Pascack Valley Regional High School District

Pascack Hills High School, Montvale, New Jersey
Pascack Valley High School, Hillsdale, New Jersey

Course Name: Elements of Innovation & Design

Born On: August, 2021
Board Approved: 8/30/21

Elements of Innovation and Design
Unit 1: What is Technology and Design?
Time Allotted: Approximately 3-4 Weeks
New Jersey Student Learning Standards (NJSLS)
8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.
8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.
8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue
8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
8.2.12.EC.1: Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition
9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is technology and design? - How can we use the design process to solve problems? - What are the resources of technology? - How might we create the best possible solution to a problem	- Define technology and its uses. - Describe the design process and how it can be used to solve problems. - Discuss the importance of collaboration and	- List different types of technology used in your daily life. - Identify problems in your life or give examples of problems that are “worth solving” - Choose a problem and try to solve it using the design process.	- Physical Device / Artifact - Prototype Development - Class Participation - Research Documentation - Extent To Which Prototype Satisfies The Design Brief

- How can we effectively communicate ideas?	communication among peers and how they contribute to the design process - Distinguish between needs and wants in the design process - Properly and safely use and maintain tools and machinery used in the project design	- Rapid Design & Redesign Challenge: (i.e. Paper Tower) - Product branding and package engineering (Ship the Chip Project)	
Resources/Materials	- Paper, Rulers, Tape, Colored Markers - Design Technology: Adobe Photoshop, Adobe Illustrator, Onshape (or similar CAD program) - Presentation Technology: Google Presentation, Prezi, PowerPoint - Modified Ship the Chip Project (Model/scaffold steps to students) - https://www.state.nj.us/education/cccs/2014/tech/ - https://www.teachengineering.org/k12engineering/designprocess - https://tryengineering.org/teacher/laser-creations/		
Interdisciplinary Connections	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. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. NJSLS 6.1.12.C.16.a Evaluate the economic, political, and social impact of new and emerging technologies on individuals and nations. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.		
Career Readiness, Life Literacies and Key Skills	9.2.12.C.1 Review career goals and determine the steps necessary for attainment. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence.		
Computer Science & Design Thinking	9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing		

	a specified task 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments. 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented
● Display labeled images of designs and parts. ● Use body movement and gestures to further explain concepts to students. ● Model and restate design steps aloud before project activity. ● Assign a native language partner. ● Show examples and non-examples of student work ● Lower reading level of text ● Use sentence starters to give student practice with academic language ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Pre- teach vocab using pictures	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Review of directions ● Have students restate directions or information back to you ● Concrete examples ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management ● Work with a partner	● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques. ● Provide an outline for project tasks. ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. ● Classroom activities should be noncompetitive.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex design challenge.

Elements of Innovation and Design
Unit 2: Safety in the Technological Design Process
Time Allotted: Approximately 2 Weeks
New Jersey Student Learning Standards (NJSLS)
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice
8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What are the safety considerations for the technological design process? - How do I properly and safely use technological tools and machinery?	- Identify tools and machinery located in the classroom. - Properly and safely use and maintain tools and machinery used in the project design (i.e. Exacto Knife, Bandsaw, Drill Press, Belt Sander, Hot Glue Gun, etc.) - Understand OSHA Safety Regulations - Demonstrate an understanding of clothing requirements and personal protective equipment - Identify the location of items needed in case of emergency.	- Model how to properly use tools and machinery - Show video as supplemental material to reinforce proper use of tools and machinery. - Discussion on the importance of safety. - Cut an item to size (i.e. puzzle piece, handle, phone stand, name plate, etc.) using a sander, bandsaw, drill press, and other primary tools and machinery with the possibility of use in a later project - Using the laser cutter to engrave or cut out their personal logos/design	- Written Tests on Safety - Explain orally how to use the equipment - A matching worksheet of the tools with their functions. - Hands-on Assessment with single-point grading rubric

Resources/Materials	- Introduction videos (YouTube) on the different tools and machinery - Worksheet - Wood - Machinery: Sander, Bandsaw, Drill Press, Laser Cutter - OSHA Safety Guidelines: https://www.osap.org/page/GuideOSHA - https://www.state.nj.us/education/cccs/2014/tech/
Interdisciplinary Connections	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. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Career Readiness, Life Literacies and Key Skills	CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP6. Demonstrate creativity and innovation.

	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence.
Computer Science & Design Thinking	9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice 8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented
● Display labeled images of designs and parts. ● Use body movement and gestures to further explain concepts to students. ● Model and restate design steps aloud before project activity. ● Assign a native language partner. ● Show examples and non-examples of student work ● Lower reading level of text ● Use sentence starters to give student practice with academic language ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Pre- teach vocab using pictures	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Review of directions ● Have students restate directions or information back to you ● Concrete examples ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management ● Work with a partner	● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques. ● Provide an outline for project tasks. ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. ● Classroom activities should be noncompetitive.	● Lead the class in the deciphering of new learning. ● Advanced product design.

Elements of Innovation and Design
Unit 3: Applying The Design Process
Time Allotted: Approximately 6-8 Weeks
New Jersey Student Learning Standards (NJSLS)

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.
8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.
8.2.12.NT.2: Redesign an existing product to improve form or function.
8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- How can we apply the design process to solve a meaningful problem? - How are structures and transportation systems applied to the innovation and design process? - How can our designs be improved through systems analysis (input, output and feedback)?	- Identify the steps of the design process - Identify a problem that is worth solving - Apply the design process to solving a problem. - Develop specifications for the project design - Use conceptual sketching to depict a design (c-sketching) - Effectively and persuasively communicate your idea for a design.	- Identify problems worth solving in your life - Choose a problem and try to solve it using the design process. - Project that Applies the Design Process: (i.e. CO_2 Car Project) - Create an advertisement for the design using PowerPoint - Sketching, Hand-drawing and Computer-Assisted Design (TinkerCAD) - Peer review a classmates' project by completing a project requirement rubric	- Identification of "real-life" problem. - Conceptual sketch for a design to justify the design based upon the key concepts learned will be assessed using a single-point grading rubric - Critique (provide feedback) on your peers' work.
Resources/Materials	- Computer, TinkerCAD, Tools and Machinery, Rapid Prototyping Devices - https://www.instructables.com/id/CO2-Race-Car/ (scaffold this project by breaking steps down for students) - https://www.state.nj.us/education/cccs/2014/tech/ - https://www.teachengineering.org/k12engineering/designproces - https://www.canva.com/ - Project Requirement Rubric		
Interdisciplinary Connections	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.		

	NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. NJSLSA.SL3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
Career Readiness, Life Literacies and Key Skills	9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP6. Demonstrate creativity and innovation. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence.
Computer Science & Design Thinking	9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented
● Display labeled images of designs and parts. ● Use body movement and gestures to further explain concepts to students. ● Model and restate design steps aloud before project activity. ● Assign a native language partner. ● Show examples and non-examples of student work ● Lower reading level of text ● Use sentence starters to give student practice with academic language ● When possible, modify assignments so the ELL student	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Review of directions ● Have students restate directions or information back to you ● Concrete examples ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of	● Take on an additional or more complex design challenge. ● Interview someone in the field of technology education about how they use the design process in their profession. ● Offer choices, once finished with basic task, with personal interest being the key.

writes less, has simpler questions to answer, fewer spelling words, etc. ● Pre- teach vocab using pictures	● Work with a partner	mastery and not one another. Classroom activities should be noncompetitive	

Elements of Innovation and Design
Unit 4: Robotics & Programming
Time Allotted: Approximately 4-6 Weeks
New Jersey Student Learning Standards (NJSLS)
8.1.12.CS.1: Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
8.1.12.CS.2: Model interactions between application software, system software, and hardware.
8.1.12.CS.3: Compare the functions of application software, system software, and hardware.
8.1.12.CS.4: Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.
8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.
8.1.12.IC.2: Test and refine computational artifacts to reduce bias and equity deficits.
8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.
8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change
8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena
8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms.
8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly using simple variables.
8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.
8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue
8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.
8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and accessible.
8.1.12.AP.9: Collaboratively document and present design decisions in the development of complex programs.

Essential Questions	**Student Learning Objectives**	**Suggested Tasks/Activities**	**Evidence of Learning (Assessment)**

- What are robotics, and where do they appear in everyday life? - How are robots programmed using the computer? - What are the essential 'elements' to a game design?	- Describe the basic uses of robotics in our everyday lives and society - Program robots using color code and block coding - Create video game designs - Construct a robot using an instructional kit (i.e. Vex)	- View media to demonstrate how robotics are used by professionals and in corporations (i.e. IBM programmed a robotic arm to deal cards) - Ozobot robotics color coding and blockly - Scratch video game designs - Code.org Hour of Code online activities - Vex robotics build a robot and use block coding activities	- Fill in blank/matching worksheet to demonstrate the uses of robotics in our everyday lives and society - Peers play games that have been created. - Present robot built to class. - Test robot under certain conditions. - Ongoing feedback to students
Resources/Materials	- Youtube videos - Worksheet - Robotics Kit - Student Laptops - Code.org - Scratch Studio		
Interdisciplinary Connections	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. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. NJSLSA.SL3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric. NJSLS 6.1.12.C.16.a Evaluate the economic, political, and social impact of new and emerging technologies on individuals and nations. NJSLS 6.1.12.C.16.b Predict the impact of technology on the global workforce and on entrepreneurship. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. RI.11-12.7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.		

Career Readiness, Life Literacies and Key Skills	9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence.
Computer Science & Design Thinking	9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection. 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented
● Display labeled images of designs and parts. ● Use body movement and gestures to further explain concepts to students. ● Model and restate design steps aloud before project activity. ● Assign a native language partner. ● Show examples and non-examples of student work ● Lower reading level of text ● Use sentence starters to give student practice with academic language ● When possible, modify assignments so the ELL student	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Review of directions ● Have students restate directions or information back to you ● Concrete examples ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and	● Take on an additional or more complex design challenge. ● Interview someone in the field of technology education about how they use the design process in their profession. ● Offer choices, once finished with basic task, with personal interest being the key.

writes less, has simpler questions to answer, fewer spelling words, etc. ● Pre- teach vocab using pictures	● Work with a partner	learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	

Elements of Innovation and Design
Unit 5: Rapid Prototyping
Time Allotted: Approximately 4-6 Weeks
New Jersey Student Learning Standards (NJSLS)
8.1.12.CS.2: Model interactions between application software, system software, and hardware.
8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue
8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.
8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and accessible.
8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
8.2.12.ITH.3: Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.
8.2.12.NT.2: Redesign an existing product to improve form or function.
8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
8.2.12.ETW.3: Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition
9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is rapid prototyping, and what are the benefits in engineering design? - What is the difference between additive and subtractive manufacturing? - What tools and machines are used for rapid prototyping?	- Describe the benefits of rapid prototyping in the engineering classroom - Describe the differences and similarities between laser cutting and 3D printing - Create custom digital 2D artwork and designs for laser cutting and engraving on artifacts - Create 3D models using computer aided drawing software to be 3D printed	- Identify the different rapid prototyping machines in the classroom via photo scavenger hunt - Create a personal logo or design with Adobe Illustrator & Photoshop to engrave on a physical artifact (i.e. cup, mug, coaster, keychain, etc.) with the laser cutter - Use TinkerCAD to 3D model an object to print on 3D printer that solves a real world or environmental problem	- Identification of rapid prototyping materials and machines - Physical Devices / Artifacts will be assessed using a single-point grading rubric

Resources/Materials	- 3D printer and filament - Epilog laser cutter and artifact materials - Student laptops - TinkerCAD - Adobe Illustrator
Interdisciplinary Connections	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. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. NJSLSA.SL3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric. NJSLS 6.1.12.C.16.a Evaluate the economic, political, and social impact of new and emerging technologies on individuals and nations. NJSLS 6.1.12.C.16.b Predict the impact of technology on the global workforce and on entrepreneurship. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. RI.11-12.7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

	HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
Career Readiness, Life Literacies and Key Skills	9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence.
Computer Science & Design Thinking	9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments. 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented
● Display labeled images of designs and parts. ● Use body movement and gestures to further explain concepts to students. ● Model and restate design steps aloud before project activity. ● Assign a native language partner. ● Show examples and non-examples of student work ● Lower reading level of text ● Use sentence starters to give student practice with academic	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Review of directions ● Have students restate directions or information back to you ● Concrete examples ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging	● Take on an additional or more complex design challenge. ● Interview someone in the field of technology education about how they use the design process in their profession. ● Offer choices, once finished with basic task, with personal interest being the key.

language ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Pre- teach vocab using pictures	example, near the teacher) ● Use an alarm to help with time management ● Work with a partner	tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	

Elements of Innovation and Design
Unit 6: Integrated Design Challenge
Time Allotted: Approximately 6-8 Weeks
New Jersey Student Learning Standards (NJSLS)
8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.
8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.
8.2.12.NT.2: Redesign an existing product to improve form or function.
8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue
8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.
8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and accessible.

Essential Questions	**Student Learning Objectives**	**Suggested Tasks/Activities**	**Evidence of Learning (Assessment)**

- How can we solve a meaningful problem by using the design process to meet the needs of the population/consumer?	- Identify the purpose of a prototype - Integrate and apply knowledge of the design process to solve a problem - Utilize rapid prototyping devices to support learning - create a design prototype or model - Effectively and persuasively communicate design ideas	- Show examples of prototypes then a final result to discuss the purpose of a prototype. - Research a population and design a device/game/puzzle that would benefit them (i.e. create an assistive technology for Parkinson's patients; puzzle for preschool students) - Create a dynamic prototype of the device/game/puzzle using the design process (i.e. Labyrinth, Automata, etc.) - Create a graphic and oral presentation of the design	- Initial Model(s) and Final Prototype - Initial design pitch/ Design Proposal - Digital portfolio (i.e. website) with evidence of the design process - Shark Tank Final Presentation will be assessed using a single-point grading rubric
Resources/Materials	- Computer, Autodesk Inventor or Onshape, Tools and Machinery, Rapid Prototyping Devices - https://www.state.nj.us/education/cccs/2014/tech/ - https://www.teachengineering.org/k12engineering/designprocess - https://www.canva.com/ - Adobe Photoshop, Illustrator		
Interdisciplinary Connections	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. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. NJSLSA.SL3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric. NJSLS 6.1.12.C.16.a Evaluate the economic, political, and social impact of new and emerging technologies on individuals and nations. NJSLS 6.1.12.C.16.b Predict the impact of technology on the global workforce and on entrepreneurship. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. RI.11-12.7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.		
Career Readiness, Life Literacies and	CRP2. Apply appropriate academic and technical skills.		

Key Skills	CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence.
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Scope and Sequence: Elements of Innovation & Design

Unit Title	Unit Length	Unit Summary
(1) What is Technology and Design?	3-4 Weeks	Students will be introduced to the design process. They will learn about the importance of outcomes of technological designs as well as the resources of technology. Activities/ Projects: - List different types of technology used in your daily life. - Identify problems in your life or give examples of problems that are "worth solving" - Choose a problem and try to solve it using the design process. - Rapid Design & Redesign Challenge: (i.e. Paper Tower) - Product branding and package engineering (Ship the Chip Project)
(2) Safety in the Technological Design Process	2 Weeks	Students will learn how to properly and safely use technological tools and machinery (i.e. Exacto Knife, Bandsaw, Drill Press, Belt Sander, Hot Glue Gun, etc.) as well as demonstrate an understanding of the OSHA Safety Regulations and proper clothing/personal protective equipment. Students will take a written safety test, explain verbally how to use the equipment, and will complete a hands-on assessment. Activities/Projects: - Model how to properly use tools and machinery - Show video as supplemental material to reinforce proper use of tools and machinery. - Discussion on the importance of safety. - Cut an item to size (i.e. puzzle piece, handle, phone stand, name plate, etc.) using a sander, bandsaw, drill press, and other primary tools and machinery with the possibility of use in a later project - Using the laser cutter to engrave or cut out their personal logos/design
(3) Applying the Design Process	6-8 Weeks	Students will apply the design process to solve a problem and they will learn about criteria, constraints, ergonomics, sustainable design, and communication. They will read, interpret, and use technical drawings as well as c-sketching. Activities/ Projects: - Identify problems worth solving in your life - Choose a problem and try to solve it using the design process. - Project that Applies the Design Process: (i.e. CO_2 Car Project) - Create an advertisement for the design using PowerPoint - Sketching, Hand-drawing and Computer-Assisted Design (TinkerCAD) - Peer review a classmates' project by completing a project requirement rubric
(4) Robotics & Programming	4-6 Weeks	Students will discuss the basic uses of robotics in our everyday lives as well as demonstrate the basic workings of a robot. Students will also learn about the essential elements that are necessary when designing a game.

		Activities/ Projects: - View media to demonstrate how robotics are used by professionals and in corporations (i.e. IBM programmed a robotic arm to deal cards) - Ozobot robotics color coding and blockly - Scratch video game designs - Code.org Hour of Code online activities - Vex robotics build a robot and use block coding activities
(5) Rapid Prototyping	4-6 Weeks	Students will discuss the benefits of rapid prototyping and will create multiple artifacts using the laser cutter/engraver and 3D printer. Activities/ Projects: - Identify the different rapid prototyping machines in the classroom via photo scavenger hunt - Create a personal logo or design with Adobe Illustrator & Photoshop to engrave on a physical artifact (i.e. cup, mug, coaster, keychain, etc.) with the laser cutter - Use TinkerCAD to 3D model an object to print on 3D printer that solves a real world or environmental problem
(6) Integrated Design Challenge	6-8 Weeks	Students will solve a meaningful problem by using the design process to meet the needs of a particular population/consumer. They will create prototypes and models to effectively communicate design ideas. Activities/Projects: - Show examples of prototypes then a final result to discuss the purpose of a prototype. - Research a population and design a device/game/puzzle that would benefit them (i.e. create an assistive technology for Parkinson's patients; puzzle for preschool students) - Create a dynamic prototype of the device/game/puzzle using the design process (i.e. Labyrinth, Automata, etc.) - Create a graphic and oral presentation of the design

Sample Single-Point Teacher-Designed Rubric

Concerns ***Areas that need improvement***	**CRITERIA** ***Standards for this Performance***	**EXPERTISE** ***Areas in which you show advanced performance or mastery***
	I produced a design/prototype that meets <u>all</u> of the established criteria.	

	I used the tools and applications correctly, handled them with care, and demonstrated professionalism.	