ORDINANCE DISPOSAL TECHNICIAN

NAVY CIVIL ENGINEERING

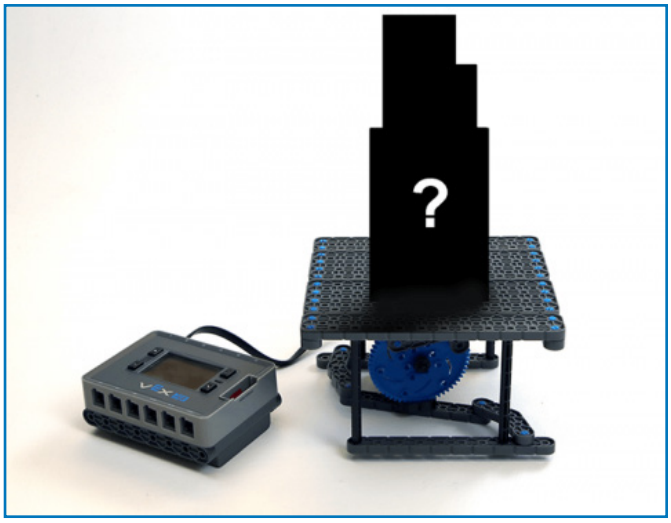
As part of the Navy Civil Engineer Corps, one can receive unrivaled hands-on experience and advanced training in civil engineering areas including architecture, construction engineering, environmental engineering, water resources engineering, geotechnical engineering, transportation engineering and community planning. You'll quickly find yourself in charge of vital Navy projects, where you might:

- Oversee Construction of everything from runways to docks to buildings of all shapes and sizes.
- Supervise and manage utilities and other critical services
- Manage a variety of skilled construction workers (Seabees)
- Approve completed work

VEX IQ

PREVIEW

TALLEST TOWER



8 - 15 YEARS OLD

45 - 145 MINUTES

BEGINNER

EDUCATIONAL STANDARDS

USA STANDARDS

Standards for Technological Literacy (STL)

- 1: F, G
- 2: Q, R
- 7: C
- 8: E, F, G
- 9: H
- 11: K, L
- 12: H
- 20: F, G

Next Generation Science Standards (NGSS)

- MS-ETS1-2
- MS-ETS1-4

Common Core State Standards (CCSS)

- RI.6-8.10
- SL.6-8.1
- WHST.6-8.2
- WHST.6-8.10
- RST.6-8.1
- RST.6-8.3
- RST.6-8.4
- RST.6-8.10

DESCRIPTION

Students are asked to follow an engineering design process to build the tallest tower possible that can withstand a simulated earthquake.

KEY CONCEPTS

Engineering Design Process, Engineering Notebook, Iterative Design, Conventional vs. Seismic Isolation Structures

OBJECTIVES:

- Create a tall tower to withstand a simulated earthquake, iteratively.
- Create an engineering notebook where their work can be organized.
- Evaluate their designs to improve and enhance them.
- Analyze how and why skyscrapers were designed.
- Analyze how a building's design withstands earthquakes.
- Apply building techniques and skills for strengthening a structure.
- Understand the design features that need to be considered when designing a tower.

MATERIALS NEEDED

- VEX IQ Super Kit
- Materials for Engineering Notebooks (either prepared, or created with lined or graph paper and folders)

STEM LAB FORMAT

The following VEX STEM Lab supports students as they learn the benefits of using the engineering design process in their robotic design to explore structure stability. In this lab, students will have the opportunity to collaborate and build an Earthquake Platform. After recording their reflections on the build in their engineering notebooks, they will be introduced to the iterative design process. Students will use the Earthquake Platform to test their initial designs and record their findings in their engineering notebook before repeating the process again to improve their designs. Students will analyze structure stability in everyday objects such as skyscrapers. Students will then explore the value of structure stability and how it is utilized during a VEX robotics competition.

Seek: The goal of this section is for students to work collaboratively to build the Earthquake Platform and answer exploration questions in their engineering notebook. (See link to web based lesson for step by step instructions associated with the lesson)

- The Completed Look of the Build
    - This page features a picture of a completely built Earthquake Platform that can be used to introduce the STEM Lab. It can be used as a student reference during the building process.
- Parts Needed
    - This page lists all the parts needed to build the Earthquake Platform. It can be used as a student reference during the building process.
- Build Instructions
    - This section features detailed steps, in a slideshow format, for students to follow to build the Earthquake Platform. The Platform will be used for the duration of the STEM Lab. Suggested Time Allotment: 30 mins.
- Exploration Questions
    - This page features several discussion questions to pique interest in the Earthquake Platform and its capabilities. Suggested Time Allotment: 5 mins.

Play: The goal of this section is for students to demonstrate how the Earthquake Platform operates and behaves when a structure is placed on top of it.

- 15-Minute Tower Build
    - This page features an activity where students build the first design of their structure to see if it can survive a simulated earthquake. The students will document their findings in their engineering notebook to be able to compare their initial design to future designs. Suggested Time Allotment: 25 mins.
- Reinforcing or Bracing Structures
    - This page explains the science behind how a structure can be reinforced using materials such as steel. Suggested Time Allotment: 10 mins.
- Iterative Design
    - This page reviews the outline of the engineering design process by defining iterations. Suggested Time Allotment: 10 mins.
- Round 2: Improve Your Design
    - This page features an activity where students build the second design of their structure to see if it can survive a simulated earthquake. The students will document their findings in their engineering notebook to compare their second design to their initial design. Suggested Time Allotment: 25 mins.

Apply: The goal of this section is for students to explain how structure stability is integrated into robotic builds and the value of this application in the natural world.

- How Skyscrapers Are Made
    - This page consists of a brief reading about skyscrapers and how their materials and shape affect their strength and stability. Suggested Time Allotment: 10 mins.
- San Francisco and Seismic Isolators
    - This page contains informational reading on the value of seismic isolation compared to onventional building design. Suggested Time Allotment: 10 mins.
- Designing Stable Robots for Competitions
    - This page discusses the necessity for a stable robot in a VEX Competition. Suggested Time Allotment: 5 mins. This section is optional.

Rethink: The goal of this section is for students to explore ways to better design their structure to withstand the simulated earthquake and recording their ideas through detailed writing and sketches.

- Prepare for the Tower Strength Challenge
    - This page explains how to set up the classroom area and group the students for the challenge they will be completing in the next section. Suggested Time Allotment: 2 mins
- Set up the Earthquake Platform
    - This page explains how to activate the motor from the robot brain in order to simulate the earthquake on the platform. Suggested Time Allotment: 3 mins
- Tower Strength Challenge
    - This page describes the rules for the Tower Strength Challenge, in which students will test their structure designs on the Earthquake Platform to see if it can last 30 seconds. Suggested Time Allotment: 10 mins
- Improve and Tinker with Your Build
    - This page offers guiding questions for students to answer as they approach the Earthquake Platform from an engineering perspective. Students will work to iterate and test improvements to their build. They will record their thoughts, ideas, and testing results in their engineering notebook through writing and sketches. Suggested Time Allotment: 10 mins

Know: The goal of this section is for students to complete a summative assessment on the content presented in the STEM lab.

- Know Questions
    - Students will answer several multiple-choice assessment questions. Students receive immediate feedback as their answer choices are submitted. Suggested Time Allotment: 5 mins.

FACILITATION NOTES

- Although the Robot Brain is included in the build of the Earthquake Platform, no programming is required. The Smart Motor will be controlled directly through the Device Menu.
- Each team does not need to build its own Earthquake Platform. In the interest of time, you can build one for all teams to use for the challenge.
- If each team is building an Earthquake Platform, you can test the platforms after Build and Explore to ensure that they work before getting to the Challenge. See the Set up the Earthquake Platform's instructions.
- The Earthquake Platform sometimes sounds noisy, but that is normal. The parts are unlikely to break.
- When the activity is introduced, a placeholder silhouette of a tower is presented in an image of the Earthquake Platform. That silhouette is not the suggested shape for designing a tower.
- An Engineering Notebook can be as simple as lined paper within a folder or binder. The notebook shown is a more sophisticated example that is available through VEX.
- The iterative process of designing, building, and testing the tower can include more rounds and/or more engineering time than what is outlined within the activity.
- During the iterative design process prior to the challenge, teams should be testing the strength and stability of their towers. In the interest of time however, they can begin testing their towers with the Earthquake Platform earlier than the challenge.
- The build of the Earthquake Platform should require approximately 30 minutes. The iterative engineering of towers, readings, and writing should require approximately 90 minutes, followed by 30 minutes for completing the application readings. The challenge should require approximately 60-90 minutes, depending on whether towers are tested simultaneously. Lastly, the assessment could require as many as 30 minutes.