2023 U04 iSTEM 1 - Introduction to Structure Building

Content Area: **CTE**
Course(s): **iSTEM**
Time Period: **April**
Length: **10 weeks**
Status: **Published**

Unit Overview:

In this unit, students will explore how structures are designed to distribute and support loads. Students will learn to identify the forces of compression, tension, and torsion and how these forces are countered through efficient and effective design practices and mini project assignments. Students teams will be assigned to complete the bridge project, where they will continue the application of the engineering design process to develop a design that can carry the heaviest load in the most cost efficient way. Students will be introduced to project management skills and techniques that will assist in developing a task list, organizing the tasks sequentially based on dependent and independent tasks, and developing a schedule to manage and monitor the efficient progress and completion of the project. Through the project management process, students will have to account for tasks not limited to the fabrication, testing, and analyzation of the performance of a structure capable of withstanding a prescribed load. Physical bridge models developed from a computer bridge simulator, structure mini-projects, and videos of structures being constructed will be the central focus of student work.

Essential Questions:

- What are different building structures?
- Where do we find examples of structures in nature?
- What common factors need to be considered when designing structures?
- What are the various loads and forces which act upon structures and increase their potential for failure?
- Differentiate between static and dynamic loads.
- Demonstrate a working knowledge of forces: tension, compression, torsion, and shear.
- How important is the concept of precision in the design and construction of a structure?
- What are the common types of trusses used in roof and bridge designs?
- Demonstrate the ability to acurately apply scale to production drawings.
- How does equilibrium correlate with the "soundness" of structures?
- Safely handle and operate knives in the production of paper models.
- What behaviors lead to a successful team and how do Team Norms help to keep these behaviors at the forefront during group work?
- What are the roles of a project manager and how can we use a Gantt Chart to schedule projects?

Enduring Understandings:

- Identify central tenents of design problems through research prior to the pursuit of solutions.
- Conduct on-going self-assessments and research in the face of evolving educational and workplace environments.
- Design quality concepts such as performance, usability, accessibility, reliability, and safety impact product development.
- Creating technical drawings using 3D computer-aided design (CAD) software documents a design according to standard engineering practices.
- Identify and assign team member roles
- Define the term group norms and discuss the importance of norms in creating an effective team

environment
- Identify strategies to resolve team conflict
- Demonstrate positive team behaviors and contribute to a positive team dynamic
- Establish common goals, equitable workloads, accountability, and create a set of team norms
- Contribute equitably to the attainment of group goals based on assigned roles
- Practice appropriate conflict resolution strategies within a team environment

Lesson Titles:

- Introduction to Structures Slides

- Mini-Project: Marshmallow Tower Project

- Bridge Types

- Online Bridge Building Game

- WP Bridge Designer

- Asian American Month Activity

- Efficient Bridge

- Online Simulator: Natural Disaster Impacts on Structures

- Mini - Project: Surviving an Earthquake

- Design Challenge #4: Bridge Building Project

- LGBTQ and Disabilities Contributions to Engineering

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Direct Instruction: Daily Overviews (Promethean Board, Chromebooks, White Board)
- Direct Instruction: Presentations - Introduction to Structures
- Instruction: Step by Step Videos / Example: WP Bridge Designer, Fabrication of Bridge Building Project
- Independent Work: Bridge Types
- Independent Work: Online Bridge Building Game
- Independent Work: Surviving Natural Disasters Online Structure Simulator
- Independent Work: LGBTQ and Disabilities Contributions to Engineering Assignment
- Partner Work: Efficient Bridge
- Indirect Instruction: Reflective Discussion, Evaluation of Data and Technical Writing - ENB Write Ups, Self Evaluations, Presentation of Projects
- Experiential: Project - Bridge Building Project
- Experiential: Mini - Project - Marshmallow Tower

- Experiential: Mini - Project - Surviving an Earthquake
- Cooperative: Partner classwork, short projects, projects and ENB entries

Summative Assessment:

- Mini - Project: Marshmallow Tower
- Mini - Project: Surviving an Earthquake
- Project: Bridge Building Project
- Quiz: Bridge ENB Write-Up
- Quiz: Efficient Bridge (Bridge Designer)
- Quiz: Surviving Natural Disasters Online Structure Simulator

Formative Assessment:

- Anticipatory Set - Overview of items for the day, future activities of the unit, and/or review of previous information from the unit
- Classroom / Student Observation - check in on student work during in-class activities / projects
- Closure of Projects - students provide results of their projects, self-evaluate projects for possible improvements that could be made, and evaluate instruction that could be improved
- Closure of Units - students complete a design project that pertains to the unit at hand as well as prior units
- Conferences between the instructor and student at various points in the semester.
- ENB (engineering notebooks) - reviewed periodically during the school year
- In-class activities where students informally present their results.
- Presentation Sample Slides - Students participate in classroom discussion on topic that is being introduced and reviewed
- Q & A session - Student led question and answer session at the start of class for project information as needed
- Question and answer sessions, formal, planned and informal, spontaneous.
- Warm-Up - review information from current topic or previous topics, preview time for current activity, and/or opportunity for clarity on the previous day's work

Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

Alternative Assignments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Standards/Indicators/Student Learning Objectives (SLOs):

9-12.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.
9-12.HS-ETS1-1.1	Asking Questions and Defining Problems
9-12.HS-ETS1-1.1.1	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
9-12.HS-ETS1-4.4.1	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.
9-12.HS-ETS1-2.6	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.
9-12.HS-ETS1-2.6.1	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-4.ETS1.B	Developing Possible Solutions
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a

	given design will meet his or her needs.
9-12.HS-ETS1-2.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Career Readiness, Life Literacies, & Key Skills:

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

Inter-Disciplinary Connections:

MA.G-CO.D	Make geometric constructions
MA.G-CO.D.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
LA.SL.9-10.1.B	Collaborate with peers to set rules for discussions (e.g., informal consensus, taking votes on key issues, presentation of alternate views); develop clear goals and assessment criteria (e.g., student developed rubric) and assign individual roles as needed.
MA.G-MG.A	Apply geometric concepts in modeling situations
LA.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
	Obtaining, Evaluating, and Communicating Information
	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.
	Cause and Effect

Technology Materials and Standards

- SmartBoard Presentations
- Chromebooks, Google Drive, Google Applications
- MS Office Software as needed
- Smartphones
- Construction Hand Tools and Safety Equipment
- WP Bridge Designer

TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.

TECH.8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.1.12.F.CS1	Identify and define authentic problems and significant questions for investigation.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
TECH.8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.
TECH.8.2.12.D.CS1	Apply the design process.

Computer Science and Design Thinking Standards

CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.ED	Engineering Design
CS.K-12.1.a	Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.
CS.K-12.2	Collaborating Around Computing and Design
CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
	Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.

Equity Considerations

LGBTQ and Disabilities Mandate

Topic: Famous individuals in i-STEM

Materials Used:

LGBTQ:

Sir Francis Bacon (1561–1626)

Florence NightingaleFrancis Bacon | Philosophy, Scientific Method, & Facts | Britannica(1820-1910)

George Washington Carver (1861-1943)

Sara Josephine Baker (1873-1945)

Alan Turing (1912-1954)

Allan Cox (1926-1987)

Sally Ride (1951-2012)

Ben Barres (1954-2017)

Ruth Gates (1962-2018)

Tim Cook (1960)

Disabilities:

Leonardo da Vinci (1452-1519)- Dyslexia

Isaac Newton (1664-1727)- Epilepsy

Thomas Edison (1847-1931)- Hearing

Charles Darwin (1809-1882)- Stutter, Dyslexia

Alexander Graham Bell (1847-1922)- Deaf

Albert Einstein (1879-1955)- Aspergers

Florence B. Seibert (1897-1991)- Mobility

Stephen Hawking (1942-2019)- ALS

John Forbes Nash (1928-2015)- Schizophrenia

Temple Grandin (1947)- Autism

Addresses the Following Component of the Mandate:

- Economic
- Political

- Social

Asian American Pacific Islander Mandate

Topic: Asian American STEM classrooms

Materials Used: https://www.pbs.org/wgbh/nova/article/asian-american-scientists-stem-classrooms-increasing-inclusion-and-visibility/

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Modifications

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

Resources & Materials:

- Project Lead the Way, Introduction to Engineering Design Information
- Walker, Exploring Drafting, II: Goodhart-Wilcox, 1996
- Gradwell & Wekch. Technology, Engineering Our World, IL: Goodhart-Wilcox, 2012
- WP Bridge Design