Branchburg Township Public Schools

Office of Curriculum and Instruction

Grade 6 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:**	**Introduction to Engineering and Design/Grade 6**

Topic/Unit Name		Suggested Pacing (Days/Weeks)
Topic/Unit #1	Introduction to Engineering Fields of Engineering and Technical Careers	2 weeks
Topic/Unit #2	Exploring the Engineering-Design Process: Phone Stand Challenge	1 week
Topic/Unit #3	Electrical Engineering: Circuits, Atoms and Electricity Ohm's Law and Resistance	4 weeks
Topic/Unit # 4	Mechanical and Computer Engineering: Turing Tumble	2 weeks

<table>
<tr><th>Topic/Unit 1 Title</th><th colspan="2">Fields of Engineering and Technical Careers</th><th>Approximate Pacing</th><th>3 weeks</th></tr>
<tr><td colspan="5">STANDARDS</td></tr>
<tr><td colspan="5">Computer Science and Design Thinking</td></tr>
<tr><td colspan="5">8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.
8.2.8.EC.2: Examine the effects of ethical and unethical practices in product design and development.
8.2.8.ITH.1: Explain how the development and use of technology influences economic, political, social, and cultural issues.
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.ITH.2: Compare how technologies have influenced society over time.
8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect an individual's everyday activities and career options.
8.1.8.IC.2: Describe issues of bias and accessibility in the design of existing technologies.</td></tr>
<tr><th colspan="2">Interdisciplinary Connections:</th><th></th><th colspan="2">Career Readiness, Life Literacies, and Key Skills:</th></tr>
<tr><td colspan="2">Language Arts
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on <u>several sources</u> and generating additional related, focused questions that allow for multiple avenues of exploration.
<u>Example:</u> Students will research engineering and technical careers using various online sources.</td><td></td><td colspan="2">9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.
Example: Students research educational needs of engineering careers.
9.2.8.CAP.2 Develop a plan that includes information about career areas of interest.
<u>Example</u>: Students research engineering and technician careers and analyze what you need for success.
9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.</td></tr>
</table>

		Example: Class will discuss why engineers are paid much higher than technicians (level of education) **9.2.8.CAP.6** Compare the costs of postsecondary education with the potential increase in income from a career choice. Example: Students research engineering and technician careers and analyze what you need for success. **9.2.8.CAP.8** Compare education and training requirements, income potential, and primary duties of at least two jobs of interest Example: As students research engineering and technician careers, they learn that their level of education has an economic impact (they can make more money from more schooling).

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS

1. What career options are available in the fields of Engineering and Technical work?
2. Why are the safety considerations and best practices associated with working in electronics important?

STUDENT LEARNING OBJECTIVES

Key Knowledge		Process/Skills/Procedures/Application of Key Knowledge
Students will know: Engineer, Technician, Associates Degree, Bachelor's Degree, Master's Degree, doctor's Degree, salary, ethics, job outlook		***Students will be able to:*** 1. Develop an understanding of professional and ethical responsibility 2. Compare and contrast different types of engineering and technicians careers 3. Identify the level of training/schooling required for various engineering and technical careers 4. Identify the starting salaries of various engineering and technical careers

ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	• Students showcase their research on an Engineering and Technician career of their choice, including job description, level of education required, and starting salary. Students will have a variety of options for final project format, including brochure, website, slides presentation, infographic, etc.
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	• Teacher observations • Exit tickets: (Example: Explain the difference between an engineer and a technician) • Project check-ins
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	Student research
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3x per year)	FILL IN WITH SGO LATER

RESOURCES
Core instructional materials: Collins Online Dictionary **:** (Example Online Dictionary for students to find Engineering terms) Occupational Outlook Handbook (Primary research website for Engineering/Tech Careers project) Career OneStop (Secondary research website for Engineering/Tech Careers project) https://www.engineerjobs.com/ (Secondary research website with local engineering job postings)
Supplemental materials: Instructional tutorials, visuals, simulations and handouts, Google Forms Careers related to solar energies (Pittsco)

Modifications for Learners
See appendix

Topic/Unit 2 Title	Exploring the Engineering-Design Process: Phone Stand Challenge	**Approximate Pacing**	1 week
STANDARDS			
Computer Science and Design Thinking			
8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer. 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.5: Explain the need for optimization in a design process. 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product. 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.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem. 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.			
Interdisciplinary Connections:		**Career Readiness, Life Literacies, and Key Skills:**	
NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.		**9.4.8.CT.2:** Develop multiple solutions to a problem and evaluate short and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).	

Example: During the last phase of the phone stand challenge, students will give constructive feedback to their peers as they share their designs. **Science Cross-Cutting Concept Standard: Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. Example: Students discover that as they change one aspect of the phone stand prototype, it affects its functionality.	Example: During a design challenge, students will evaluate the short and long-term effects of their designs to help them choose which design to prototype. **9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal. Example: During the Brainstorming/Planning phases of a design challenge, students will consider a variety of potential solutions proposed by group members. The group must consider all ideas and their potential advantages and drawbacks when choosing 1 idea to move forward with.

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS

1. How can you use the engineering-design process to solve real-world problems?
2. What is technology? What impacts does technology have on society?
3. How does a design brief structure a design challenge?
4. What does it mean to have a “maker mindset”? Why is this important?
5. How can you demonstrate safe practices while working in a makerspace?

STUDENT LEARNING OBJECTIVES

Key Knowledge	Process/Skills/Procedures/Application of Key Knowledge
Students will know: Engineering Habits of Mind(systems thinking, creativity, collaboration, communication, persistence, optimism, ethical considerations), Engineering Design Process, Process, Growth Mindset, Design Brief, Engineering Notebook, Constraints, Advantages, Tradeoffs, Tasks, Brainstorm, Prototype, Redesign, 4 Outcomes Model (intended desirable, intended undesirable, unintended desirable, unintended undesirable)	***Students will be able to:*** ● Follow the engineering-design process to solve a real-world problem ● Identify solutions to real-world problems given the problem constraints and available resources/tools ● Redesign solutions based on data from testing

	• Consider both the intended and unintended outcomes of a design solution and its positive and negative impacts on users
ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	Engineering notebook demonstrating student understanding of the engineering-design process
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	Schematic drawings, evidence of brainstorming (morphological charts, webs, charts, etc)
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	Prototype
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	FILL IN WITH SGO LATER
RESOURCES	
Core instructional materials: • Phone Stand Challenge Design Brief and origami tutorial : Link to other Phone Stand Challenges (Note : Can change when we find one we settle on for 6th grade) • Engineering Notebook	
Supplemental materials: • Quick Problem-Solving Activities Folder Google Drive Link	
Modifications for Learners	
See appendix	

<table>
<tr><th>Topic/Unit 3 Title</th><td>Electrical Engineering</td><th>Approximate Pacing</th><td>4 weeks</td></tr>
<tr><th colspan="4">STANDARDS</th></tr>
<tr><th colspan="4">Computer Science and Design Thinking</th></tr>
<tr><td colspan="4">8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
8.1.8.DA.5: Test, analyze, and refine computational models.
8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
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.5: Explain the need for optimization in a design process.
8.2.8.ED.6: Analyze how trade-offs can impact the design of a product.
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.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem.
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.</td></tr>
<tr><th colspan="2">Interdisciplinary Connections:</th><th colspan="2">Career Readiness, Life Literacies, and Key Skills:</th></tr>
<tr><td colspan="2">6.EE.B.7: Solve real-world and mathematical problems by writing and solving equations of the form x + p = q and px = q for cases in which p, q and x are all nonnegative rational numbers.
<u>Example</u>: Students use Ohm's Law equation $I = V/R$ to calculate the voltage, resistance, and/or electric current needed to complete a circuit.

Science Cross-Cutting Concept Standard: Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural or designed systems.</td><td colspan="2">9.2.8.CAP.16 Research different ways workers/employees improve their earning power through education and the acquisition of new knowledge and skills.
<u>Example</u>: Students learn how to work circuits which is an essential skill for electricians, such as designing electrical plans for new construction.
9.2.8.CAP.15 Present how the demand for certain skill, the job market and credentials can determine an individual's earning power
<u>Example</u>: Knowing how to create a schematic drawing in CAD software (TinkerCad Circuit) to digitally develop a circuit is a</td></tr>
</table>

<u>Example:</u> Students discover that as they change one aspect of the circuit, it affects its functionality. **6.RI.6.7:** Integrate information presented in different media or formats (visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. <u>Example:</u> After students have learned about circuits through drawings, online programs and physical models, they will summarize what they have learned in writing, integrating all of this information together.	skill/credential.

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS

1. Why and how are circuits important in the real world?
2. Why is it important that those who create and use circuit diagrams use common symbols or conventions?
3. What is a conductor, and how can you predict whether or not a material will be a good conductor?
4. How can you use a simulation to model a desired outcome?
5. Why is the mathematical relationship expressed through Ohm's Law so important for designing circuits?
6. Why are the safety considerations and best practices associated with working in electronics important?
6. Why do electricians need to measure current, voltage, and resistance when creating a circuit and evaluating electrical circuits?

STUDENT LEARNING OBJECTIVES

Key Knowledge	Process/Skills/Procedures/Application of Key Knowledge
Students will know: schematic drawing, resistors, power supplies, continuity, voltage, variable switches, breadboards, L.E.D. atoms, electricity, protons, neutrons, electrons, orbit	***Students will be able to:*** ● use meters to find out if electricity is flowing ● read and interpret electronic circuitry symbols ● interpret schematic drawings to make a complete circuit using a digital program ● create and interpret circuit created on a digital program to develop physical model of circuit on a breadboard ● explain the functions of an atom (protons, neutrons, electrons) ● calculate the resistance need the make a complete and functional circuit (using Ohm's Law)

ASSESSMENT OF LEARNING

Summative Assessment (Assessment at the end of the learning period)	Engineering Notebook Circuits Assessment (using schematic drawings) Quiz on the functions of an atom
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	Schematic drawings, online simulations
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	Breadboard Circuitry to demonstrate understanding of Ohm's Law; Student centered demonstrations, measurements, explorations of the connections of real world circuitry to their world (such as: Why do some Apple chargers not charge an IPAD?; Compare and contrast car chargers to AC chargers.; Compare classroom lab power sources such as 9V batteries to those used in laptops)
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	FILL IN WITH SGO LATER

RESOURCES

Core instructional materials:
- Graphical programs including tutorials, such as Tinkercad and SketchUp
- Breadboards and electrical components

Supplemental materials:
- Various meters, such as voltage, continuity, Ohms
- Project Lead the Way, Youtube, PHET simulations(Circuits, Conductors and Insulators)
- Scrappy circuits website, Core Brick Task Cards, and physical materials needed to create the core bricks

Modifications for Learners

See appendix

Topic/Unit 4 Title	Mechanical and Computer Engineering	**Approximate Pacing**	3 weeks

STANDARDS	
Computer Science and Design Thinking	
8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer. 8.2.8.NT.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem. 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.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. 8.1.8.AP.1: Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode. 8.1.8.AP.3: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. 8.1.8.AP.4: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. 8.1.8.AP.5: Create procedures with parameters to organize code and make it easier to reuse. 8.1.8.AP.6: Refine a solution that meets users' needs by incorporating feedback from team members and users. 8.1.8.AP.8: Systematically test and refine programs using a range of test cases and users. 8.1.8.AP.9: Document programs in order to make them easier to follow, test, and debug.	
Interdisciplinary Connections:	**Career Awareness, Exploration, Preparation and Training**
MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. <u>Example:</u> After students place their parts on the Turing Tumble, they test their solution and make adjustments until they find a method that satisfies the puzzles' requirements. Mathematical Practice 1: Make sense of problems and persevere in solving them. <u>Example</u>: Students employ a growth mindset approach to solving each Turing Tumble puzzle. Students utilize their resources available to help them when they become stuck.	**9.4.8.CI.3**: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2). <u>Example</u>: Students work in collaborative, diverse teams to complete mechanical computing engineering puzzles and implement new parts to help resolve new challenges . **9.4.8.CI.4**: Explore the role of creativity and innovation in career pathways and industries. <u>Example:</u> A class discussion will focus on how creativity and innovation has impacted personal computer usage and the development of computing devices.

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS

1. How is the Turing Tumble like a computer?
2. How does mechanical computing compare to electronic computing?
3. How does systematic troubleshooting help you identify the source of a problem?
4. How has computing evolved over the last 200 years based on societal needs?

STUDENT LEARNING OBJECTIVES

<table>
<tr><th>Key Knowledge</th><th>Process/Skills/Procedures/Application of Key Knowledge</th></tr>
<tr><td>Students will know:
mechanical energy, electrical energy, microchips, processor, ramps (wires), bits (transistors), crossovers (vias), switches, algorithm, logic, function, input, output, circuit board, nested loops, compound conditionals, troubleshooting, logic gates, truth tables, binary operations</td><td>Students will be able to:
● Solve mechanical computing engineering puzzles involving systematic troubleshooting to test, refine, and debug a solution
● Explain how mechanical computing models the electricity in a computing device
● Predict the output of the device based on the input using a flowchart or pseudocode
● Design programs using loops, variables, and parameters (data)</td></tr>
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ASSESSMENT OF LEARNING

Summative Assessment (Assessment at the end of the learning period)	Successful completion of puzzle challenges with individual objectives, documented in the form of photo, video, or written explanation
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	Teacher and student observations, photos documenting stages of progress, student logs of puzzle completion.
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	Verbal or written explanation of computer logic to complete stated objectives. Use backwards design to explain the logic behind a puzzle solution.
Benchmark Assessments (used to establish baseline	FILL IN WITH SGO LATER

achievement data and measure progress towards grade level standards; given 2-3 X per year)	

RESOURCES
Core instructional materials: Turing Tumble kits and instructional slideshows Turing Tumble Educator Guide Turing Tumble Practice Guide Turing Tumble Online Simulator # 1 Turing Tumble Online Simulator # 2
Supplemental materials: ● Turing Tumble Youtube channel ● Additional puzzles at edu.turingtumble.com ● Turing Tumble Infographic ● Instructional tutorials ● Alan Turing BrainPOP video & activities
Modifications for Learners
See appendix