Name: _____ Class: ____ Date: _____

A Microscopic Investigation of Internal Forces

Learner Outcomes:

- Identify points of failure and modes of failure in natural and built structures
- Identify tension, compression, shearing and bending forces within a structure; and describe how these forces can cause the structure to fail
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Key Terms:

Internal Forces	Compression	Twist
External Forces	Shear	Metal Fatigue
Tension	Buckle	Torsion

Background Information:

No structure or material is perfect. If a great enough force acts on a structure, it will begin to fail. Even before complete failure, a material will show stresses that are unique to the type of internal force that has been exerted on a material. A microscope can aid the human eye in detecting stresses before complete failure occurs. For comparison, a negative control (a material that has had nothing done to it) can be used to better understand results.

Research question: How do different types of internal forces and stresses affect the structure of a variety of stir sticks?

Hypothesis: If different stir sticks are stressed in different ways, then the structure of the stick will be deformed in a manner that can be observed with a microscope.

Materials:

Stir sticks (5)	beaker tongs	microscope
beaker (400ml)	hotplate	iodine

Safety Precautions: Care must be exercised with the iodine solution as it is a poison. Basic care must be taken not to injure oneself during the experiment.

Procedure:

1. Place 5 stir sticks into the 400 mL beaker.
2. Add 5 ml of iodine solution.
3. Fill the beaker with 300ml of water.
4. Heat the beaker to the boiling point.
5. Remove the beaker from the heat and let it sit overnight.
6. Perform each of the designated tests for tensile strength, torsion, shear, and compression. Describe how each stress was applied
7. Using the dissection microscope, observe the damage inflicted upon each of the stir sticks.
8. Record the results in the form of a drawing, and record the image of a 5^{th}, undamaged, stir stick (the control).

Observations:

Stir Stick	Type of Stress	How Stressed	Macroscopic observations	Microscopic observations
1				
2				
3				
4				
5	**none**			

Analysis:

1. Why was it necessary to have a control?

2. What did the torsion stick look like?

3. What did the compression stick look like?

4. What did the shear stick look like?

5. What did the tension stick look like?

6. Which stir stick demonstrated the most damage?

7. In general, what does the damage look like microscopically?

Extension:

1. Why would scientists need to study the ***microscopic*** damage done to building materials?