Innovators in STEM
Grades 8
Unit 1 Plan

acher(s)	
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Unit Overview

Unit Title	Transportation of the Future
Unit Length	30 days; 15 periods; 42-minute periods
Performance Task	***Transportation of the Future*** Students explore the topic of sustainable and autonomous transportation in supporting the expansion of human settlement and quality of life. Through the Design Thinking Process, students prototype a solution to how transportation can be sustainable and what it entails to integrate automation into our society safely and ethically. Students design the body of a car and code it using Arduino code, to automatically follow another path and create an autonomous city as a class. ***Learning Process:*** *Design Thinking Process*
Essential Questions	How can sustainable and autonomous transportation address issues of affordable clean energy, and inclusive and sustainable industrialization?
Enduring Understandings	We can consider the role of transportation in developing communities that are inclusive, safe, sustainable, and affordable and how science and technology may help us design sustainable solutions.
Pacing Guide	Link to unit pacing guide.

Goals

STEM Program Goals *By the end of the 8th grade…*		**Unit Goal** *By the end of this unit…*
Communication	Students will be able to	Students will be able to prototype their

	communicate their solutions by **following the conventions of written, technological, and verbal communication** to reach their audiences.	solutions and communicate their ideas using the appropriate written, verbal, and technical communication tools.
Collaboration	Students will be able to ensure **all group members** have a **meaningful and valued role** and navigate conflicts to ensure the group reaches its desired outcomes.	Students will be able to collaborate to develop collective knowledge on a topic and utilize the information to design independent solutions.
Creativity	Students will be able to **problem-solve multiple approaches** through questioning and researching to act on one approach and **realize a solution**.	Students will be able to consider multiple approaches to solving sustainable or autonomous transportation designs and prototype at least one solution.
Critical Thinking	Students will be able to **compare and contrast points of view**, ideas, data, concepts, solutions, etc. to **evaluate the value** of information **to an objective conclusion**.	Students will be able to reflect on the approaches of others and determine the extent to which others' designs influence their solutions.

Connections

Discipline	Connected Standards
Science (2020 NJSLS)	**Engineering Design MS.ETS.1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
	Engineering Design MS.ETS.3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
	Earth and Human Activity MS.ESS3.3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Computer Science and Design Thinking (2020 NJSLS)	**Engineering Design 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).
	Nature of Technology 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.
English Language Arts (2020 NJSLSA)	**Writing Anchor W7** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
	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)	**Knowledge Constructor 1.3.d** Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
	Innovative Designer 1.5.c Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
UN Sustainable Development Goals	**Goal 7: Affordable and Clean Energy** Access to affordable, reliable, sustainable and modern energy for all.
	Goal 9: Industry, innovation, and infrastructure Promote inclusive and sustainable industrialization.
	Goal 11: Sustainable cities and communities Make cities and human settlements inclusive, safe, resilient and sustainable.

Learning Process and Check Points

Assessment Type	Learning Phase	Assessment Name	Description	Goal Assessed
Formative	Empathize	A written impact statement.	Research the impact of transportation using non-renewable energy sources on the environment and the factors that can make it more sustainable.	Critical Thinking
Formative	Define	Performance task research.	Research green vehicle solutions that have been attempted in the past and advancements currently being developed and propose strategies to address the impacts identified. Research the technology that allows autonomous vehicles to integrate safely into the traffic patterns within a community.	Collaboration
Formative	Ideate	A rough draft of autonomous code design.	Plan out the code that will be written for autonomous travel of the DigiRacer. Draft an implementation plan for green vehicles and autonomous transport.	Creativity
Formative	Prototype	An assembled prototype.	Build the autonomous vehicle and program it to move safely through the autonomous town. Create an implementation plan for green vehicles and autonomous transport.	Creativity
Formative	Test and Iterate	An improvement plan based on testing data and feedback.	Share the prototype and implementation plan and solicit feedback from peers. Make note of potential improvements that could be made and the areas that seem like they would be the most successful.	Communication

Summative	Share	Performance Task	Present the prototype and implementation plan for sustainability and autonomous transportation.	Communication Collaboration Creativity Critical Thinking
Summative	Reflect	Unit reflection journal.	Reflect on the Design Thinking learning experience.	Communication Collaboration Creativity Critical Thinking

Unit Resources

Type	Purpose/Description	Access the Resource
Programmable Car Kit	Programmable car for students to build and code for autonomous travel	*Recommendation:* DigiRacer
Coding Software	Coding software to design autonomous code	*Recommendation:* DigiRacer Coding Application
Layout for Autonomous City	An outline of "roads" for movement of vehicles	Use tape, cardboard, or paper to create the layout.
Tools	Hand tools for building the autonomous car	Supply students with small tools for assembly of vehicle
Computers	Devices for coding	Provide equipment for students to create code.
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)*
• Sustainable • Green Design • Autonomous • Prototype • Implementation	• Arduino Code • Atomic and molecular interactions • Periodic table of elements • Molecules • Energy transfer

• Design Thinking • Non-Renewable • Iteration • Environmental Impact • Infrastructure	• Motion • Newton's laws • Potential/Kinetic Energy • Light and sound waves

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.
Modification *A change to the learning objective.*	Adjust requirements to either the green design plan or the autonomous vehicle prototype. Have students complete just one of the products or one at a time.	For students who may need extra time to complete project requirements., modify which parts of the project students will complete.
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.*	Real-life examples of automation.	Students research or explore educator-curated samples of automation in real life. Supports students who benefit from concrete examples.
	Group roles - some roles might include: *programmer, architect, quality assurer, project manager*	Utilize intentional group roles to support student collaboration.
	Provide a Design Thinking Cycle checklist.	Provide the steps of the Design Thinking Cycle to remind students of the process and move autonomously through it.
	Provide or co-create sample or exemplar code.	Sample coding programs to model how coding commands create automation.
	Have students utilize offline coding cards.	Students plan their coding programs offline using manipulative cards prior to or

		alongside coding with the software.
	Have students present to peers and exchange ideas and/or feedback earlier in the design cycle.	Sharing ideas with peers can help generate ideas, provide modeling to students who may benefit from an example, as well as support student troubleshooting and iteration.
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 choices whereas others may benefit from open-ended choices and can work through the abstract.
Extension *A way of extending the learning of a 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. Ensure software and hardware for coding are set up and prepared for student access.

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:

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	Empathize		
Day 2		Students will be able to research the impact of transportation using non-renewable energy sources on the environment and the factors that can make it more sustainable.	A research-based summary of the environmental impact of transportation.
Day 3	Define		
Day 4		Students will be able to research green vehicle solutions that have been attempted in the past and advancements currently being developed. Students will be able to research the technology that allows autonomous vehicles to integrate safely into the traffic patterns within a community.	A research-based list of green vehicle solutions A research-based summary of autonomous transportation technology.
Day 5	Ideate		
Day 6		Students will be able to brainstorm ideas for an implementation plan for green vehicles and autonomous transport. Students will be able to plan out the code that will be written for the autonomous travel of the DigiRacer.	Proposed strategies for an implementation plan for green vehicles Drafts of coding requirements for automation
Day 7	Prototype		
Day 8			
Day 9		Students will be able to build their autonomous vehicle and program it to move safely through the autonomous town.	Fully assembled and customized Digi Racer Arduino Code for

		Students will be able to create an implementation plan for green vehicles and autonomous transport.	autonomous vehicle
Day 10	Test & Iterate		
Day 11			
Day 12		Students will be able to share their prototype and implementation plan and solicit feedback from peers. Students will be able to make note of potential improvements that could be made and the areas that seem like they would be the most successful.	A list of improvements that could be made to the prototype and implementation plan
Day 13	Share		Presentation of automation demonstration and implementation plan
Day 14		Students will be able to present their prototype and implementation plan for sustainability and autonomous transportation.	*Optional:* Peer feedback
Day 15	Reflect	Students will be able to reflect on their design thinking learning experience.	A journal reflection of the learning experience