

Name: _____

Date: _____

Building a Stronger (Sweeter) New Orleans Activity — Young's Modulus of a Marshmallow: Lab Procedures

Based on a lab by Kenneth A. Pestka II, Dalton State College, Dalton GA

The following procedure is for teacher/instructor demonstration only. Have students participate in the various steps of the demo as desired (student volunteers could assist with each step).

As steps 1-5 are completed, the values obtained should be recorded on the chalk/white board (similar to the table below).

	Mass (g)	Height (cm)	Diameter (cm)	Area of the top (cm ²)	Volume (cm ³)	Density (g/cm ³)
Jumbo Marshmallow						

Demonstration Steps

Data Collection

Determine the composite material's Young's modulus. Record your data in Tables 3a-c.

- Obtain one jumbo size marshmallow, and measure its diameter with a ruler and calculate its surface area.

$$r = \frac{d}{2}$$

$$\text{area of circle} = \pi r^2$$

- Measure the height of the marshmallow.
- Calculate the volume of the marshmallow.

$$V = \text{area of circle} \times \text{height}$$

- Measure the mass of the marshmallow using the balance or scale.
- Calculate the density of the marshmallow.

$$d = \frac{M}{V}$$

Marshmallow Strength Test

As steps 1-9 are completed, the values obtained should be recorded on the chalk/white board (similar to the table below).

- Measure the mass of the wooden block using the balance or scale and record it on the data table in the Trial 1 row.
- Calculate the weight of the block in Newtons ($\text{weight} = \frac{\text{mass (g)}}{1000 \times 9.8}$), and record it in the data table.
- Place the wooden block over the marshmallow.
- Measure the marshmallow's new height, and record it.
- Add the smallest mass to the wooden block above the marshmallow. Record the new total mass and total force applied to the marshmallow and record the values in the data table in the Trial 2 row.
- Measure the new height and record it in the data table.

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7. Repeat until you have tested 5 weights (i.e., 5 trials).

8. Calculate strain

$$\text{strain} = \frac{\text{compression}}{\text{original height}}$$

9. Calculate stress. Stress is the force/surface area.

$$\text{stress} = \frac{\text{applied force}}{\text{sample surface area}}$$

Data Analysis

On the chalk/white board, graph stress vs. strain and add a best fit line with an equation.

Class Discussion

Discuss with students the following facts.

- The slope of the graph is Young's modulus. The greater Young's modulus, the less deformation the marshmallow undergoes for the same applied pressure.
- If the graph is linear, it tells us that the material is elastic. That means that when the stress (force) is removed, the marshmallow will return back to its original size without remaining deformed.
- If the graph is not linear (or part of the graph is not linear) that tells us that the force is causing the marshmallow to be permanently deformed.