

## Submarine Force Museum Lesson Plan

Developed by 2015 Submarine Force Library and Museum STEM –H Teacher Fellow  
Ted Allen, Science Teacher, Ledyard Middle School, Ledyard, CT

Lesson Name Engineering Design: Tower Building Number of minutes in the Lesson 45

Intended Audience fifth – ninth grade

**Content Standards:** Identify state **CCSS content and literacy standards** (when applicable) **and** national curricular standards this lesson is designed to help students attain. Also include **state and district standards** as well as the **Technology Standards** and **CCSS Math Standards** when applicable.

MS-ETS1-1. 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.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. 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.

MS-ETS1-4. 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.

**Pre-Visit Materials/Activities:** Describe the students' prior knowledge or skill related to the learning objective(s) and the content of this lesson, using data from pre-assessment as appropriate. What background knowledge or skills do you want students' to come to the museum prepared with, and what materials will you provide to groups ahead of time so they are prepared for this lesson?  
**None needed**

**Set up Before the Lesson Begins:** Describe any preparation that is necessary before the lesson.

**Gather and organize enough materials for all groups. For one trial, each group needs:**

- 20 craft sticks
- 10 rubber bands
- 4 paper clips
- 1 meter of masking tape
- Assorted metric weights or objects of known mass

**Content Objective(s):** Identify specific and measurable learning objectives for this lesson. Remember only one for a 45 minute class, two for a 90 minute class.

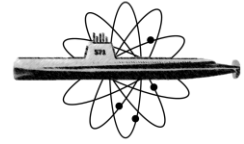
**Challenge:** Your **TASK** is to build a structure that will support the maximum amount of weight at a height of 30 cm. Familiarization with basic ideas of engineering practices and design.

**Language Objective(s):** Distinguish between receptive skills (**listening and reading**) and productive skills (**speaking and writing**). Please **include how you would use them all where appropriate:** Listening, reading, speaking and writing.

Group will listen to an explanation of the steps of engineering design practices.

Group will apply these to build a tower, with provided materials, that will hold a much weight as possible.

Groups will discuss the processes used and future changes they would make.



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**Initiation:** Briefly describe how you will initiate the lesson. (Set expectations for learning; articulate to learners what they will be doing and learning in this lesson, how they will demonstrate learning, and why this is important).

**Challenge:** Your **TASK** is to build a structure that will support the maximum amount of weight at a height of 30 cm.

You will be provided with a ruler that may not be damaged and may not be part of your solution.

The weights may not be damaged and may not have the mailing labels attached to them.

### **Lesson Development:**      **(Add a Time for Each Segment of the Lesson)**

**Performance Tasks:** Describe in outline how you will develop the lesson and what learning activities students will be engaged in order to gain the key knowledge and skills identified in the student learning objective(s).

Use the Worksheet included at the end of the lesson plan for copying, for the students to complete the following tasks:

**Defining the problem** with “precision” involves thinking deeply about the problem your solution needs to address.

What is the problem presented?

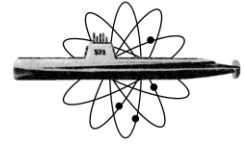
**Developing possible solutions** includes brainstorming, discussing ideas, and communicating in your team about the “How” you will solve the problem. A two stage process of evaluating the different ideas that have been proposed: by using a systematic method to determine which solutions are most promising, and by testing different solutions, and then combining the best ideas into new solution that may be better than any of the preliminary ideas

What are some ideas (all members should be encouraged to share)?

### **BUILD: Construct and test your team’s first tower. Record results below.**

**Improving designs** involves an iterative process in which students test the best design, analyze the results, modify the design accordingly, and then re-test and modify the design again. Groups may go through this cycle two, three, or more times in order to reach the optimal (best possible) result.

Discuss what worked, what didn’t, improvements that can be made, gather materials and try again.



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**REPEAT:** (three times total if possible). Record weight held on all attempts and be prepared to share the discussions your group had to improve your design, was your third attempt your best, if doing a fourth attempt what would you change?

Weight Held Prototype I \_\_\_\_\_

Weight Held Prototype II \_\_\_\_\_

Weight Held Prototype III \_\_\_\_\_

Weight Held IV or Final \_\_\_\_\_

**Teaching and Learning Strategy:** Strategies that you used during the lesson, including **modeling, guided practice and independent practice** where applicable.

**Monitoring and Adjusting:** How do you know the students have learned what you taught them and that they have achieved the objective?

**Assessment:** How will you ask students to demonstrate mastery of the student learning objectives? Attach a copy of any assessment materials you will use, along with assessment criteria.

**Closure:** Briefly describe how you will close the lesson and help students understand the purpose of the lesson. (Interact with learners to elicit evidence of student understanding of purpose(s) for learning and mastery of objectives)

**Post-Visit Materials/Activities:** Provide additional materials if they would reinforce a good learning experience after leaving the museum.

**Technology:** Please explain the technology used: why you will use it, how you will use it and how you will assess the results of using this technology.

None needed

**Key Vocabulary:** Words students need to know in order to reach the objectives.

**Extension:** What do you have in place in case during the lesson you finish early, run out of time or need to accommodate students who complete the class work before other students, or your technology fails?

**Finish Early: Give 4<sup>th</sup> attempt**

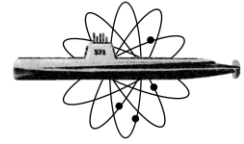
**Run out of time: Only give 2 attempts**

**Technology Fails: N/A**

**Materials:** Each team will need the below list of materials, for each attempt:

- 20 craft sticks
- 10 rubber bands
- 4 paper clips
- 1 meter of masking tape
- Assorted metric weights or objects of known mass

**Resources:** Include any resources you may use such as textbooks and any technological resources.



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### Engineering Design Worksheet

**Defining the problem** with “precision” involves thinking deeply about the problem your solution needs to address.

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