

ELECTRICAL INSTRUMENT SERVICE, INC.
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STEM Symposium: Breaking Chocolate

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MODEL ESD-5
NO. ES17475

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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)

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)
- Use math & science in these steps

Typical decision aid

Simplified Quality Function Deployment (QFD) Template Name: _____	IDEA 1:	IDEA 2:	IDEA 3:	IDEA 4:	IDEA 5:
REQUIREMENT 1:					
REQUIREMENT 2:					
REQUIREMENT 3:					
REQUIREMENT 4:					
REQUIREMENT 5:					

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

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)

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metric and egyptian measures collide

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

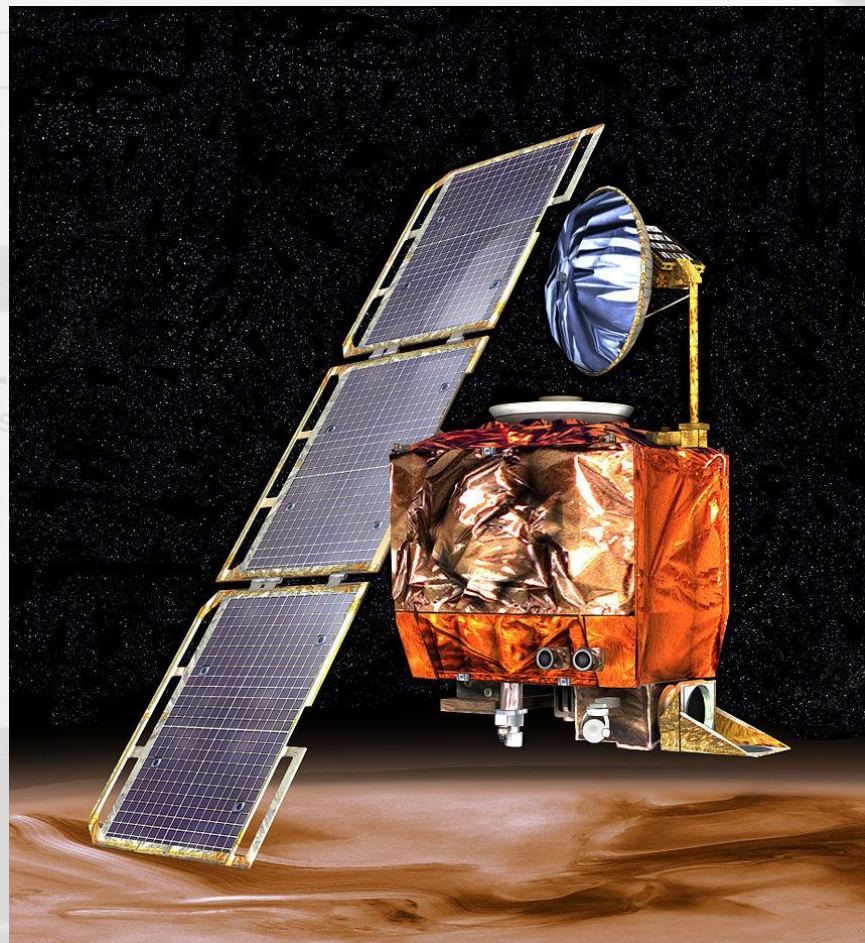


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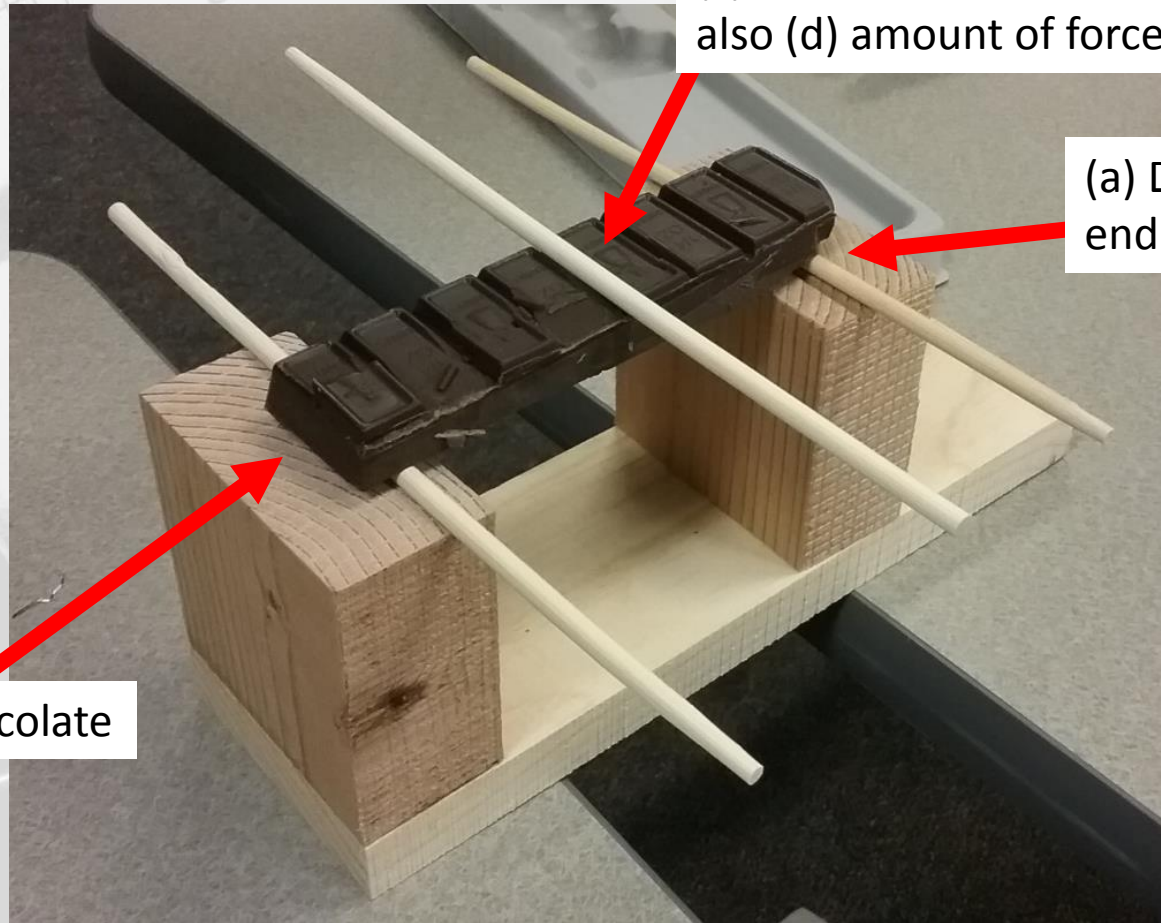
The MCO MIB has determined that the root cause for the loss of the MCO spacecraft was the failure to use metric units in the coding of a ground software file, "Small Forces," ...

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:



(c) Thickness at center chopstick,
also (d) amount of force to break

(a) Distance between
end chopsticks

(b) Width of chocolate

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 ± 10 g at 1 kg? Is it ± 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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- 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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