Innovators in STEM
Grades 5
Unit 1 Plan

acher(s)	
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Unit Overview

Unit Title	Empathetic Engineering
Unit Length	30 days; 15 periods; 42-minute periods
Performance Task	***Empathetic Engineering*** Students engineer a solution to support someone's everyday use of an object or to complete a task, such as designing a utensil for someone with limited mobility or a water filtration system. Students will unpack how the design relates to their audience, the impact on the global society, the training that is needed to implement the design effectively, and the financial impact of producing the design. Students will utilize their knowledge and skills from science as they consider variables, and data, conduct experiments and utilize the design process. ***Learning Process:*** *Engineering Design Process*
Essential Questions	How do engineers design innovative solutions that consider the needs of individuals and society such as sustainability, employment, and inclusivity?
Enduring Understandings	Engineers can use design processes, data, and empathy to design solutions that meet the needs of individuals and societies. Engineers should use human-centered design practices and work to create greater access and equity in their designs.
Pacing Guide	Link to unit pacing guide.

Goals

STEM Program Goals	**Unit Goal**
By the end of the 5th grade…	*By the end of this unit…*

Communication	Students will be able to **ask, listen, and respond to questions**, allowing for the **equitable flow of ideas**.	Students will be able to explain how their design addresses a need(s) and promotes access and equity, as well as the limitations of the design.
Collaboration	Students will be able to **utilize group roles** to manage time, resources, and tasks.	Students will be able to work collaboratively, utilizing group roles, to determine a design and justify their design according to variables and constraints.
Creativity	Students will be able to **brainstorm answers or solutions** to questions or problems and **create something** that **serves a particular purpose**.	Students will be able to use information from academic subjects, and global discourse to brainstorm approaches and test their design. Students will utilize feedback and data to iterate their design.
Critical Thinking	Students will be able to **break down the parts** of a problem, question, or task and determine **which information is relevant** to determining a solution and **explain how the evidence supports** their approach.	Students will be able to use the steps of the Engineering Design Process to break down the parts problem and determine which information is relevant to their design and explain how the evidence supports their approach.

Connections

Discipline	Connected Standards
Science (2020 NJSLS)	**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.
	Engineering Design 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.
	Engineering Design 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.
Computer Science and Design Thinking (2020 NJSLS)	**Design Thinking 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.

	Interaction of Technology and Humans 8.2.5.ITH.1 Explain how societal needs and wants influence the development and function of a product and a system.
	Ethics & Culture 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.
English Language Arts (2020 NJSLSA)	**Writing Anchor W4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
	Speaking and Listening Anchor SL5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
	Language Anchor L6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.
Technology (ISTE Standards for Students)	**Innovative Designer 1.4.a** Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
UN Sustainable Development Goals	**Goal 8: Decent work and economic growth** ● Sustainable economic growth ● Full and productive employment and decent work for all.
	Goal 9: Industry, innovation, and infrastructure ● Promote inclusive and sustainable industrialization. ● Foster innovation.

Learning Process and Check Points

Assessment Type	Learning Phase	Student Product	Description	Goal Assessed
Formative	Investigate	A completed research graphic organizer.	Research the history of accessible design.	Communication Critical Thinking

Formative	Brainstorm	Brainstorming notebook with ideas for a device.	Make a list of ideas for your device.	Collaboration Creativity
Formative	Plan	At least two annotated design sketches.	Narrow your idea list down to two or three possibilities and create annotated sketches for each.	Collaboration Communication Creativity
Formative	Build	A physical prototype of the most promising design sketch.	Select your most impactful sketch and build your prototype.	Collaboration Creativity
Formative	Test and Iterate	An iteration plan based on testing.	Test your design and make improvements.	Communication Creativity Critical Thinking
Summative	Share	Performance Task	Create a compelling presentation for your submission.	Communication Collaboration Creativity Critical Thinking
Summative	Reflect	Unit reflection journal.	Reflect on the Engineering Design process.	Communication Collaboration Creativity Critical Thinking

Unit Resources

Type	Purpose/Description	Access the Resource
Physical Building Materials	Materials for the assistive device	Gather craft and recyclable materials for building.
Optional: **Mechanized Parts**	Motorized parts for the device	*Recommendation:* Hummingbird Robotics Kit
UN Sustainable Development Goals	Students draw connections between their designs and real-world problems/goals	https://sdgs.un.org/goals
Optional: **Student Design Log**	Students record their learning and reflection as part of the design process	Create a digital or physical resource for students.

Vocabulary

Academic Vocabulary *(Tier 2 Words)*		Subject-Specific Vocabulary *(Tier 3 Words)*	
• Consortium • Durability • Differently-abled • Functional • Independence	• Safety	• Accessibility • Assistive technology	• Prototype

Differentiation

Type *The type of differentiation strategy.*	**Strategy** *The specific differentiation strategy.*	**Implementation** *When, how, or why the strategy is implemented.*
Modification *A change to the learning objective.*	Set individualized and relevant learning goals based on the performance task rubric.	For students who are working on developing their skills but below grade level expectations, use the performance task rubric to identify which criteria levels the students will meet (ie. some students will have a goal of achieving level 4 whereas others might have a goal of achieving level 2).
	Provide a specific resource to use.	Reduce the scope of research to ensure students connect with the information necessary to continue with the other components of the task.
Scaffold *A support to aid access, learning, and mastery of an objective. May result in a change in the time, input, output, or size of learning experiences.*	Provide examples of assistive technology.	Students research or explore educator curated assistive technology in real life. Supports students who benefit from concrete examples.
	Provide a selection of resource sources to choose from.	Reduce the scope of research to ensure students connect with the information necessary to continue with the other components of the task.
	Group roles - some roles might include: *materials manager, researcher, quality assurer, project manager*	Utilize intentional group roles to support student collaboration.

	Provide an engineering Design Process checklist.	Provide the steps of the Engineering Design Process to remind students of the process and move autonomously through it.
	Provide a presentation template.	Provide a template for sharing their submission.
Enrichment *A way to provide students personalized, in depth learning.*	Student choice of topics.	Students can have as little as or as much choice in the topic of their solution. Some students benefit from a concrete list of structured choice whereas others may benefit from open ended choice and can work through the abstract.
	Additional Device Requirements	Place additional requirements on the assistive technology to increase the challenge level of the design process. Potential requirements may be connected to motorization, durability, mass limits, or materials.
Extension *A way of extending the learning of unit, objective, or lesson.*	Students enter their solutions into the New Jersey STEAM Tank competition.	Students, with the support of an educator, can enter their design solutions into the STEAM Tank competition to share publicly and iterate their ideas with the support of mentors from the field.

Unit Preparation

Technology Set Up	1. **Complete the next section, "Unit Considerations," and reflect on student strengths, areas of anticipated challenges, and appreciate differentiation strategies.** 2. **Review the sample Pacing Guide and modify it to accommodate your learning schedule.** 3. Confirm that all devices are functional and any accounts or subscriptions required are set up. 4. Gather and organize construction materials.
Unit Considerations *Teacher Reflection*	*Think about students' current skills and knowledge, what they may struggle with, where differentiation might be appropriate, and how this unit can be customized for your classroom. Write your reflections below:*
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Pacing Guide

The learning phases and project checkpoints are outlined below. Complete, revise, and/or expand upon the pacing guide for your classroom.

Day/Class Period	Phase	Aim / Activity *What is the learning objective? What will students do?*	Assessment *How will you assess learning?*
Day 1	Investigate		
Day 2		Students will be able to research the history of accessible design.	Students will create a list of need-to-learns.
Day 3	Brainstorm		
Day 4		Students will be able to brainstorm ideas for an assistive device.	Students will create a list of ideas and explanations.
Day 5	Plan		
Day 6		Students will be able to evaluate ideas for feasibility and choose viable ideas to create annotated sketches for each.	Students will create two to three annotated sketches.
Day 7	Build		
Day 8			
Day 9			
Day 10		Students will be able to reach consensus on a design and build a prototype.	Students will build a prototype.
Day 11	Test and Iterate		
Day 12		Students will be able to test a prototype and make suggestions for its improvement.	Students will document at least one improvement to the prototype.
Day 13	Share		

Day 14		Students will be able to create a compelling presentation about an invention.	Students will create a presentation for submission to the contest committee and their peers.
Day 15	Reflect	Students will be able to reflect on the Engineering Design Process and their learning experience.	Students will create a journal reflection of their learning experience