



Civil Engineering-Tower Construction

Submitted by: Michael McMeans, Engineering
South High School, Kingsport, Tennessee

Target Grade: 9-12

Time Required: 100 minutes

Standards:

- HS-ETS1-1 Engineering Design: 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 Engineering Design: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Lesson Objectives:

Students will:

- Understand the key roles and job duties of civil engineers
- Build the tallest tower while having the most affordable budget
- Act as civil engineers while following the engineering design process

Central Focus:

In this engineering design activity lesson, students will first learn about Civil Engineers. Then, students will be given an engineering challenge to design a tower with specific constraints. They are constrained by time, materials, and will also have to budget for materials to keep the cost as low as possible. Students must use the Engineering Design Process in building their towers.

Background Information:

Civil Engineers are professional engineers who work with, design, construct, and preform maintenance on infrastructure that all humans (and many animals) use. They must keep in mind the environment, public health, and the environment when designing. Without civil engineers, we couldn't live life as we know it. They design roads, bridges, railroads, dams, buildings, sewer systems, airports, and so much more.



The Engineering Design Process is a series of steps that engineers use to develop a solution to a problem. The steps don't always happen linearly, and many times must be repeated to get the best outcome.

Materials

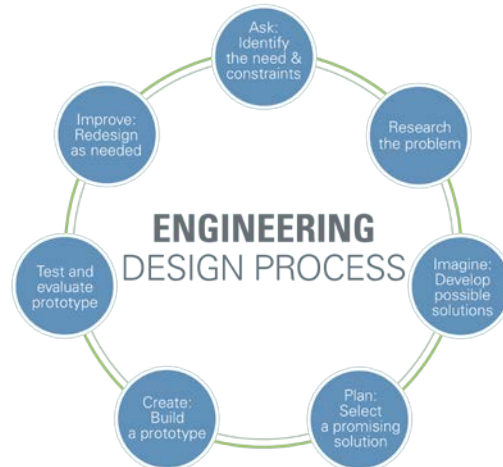
- Straws
- Tape
- Craft Sticks
- Cutters
- Scissors
- Worksheet

Instruction

Bellwork (5 minutes): As they come in, students will complete an engineering journal entry by writing one paragraph that contains at least 5 facts about civil engineering. Students should be prepared to discuss the facts.

Lesson:

- The teacher will show a [video](#) on the day in the life of a civil engineer
- The teacher will lead a discussion on the key observations made from the video prompting with questions that include such things as: a typical day, job location, materials needed, work atmosphere, companies to work for, involvement in the construction. This first video showed more of the project management side of the engineer's job. (8 min)
- The teacher will show a second [video](#) that shows civil engineering working in the field and then lead a discussion on the different types of jobs engineers can hold and their work environment. Use the discussion from this video to discuss how civil engineers make an impact on everyone in the community they work in. (8 min)
- The teacher will explain the rules to the straw tower challenge.
 - Working with your group, build the tallest straw tower possible capable of supporting the weight of a book for no more than \$15,000 in materials.
 - The team that builds the tower capable of supporting a book with the lowest cost per inch wins.
- Students should get into pairs. Talk about holding each other accountable, choosing someone who will share the work and be responsible for the final outcome
- The students will be given 10 minutes to brainstorm ideas and create a drawing of the structure they intend to build.
- The students will then be given 40 minutes to build their straw tower



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- Next the students will present their drawing from their initial stages of planning, their tower, test their tower, and give an evaluation of how much money they spent on their challenge.
- Finally students will have to write a report of their project and explain ways they would do their project differently and explain how they could have been more cost effective. The Final Report should include answers to the following questions:
 1. Compare for me your drawing and how your tower actually turned out.
 2. Breakdown the process you went through while constructing your tower.
 3. Predict the outcome of your bridge test based upon your construction and design.
 4. Evaluate your overall success or failure based on the result of your test on your tower
 5. List the changes you would have made to your tower in order for it to be more successful or list the success that you had on your tower that made it hold the full amount of weight.

Differentiation

Students with IEPs will be given extra time and assistance by the teacher to complete their budget sheet, brainstorming and construction. When appropriate, a student with an IEP may be paired with another student to help. Students who are English learners will receive the budget instructions in their native language so they can understand the assignment.

Assessment

Student learning will be assessed by the completion of the budget sheet and through the final report.

Straw Tower Challenge

Group Name: _____

Mission:

Working with your group, build the tallest straw tower possible capable of supporting the weight of a book for no more than \$15,000 in materials.

Challenge:

You may only use the straws (50), craft sticks (5) and tape (3ft) provided to your group to complete the tower. The straws are worth \$200 a piece the craft sticks are worth \$280 a piece and the tape is \$100 an inch. Your group must figure out the total cost of your tower and stay within the \$15,000 maximum budget. The team that builds the tower capable of supporting a book with the lowest cost per inch wins.

Rules:

- You may only use the material you are provided with.
- Straws that are cut and unused are considered “used” materials.
- The tower must be able to hold a book and stay set and upright for no less than 10 seconds.
- The book must rest at the highest point on the tower.

Pricing Grid:

# of Straws	Cost/Straw			
_____	x	_____	=	\$ _____
Inches of Tape	Cost/Inch			
_____	x	_____	=	\$ _____
# of craft sticks	Cost/Craft stick			
_____	x	_____	=	\$ _____
Total Cost of Tower				\$ _____
Height of Tower				_____
Cost per Inch (Total Cost of Tower / Height of Tower)				\$ _____