Unit 2 - Building Our World: Design and Engineering

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
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Unit Overview

This unit will be giving students the opportunity to plan, test, and innovate design and engineering concepts through a variety of concepts. Students will be enhancing their knowledge of design by creating real world models and tools through problem-based learning. Students will be exploring design through a variety of forms of technology, building materials, renewable energy resources, and models. In addition, students will be expanding on their creativity, critical thinking, problem solving skills, and collaborative skills. The unit will empower student creativity, innovation, persistence, and technological literacy.

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 Legos, pipe cleaners, KEVA planks, cardboard, and other classroom materials to materials of a larger scale project.
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

How do you read code?
How can you predict outcomes from reading code?
What is ways code makes simple choices?
What are ways coding is used in our everyday world?
What is the importance of working together when developing code?
Why is it important to reflect on past mistakes?
How can system limitations affect project design?
What are reasons for having a well-detailed plan?
What is the importance of digital citizenship?

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.
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.
Career Exploration - What careers use creating models and designs using STEAM?

Standards: Content

CS	Computing Systems
9.2.5.CAP	Career Awareness and Planning
9.4.2.CI	Creativity and Innovation
	Brainstorming can create new, innovative ideas.
	An individual's passions, aptitude and skills can affect his/her employment and earning potential.
	Computing devices may be connected to other devices to form a system as a way to extend their capabilities.
8.1.5.CS.1	Model how computing devices connect to other components to form a system.
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
9.2.5.CAP.2	Identify how you might like to earn an income.
	Software and hardware work together as a system to accomplish tasks (e.g., sending, receiving, processing, and storing units of information).
9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
9.2.5.CAP.3	Identify qualifications needed to pursue traditional and non-traditional careers and occupations.
9.4.2.CT	Critical Thinking and Problem-solving
8.1.5.CS.2	Model how computer software and hardware work together as a system to accomplish tasks.
	Shared features allow for common troubleshooting strategies that can be effective for many systems.
9.2.5.CAP.4	Explain the reasons why some jobs and careers require specific training, skills, and

	certification (e.g., life guards, child care, medicine, education) and examples of these requirements.
	Critical thinkers must first identify a problem then develop a plan to address it to effectively solve the problem.
9.4.2.CT.1	Gather information about an issue, such as climate change, and collaboratively brainstorm ways to solve the problem (e.g., K-2-ETS1-1, 6.3.2.GeoGI.2).
8.1.5.CS.3	Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.
	Income and benefits can vary depending on the employer and type of job or career.
NI	Networks and the Internet
9.2.5.CAP.5	Identify various employee benefits, including income, medical, vacation time, and lifestyle benefits provided by different types of jobs and careers.
9.4.2.CT.2	Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3).
	There are a variety of factors to consider before starting a business.
	Information needs a physical or wireless path to travel to be sent and received.
9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
8.1.5.NI.1	Develop models that successfully transmit and receive information using both wired and wireless methods.
9.4.2.DC	Digital Citizenship
9.2.5.CAP.6	Compare the characteristics of a successful entrepreneur with the traits of successful employees.
	Digital artifacts can be owned by individuals or organizations.
9.2.5.CAP.7	Identify factors to consider before starting a business.
	Distinguishing between public and private information is important for safe and secure online interactions. Information can be protected using various security measures (i.e., physical and digital).
	Individuals can choose to accept inevitable risk or take steps to protect themselves by avoiding or reducing risk.
8.1.5.NI.2	Describe physical and digital security measures for protecting sensitive personal information.
9.4.2.DC.1	Explain differences between ownership and sharing of information.
9.4.2.DC.2	Explain the importance of respecting digital content of others.
9.2.5.CAP.8	Identify risks that individuals and households face.
IC	Impacts of Computing
	Individuals should practice safe behaviors when using the Internet.
	The development and modification of computing technology is driven by individual's needs and wants and can affect individuals differently.
9.2.5.CAP.9	Justify reasons to have insurance.
8.1.5.IC.1	Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.
9.4.2.DC.3	Explain how to be safe online and follow safe practices when using the internet (e.g., 8.1.2.NI.3, 8.1.2.NI.4).
9.4.2.DC.4	Compare information that should be kept private to information that might be made public.

8.1.5.IC.2	Identify possible ways to improve the accessibility and usability of computing technologies to address the diverse needs and wants of users.
	An individual's digital footprint reflects the various actions an individual makes online, both positive and negative.
DA	Data & Analysis
	Data can be organized, displayed, and presented to highlight relationships.
9.4.2.DC.5	Explain what a digital footprint is and how it is created.
8.1.5.DA.1	Collect, organize, and display data in order to highlight relationships or support a claim.
	Digital communities allow for social interactions that can result in positive or negative outcomes.
9.4.2.DC.6	Identify respectful and responsible ways to communicate in digital environments.
	The type of data being stored affects the storage requirements.
8.1.5.DA.2	Compare the amount of storage space required for different types of data.
	Young people can have a positive impact on the natural world in the fight against climate change.
	Individuals can select, organize, and transform data into different visual representations and communicate insights gained from the data.
9.4.2.DC.7	Describe actions peers can take to positively impact climate change (e.g., 6.3.2.CivicsPD.1).
9.4.2.GCA	Global and Cultural Awareness
8.1.5.DA.3	Organize and present collected data visually to communicate insights gained from different views of the data.
8.1.5.DA.4	Organize and present climate change data visually to highlight relationships or support a claim.
	Individuals from different cultures may have different points of view and experiences.
	Many factors influence the accuracy of inferences and predictions.
9.4.2.GCA.1	Articulate the role of culture in everyday life by describing one's own culture and comparing it to the cultures of other individuals (e.g., 1.5.2.C2a, 7.1.NL.IPERS.5, 7.1.NL.IPERS.6).
9.4.2.IML	Information and Media Literacy
8.1.5.DA.5	Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
AP	Algorithms & Programming
	Digital tools and media resources provide access to vast stores of information that can be searched.
9.4.2.IML.1	Identify a simple search term to find information in a search engine or digital resource.
	Different algorithms can achieve the same result. Some algorithms are more appropriate for a specific use than others.
8.1.5.AP.1	Compare and refine multiple algorithms for the same task and determine which is the most appropriate.
	Digital tools can be used to display data in various ways.
	Programming languages provide variables, which are used to store and modify data.
9.4.2.IML.2	Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
8.1.5.AP.2	Create programs that use clearly named variables to store and modify data.
	A variety of diverse sources, contexts, disciplines, and cultures provide valuable and

	necessary information that can be used for different purposes.
	A variety of control structures are used to change the flow of program execution (e.g., sequences, events, loops, conditionals).
9.4.2.IML.3	Use a variety of sources including multimedia sources to find information about topics such as climate change, with guidance and support from adults (e.g., 6.3.2.GeoGI.2, 6.1.2.HistorySE.3, W.2.6, 1-LSI-2).
8.1.5.AP.3	Create programs that include sequences, events, loops, and conditionals.
	Information is shared or conveyed in a variety of formats and sources.
	Programs can be broken down into smaller parts to facilitate their design, implementation, and review. Programs can also be created by incorporating smaller portions of programs that already exist.
9.4.2.IML.4	Compare and contrast the way information is shared in a variety of contexts (e.g., social, academic, athletic) (e.g., 2.2.2.MSC.5, RL.2.9).
9.4.2.TL	Technology Literacy
8.1.5.AP.4	Break down problems into smaller, manageable sub-problems to facilitate program development.
	Digital tools have a purpose.
8.1.5.AP.5	Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.
9.4.2.TL.1	Identify the basic features of a digital tool and explain the purpose of the tool (e.g., 8.2.2.ED.1).
	Individuals develop programs using an iterative process involving design, implementation, testing, and review.
8.1.5.AP.6	Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.
9.4.2.TL.2	Create a document using a word processing application.
ED	Engineering Design
9.4.2.TL.3	Enter information into a spreadsheet and sort the information.
	Engineering design is a systematic and creative process of communicating and collaborating to meet a design challenge. Often, several design solutions exist, each better in some way than the others.
9.4.2.TL.4	Navigate a virtual space to build context and describe the visual content.
8.2.5.ED.1	Explain the functions of a system and its subsystems.
9.4.2.TL.5	Describe the difference between real and virtual experiences.
9.4.2.TL.6	Illustrate and communicate ideas and stories using multiple digital tools (e.g., SL.2.5.).
8.2.5.ED.2	Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
	Collaboration can simplify the work an individual has to do and sometimes produce a better product.
8.2.5.ED.3	Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
	Engineering design requirements include desired features and limitations that need to be considered.
9.4.2.TL.7	Describe the benefits of collaborating with others to complete digital tasks or develop digital artifacts (e.g., W.2.6., 8.2.2.ED.2).

8.2.5.ED.4	Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
8.2.5.ED.5	Describe how specifications and limitations impact the engineering design process.
8.2.5.ED.6	Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process.
ITH	Interaction of Technology and Humans
	Societal needs and wants determine which new tools are developed to address real-world problems.
8.2.5.ITH.1	Explain how societal needs and wants influence the development and function of a product and a system.
	A new tool may have favorable or unfavorable results as well as both positive and negative effects on society. Technology spurs new businesses and careers.
8.2.5.ITH.2	Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.
8.2.5.ITH.3	Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
8.2.5.ITH.4	Describe a technology/tool that has made the way people live easier or has led to a new business or career.
NT	Nature of Technology
	Technology innovation and improvement may be influenced by a variety of factors. Engineers create and modify technologies to meet people's needs and wants; scientists ask questions about the natural world.
8.2.5.NT.1	Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
8.2.5.NT.2	Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.
8.2.5.NT.3	Redesign an existing product for a different purpose in a collaborative team.
8.2.5.NT.4	Identify how improvement in the understanding of materials science impacts technologies.
	The technology developed for the human designed world can have unintended consequences for the environment. Technology must be continually developed and made more efficient to reduce the need for non-renewable resources.
8.2.5.ETW.1	Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
8.2.5.ETW.2	Describe ways that various technologies are used to reduce improper use of resources.
8.2.5.ETW.3	Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.
8.2.5.ETW.4	Explain the impact that resources, such as energy and materials used to develop technology, have on the environment.
8.2.5.ETW.5	Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change.
EC	Ethics & Culture
	Technological choices and opportunities vary due to factors such as differences in economic resources, location, and cultural values.
8.2.5.EC.1	Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects.

Standards: Interdisciplinary

3-5-ETS1	Engineering Design
3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
	Asking Questions and Defining Problems
	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.
	Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
ETS1.A	Defining and Delimiting Engineering Problems
	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	Influence of Engineering, Technology, and Science on Society and the Natural World
	People's needs and wants change over time, as do their demands for new and improved technologies.
3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
	Constructing Explanations and Designing Solutions
	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
	Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
ETS1.B	Developing Possible Solutions
	Research on a problem, such as climate change, should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
	At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
	Influence of Engineering, Technology, and Science on Society and the Natural World
	Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
	Planning and Carrying Out Investigations
L.KL.5.1	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

	Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
ETS1.B	Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
L.VL.5.2	Determine or clarify the meaning of unknown and multiple-meaning academic and domain-specific words and phrases based on grade 5 reading and content, choosing flexibly from a range of strategies.
ETS1.C	Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
L.WF.3.3	Demonstrate command of the conventions of writing including those listed under grade two foundational skills.
L.VL.4.2	Determine or clarify the meaning of unknown and multiple-meaning academic and domain-specific words and phrases based on grade 4 reading and content, choosing flexibly from a range of strategies.
RI.CR.5.1	Quote accurately from an informational text when explaining what the text says explicitly and make relevant connections when drawing inferences from the text.
L.KL.3.1	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.VL.3.2	Determine or clarify the meaning of unknown and multiple-meaning academic and domain-specific words and phrases based on grade 3 reading and content, choosing flexibly from a range of strategies.
RI.CR.4.1	Refer to details and examples as textual evidence when explaining what an informational text says explicitly and make relevant connections when drawing inferences from the text.
RI.CR.3.1	Ask and answer questions and make relevant connections to demonstrate understanding of an informational text, referring explicitly to textual evidence as the basis for the answers.
W.WR.4.5	Conduct short research projects that use multiple reference sources (print and non-print) and build knowledge through investigation of different aspects of a topic.
W.RW.4.7	Write routinely over extended time frames (with time for research and revision) and shorter time frames (a single sitting) for a range of tasks, purposes, and audiences.
SL.PE.4.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.
SL.PE.4.1.D	Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
W.RW.3.7	Engage in independent and task-based writing for both short and extended periods of time, producing written work routinely.
SL.AS.4.6	Differentiate between contexts that call for formal English (e.g., presenting ideas) and situations where informal discourse is appropriate (e.g., small-group discussion); use formal English when appropriate to task and situation.
SL.UM.3.5	Use multimedia to demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details.
SL.AS.3.6	Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification.

Assessment Evidence

Formative	Collaborative Activities, Homework, Classwork, Discussion, Independent Class Assignment, Informal Observations of Students, Interactive Notebooks, Self-Assessments, Exit Tickets, Lego Building Tasks, Teacher Constructed Games, Student Pre-Planning, Group Self-Assessment, Code.Org Courses.
Summative	Tests, Pre-Assessments, Quizzes, Written Responses, Projects, Group Projects Code.org "Dance Party", Code.org 4th Grade Project, Ozobot Maze Creation, 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, Legos, KEVA Planks, Building straws, Pipe Cleaners, Cardboard, Carolina Science Renewable Energy Kits, Makey Makey STEM Pack Classroom Literacy Kit, MakerBot 3-D Printer, 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		Relationship Skills
	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
	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		