Unit 2 - Creating a Better World: Design and Engineering

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

Unit Overview

This unit will be discussing the role of coding in our everyday world. Students will be learning a hands-on approach to developing written and binary code. Coding will be used to promote critical thinking, problem solving, and collaborative work. Students will be learning coding as if it is a new language which requires students to use logical communication to problem solve and utilize critical thinking. Students will be learning ways to develop computer technology such as web development, apps, games, animations, coding and its role in society, and physical computing. Students will be learning and reviewing coding commands such as looping, events, sequencing, and binary code through algorithms, looping, debugging, tinkering, functions, and events as coding techniques. In addition, students will be relating coding to robotics as an application of coding. Students will be constructing, deconstructing, debugging, and creating written code for robots. Students demonstrate and complete a variety of real-word tasks using robotics. Also, students will be expanding on their creativity, critical thinking, problem solving skills, and collaborative skills.

Enduring Understandings

Establishing collaborative student-centered ideologies where students gain an understanding of the purpose of working together to accomplish a mutual goal.
Gaining an understanding of the importance of preplanning and the role it plays regarding the final product.
Exploring examples of products and designs that have changed our world. In addition, products that scientists are currently working on.
Understanding types of careers which use STEAM concepts.
Creating a connection between concepts taught and STEAM careers.
Relating materials such as 3-D printing, Makey Makey, circuity, and other classroom materials to materials of a larger scale project.
Understanding how a circuit is created and how simple circuits can enhance a product.
Building a connection to future career and homeownership and how building and design and circuit relate.
Understanding the importance of renewable energy. The roles of solar, hydro, and wind energy.
Building connections between designing models to mathematical concepts.
Determining ways to improve designs created by students through evidence and testing.

Essential Questions

Why is planning an important part of creating a team developed design?
How can you determine what materials are cost effective to construct your design?
What is the importance of engineering throughout our everyday world?
What are examples of products created by 3-D printing and design?
What type of careers do you think solve problems from building designs?

What type of materials would builders use to create your design?
What careers use creating models and designs using STEAM?
What impacts does 3-D printing have on our world? • How is electricity utilized to power a variety of products?
What is the importance of understanding circuits?
How would creating an elementary circuit affect future tasks as a potential homeowner or in your career?
What is the importance of teamwork?
How and why was your design successful or unsuccessful?
What role did STEAM play in the creation of your design?
What were the most challenging aspects of your design?
How can you create a better design to accomplish the goal you established?

Learning Objectives

Be able to apply engineering and design to solve a series of authentic problems.
Investigate ways of designing structures by problem solving, collaboration, creativity, and critical thinking.
Be able to plan and test a series of designs based on preplanning, drawing, and trial and error.
Brainstorm a variety of ideas including how to solve a problem and build a product.
Develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Be able to discuss and demonstrate why their design works, the strengths, weaknesses, and modifications of their designed product.
Develop an understanding for utilizing 3-D printing skills to real-world design.
Relating the use of circuits to everyday tasks.
Identifying simple tasks around their home where students can solve simple household structure and electric problems.
Identify and list the resources needed to complete their design.
Develop, test, and refine prototypes as part of a design process.
Be able to generate ideas, test theories, create innovative samples, or solve authentic problems.
Utilize different forms of renewable energy and understand how solar, wind, and hydro energy work.
Ask questions to determine cause and effect relationships between different objects.

Standards: Content

CS	Computing Systems
	The study of human–computer interaction can improve the design of devices and extend the abilities of humans.
8.1.8.CS.1	Recommend improvements to computing devices in order to improve the ways users interact with the devices.
	Software and hardware determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple considerations and potential trade-offs.
8.1.8.CS.2	Design a system that combines hardware and software components to process data.
8.1.8.CS.3	Justify design decisions and explain potential system trade-offs.

	Troubleshooting a problem is more effective when knowledge of the specific device along with a systematic process is used to identify the source of a problem.
8.1.8.CS.4	Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.
NI	Networks and the Internet
	Protocols, packets, and addressing are the key components for reliable delivery of information across networks.
8.1.8.NI.1	Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.
8.1.8.NI.2	Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.
	The information sent and received across networks can be protected from unauthorized access and modification in a variety of ways. The evolution of malware leads to understanding the key security measures and best practices needed to proactively address the threat to digital data.
8.1.8.NI.3	Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems.
8.1.8.NI.4	Explain how new security measures have been created in response to key malware events.
IC	Impacts of Computing
	Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.
8.1.8.IC.1	Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options.
8.1.8.IC.2	Describe issues of bias and accessibility in the design of existing technologies.
DA	Data & Analysis
	People use digital devices and tools to automate the collection, use, and transformation of data. The manner in which data is collected and transformed is influenced by the type of digital device(s) available and the intended use of the data.
8.1.8.DA.1	Organize and transform data collected using computational tools to make it usable for a specific purpose.
	Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals. Data is organized and accessible based on the application used to store it.
8.1.8.DA.2	Explain the difference between how the computer stores data as bits and how the data is displayed.
8.1.8.DA.3	Identify the appropriate tool to access data based on its file format.
	The purpose of cleaning data is to remove errors and make it easier for computers to process.
8.1.8.DA.4	Transform data to remove errors and improve the accuracy of the data for analysis.
	Computer models can be used to simulate events, examine theories and inferences, or make predictions.
8.1.8.DA.5	Test, analyze, and refine computational models.
8.1.8.DA.6	Analyze climate change computational models and propose refinements.
AP	Algorithms & Programming
	Individuals design algorithms that are reusable in many situations. Algorithms that are

	readable are easier to follow, test, and debug.
8.1.8.AP.1	Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.
	Programmers create variables to store data values of different types and perform appropriate operations on their values.
8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
	Control structures are selected and combined in programs to solve more complex problems.
8.1.8.AP.3	Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.
	Programs use procedures to organize code and hide implementation details. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.
8.1.8.AP.4	Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.
8.1.8.AP.5	Create procedures with parameters to organize code and make it easier to reuse.
	Individuals design and test solutions to identify problems taking into consideration the diverse needs of the users and the community.
8.1.8.AP.6	Refine a solution that meets users' needs by incorporating feedback from team members and users.
8.1.8.AP.7	Design programs, incorporating existing code, media, and libraries, and give attribution.
8.1.8.AP.8	Systematically test and refine programs using a range of test cases and users.
8.1.8.AP.9	Document programs in order to make them easier to follow, test, and debug.
ED	Engineering Design
	Engineering design is a systematic, creative, and iterative process used to address local and global problems. The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes.
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.
	Engineering design requirements and specifications involve making trade-offs between competing requirements and desired design features.
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
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).
ITH	Interaction of Technology and Humans
	Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.

8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
	Technology interacts with society, sometimes bringing about changes in a society's economy, politics, and culture, and often leading to the creation of new needs and wants. New needs and wants may create strains on local economies and workforces. Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.
8.2.8.ITH.2	Compare how technologies have influenced society over time.
8.2.8.ITH.3	Evaluate the impact of sustainability on the development of a designed product or system.
8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
NT	Nature of Technology
	Technology advances through the processes of innovation and invention which relies upon the imaginative and inventive nature of people. Sometimes a technology developed for one purpose is adapted to serve other purposes. Engineers use a systematic process of creating or modifying technologies that is fueled and constrained by physical laws, cultural norms, and economic resources. Scientists use systematic investigation to understand the natural world.
8.2.8.NT.1	Examine a malfunctioning tool, product, or system and propose solutions to the problem.
8.2.8.NT.2	Analyze an existing technological product that has been repurposed for a different function.
8.2.8.NT.3	Examine a system, consider how each part relates to other parts, and redesign it for another purpose.
8.2.8.NT.4	Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product.
ETW	Effects of Technology on the Natural World
	Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve trade-offs between environmental and economic needs, while others have positive effects for both the economy and environment.
8.2.8.ETW.1	Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs.
8.2.8.ETW.2	Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).
8.2.8.ETW.3	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.
8.2.8.ETW.4	Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.
EC	Ethics & Culture
	Technological disparities have consequences for public health and prosperity.
8.2.8.EC.1	Explain ethical issues that may arise from the use of new technologies.
8.2.8.EC.2	Examine the effects of ethical and unethical practices in product design and development.

Standards: Interdisciplinary

9.2.8.CAP	Career Awareness and Planning
	An individual's strengths, lifestyle goals, choices, and interests affect employment and income.
9.2.8.CAP.1	Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.
9.2.8.CAP.3	Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.
7.EE	Expressions and Equations
	Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.
	Digital tools and media resources provide access to vast stores of information, but the information can be biased or inaccurate.
9.4.8.IML.1	Critically curate multiple resources to assess the credibility of sources when searching for information.
7.EE.B	Solve real-life and mathematical problems using numerical and algebraic expressions and equations
7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
RL.MF.7.6	Compare and contrast texts (e.g., a written story, drama, or poem) to its audio, filmed, staged, or multimedia version and analyze the unique qualities of different mediums, including the effects of techniques unique to each medium (e.g., lighting, sound, color, or camera focus and angles in a film).
	Specific situations require the use of relevant sources of information.
W.IW.7.2	Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
W.IW.7.2.A	Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.
SL.II.7.2	Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
SL.UM.7.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Assessment Evidence

Formative	Collaborative Activities, Homework, Classwork, Discussion, Independent Class Assignment, Informal Observations of Students, Interactive Notebooks, Self-Assessments, Exit Tickets STEAM - Code.Org Courses, Teacher Constructed Games, Self and Group Assessments

	Student Pre-Planning
Summative	Tests, Pre-Assessments, Quizzes, Written Responses, Projects STEAM - Code.org “Purpose An App”, Code.org “Personal Web Page”, Code.org “Webpage a for Purpose”, Ozobot Ozoblocky Coding, Group Work Projects, Makey Makey Coding Projects
Alternative & Benchmark	Alternative – Project Based Learning, Graphic Organizers, Student Portfolio, orally assessed responses Benchmark – Teacher generated project or assessment, Tests, Student portfolio/project
Assessment Evidence Resource	

Instructional Resources

Smartboard, Computers, iPads, websites and digital interactives/models, multi-media presentations, video streaming, Brain Pop, Microsoft 365, Ozobots, Ozobot Coding Reference Sheet, Code.Org tools, Makey Makey STEM Pack, Instructional Resource List

Curricular Mandates

Below are the curricular requirements as defined in NJ Administrative Code and Statute

	Amistad		Diversity, Equity, and Inclusion
	Holocaust		LGBT and Disabilities (Grades 6-12)
	Climate Change		Asian American & Pacific Islander

Social Emotional Learning (SEL) Competencies

NJ Social and Emotional Learning Competencies & Sub-Competencies

	Self-Awareness	X	Relationship Skills
X	Responsible Decision-Making		Social Awareness
	Self-Management		

21st Century Skills & Themes

X	Global and Cultural Awareness	X	Technology Literacy		Planning and Budgeting
X	Creativity and Innovation		Financial Institutions		Risk Management and Insurance
X	Information and Media Literacy		Digital Citizenship		Economic and Government Influences
X	Critical Thinking and Problem Solving		Credit Profile	X	Career Awareness and Planning
	Civic Financial Responsibility		Financial Psychology		