Branchburg Township Public Schools

Office of Curriculum and Instruction

Grade 8 Technology Curriculum

Adopted by the Board of Education September 2023

This curriculum is aligned with the 2020 New Jersey Student Learning Standards in Computer Science and Design Thinking

Curriculum Scope and Sequence			
Content Area	Technology	**Course Title/Grade Level:**	8th Grade: Automation and Robotics

Topic/Unit Name		Suggested Pacing (Days/Weeks)
Topic/Unit 1	Solar-Powered Car Design Challenge	3 weeks
Topic/Unit 2	Computer Programming & Design of Mechanical Smoothie Maker	6-7 weeks

Topic/Unit 1 Title	Solar-Powered Car Design Challenge	Approximate Pacing	3 weeks
STANDARDS			
Computer Science and Design Thinking			
8.1.8.DA.5: Test, analyze, and refine computational models. 8.1.8.DA.6: Analyze climate change computational models and propose refinements. 8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values. 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. 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). 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. 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. 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. 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.			

Interdisciplinary Connections:	**Career Readiness, Life Literacies, and Key Skills:**
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Example : Students design and build solar powered vehicles to model alternative energy solutions and minimize climate change impact.	**9.4.8.CI.1**: Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions).

SL.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. Example: Students communicate with each other as they test their solar-powered cars for effectiveness. Students share suggestions for classmates as examples for other students who were not yet successful. Students consider alternate approaches to the same task through discussion and collaboration. **8.SP.A.1:** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **8.SP.A.2:** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. Example: Students graph data from solar vehicle trials on a scatter plot. The class creates a line of best fit to summarize the overall trend.	Example : Students analyze graphs and texts showcasing the impacts of climate change and engage in discussions with their peers and teachers. **9.4.8.CT.3:** Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome Example: Students compare gasoline, ethanol, hybrid, and electric vehicles and their advantages and drawbacks.

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS
● How has human activity impacted the environment over time? ● How can renewable energy mitigate climate change issues? ● How do the variables of speed and velocity impact design choices? ● How does climate change data influence technological advancement?

STUDENT LEARNING OBJECTIVES	
Key Knowledge	**Process/Skills/Procedures/Application of Key Knowledge**
Students will know: climate change, sustainability, renewable energy, fossil fuel, greenhouse gasses, angle, area. artificial, conclusion, constraint, control, data, diameter, gear, hypothesis,	***Students will be able to:*** ● Apply the engineering-design process to prototype a solar-powered vehicle

intensity, lumen, natural, ratio, revolution, specification, speed, troubleshooting skills, variable, variation, velocity, scatterplot, line of best fit	● Interpret climate change data in the form of graphs, charts, and articles to inform the brainstorming design stage ● Calculate velocity of solar-powered vehicles by dividing distance traveled by the amount of time traveled ● Compile and display classroom data in a scatterplot, and find the line of best fit ● Compare the efficiency of solar-powered vehicles to other power sources, including gasoline, hybrid, and electric

ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	Engineering notebook documenting design process steps for solar-powered vehicle challenge
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	Class discussions Climate change article summaries (oral or written) Teacher observations of student work and inquiry-based activities
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	Solar-powered vehicle prototype
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3x per year)	Students demonstrate their growth in writing computer programs to solve real-world problems in the beginning and end of this 10 week course.

RESOURCES
Core instructional materials: ● Pitsco Solar Powered Vehicle Teacher's Guide ● Ray Catcher Solar Vehicle Student Guide ● Solar Transportation STEM PBL Unit components: solar panel, motors, balsa wood sheets, alligator clips, wheels, etc.

• Solar-powered vehicle Engineering notebook
Supplemental materials: • **Videos:** Build the Ray Catcher, Experiment with the Ray Catcher, Apply It • www.njclimateeducation.org • Human Impact & Understanding Sustainable Energy (resource from Rutgers University)
Modifications for Learners
See appendix

Topic/Unit 2 Title	Computer Programming & Design of Mechanical Smoothie Maker	**Approximate Pacing**	6-7 weeks
STANDARDS			
Computer Science and Design Thinking			
8.1.8.DA.4: Transform data to remove errors and improve the accuracy of the data for analysis. 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. 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). 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 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. 8.1.8.CS.2: Design a system that combines hardware and software components to process data. 8.1.8.CS.4: Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems 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. 8.1.8.NI.3: Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems. 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.			

Interdisciplinary Connections:	Career Readiness, Life Literacies, and Key Skills:
7.RP.A.2a: Decide whether two quantities are in a proportional relationship by testing for equivalent ratios. **8G.A.1:** Verify experimentally the properties of rotations, reflections, and translations. <u>Example:</u> Students find the gear ratio and calculate an equivalent ratio; this tells students that for every 1 time one gear turns, a connected gear also turns a certain number of times. **MS-ETS1-1.** 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. <u>Example</u>: Students must first design and then program a blender to perform a specific task using different physical parts and computer programming skills.	**9.4.8.TL.6:** Collaborate to develop and publish work that provides perspectives on a real-world problem <u>Example</u>: Students communicate with each other as they test their computer programs for effectiveness. Students share suggestions for classmates as examples for other students who were not yet successful. Students consider alternate approaches to the same task through discussion and collaboration.

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS

Essential Questions

- How can potential energy be transferred to kinetic energy?
- What are the distinguishing characteristics of a robot?
- How can you solve problems using simple machines?
- How are speed and torque related?
- How can you test a computer program to determine whether or not it was successful?
- How can you write computer programs to solve real-world problems?
- Why is programming important to society?

Enduring Objectives/Understandings

- Energy can be stored and used to create motion.
- Energy has the capacity to do work.
- Work is energy that is transferred from one object to another.
- Robots have defining characteristics that set them apart from machines.

• Automation via robotic technology is a viable solution for many tasks. • Robots are complex devices that continue to impact society		
STUDENT LEARNING OBJECTIVES		
Key Knowledge		**Process/Skills/Procedures/Application of Key Knowledge**
Students will know: • Energy cannot be created nor destroyed; however, it can be converted from one form to another. • Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others. • Power systems must have a source of energy, a process, and loads. • The six simple machines and how they can produce mechanical advantage. • The different types of robots/automation, examples of each. • Why humans use robots and automations in certain applications. • The careers that are available in the field of robotics and automation. • Principles of simple machines and how they change mechanical power.		***Students will be able to:*** • Solve problems using simple machines • Write computer programs to solve a real-world problem • Modify the language of computer programs repeatedly until the program meets the design constraints of the task. • Test computer programs to determine the level of effectiveness of their design. • Create working models to solve a technological design challenge • Assess a task to determine whether a human operator or robotic technology is the best solution.
ASSESSMENT OF LEARNING		
Summative Assessment (Assessment at the end of the learning period)	• Final version of Smoothie Maker/Blender product • Quizzes: vocabulary, inventory, gear ratios, speed and torque	
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	• Iterations to successful Smoothie Maker/Blender product. • Class discussions • Teacher observations of student work and inquiry-based activities	

Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	• Creation of mechanisms used to develop Smoothie Maker/Blender product
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	• Students demonstrate their growth in writing computer programs to solve real-world problems in the beginning and end of this 10 week course.
RESOURCES	
Core instructional materials: • Graphical programs, such as RoboPro • FischerTechnik kits	
Supplemental materials: • Robotics and automation kits, such as Fischer-Technik • Instructional tutorials, visuals, simulations and handouts, Youtube, PHET (Torque-Rotation)	
Modifications for Learners	
See appendix	