Unit 3 - Design

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

Unit Overview

This unit is an authentic performance task based on the prior knowledge students have developed throughout the year. Students will be developing and creating, and designing projects based on real-world problems. Students will be using resources and tools to infuse science, technology, the arts, engineering, and mathematics into designs and products.

Enduring Understandings

Students will gain an understanding of design, problem solving, trial and error, critical thinking, and engineering concepts.
Understanding the importance of preplanning and teamwork.
Building connections between real-world designs and models.
The role STEAM plays in a variety of careers, critical thinking, and problem solving.
Being able to create a list of instructions that enables others to understand and complete a task.
Understanding the importance of why and how structures are built.
Understanding reasons why their projects succeeded or failed. Being able to give an explanation and reasoning on their design's successes or failures.
For the job I am interested in, what skills do I need to have? Education?

Essential Questions

Why is planning an important part of building a design?
How is drawing a plan important to making a design?
How did you create your design?
Did the design turn out how you thought it was going to turn out?
What type of real-world problem did your design solve?
What type of materials are you using to create your product/design?
Why did you create your design the way you did?
What type of careers do you think solve problems from building designs?
What type of materials would builders use to create your design?
What type of job am I interested in?
What is income?
Why would someone want to open their own business?
Why do we have copyrights?

Learning Objectives

Be able to apply engineering and design to solve a series of authentic problems.
Investigate ways of designing structures through 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.
Demonstrate reasons why a design or product is important to the everyday world.
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.
Be able create and demonstrate a list of steps needed to complete an everyday task.
Be able to determine a situation people want to change and discuss the problem and ways it can be solved.
Be able to create a design based on a plan, sketch, and model through trial and error, collaboration, problem solving, creativity, and critical thinking.
Analyze their structure and design and determine the strengths and weaknesses.
Be able to discuss reasoning of why their design worked or how it can be improved.

Standards: Content

9.4.2.CI	Creativity and Innovation
9.1.2.CAP	Career Awareness and Planning
CS	Computing Systems
	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
	Individuals use computing devices to perform a variety of tasks accurately and quickly. Computing devices interpret and follow the instructions they are given literally.
	Different types of jobs require different knowledge and skills.
	Brainstorming can create new, innovative ideas.
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).
8.1.2.CS.1	Select and operate computing devices that perform a variety of tasks accurately and quickly based on user needs and preferences.
9.1.2.CAP.1	Make a list of different types of jobs and describe the skills associated with each job.
	A computing system is composed of software and hardware.
	Income is received from work in different ways including regular payments, tips, commissions, and benefits.
9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
9.4.2.CT	Critical Thinking and Problem-solving
8.1.2.CS.2	Explain the functions of common software and hardware components of computing systems.
9.1.2.CAP.2	Explain why employers are willing to pay individuals to work.
	Describing a problem is the first step toward finding a solution when computing systems do not work as expected.
	There are benefits and drawbacks to being an entrepreneur.

8.1.2.CS.3	Describe basic hardware and software problems using accurate terminology.
9.1.2.CAP.3	Define entrepreneurship and social entrepreneurship.
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).
	Multiple solutions often exist to solve a problem.
9.1.2.CAP.4	List the potential rewards and risks to starting a business.
NI	Networks and the Internet
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).
9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
	Computer networks can be used to connect individuals to other individuals, places, information, and ideas. The Internet enables individuals to connect with others worldwide.
8.1.2.NI.1	Model and describe how individuals use computers to connect to other individuals, places, information, and ideas through a network.
	An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.
	Digital artifacts can be owned by individuals or organizations.
8.1.2.NI.2	Describe how the Internet enables individuals to connect with others worldwide.
	Connecting devices to a network or the Internet provides great benefits, but care must be taken to use authentication measures, such as strong passwords, to protect devices and information from unauthorized access.
9.4.2.DC.1	Explain differences between ownership and sharing of information.
8.1.2.NI.3	Create a password that secures access to a device. Explain why it is important to create unique passwords that are not shared with others.
9.4.2.DC.2	Explain the importance of respecting digital content of others.
	Individuals should practice safe behaviors when using the Internet.
8.1.2.NI.4	Explain why access to devices need to be secured.
	Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.
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).
	Computing technology has positively and negatively changed the way individuals live and work (e.g., entertainment, communication, productivity tools).
9.4.2.DC.4	Compare information that should be kept private to information that might be made public.
	An individual's digital footprint reflects the various actions an individual makes online, both positive and negative.
8.1.2.IC.1	Compare how individuals live and work before and after the implementation of new computing technology.
9.4.2.DC.5	Explain what a digital footprint is and how it is created.
	Digital communities allow for social interactions that can result in positive or negative outcomes.
	Individuals collect, use, and display data about individuals and the world around them.
8.1.2.DA.1	Collect and present data, including climate change data, in various visual formats.

9.4.2.DC.6	Identify respectful and responsible ways to communicate in digital environments.
	Young people can have a positive impact on the natural world in the fight against climate change.
	Computers store data that can be retrieved later. Data can be copied, stored in multiple locations, and retrieved.
9.4.2.DC.7	Describe actions peers can take to positively impact climate change (e.g., 6.3.2.CivicsPD.1).
8.1.2.DA.2	Store, copy, search, retrieve, modify, and delete data using a computing device.
	Data can be used to make predictions about the world.
	Individuals from different cultures may have different points of view and experiences.
8.1.2.DA.3	Identify and describe patterns in data visualizations.
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).
8.1.2.DA.4	Make predictions based on data using charts or graphs.
	Individuals develop and follow directions as part of daily life. A sequence of steps can be expressed as an algorithm that a computer can process.
	Digital tools and media resources provide access to vast stores of information that can be searched.
8.1.2.AP.1	Model daily processes by creating and following algorithms to complete tasks.
9.4.2.IML.1	Identify a simple search term to find information in a search engine or digital resource.
	Real world information can be stored and manipulated in programs as data (e.g., numbers, words, colors, images).
	Digital tools can be used to display data in various ways.
8.1.2.AP.2	Model the way programs store and manipulate data by using numbers or other symbols to represent information.
9.4.2.IML.2	Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
	A variety of diverse sources, contexts, disciplines, and cultures provide valuable and necessary information that can be used for different purposes.
8.1.2.AP.3	Create programs with sequences and simple loops to accomplish tasks.
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).
	Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.
	Information is shared or conveyed in a variety of formats and sources.
	Complex tasks can be broken down into simpler instructions, some of which can be broken down even further.
8.1.2.AP.4	Break down a task into a sequence of steps.
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).
	People work together to develop programs for a purpose, such as expressing ideas or addressing problems. The development of a program involves identifying a sequence of events, goals, and expected outcomes, and addressing errors (when necessary).
	Digital tools make it possible to analyze and interpret data, including text, images, and

	sound. These tools allow for broad concepts and data to be more effectively communicated.
	Digital tools have a purpose.
8.1.2.AP.5	Describe a program's sequence of events, goals, and expected outcomes.
8.1.2.AP.6	Debug errors in an algorithm or program that includes sequences and simple loops.
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).
ED	Engineering Design
9.4.2.TL.2	Create a document using a word processing application.
	The mode of information can convey a message to consumers or an audience.
	Engineering design is a creative process for meeting human needs or wants that can result in multiple solutions.
9.4.2.TL.3	Enter information into a spreadsheet and sort the information.
8.2.2.ED.1	Communicate the function of a product or device.
9.4.2.TL.4	Navigate a virtual space to build context and describe the visual content.
9.4.2.TL.5	Describe the difference between real and virtual experiences.
8.2.2.ED.2	Collaborate to solve a simple problem, or to illustrate how to build a product using the design process.
	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.2.TL.6	Illustrate and communicate ideas and stories using multiple digital tools (e.g., SL.2.5.).
8.2.2.ED.3	Select and use appropriate tools and materials to build a product using the design process.
	Collaboration can simplify the work an individual has to do and sometimes produce a better product.
	Limitations (constraints) must be considered when engineering designs.
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).
8.2.2.ED.4	Identify constraints and their role in the engineering design process.
	Human needs and desires determine which new tools are developed.
8.2.2.ITH.1	Identify products that are designed to meet human wants or needs.
8.2.2.ITH.2	Explain the purpose of a product and its value.
	Technology has changed the way people live and work. Various tools can improve daily tasks and quality of life.
8.2.2.ITH.3	Identify how technology impacts or improves life.
8.2.2.ITH.4	Identify how various tools reduce work and improve daily tasks.
8.2.2.ITH.5	Design a solution to a problem affecting the community in a collaborative team and explain the intended impact of the solution.
	Innovation and the improvement of existing technology involves creative thinking.
8.2.2.NT.1	Model and explain how a product works after taking it apart, identifying the relationship of each part, and putting it back together.
8.2.2.NT.2	Brainstorm how to build a product, improve a designed product, fix a product that has stopped working, or solve a simple problem.
	The use of technology developed for the human designed world can affect the

	environment, including land, water, air, plants, and animals. Technologies that use natural sources can have negative effects on the environment, its quality, and inhabitants. Reusing and recycling materials can save money while preserving natural resources and avoiding damage to the environment.
8.2.2.ETW.1	Classify products as resulting from nature or produced as a result of technology.
8.2.2.ETW.2	Identify the natural resources needed to create a product.
8.2.2.ETW.3	Describe or model the system used for recycling technology.
8.2.2.ETW.4	Explain how the disposal of or reusing a product affects the local and global environment.
	The availability of technology for essential tasks varies in different parts of the world.
8.2.2.EC.1	Identify and compare technology used in different schools, communities, regions, and parts of the world.

Standards: Interdisciplinary

1.OA	Operations and Algebraic Thinking
2.OA	Operations and Algebraic Thinking
K.CC	Counting and Cardinality
K-2-ETS1	Engineering Design
K.CC.A	Know number names and the count sequence
1.OA.A	Represent and solve problems involving addition and subtraction
K-2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change (e.g., climate change) to define a simple problem that can be solved through the development of a new or improved object or tool.
2.OA.A	Represent and solve problems involving addition and subtraction
2.OA.A.1	Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
	Asking Questions and Defining Problems
1.OA.A.1	Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
K.CC.A.1	Count to 100 by ones and by tens.
1.OA.A.2	Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
K.CC.A.2	Count forward beginning from a given number within the known sequence (instead of having to begin at 1).
	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.
2.OA.B	Add and subtract within 20
K.CC.A.3	Write numbers from 0 to 20. Represent a number of objects with a written numeral 0–20 (with 0 representing a count of no objects).
	Ask questions based on observations to find more information about the natural and/or

	designed world(s).
2.OA.B.2	With accuracy and efficiency, add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.
	Define a simple problem that can be solved through the development of a new or improved object or tool.
2.OA.C	Work with equal groups of objects to gain foundations for multiplication
ETS1.A	Defining and Delimiting Engineering Problems
2.OA.C.3	Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.
	A situation that people want to change or create can be approached as a problem to be solved through engineering.
	Ask questions, make observations, and gather information about a situation people want to change (e.g., climate change) to define a simple problem that can be solved through the development of a new or improved object or tool.
	Before beginning to design a solution, it is important to clearly understand the problem.
1.OA.C	Add and subtract within 20
K-2-ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
	Developing and Using Models
1.OA.C.5	Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
	Develop a simple model based on evidence to represent a proposed object or tool.
K.OA	Operations and Algebraic Thinking
K.OA.A	Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from
K.OA.A.1	Represent addition and subtraction up to 10 with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations.
K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
K.OA.A.2	Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings to represent the problem.
	Analyzing and Interpreting Data
	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
	Analyze data from tests of an object or tool to determine if it works as intended.
K.NBT	Number and Operation in Base Ten
2.M	Measurement
K.NBT.A	Work with numbers 11–19 to gain foundations for place value
K.NBT.A.1	Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones.

2.M.A	Measure and estimate lengths in standard units
K.M	Measurement
K.M.A	Describe and compare measurable attributes
K.M.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
2.M.A.4	Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.
K.M.A.2	Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.
1.M	Measurement
1.M.A	Measure lengths indirectly and by iterating length units
1.M.A.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object.
1.M.A.2	Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.
K.G	Geometry
K.G.A	Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres)
K.G.A.1	Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.
K.G.B	Analyze, compare, create, and compose shapes
K.G.B.5	Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.
SL.PE.1.1	Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.
SL.PE.1.1.A	Follow agreed-upon norms for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).
SL.PE.K.1	Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
SL.PE.K.1.A	Follow agreed-upon norms for discussions (e.g., listening to others with care and taking turns speaking about the topics and texts under discussion).
SL.II.K.2	Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
SL.PE.2.1	Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.
SL.AS.2.6	Produce 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, Engineering Design Process Response Sheets, Self-Assessments, Exit Tickets, Code.Org Courses, Teacher Constructed Games, Self and Group Assessments Student Pre-Planning, Design Checkpoints
Summative	Written Responses/ Response sheets, Projects Kindergarten: Designing an Improved House (Based on Three Little Pigs) 1st Grade: Reimagining and Designing a School Playground 2nd: Designing a School
Alternative & Benchmark	Alternative – Project Based Learning, Graphic Organizers, Student Portfolio, assessment of oral 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, Pipe Cleaners, Straws, Legos, KEVA Planks, Building Blocks, Cardboards, Builders Straws and Connectors, Markers, Rulers 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

X	Self-Awareness	X	Relationship Skills
X	Responsible Decision-Making		Social Awareness
X	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		Career Awareness and Planning
	Civic Financial Responsibility		Financial Psychology		