Lesson

How Hard is Chocolate?

Suggested Grade Level

9-12

Run Time

Approximately 45-50 minutes

PDE Standards

- 3.1.10 B: Describe concepts of models as a way to predict and understand science and technology
- 3.1.10 C: Apply patterns as repeated processes or recurring elements in science and technology
- 3.1.10 E: Describe patterns of change in nature, physical and man made systems
- 3.2.10 B: Apply process knowledge and organize scientific and technological phenomena in varied ways
- 3.2.10 C: Apply the elements of scientific inquiry to solve problems
- 3.6.10 C: Apply physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design to real world problems
- 3.7.10 B: Apply appropriate instruments and apparatus to examine a variety of objects and processes

Content Objectives

1. Students will conduct an experiment mimicking a hardness test.
2. Students will infer reasons for various levels of hardness among chocolate bars.
3. Students will determine the hardness of chocolate bars.
4. Students will examine indentations to determine the hardness of chocolate bar and infer reasons for the differences in hardness.

Process Objectives

1. Students will calculate the hardness of various chocolate bars.
2. Students will calculate the potential and kinetic energy of an indenter.
3. Students will compare the hardness of various chocolate bars.

Assessment Strategies

1. Completion of the “How Hard is Chocolate?” lab

Materials

- Video clips
    1. "Bend Twist & Break, Fracture Surfaces"
    2. "Bend Twist & Break, Beyond the Laboratory"
- Computer with Internet access
- 4 different Hershey's chocolate bars, for example:
    1. Regular milk chocolate (1.55 oz.)
    2. Dark chocolate (1.45 oz.)
    3. Hershey's Mr. Goodbar (1.75 oz.)
    4. Nestle Crunch bar (1.55 oz.)
- Roll of pennies
- Tape
- Metric ruler or tape measure.
- Analytical balance
- Sheet of blank paper

Procedure

PART 1:

1. Students should view video clip "Bend Twist & Break, Fracture Surfaces".
2. Teacher should lead a discussion on various mechanical experimental designs that would test different physical properties of the chocolate bars.
3. Students should create a hypothesis which ranks the various chocolate bars in order form hardest to softest.

PART 2:

1. Students should complete the laboratory activity.

PART 3:

1. Students should watch video clip "Bend Twist & Break, Beyond the Laboratory".
2. Teacher should lead a discussion around various objects and careers in which the experiment would be useful.

Extension

1. Using the Virtual Microscope (http://virtual.itg.uiuc.edu/), students can view the candy bar samples under an electron microscope.

2. Students can compare results and average the data.

3. Some of the candy bars can be frozen and the same experiment conducted. One major source of error here would be heating of the bar while the experiment in being conducted.