STEM Symposium: Breaking Chocolate

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Electronic resources will be hosted at: sites.ieee.org/albuquerque
Objectives

• Intro to Engineering processes
  – Breaking chocolate as a vehicle
• Measurements of physical properties (quantities)
  – Different physical quantities, such as length and force
• Uncertainty in measurements
• Calibration of a measurement instrument (applying the methods of the engineering design process)

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Intro to Engineering

• Engineers solve real world problems using a structured process:
  – Identify and understand needs or requirements
  – Generate potential solutions
  – Evaluate and analyze
  – Produce and document the solution

• Handout engineering decision matrix (example slide next)

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## Typical decision aid

**Simplified Quality Function Deployment (QFD) Template**

- **Name:** __________________________

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The “breaking chocolate” experiment

• Initially designed for high school physical sciences
  – We adapt to use cross-cutting concepts in engineering and measurement for 6-8, adaptable to lower grades

• Three-point breaking strength test
  – Measurements are crucial in calculating the breaking strength:
    • Thickness and width of the chocolate
    • Distance between the end supports
    • Applied force that breaks the chocolate

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What do we measure

• Physical properties and their quantities (we will often use “physical quantities” when referring to physical properties)
  – The SI system (commonly called metric)
metric and egyptian measures collide

Wait a minute. Which one is a cubit and which is a centimeter?

The MCO MIB has determined that the root cause for the loss of the MCO spacecraft was the failure to use metric units in the coding of a ground software file, “Small Forces,”...
What is length?

- Hands on #1, hand out rulers to tables, copies of the coin properties, and a handful of coins per table
- Teacher groups to determine process for identifying useful rulers, test process, and report out (per table group) (quick 2 sentence verbal explanation of best solution)
Set up the chocolate breaking experiment

- 3 contact points breaking strength:
  - (a) Distance between end chopsticks
  - (b) Width of chocolate
  - (c) Thickness at center chopstick, also (d) amount of force to break
What about force?

• Hand out scales, nickels, cups, string; balance stations already set up
• Purpose: How useful is the luggage scale? (Is it good to $\pm 10$ g at 1 kg? Is it $\pm 10$ g at 1.5 kg? How about at 0.5 kg?)
• Groups take 3 minutes to plan, test, and be ready to report (2 sentences per group, or write as a “tweet”)
Let’s get to breaking!

• Each table gets a bunch of wood blocks, chopsticks, string, and 1 luggage scale; at least three bars of chocolate; make sure each table has a different type of chocolate
• Remember to handle the chocolate as little as possible (melting!)
• Report (make your own table with poster paper & markers)
  – Your table team name, and the type of chocolate
  – Distance between endpoints
  – Distance center to endpoints (should be as close to the same as possible)
  – Width of chocolate
  – Thickness of chocolate where the center chopstick is
  – Breaking force
• Make a summary tweet!

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Acknowledgments

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• The Albuquerque IEEE section, the UNM IEEE student section, Sandia Nat’l Labs, the Albuquerque inter-technical-society council, NCSLI

• You can always reach me at hdtran@sandia.gov; I will do my best to respond in a timely fashion

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