Unit 2: Technology in Structures (4 weeks)

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
Status: **Published**

UNIT RATIONALE

Technology exists in all facets of modern life. One classification of technology often overlooked is that of structures. Buildings and bridges do not just happen - engineers design them based on scientific principles to stand up against many types of forces. Without an understanding of these forces and how to build and strengthen against them, man-made structures would never last.

ESSENTIAL QUESTIONS

What is a structure?
What are the functions of and types of structures?
How do forces act upon a structure?
What are the different types of bridges and what are they used for?
What are dead and live loads, and how are they calculated?

STANDARDS

NEW JERSEY STUDENT LEARNING STANDARDS: 21st CENTURY

CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand

CRP.K-12.CRP8.1	how to bring innovation to an organization.
	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

NEW JERSEY STUDENT LEARNING STANDARDS: CONTENT AREA

New Jersey (NJSLS) - Grades 6-8 - Computer Science and Design Thinking (2020)

8.2.8.ED.1:

Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

8.2.8.ED.2:

Identify the steps in the design process that could be used to solve a problem.

8.2.8.ED.3:

Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

8.2.8.ED.4:

Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.

8.2.8.ED.7:

Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

CS.6-8.8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
CS.6-8.8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
CS.6-8.8.2.8.ED.4	Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
CS.6-8.8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

NEW JERSEY STUDENT LEARNING STANDARDS: CAREER READINESS, LIFE LITERACIES AND KEY SKILLS

TECH.9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.
TECH.9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
TECH.9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).
TECH.9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).

NEW JERSEY STUDENT LEARNING STANDARDS: COMPUTER SCIENCE AND DESIGN THINKING

CS.6-8.8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
CS.6-8.8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
CS.6-8.8.2.8.ED.4	Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
CS.6-8.8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

PRE-ASSESSMENTS

SAVED

Pre-assessment: Students are instructed to list 5 examples of structures.
Structure Design and Build activity (holding books - initial)

INSTRUCTIONAL PLAN

MODULE 1

Student Learning Intentions (SLI) WALT: **(We are learning to…)**	I am learning about structures so that I can identify structure types and describe their functions.
Student Learning Strategies	Class discussion Research Writing prompts Self-reflection Peer learning Cooperative learning Demonstration
Success Criteria	I can identify structures as shells, frames, and solids. I can describe how structures function - to protect, to support, to contain, and to span.
Formative Assessment (drives instructional decisions)	Feedback and participation during discussions Completion of research activities
Activities and Resources	1. Present the idea of structures and have students individually list 5 examples of them in their EDP journals. Students share their examples with the class. 2. Introduce the idea of structures as technology. Students differentiate pictures of manmade and natural structures, and functions - to protect, support, contain, and span. Students go back to the examples they recorded previously and label them as manmade/natural and their function. 3. Introduce the three main types of structures - shell, frame, and solid. Show examples and have students identify them through a worksheet or projected activity. Students return again to their examples and label the types. After review and discussion, students will discuss and give "standard" examples of each of the types of structures. (ex. Shell - box; frame - bridge/house/ladder; solid - wall/brick/dam) 4. Next, initiate a discussion on why structures are technology - Are manmade structures technology? Are natural ones technology? Why or why not? Given our previous definition of technology, how do structures fit it?

	How are science and engineering used to create structures?
Suggested Modifications	

MODULE 2

Activity 2 - Structural Forces

Student Learning Intentions (SLI) WALT: (We are learning to…)	I am learning about structural forces so that I can identify possible points of failure in a structure. I am learning how to strengthen a structure to prevent failure due to structural forces.
Student Learning Strategies	Class discussion Writing prompts Self-reflection Peer learning Cooperative learning Demonstration Hands-on practice Iteration
Success Criteria	I can describe compression, tension, and bending and how they act on a structure to cause failure. I can describe how different methods can strengthen a structure against certain forces.
Formative Assessment (drives instructional decisions)	Feedback and participation during discussions Completion of design/building activities
Activities and Resources	1. Review previously covered concepts. 2. Introduce students to a structure building activity - using what we've learned so far, students will attempt to build a structure out of copy paper and tape that can hold up as many books as possible. Students work in pairs and ideate/sketch on paper for their journals, and try then out.

	3. Next day, introduce the concept of strengthening structures to manage the effect of structural forces. Explain and demonstrate structural forces - compression, tension, bending. Explain and demonstrate ways to strengthen structures: material shapes (corrugation, tubes), triangulation, foundations, center of gravity, weight distribution, reinforcement.
	4. Students reconvene with their partners and discuss what went well previously and what could be improved based on new information. Students make adjustments and try again. Relate the steps taken to the engineering design process.
Suggested Modifications	

MODULE 3

Activity 3 - Bridges as Structures

Student Learning Intentions (SLI) WALT: (We are learning to…)	I am learning about different types of bridges so that I can choose an appropriate type for a given purpose.
Student Learning Strategies	Class discussion Research Writing prompts Self-reflection Peer learning Cooperative learning Demonstration Jigsaw
Success Criteria	I can differentiate between bridge types and choose an appropriate type for a given purpose.
Formative Assessment (drives instructional decisions)	Feedback and participation during discussions Completion of research activities
Activities and Resources	1. Introduce bridges as structures. Compare simple and complex bridges - all bridges are unique. Pose the question: How would each of the different types o

structures work (or not) as bridges?

2. Background some history on bridges - fallen/cut logs (natural bridges); rope bridges; stone arch bridges; wooden bridges; steel and concrete bridges. Discuss - all bridges are made for different purposes and each material has benefits and drawbacks.

3. Introduce types of bridges - Beam; truss; arch; modern suspension; cable-stayed. Students will jigsaw to research the types of bridges (including a description, several examples, how they are constructed, and what purpose they would be best for). Students will keep notes on worksheets and store in journals, and share results with the class (noting any corrections).

Resource: https://www.teachengineering.org/lessons/view/cub_brid_lesson01

Suggested Modifications	

MODULE 4

Activity 4 - Structural Forces on Bridges

Student Learning Intentions (SLI) WALT: (We are learning to…)	I am learning how structural forces affect a bridge so that I can identify possible points of failure and correct them.
Student Learning Strategies	Class discussion Research Writing prompts Self-reflection Peer learning Cooperative learning Demonstration Hands-on practice
Success Criteria	I can describe how six kinds of structural forces can cause failure in a bridge design.
Formative Assessment (drives instructional decisions)	Feedback and participation during discussions Completion of demo activities

Activities and Resources	1. With different types of bridges, there are different types of forces acting against them. Review previous structural forces - compression, tension, and bending. 2. After review, hand out [worksheet](#) for students to identify bridge types and forces. When students are done, review and discuss as a class. 3. Introduce and demonstrate new forces - torsion, shearing, and racking. Discuss: What types of structures would we see these in? Why were these not included on the worksheet? (ex. answer - often 3-D rather than direct linear forces) 4. Hand out materials to small groups to construct simple versions of each of the bridge types (cardboard, index cards, books, string, rope). Walk students through constructing and viewing demonstrations of each of the forces. Resource:https://www.teachengineering.org/activities/view/cub_brid_lesson01_activity1
Suggested Modifications	

MODULE 5

Activity 5 - Straw Bridge Build

Student Learning Intentions (SLI) WALT: (We are learning to…)	I am learning about different types of bridges so that I can choose an appropriate type for a given purpose. I am learning how structural forces affect a bridge so that I can identify possible points of failure and correct them. I am learning about loads on a structure so that I can calculate dead and live loads of a bridge.
Student Learning Strategies	Class discussion Research Writing prompts Self-reflection Peer learning Cooperative learning Demonstration Hands-on practice Iteration
Success Criteria	I can differentiate between bridge types and choose an appropriate type for a given purpose.

	I can describe structural forces and how they act on a structure to cause failure. I can describe how different methods can strengthen a structure against certain forces. I can calculate the ultimate, dead, and live loads of a model bridge.
Formative Assessment (drives instructional decisions)	Feedback and participation during discussions Completion of design/building activities and loads data
Activities and Resources	Students work in teams of two and follow the engineering design process - begir by listing requirements and goals, then look through their notes and research on the internet and in reference books for information. Students then sketch out their ideas and get feedback from peers and the teacher. After, students are welcome to start their builds, testing and making adjustments as needed. (work happens over several days) 2. As students finish and are ready for failure testing, introduce the concepts of ultimate load, dead load, live load, and environmental load. Students learn to identify and calculate these load types with a worksheet. Resource: https://www.teachengineering.org/lessons/view/cub_brid_lesson02 3. Students proceed to failure test their designs by adding weight until their bridges fail. Students record this information (Google Doc) and calculate their structural loads. 4. After all students have failure tested, begin discussion on what went well, what didn't, what teams might change if they were to do it again. Relate this to the engineering design process.
Suggested Modifications	

SUGGESTED MODIFICATIONS

Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)
English Language Learners **Native language support**: The teacher provides auditory or written content to students in their native language. **Adjusted Speech**: The teacher changes speech patterns to increase student comprehension. This could include facing t

students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Studen[ts] will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference [to] acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or direction[s] to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers us[e] the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or tw[o] to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignmen[t] or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk studen[t] may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way t[o] intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, a[s] the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the

student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

REFLECTIONS

INTERDISCIPLINARY CONNECTIONS: NEW JERSEY STUDENT LEARNING STANDARDS FOR ELA, SOCIAL STUDIES, SCIENCE AND/OR MATHEMATICS

LA.RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
LA.RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
LA.WHST.6-8.1.A	Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
LA.WHST.6-8.1.B	Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
LA.WHST.6-8.1.E	Provide a concluding statement or section that follows from and supports the argument presented.
LA.WHST.6-8.4	Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.
LA.WHST.6-8.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
LA.WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
LA.WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research.