

Mechanical Properties of Chocolate- How Hard is your Chocolate?

Lesson

Hardness of chocolate

Suggested Grade Level

6-8

Approximate Run Time

60 -90 minutes (approximately 2-3 class periods)

PDE Standards

- 3.2.7 A: Explain and apply technological knowledge.
- 3.2.7 B: Apply process knowledge to make and interpret observations.
- 3.2.7 C: Identify and use elements of scientific inquiry to solve problems.
- 3.2.7 D: Know and use technological design process to solve problems.
- 3.4.7 A: Describe concepts about the structure and properties of matter.
- 3.4.7 C: Identify and explain the principles of force and motion.
- 3.6.7 C: Explain physical technologies of structural design, analysis and engineering, financial affairs, structural production, marketing, research and design.
- 3.7.7. A: Describe the safe and appropriate use of tools, materials, and techniques to answer questions and solve problems.
- 3.7.7. B: Use appropriate instruments and apparatus to study materials.
- 3.8.7 A: Explain how sciences and technologies are limited in their effects and influences on society.

National Standards

- NS 5-8.1: Science as inquiry
 - Abilities necessary to do scientific inquiry.
 - Understandings about scientific inquiry.
- NS 5-8.2: Physical science
 - Properties and changes of properties in matter.
 - Motions and forces.
 - Transfer of energy.
- NS 5-8.5: Science and technology.
 - Abilities of technological design.
 - Understandings about science and technology.

Content Objectives

1. Students will be able to calculate, measure and identify the hardness of various chocolate bars.
2. Students will apply previous knowledge of velocity and energy to find the hardness of candy bars.

Process Objectives

1. Students will be able to determine the hardness of various substances using quantitative data.
2. Students will make observations of the hardness of chocolate while dropping the indenter on various chocolate bars.
3. Students will be able to determine the amount of hardness of a candy bar by first determining the potential and kinetic energy and the velocity of the indenter upon impact of the candy bar.
4. Students will compare and contrast the hardness of chocolate bars.

Assessment Strategies

1. Completion of the lab questions.
2. Informal evaluation of participation in group discussion.

Materials

- Mechanical Properties of Chocolate Lab: How Hard is Your Chocolate, Questions and Data Sheet

Procedure

Part 1: Hardness of Materials

1. Introduce this lesson by asking the students to share their ideas about hardness of substances.
 - a. Show the video clip “Bend Twist & Break, the Bridge” to introduce materials.
 - b. Discuss the difference between graphite (in pencils that they use in class) and diamond (the hardest mineral on Earth) to introduce materials.
 - c. Ask the students to discuss differences between materials around them.
 - d. What are some ways that they have determined the hardness of substances?
2. Ask the students to share ideas about why some materials are harder than others. How could they test each material?
3. Talk to the students about some ways they are familiar with the concept that some materials are harder than others. For example, everyday when you chew your food your teeth don't break because your teeth are harder than the foods you chew. What are some of the foods that you eat? What would happen if you tried to eat food harder than your teeth?
4. Review hardness and the Mohs Hardness Scale.
5. In 1812, Friedrich Mohs came up with a way of ranking materials on a comparative scale – he simply took 2 different materials and observed which one got scratched when they were rubbed together. Since then, a more quantitative measure of hardness has been developed. Modern hardness testers take a well defined shape and press it into a material with a certain force, observing the indent it leaves in the material when it is removed.

6. Introduce lab.
7. Show the video clip “Bend Twist & Break, Breaking Glass” before students make hypothesis.
8. Complete lab.
9. Complete conclusion questions.
10. Discuss lab and conclusion questions as a class.

Part 3: Video

- Use the video clips “Bend Twist & Break, the Bridge” and “Bend Twist & Break, Breaking Glass” during this lesson.
- The video clip “Bend Twist & Break, the Bridge” will go with the introduction discussion. “Bend Twist & Break, Breaking Glass” will be viewed before students make their hypothesis.

Part 4: Other Examples

1. Teacher-led discussion about how some materials are harder than another.
2. What are the advantages and disadvantages of hard materials? What are the advantages and disadvantages of soft materials?

Extension

1. Try changing the height of the drop, the weight of the indenter, or the shape of the indenter (different size marbles, or use pencils) to see effects discussed in question 6.
2. Try the experiments with different materials. Any material which can deform under the weight of your thumb is appropriate for this lab. Some easily available materials to test would be wax (i.e. candles), silly putty, clay etc.