

Name:

Date:

Class:

Day 4: Using Engineering Design Process, IMA/AMA, Hypotheses, and Calculations

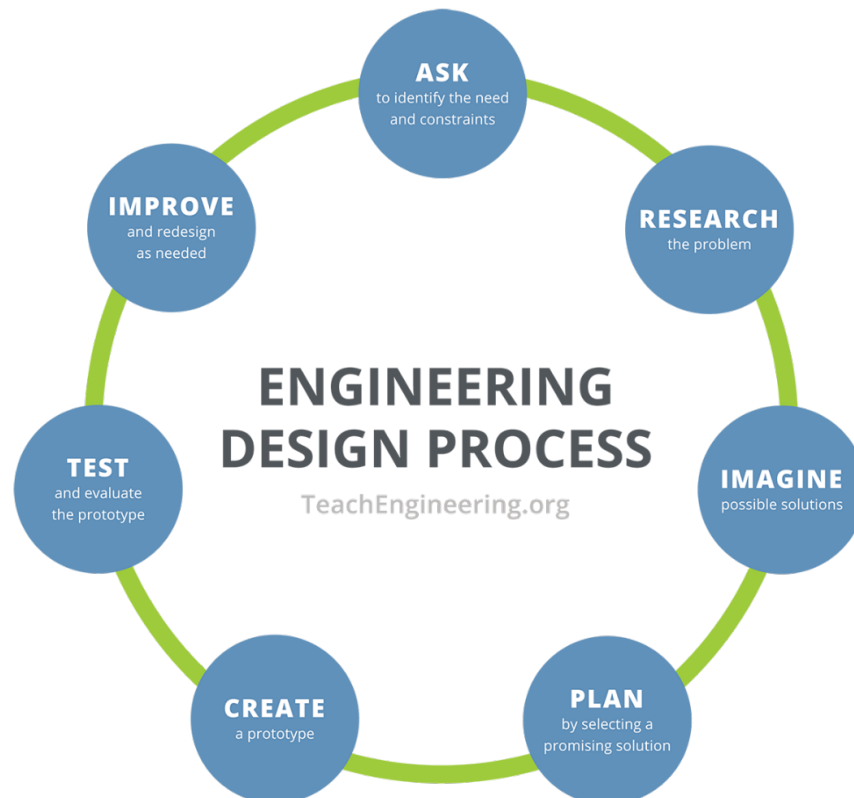
Design Challenge:

Design a method to transport material up a hill. The method must reduce the amount of friction and cannot involve modifying the inclined plane. The design must incorporate the minga tradition, while also using discarded materials common to the area.

Materials Needed:

- 1 3-lb weight (flat plate weight or bagged sand)
- 12-24" of string or thin rope
- 1 Newton scale/spring scale
- scissors
- glue or tape
- access to commonly discarded items such as the following:
 - empty plastic jug or bottle (large enough to hold the weight)
 - dog or cat food bag
 - empty flour or rice bag
 - other recyclable materials

Engineering Design Process



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Instructions:

1. Review the challenge: Using commonly discarded materials, create a method for moving a weighted object.
2. Examine the available materials and discuss with your team which ones might provide the greatest mechanical advantage (i.e., makes the task easier using force, tools, or structure).
3. Imagine and brainstorm ideas. Sketch your prototype below.
4. Plan a solution using the selected materials to help move the weight across an inclined plane.
5. Design and build a solution using the selected materials to help move the weight across an inclined plane.
6. Measure the Newtons of force required to move the weight on a control surface (a baseline with no added materials or modifications).
7. Hypothesize how many Newtons of force will be needed to drag the weight across each of the five different surfaces using your design. (Tip: Consider smoothness, texture, and the material of each surface.)
8. Test your design by dragging the weight across each surface, one at a time.
9. Record the actual force (in Newtons) required for each surface.
10. Calculate the difference between your predicted and measured values for each surface.
11. Complete your findings summary by discussing with your team:
 - a. Your final design and how it worked.
 - b. The values you measured.
 - c. Your testing method.
 - d. How accurate your predictions were.
12. Fill out Table B.

Imagine and Brainstorm: Prototype Sketches

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Table A: Hypotheses and All Measurements in Newtons

	Hypothesis	Actual Measurement	Difference
Control Surface	N/A		
Turf			
Carpet			
Bubble Wrap			
Vinyl Flooring			
Felt			

Findings Summary - Were You Right/Wrong? Why? Justify.

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Table B: Actual Mechanical Advantage Calculations (all measurements in Newtons)

	Resistance (Fr)	Effort (Fe)	AMA (Fr / Fe)
Control Surface			
Turf			
Carpet			
Bubble Wrap			
Vinyl Flooring			
Felt			