Using Science Olympiad Events to Bring Engineering and Design Into the Classroom

April 9, 2016

Projects

- Have you had your students do one of these (or something similar)?
  - Catapult/Trebuchet
  - Egg drop challenge
  - Mouse trap vehicles

- Why do we ask our students to do them?

What is Science Olympiad?

- Annual set of competitions for:
  - Middle School Students
  - High School Students
- Students cross-train to compete in several of the 23 different events:
  - Life Sciences
  - Physical Sciences
  - Earth and Space Sciences
  - Engineering
  - Problem Solving

SCIENCE OLYMPIAD™

Exploring the World of Science

SO events with connection to engineering

- Robot Arm
- Scrambler
- Egg-O-Naut
- MagLev
- Electric Vehicle
- Mission Possible (Rube Goldberg Device)
- Bridge/Tower/Boomilever

Boomilever

- What the heck is a boomilever???
  - Think of the arm of a crane – a structure that supports a load at the distal end

Boomilever

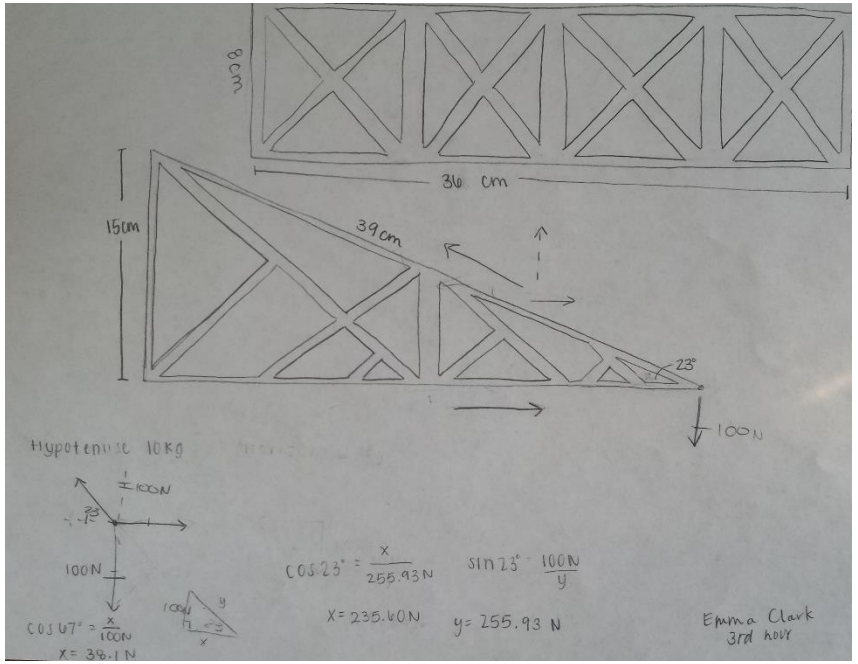
- Materials – Balsa, light plywood, adhesives - What does this cost???
- In-Class project? – Access to tools, safety
- Timing?
- Testing Apparatus?

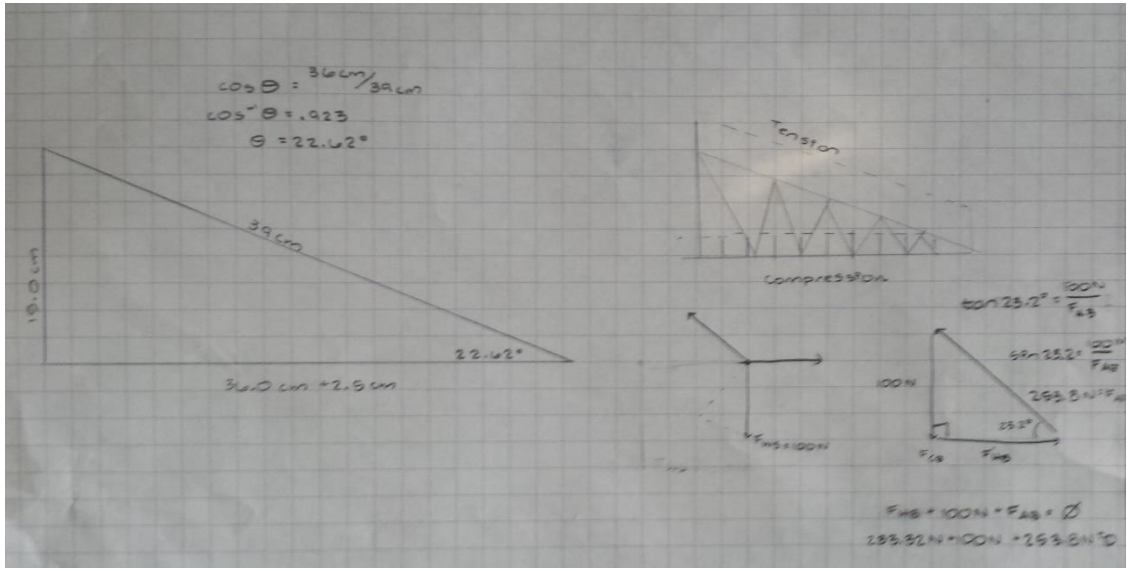
Boomilever

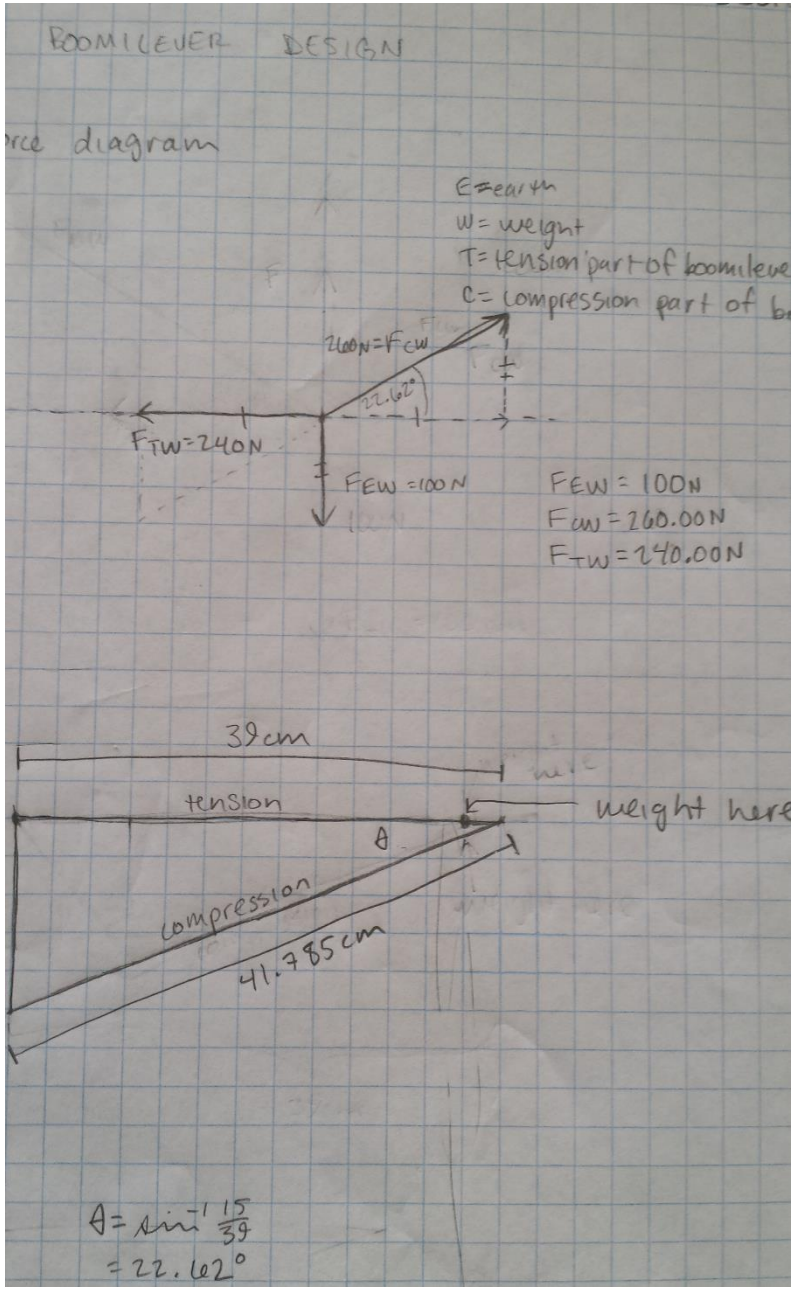
- Objective: Design, construct, and test the most efficient structure that can hold a given mass
- Key Elements
  - Students must submit a design
  - Students must perform a minimum number of tests
  - Students compete for the most efficient structure

Boomilever

- Design







Boomilever

- Test

Boomilever

- Compete

From the *Framework* Document

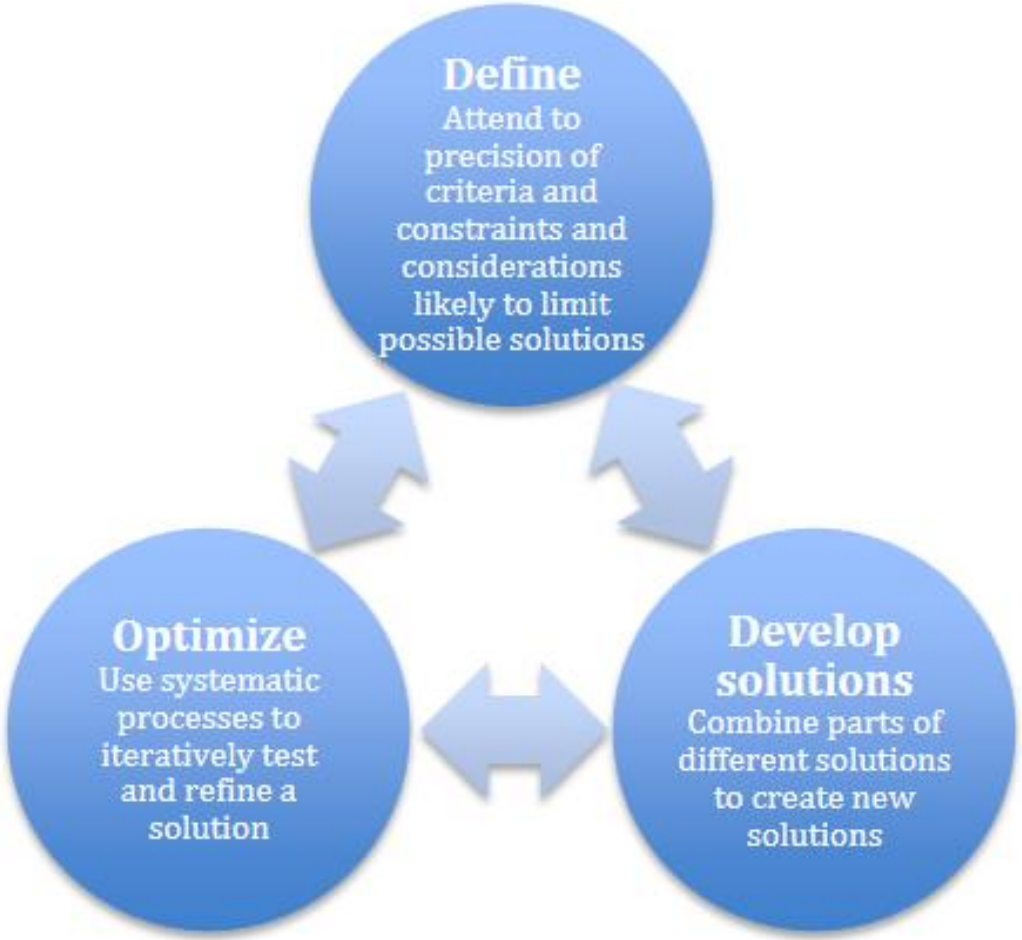
- Defining and delimiting engineering problems
- Designing solutions to engineering problems
- Optimizing the design solution

New Michigan Science Standards
Engineering Design

- Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

New Michigan Science Standards

Engineering Design



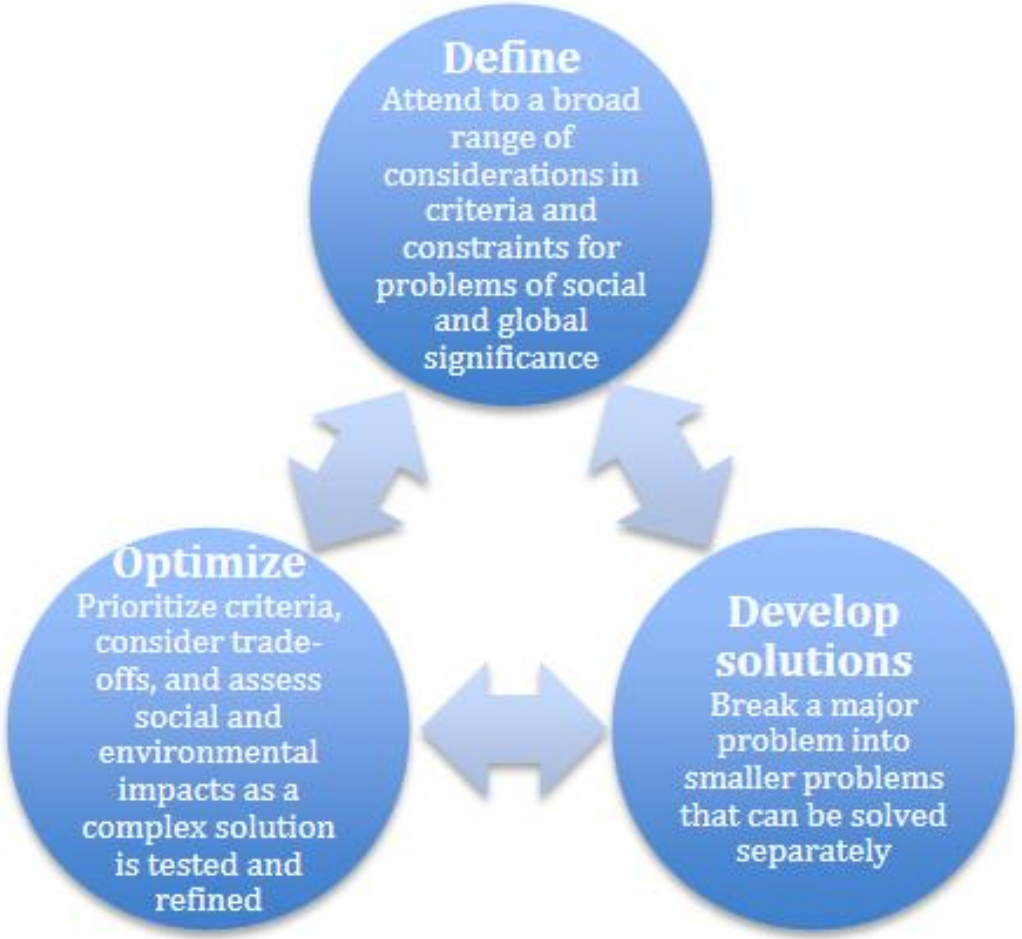
New Michigan Science Standards

Engineering Design (High School)

- Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

New Michigan Science Standards

Engineering Design (High School)



Engineering Design Connections – Physical Sciences

HS-PS1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. *

HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. *

* - Integrates traditional science content with engineering. Includes a Michigan specific performance expectation.

**- Allow for local, regional, or Michigan specific contexts or examples in teaching and assessment.

Engineering Design Connections – Life Sciences

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* **

HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. **

* - Integrates traditional science content with engineering. Includes a Michigan specific performance expectation.

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Engineering Design Connections – Earth and Space Sciences

HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. * **

HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. *

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Engineering Design – Centered and Connected

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

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