Inquiry Activity: Deflection of a Rectangular, Center-Loaded Beam

A beam is one of the most basic building components that we use on a regular basis. If you've ever crossed a stream on a log or driven across a bridge, you have taken advantage of this most basic construction element. In this activity, you will explore how the different dimensional factors of a beam affect the flexibility of a beam. Your goal is to develop a model that will allow you to accurately predict the deflection of a rectangular, center-loaded beam that is supported on both ends.

MATERIALS

Vernier LabQuest2 or LabQuest Mini

computer running Logger *Pro* software (optional if using LabQuest 2)

Vernier Structures and Materials Tester (VSMT)

wood (supplied by the instructor)

other materials (supplied by the instructor)

INVESTIGATION Design

1. Brainstorm with your group to determine factors affecting the deflection[[1]](#footnote-1) of a rectangular, center-loaded beam. You might even grab a stick and flex it to get some ideas. List your ideas on a separate piece of paper.

2. Organize these factors into two groups: directly related (if this factor increases, the flexibility increases too) and inversely related (if this factor increases, the flexibility decreases).

3. Create a "loose" mathematical model for the deflection of the beam by putting the direct-related factors in the numerator and the inverse-related factors in the denominator. For example, if you consider the force you apply, then you would expect that as you increase the force the amount of deflection the beam experiences will increase. Therefore, you would put force in the numerator of your equation.

4. Design an investigation to test your factors and determine the actual mathematical model. For example, the relationship between force and displacement may be linear, or squared, or it may have some other power relationship. The model you develop will allow you to predict the amount of deflection experienced by a rectangular, center-loaded beam that is supported on each end. Determine (and document) how you will conduct your investigation with your group. Be sure that you are able to isolate each factor for consideration and that you will collect enough data to support your model.

5. Test your model with several configurations of rectangular, center-loaded beams. Use beams provided by your instructor or choose beams that you did not test during data collection.

Follow-up Questions

1. What dimension should you increase if you want to *decrease* the deflection of a beam by the greatest factor? Explain.

2. Consider a rectangular, center-loaded beam that has a ratio of 1:2 for height:width. If you turn it on edge, what change in deflection will you observe? Be specific and justify your answer.

3. Does a beam under a light load deflect at all? Defend your answer.

4. One factor you might have considered in this inquiry is how the height of the beam affects the deflection. Is there a difference between stacking a second beam on top of the first versus getting a beam that is twice as thick? Perform a comparison after discussing your ideas with your team. Comment on your findings.

1. "Deflection" refers to the distance the center of the beam moves relative to its resting position. [↑](#footnote-ref-1)