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Testing Soft Materials Worksheet

Instructions: You are an engineer tasked with selecting a material that can best withstand tension (stretching forces) without breaking. You will be given two different materials, and your goal is to determine how much force each material can handle while staying within its elastic limit.

Research

Research soft material properties such as elasticity, tensile strength, and how engineers use stress and strain tests to evaluate soft materials. Write down your notes below.

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Stress Test

Instructions: You are now going to set up a testing apparatus to conduct stress tests on two materials: polyurethane and clear elastic rubber.

Materials:

- 1 rectangular strip of polyurethane (10 cm x 1 cm x 2 mm)
- 1 rectangular strip of clear elastic rubber (10 cm x 1 cm x 0.5 mm)
- 1 set of weights
- 1 ruler or measuring tape
- 1 lab stand
- 1 clamp (to securely attach the material strip to the lab stand)
- 1 S hook or carabiner (to hang the weights from)
- 1 laptop with access to Excel (or Google Sheets)
- 1 utility knife

Procedure:

1. Collect your group's materials.
2. Set up your testing apparatus by doing the following:
 - a. Secure one end of the polyurethane or clear elastic rubber strip to the lab stand using a clamp or secure knot.
 - b. Cut a small hole/slit 9 cm from the stop of the strip.
 - c. Add the hook or carabiner to the bottom of the material strip through the small hole.
3. Make sure the testing apparatus is stable using the smallest weight. Do the following:
 - a. Add the smallest weight to the hook or carabiner.
 - b. Ensure the material does not swing or move excessively.
 - c. Ensure the weights hang vertically from the rubber strip.
4. Test your first material:
 - a. With no weights attached, measure the exact length of the material strip. (Note: It should be 10 cm.) Record this in the table below.
 - b. Start with the smallest weight (e.g., 50 g) and add it to the hook or carabiner.
 - c. After attaching the first weight, allow the material to stabilize, and then measure the length of the material. Record this value in the table below.
 - d. Add the next weight, allow the material to stabilize, and then measure the length of the materials.
 - e. Continue until the material breaks or deforms.
5. Test your second material:
 - a. Follow Steps 4a through 4e.

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Table 1: Polyurethane

Weight (g)	Force = $9.8 \cdot \text{weight} / 1000$	Length (mm)	Stress = force / cross-section area	Stretch ratio = length / original length
0				
200				
400				
600				
800				
1000				

Table 2: Clear elastic rubber

Weight (g)	Force = $9.8 \cdot \text{weight} / 1000$	Length (mm)	Stress = force / cross-section area	Stretch ratio = length / original length
0				
50				
100				
150				
250				
300				

6. Use an Excel spreadsheet to complete the tables above.
7. Using Excel, plot the stress vs. stretch for each material.
8. Calculate the slope of each plot.

Analysis

1. What worked during the stress tests?

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2. What didn't work during the stress tests? Why?

3. Which material performed best under stress? Which data supports your answer?

4. Why do you think this material performed better?

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Improve

1. What do you think you would want to improve in this stress test? Setup? Materials? Procedure?

2. What was the most challenging part of this activity?