Pascack Valley Regional High School District

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

Course Name: Research in Innovation & Design (Honors)

New Jersey Curricular Mandates for Technology Education

Disabled & LGBT:
18A:35-4.35 - History of disabled and LGBT persons included in middle and high school curriculum. A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards.

Diversity, Equity, and Inclusion (DEI):
C.18A:35-4.36a - Curriculum to include instruction on diversity and inclusion. 1. a. Beginning in the 2021-2022 school year, each school district shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards. b. The instruction shall: (1) highlight and promote diversity, including economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance; (2) examine the impact that unconscious bias and economic disparities have at both an individual level and on society as a whole; and (3) encourage safe, welcoming, and inclusive environments for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs. c. The Commissioner of Education shall provide school districts with sample learning activities and resources designed to promote diversity and inclusion.

Amistad Law:
N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

Climate Change:
2020 NJSLS-Computer Science and Design Thinking: At the core of computer science and design thinking education, is the goal to prepare students with the essential knowledge and skills to make their local and global communities a better place to live. Learning experiences that enable students to apply content knowledge and employ computational thinking skills prepare students for the work of tomorrow by proposing solutions concerning the balancing of societal, environmental, and economic needs for a sustainable future. Further, leveraging topics such as computational sustainability and clean technology (Cleantech), technologies that either reduce or optimize the use of natural resources while reducing the negative effect that technology has on the planet and its ecosystems, is essential for developing a populace with the knowledge and skills necessary to mitigate the effects of climate change.

Honors Research in Innovation & Design
Unit 1: What is Technology and Design?

Time Allotted: Approximately 3-4 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.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).

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 - How can we effectively communicate ideas?	- Define and describe technology and its applications - Distinguish technology from science (natural world vs. human-made world) - Describe the design process and how it can be used to solve problems - Identify the four outcomes of technological design: expected desired, expected undesired, unexpected desired, unexpected undesired - Describe the seven resources of technology: people, information, time, materials, energy, capital, tools & equipment - Distinguish between needs and wants in the design process - Understand the processes of collaboration and communication and how they contribute to 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) - Identify problems in your life that are "worth solving" and propose a solution in the form of a conceptual sketch and/or model - Discuss inventions/innovations that have changed the way we interact with the world	- Physical Device / Artifact - Digital Presentation - Prototype Development - Class Participation - Research Documentation - Extent To Which Prototype Satisfies The Design Brief - Quizzes
Resources/Materials	- Paper, Rulers, Tape, Colored Markers - Design Technology: Adobe Photoshop, Adobe Illustrator, Onshape (or similar CAD program) - Presentation Technology: Google Presentation, Prezi, PowerPoint - 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.
Life Literacies & Key Skills	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
Information and Media Literacy & Technology Literacy	9.4.12.IML.1: Compare search browsers and recognize features that allow for filtering of information. 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.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change 9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations 9.4.12.IML.9: Analyze the decisions creators make to reveal explicit and implicit messages within information and media 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 9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. 9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
Career Readiness, Life Literacies & Key Skills Practices	Act as a responsible and contributing community member and employee Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. Work productively in teams while using cultural/global competence.

Modifications			
Multi-Lingual 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. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions ● 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.	● 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.

Honors Research in Innovation & Design
Unit 2: Safety in the Engineering Design Process

Time Allotted: Approximately 2 Weeks

New Jersey Student Learning Standards (NJSLS)

9.3.12.AC.3 Comply with regulations and applicable codes to establish and manage a legal and safe workplace.

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).

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?	- 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	- 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 - Discussion on the importance of safety	- Written Tests on Safety - Explain orally how to use the equipment - Hands-on Assessment with single-point grading rubric

	personal protective equipment - Identify the location of items needed in case of emergency. - Identify the tools and where they are located in the classroom.
Resources/Materials	- Wood - Machinery: Sander, Bandsaw, Drill Press, Laser Cutter - OSHA Safety Guidelines: https://www.osap.org/page/GuideOSHA
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.
Life Literacies & Key Skills	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
Information and Media Literacy & Technology Literacy	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.3: Analyze the effectiveness of the process and quality of collaborative environments. 9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. 9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
Career Readiness, Life Literacies & Key Skills Practices	Act as a responsible and contributing community member and employee Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Work productively in teams while using cultural/global competence.

Modifications			
Multi-Lingual Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
- Display labeled images of designs and parts. - Restate design steps aloud before project activity. - Assign a native language partner. - When possible, modify	- Provide extended time for the creation of products. - Scaffolded explanations for proper use of equipment. - Provide an outline of lessons - Get a written list of instructions - Receive large project as smaller tasks with individual deadlines	- Provide peer mentoring to improve techniques. - Provide an outline for project tasks. - Incorporate student choice - Use effort and achievement rubrics - Assure students they can be successful	- Lead the class in the deciphering of new learning. - Advanced product design.

assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provide a variety of texts and resources on curriculum topics at a range of reading levels. ● Provide models of completed homework assignments, projects, etc.	● 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	● 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.	

Honors Research in Innovation & Design

Unit 3: Applying The Engineering Design Process - Research & Analysis

Time Allotted: Approximately 12-14 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.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.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.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.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- How can we apply the design process to solve a meaningful problem or a problem "worth" solving? - How can our designs be improved through systems analysis (input, output and feedback)? - How does the Engineering Design Process reflect constant iteration rather than just linear problem solving?	- 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 - Read, interpret and use technical drawings - Use conceptual sketching to depict a design (c-sketching)	- Identify problems worth solving in your life - Original student project that applies the Engineering Design Process - Isometric and Orthographic Sketching, Hand-drawing and Computer-Assisted Design (Inventor or Onshape) - Peer Reviewing and self-assessment - Students meet with and	- Identification of "real-life" problem that is appropriate for the given real-world criteria and constraints - Conceptual sketch for a design and a written piece 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

- How is The Engineering Design Process similar/different from Design Thinking? -	- Understand and use principles of measurement and spatial relationships. - Distinguish between criteria and constraints - Understand ergonomics - Utilize sustainable design - Effectively and persuasively communicate your idea for a design.	interview experts related to their field of research and their project topics - Independently present a written document and oral presentation of the Research & Design Proposal for their year-long engineering design project	- Research & Design Proposal - Creation of a digital portfolio (i.e. Google Drive Folder) to record on-going research and notes, log weekly project progress, gather self-assessments and reflections, and record teacher and peer feedback.
Resources/Materials	- Computer, Autodesk Inventor or Onshape, Tools and Machinery, Rapid Prototyping Devices - https://www.instructables.com/id/CO2-Race-Car/ - https://www.teachengineering.org/k12engineering/designproces - 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. 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.		
Life Literacies & Key Skills	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		
Information and Media Literacy & Technology Literacy	9.4.12.IML.1: Compare search browsers and recognize features that allow for filtering of information. 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.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change		

	9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations
	9.4.12.IML.9: Analyze the decisions creators make to reveal explicit and implicit messages within information and media
	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
	9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
	9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
Career Readiness, Life Literacies & Key Skills Practices	Act as a responsible and contributing community member and employee
	Consider the environmental, social, and economic impacts of decisions.
	Demonstrate creativity and innovation.
	Utilize critical thinking to make sense of problems and persevere in solving them.
	Model integrity, ethical leadership, and effective management.
	Plan education and career paths aligned to personal goals.
	Use technology to enhance productivity, increase collaboration, and communicate effectively.
	Work productively in teams while using cultural/global competence.

Modifications			
Multi-Lingual Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
- When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. - Provide models of completed homework assignments, projects, etc. - Assign a native language partner. - Use sentence/paragraph frames to assist with writing peer review. - Provide extended time for written responses and reports.	- Use scaffolds, such as prompting to assist with the design process. - Provide extended time for written responses and reports. - Use a graphic organizer to categorize concepts. - Get a written list of instructions - Receive large project as smaller tasks with individual deadlines - 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	- 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 mastery and not one another. Classroom activities should be noncompetitive	- 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.

Honors Research in Innovation & Design
Unit 4: Applying The Engineering Design Process - Iterative Design Prototyping

Time Allotted: Approximately 12-14 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.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.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.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.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- How can we apply the design process to solve a meaningful problem or a problem "worth" solving? - How can our designs be improved through systems analysis (input, output and feedback)? - How does the Engineering Design Process reflect constant iteration rather than just linear problem solving? - What hands-on tools and skills are required during the iterative prototyping process? - What is the difference between a model and prototype? - How do products develop from ideas, to models and prototypes, to manufactured goods and products?	- Identify the steps of the design process - Apply the design process to solving a unique real-world problem through iteration - Apply research to the design and carry out modeling and fabrication of prototypes using authentic materials - Create technical drawings (CAD) of your design solution - Use conceptual sketching to depict a design (c-sketching) - Understand and use principles of measurement and spatial relation - Distinguish between criteria and constraints. - Apply ergonomic features to the design - Utilize sustainable design in the creation of models and prototypes - Identify the purpose of a prototype - Integrate and apply knowledge of	- Apply the steps "Research" and "Brainstorming" from the Engineering Design Process to the steps "Develop Solutions/ Build A Model" - Use CAD software, rapid prototyping (i.e. laser cutting, 3D printing) or alternative methods to create a final prototype and finished solution design - Gather teacher, peer, and field expert feedback	- Conceptual sketch for a design and a written piece to justify the design based upon the key concepts learned will be assessed using a single-point grading rubric - Frequent updates of a digital portfolio (i.e. Google Drive Folder) to record on-going research and notes, log weekly project progress, gather self-assessments and reflections, and record teacher and peer feedback. - Final Presentation in the form of Slides, Powerpoint, Prezi, iMovie or online portfolio website to submit to Science Fair, Symposium, or similar public event - Physical artifact, model, or prototype assessed on single-point grading rubric

	- the design process to solve a problem - Utilize rapid prototyping devices to support learning - create a design prototype or model

Resources/Materials	- https://www.teachengineering.org/k12engineering/designprocess
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.
Life Literacies & Key Skills	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
Information and Media Literacy & Technology Literacy	9.4.12.IML.1: Compare search browsers and recognize features that allow for filtering of information. 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.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change

	9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations
	9.4.12.IML.9: Analyze the decisions creators make to reveal explicit and implicit messages within information and media
	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
	9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
	9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
Career Readiness, Life Literacies & Key Skills Practices	Act as a responsible and contributing community member and employee
	Consider the environmental, social, and economic impacts of decisions.
	Demonstrate creativity and innovation.
	Utilize critical thinking to make sense of problems and persevere in solving them.
	Model integrity, ethical leadership, and effective management.
	Plan education and career paths aligned to personal goals.
	Use technology to enhance productivity, increase collaboration, and communicate effectively.
	Work productively in teams while using cultural/global competence.

Modifications			
Multi-Lingual Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
- Provide extended time for written responses and reports. - When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. - Provide a variety of texts and resources on curriculum topics at a range of reading levels. - Provide models of completed homework assignments, projects, etc. - Assign a native language partner. - Use sentence/paragraph frames to assist with writing reports.	- Use scaffolds, such as prompting to assist with the design process and with the writing process. - Provide extended time for written responses and reports. - Use a graphic organizer to categorize concepts. - Get a written list of instructions - Receive large project as smaller tasks with individual deadlines - 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 - Work independently if preferred	- 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	- 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.

		tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	

Honors Research in Innovation & Design
Unit 5: Community Engagement

Time Allotted: Approximately 5-6 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.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.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.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.

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? - How can we engage learning and exploration of engineering within our communities? - How can we communicate our ideas clearly and effectively?	- Create a visual aid display (i.e. poster, slideshow, or tri-fold board) to summarize and analyze the research and design process - Effectively and persuasively communicate design ideas	- Present Final Project at a Science Fair, Symposium, or similar public event - Illicit community feedback - Present Final Project to students in other classes (i.e. Intro to Innovation & Design) and younger students (i.e. Middle Schoolers)	- Digital portfolio (i.e. Google Drive folder or Website) with evidence of the design process) and visual aid display - Science Fair/Symposium Final Presentation will be assessed using a single-point grading rubric

Resources/Materials	- Computer, Slides, Wide-format poster printer - 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.
Life Literacies & Key Skills	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
Information and Media Literacy & Technology Literacy	9.4.12.IML.1: Compare search browsers and recognize features that allow for filtering of information.
	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.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience
	9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately
	9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity
	9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change
	9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations
	9.4.12.IML.9: Analyze the decisions creators make to reveal explicit and implicit messages within information and media
	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
	9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
	9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
Career Readiness, Life Literacies & Key Skills Practices	Act as a responsible and contributing community member and employee
	Demonstrate creativity and innovation.

Model integrity, ethical leadership, and effective management. Work productively in teams while using cultural/global competence.			

Modifications			
Multi-Lingual Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
- Provide a template for documenting the design process. - When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. - Provide models of completed homework assignments, projects, etc. - Assign a native language partner. - Provide extended time for written responses and reports.	- Provide additional time for project development. - Work with a peer to develop a simpler design. - Utilize graphics to support learning. - Provide an outline of lessons - Get a written list of instructions - Receive large project as smaller tasks with individual deadlines - 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	- Invite parents, neighbors, friends, the school principal and other community members to attend class performances. - Break the design process into smaller pieces. - Conference with teacher during the design planning process. - Provide a detailed framework for the project design. - 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 mastery and not one another. Classroom activities should be noncompetitive	- Offer choices, once finished with basic task, with personal interest being the key. - Develop more complex designs based on extensive research both individually and in collaboration with peers.

Scope and Sequence: Introduction to 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: - Rapid Design & Redesign Challenge: (i.e. Paper Tower) - Identify problems in your life that are "worth solving" and propose a solution in the form of a conceptual sketch and/or model - Discuss inventions/innovations that have changed the way we interact with the world
(2) Safety in the Engineering 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: - 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 - Discussion on the importance of safety
(3) Applying the Engineering Design Process - Research & Analysis	12-14 Weeks	Students will begin applying the design process to solve a problem they have deemed "worth solving" and of interest to them. They will learn about criteria, constraints, ergonomics, sustainable design, and communication. They will read, interpret, and use technical drawings as well as c-sketching. Students will conduct scholarly research on the topics surrounding their design. Activities/ Projects: - Identify problems worth solving in your life - Original student project that applies the Engineering Design Process - Isometric and Orthographic Sketching, Hand-drawing and Computer-Assisted Design (Inventor or Onshape) - Peer Reviewing and self-assessment - Students meet with and interview experts related to their field of research and their project topics - Independently present a written document and oral presentation of the Research & Design Proposal for their year-long engineering design project
(4) Applying the Engineering Design Process - Iterative Design Prototyping	12-14 Weeks	Students will learn about 3D modeling, rapid prototyping, systems, manufacturing, and human-centered design. 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. They will gather peer, teacher, and field expert feedback to continue improving their designs through multiple iterations .

		Activities/Projects: - Apply the steps "Research" and "Brainstorming" from the Engineering Design Process to the steps "Develop Solutions/ Build A Model" - Use CAD software, rapid prototyping (i.e. laser cutting, 3D printing) or alternative methods to create a final prototype and finished solution design - Gather teacher, peer, and field expert feedback
(5) Community Engagement	5-6 Weeks	Students will extend their learning by engaging with their community to present their Final Projects at public events. They will create visual aid displays and a final portfolio to share their documented research and design process. Activities/Projects: - Present Final Project at a Science Fair, Symposium, or similar public event - Illicit community feedback - Present Final Project to students in other classes (i.e. Intro to Innovation & Design) and younger students (i.e. Middle Schoolers)

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.	