Engineering II

Unit Title: Creativity & the Design Process

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Computer Science and Design Thinking
8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis. •

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.

8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment

CTE Standards
9.3.ST-ET.1 Use STEM concepts and processes to solve problems involving design and/or production.

9.3.ST-ET.3 Apply processes and concepts for the use of technological tools in STEM.

9.3.ST-ET.4 Apply the elements of the design process.

9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems

9.3.ST-SM.1 Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.

9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Computer Science and Design Thinking		
Standard	**Performance Expectations**	**Core Ideas**
8.2.12.ED.1	Use research to design and create a product or system that addresses a problem and make	Engineering design is a complex process in which creativity, content

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	modifications based on input from potential consumers.	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.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.	
8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.	
8.2.12.ED.4	Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.	
8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
8.2.12.ED.6	Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).	
8.2.12.ITH.2	Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.	Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product	Engineers use science, mathematics, and other disciplines to improve technology. Increased collaboration among engineers, scientists, and mathematicians can improve their work and designs. Technology, product, or system redesign can be more difficult than the original design.
8.2.12.ETW.2	Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment	Development and modification of any technological system needs to take into account how the operation of the system will affect natural resources and ecosystems. Impacts of technological systems on the environment need to be monitored and must inform decision-making. Many technologies have been designed to have a positive impact on the environment and to monitor environmental change over time.

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Career Readiness, Life Literacies and Key Skills		
Standard	**Performance Expectations**	**Core Ideas**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).	With a growth mindset, failure is an important part of success.
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).	
9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).	
9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.	
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
9.4.12.TL.2	Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.	
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.
9.4.12.TL.4	Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).	

Central Idea/Enduring Understanding:	**Essential/Guiding Question:**
The design process gives structure to creativity. Organization allows engineers to be timely and efficient.	● How does the engineering design process relate to problem solving and critical thinking? ● Is there a place for creativity in engineering design? ● Why follow a process? ● What is the relationship between the design process and the project plan? ● How does organization affect the project plan? ● How does project planning and collaboration allow teams to successfully work together? ● What role does documentation play in Engineering? ● What are the major factors that engineers consider when selecting components for a project?
Content: ● Engineering design process ● Circuits and Sensors	**Skills(Objectives):** Identify and explain steps of the engineering design process. Identify and brainstorm solutions to problems.

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• Microprocessors • Critical Path	Identify and describe each step of the design process. Explain how each step is connected to the other. For a given object, describe examples of creative revisions/refinements of a design. Construct an organizational chart for a given project. Illustrate the Critical Path method for a given project. Identify and explain how various timing circuits can be developed. Develop and manage a project plan using project management software. Design and implement electronic circuits using a microcontroller (Audrino)
Interdisciplinary Connections: As students learn concepts, they will develop projects that demonstrate their proficiency in science, math, literacy, and computer science.	

Stage 2: Assessment Evidence

Performance Task(s): Students will identify a self selected project based on a specific need. They will collaborate with peers to conduct the research and provide a roadmap of the project. A design document and mock up are required , which will include an analysis of price, manufacturer, source and pros/cons of each desired item in order to determine the most effective parts for the project. Students will develop a prototype of their project and present it to a peer review panel.	**Other Evidence:** Engineering Logbooks Project Rubrics Quizzes RoadMap and Mock up of project Peer Review Tests Self-Assessment by student of their learning activities Teacher observation of student performance during learning activities

Stage 3: Learning Plan

Learning Opportunities/Strategies: Individual and group presentations Demonstrations Programming Design Presentations Small group work Guest Speakers	**Resources:** Audrino TinkerCad Videos 3D Printers Glowforge Google Apps for Education LGBT and Disabilities Resources: • LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books DEI Resources: • Learning for Justice

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	• GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation *Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
On Grade level activities plus additional projects and leadership roles on project teams. Mentoring other students	Projects Engineering Logbooks Presentations Project Meeting minutes	On Grade level activities plus projects based on the student's ability. Extra time One on One coaching opportunities during study hall and after school tutoring Work with a student mentor.	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Pacing Guide

Engineering II	Content/Resources	Standards
UNIT 1:		
Creativity and Design Process (90 Days)	Audrino TinkerCad Videos GlowForge 3D Printers Google Apps for Education	8.2.12.ED.1 8.2.12.ED.2 8.2.12.ED.3 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.2 8.2.12.NT.1 8.2.12.ETW.2 9.3.ST-ET.1 9.3.ST-ET.3 9.3.ST-ET.4 9.3.ST-ET.5 9.3.ST-SM.1 9.3.ST-SM.2