, but this time place the meterstick on the tables so that its narrow side is facing down. Make sure you indicate in your data table which data is for the flat meter stick and which data is for the narrow side.

Data Analysis
9. Use the table prepared by the teacher on the blackboard to share your results with your peers.

10. Using the class data prepare two graphs:
Graph 1 will portray the beams’ deflection (when the beams were oriented so that they were wide and low) vs. the mass hung on the beams. Graph 2 will portray the same variables only for the case when the beams were oriented narrow side down. Locate the deflection on the vertical axes and the mass on the horizontal axes (why?). Your graph will contain a number of curves, one for each span tested. Make sure to draw each curve with a different colored marker.

11. Now create two additional graphs, more challenging graphs:

Graph 3 will portray the beams’ deflection (when they were oriented wide side down) vs. their span. The graph will contain several curves, one for each mass hung from beams. Make sure to draw each curve with a different colored marker. Graph 4 will be to graph 2 as graph 3 is to graph 1.