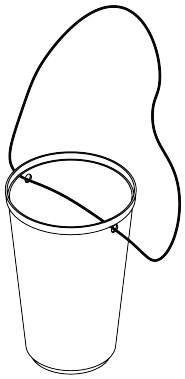
Three Point Bend Test

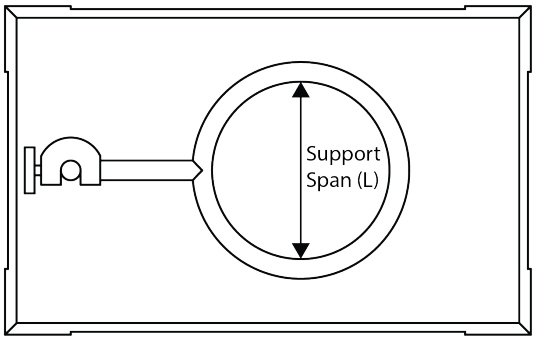
Materials
hole punch
string (6-8”)
12-16 oz plastic cup
ring stand
ring clamp

Setup

1. Create the hanging cup as shown in the diagram.
   a. Punch two holes in the top of a plastic cup.
   b. Cut a length of string approximately 50 cm long.
   c. Thread the string through the two punched holes.
   d. Tie a knot in the string so that the string forms a loop.



2. Measure the inner diameter of the ring stand ring (in *millimeters*). This is the **Support Span (L)**.



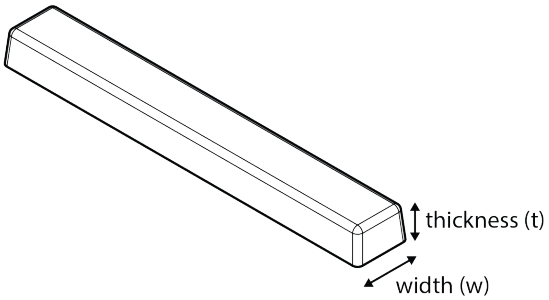
Ringstand Top View

Measure Dimensions

3. Measure and record the following dimensions of your sample.

    a. **Width (w)** of the crayon sample (in *millimeters*)

    b. **Thickness (t)** of the crayon sample (in *millimeters*)



Testing

4. Place the sample on the ring of the ring stand.

5. Loop the string of the cup over the center of the sample. Be sure the string is in the center of the crayon.

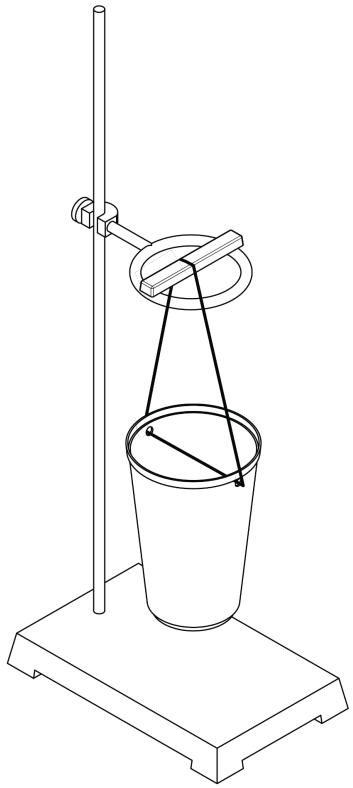
6. Adjust the height of the ring stand as needed so that the cup is not touching the bottom of the ring stand. The cup should be at least 2 cm from the base of the stand. *(You will want this distance to remain small so that cubes do not fall far when the sample breaks.)*

7. Begin placing 1 gram cubes into the cup carefully. Add cubes one at a time.

8. Continue adding cubes to the cup at a steady rate until the sample breaks.

9. Find the **mass (m)** (in *kilograms*) of the cup, string, and cubes using a scale or mass balance.

(Alternatively, students can weigh the cup and string separately and count the cubes as they put them in the cup. 1 cube = 1 gram)



Support Span (in mm)	
Dimension of sample – width (in mm)	
Dimension of sample – thickness (in mm)	
Mass (in g) at break / convert to kg	

Calculate Flexural Strength

Flexural strength, also known as bending strength, quantifies a material's ability to withstand bending without breaking. It represents the maximum amount of stress a sample can take before permanently deforming or breaking. It can be considered the "breaking point" of the material tested.

10. Calculate the force of the **load (P)** (in *Newtons*) by multiplying the **mass (m)** (in *kilograms*) by the acceleration due to gravity (9.81 m/s^2).

$$P = m \times 9.81$$

11. Calculate the **flexural stress (σ)** (in *Megapascals*) using the formula below. **Width (w)**, **thickness (t)**, and **support span (L)** are all in millimeters. **Load (P)** is in Newtons.

$$Flexural\ Strength = \frac{1.5PL}{wt^2}$$