Innovative Computer Design II

9th-12th

Prepared by:

Danielle Vandenberghe

Superintendent of Schools:

Marie C. Cirasella, Ed.D.

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Innovative Computer Design II

Course Description: This course introduces students to principles in STEM (Science Technology Engineering and Math) and Design. Students will learn how computer software and rapid prototyping processes, such as 3D printing, can be used to design and create products, ranging from car parts and smartphone cases to graphics, fashion accessories, and prosthetics. This is a project-based course where students will be immersed in the design process as it relates to identifying and solving real-world problems.

Course Sequence:

Unit 1: Engineering and Safety
Unit 2: Design
Unit 3: Renewable Energy and Sustainable Design
Unit 4: Design Challenge

Unit 1 - Overview	
Content Area: Computer Science	
Unit Title: Engineering and Safety	
Grade Level: 9-12	
Core Ideas: Students will be introduced to the engineering design process and the different areas of engineering. They will learn about the importance of outcomes of technological designs and the resources of technology. Students will learn how to properly and safely use technological tools and machinery (i.e. Exacto Knife, Drill Press, Sander, Laser Cutter, 3D Printer, Heat Press, Hot Glue Gun, etc.) as well as demonstrate an understanding of the OSHA Safety Regulations and proper clothing/personal protective equipment. Lastly, students will learn about different engineering designs and complete their own tasks.	
Unit 1 - Standards	
Standards (Content and Technology)**:**	
CPI#:	**Statement:**
Computer Science and Design Thinking	
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)
Career Readiness, Life Literacies, and Key Skills	
9.1.12.CFR.3	Research companies with corporate governance policies supporting the common good and human rights.
9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, and drug tests) used by employers in various industry sectors.
9.3.12.AC.3	Comply with regulations and applicable codes to establish and manage a legal and safe workplace
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
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 (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
9.4.12.TL.2	Generate data using formula-based calculations in a spreadsheet and draw conclusion 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 (e.g., 7.1.AL.IPERS.6).
Intercultural Statements (Amistad, Holocaust, LGBT, etc...)	
LGBTQ and Disabilities NJSA 18A:35-4.35	Explore engineers in the LGBTQ community, including but not limited to Allan Hellman, Sally Ride, Alan Joyce, Peter Landin, and Christopher Strachey
Amistad Law NJSA 18A:35-4.43	Explore African-American engineers, including but not limited to Annie Easley, Elijah McCoy, Jerry Lawson, Ursula Burns, and Guion Bluford
Holocaust Law NJSA 18A:35-28	Explore Jewish engineers, including but not limited to Marjem Chatterton, Judith Love Cohen, Umberto Colombo, Ralph Baer, Yossi Gross, and Walter Freud

AAPI Law NJSA 18A:25-4.44	Explore Asian-American/Pacific Islander engineers, including but not limited to Ven te Chow, Rustum Roy, Fujio Matsuda, Thomas Lee and King-Sun Fu
Interdisciplinary Connection	
Math - MP1	Make sense of problems and persevere in solving them
Math - MP5	Use appropriate tools strategically
Science 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.
Science 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
History 6.1.12.SE.14.a	Explore the various ways women, racial and ethnic minorities, the LGBTQ community, and individuals with disabilities have contributed to the American economy, politics and society
Companion Standards	
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
Social and Emotional Learning	
Self-Awareness	● Examining prejudices and biases ● Having a growth mindset
Self-Management	● Exhibiting self-discipline and self-motivation ● Using planning and organizational skills
Social Awareness	● Taking others' perspectives ● Understanding the influences of organizations/systems on behavior
Relationship Skills	● Communicating effectively ● Practicing teamwork and collaborative problem-solving ● Showing leadership in groups
Responsible Decision-Making	● Demonstrating curiosity and open-mindedness ● Recognizing how critical thinking skills are useful both inside & outside of school

Unit Essential Question(s):

- What are 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?
- What are the safety considerations for the technological design process?
- How do I properly and safely use technological tools and machinery?
- How do we create a working environment that is safe, efficient, and meets regulations?
- How can we use mechanical advantage to our advantage in machines seen every day in the world around us?

Unit Enduring Understandings:

- Understand the Engineering Design Process and apply it to projects
- Understand different careers in engineering
- Be better problem solvers when it comes to engineering
- Understand how to use the tools of the classroom safely and be able to demonstrate it.
- Create a safe working environment
- Understand parts of mechanical parts and how they can work together.

Evidence of Learning

Formative Assessments:

- Do Now
- Teacher observations

- Questioning
- Quizzes
- Practice Programs
- Entry tickets
- Exit tickets
- Online games
- Discussions
- Homework

Summative/Benchmark Assessment(s):

- Projects
- Tests
- Chapter Review / Quizzes
- Chapter Assignments
- Labs
- Final Project

Alternative Assessments:

- Portfolio
- Projects
- Online tests / assignments

Resources/Materials:
Paper, Rulers, Tape, Colored Markers, Wood
Machinery: Sander, Laser Cutter, 3D printer, Hot Glue Gun, Heat Press
Design Technology: Adobe Photoshop, Adobe Illustrator, Onshape (or similar CAD program), Canva
https://www.teachengineering.org/k12engineering/designprocess
https://sphero.com/pages/blueprint-content

Key Vocabulary: constraint, engineering desing loop, iterative, requirement, target population, code, ratent, standard, brainstorming, computer-aided design, dynamic analysis, engineering analysis, static analysis, manufacturing, model, rapid prototyping, engineering drawing, machinist, goggles, safety measures, laser cutter, 3d printer, heat press, hot glue gun, sander, lever, fulcrum, effort force, resitance force, mechanical linkage, degrees of freedom, slider, link, node, pivot, fixed point, pantograph, complex machine, pulley, block and tackle, hook and trolley block, screw, lead screw, mechanical advantage, ideal mechanical advantage, actual mechanical advantage, gear, gear train, gear ratio, driven gear, driving gear, idler gear, rotational speed, torque, compound gear

Suggested Pacing Guide

Lesson Name/Topic	Student Learning Objective(s)	Suggested Tasks/Activities:	Day(s) to Complete
Engineering Design Process	● Define and describe technology and its applications. ● Distinguish technology from science (natural world vs human-made world) ● Describe and understand the design process and how it can be used to solve problems	● Review the engineering design process and discuss how it applies to solving problems. ● Complete a review game to check student understanding	1-2 class periods

Creative Engineering Design	• 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.
		• Work through the steps of the Creative Engineering Design process in the context of a project
		  ○ Identify the need
		  ○ Research the problem
		  ○ Brainstorm possible solutions
		  ○ Select a promising solution using engineering analysis
		  ○ Create and test a prototype
		  ○ Improve and redesign/ manufacturer a product
			7-8 class periods

Safety	• Properly and safely use and maintain tools and machinery used in the project design • Understand OSHA Safety regulations • Demonstrate and understanding of clothing requirements and personal protective equipment • Identify the location of items needed in case of emergency • Identify the tools and where they are located in the classroom	• Discussion on the importance of safety • Demonstration of using machinery following safety rules • Written test on Safety • Explain orally how to use the equipment	1 week

Simple Machines - Introduction to Engineering	• Identify and explain the function of each simple machine
	• Build working models of each simple machine
	• Calculate the ideal mechanical advantage (IMA) in their mechanical systems
	• Combine multiple simple machines into a compound machine to complete a task
		• Complete the following lessons with hands-on activities
		  ○ Introducing the lever
		  ○ Introducing the common linkages
		  ○ Introducing the pulley
		  ○ Introducing the screw
		  ○ Introducing gears
		  ○ Pantograph art machines with levers and linkages
		  ○ Pulleys and construction cranes
		  ○ Mechanical advantage in a motorcycle lift
		  ○ Speed and Torgue with compound gears
			4 weeks

		○ Animal motion profiles	

Teacher Notes:

Additional Resources:

Differentiation/Modification Strategies

Students with Disabilities	English Language Learners	Gifted and Talented Students	Students at Risk	504 Students
• Allow errors • Rephrase questions, directions, and explanations • Allow extended time to answer questions and permit drawing as an explanation • Accept participation on any level, even one word • Consult with Case Managers and follow IEP accommodations/ modifications	• Assign a buddy, same language or English speaking • Allow errors in speaking • Rephrase questions, directions, and explanations • Allow extended time to answer questions • Accept participation at any level, even one word	• Provide extension activities • Build on students' intrinsic motivation • Consult with parents to accommodate students' interests in completing tasks at their level of engagement	• Provide extended time to complete tasks • Consult with Guidance Counselors and follow I&RS procedures/action plans • Consult with other members of the 7th grade team for specific behavior interventions • Provide rewards as necessary	• Allow errors • Rephrase questions, directions, and explanations • Allow extended time to answer questions and permit drawing as an explanation • Accept participation on any level, even one word • Consult with Case Managers and follow IEP accommodations/ modifications • Assign a buddy, same language or English speaking

Unit 2- Overview	
Content Area: Computer Science	
Unit Title: Design	
Grade Level: 9-12	
Core Ideas: Students will apply the design process to solve different design challenges while learning to design for the laser cutter, 3D printer, Cricut, and sublimation printer. Students will also focus on creating wearable technology and rapid prototyping. They will learn about criteria, constraints, ergonomics, sustainable design, and communication.	
Unit 2 - Standards	
Standards (Content and Technology)**:**	
CPI#:	**Statement:**
Computer Science and Design Thinking	
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.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.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
Career Readiness, Life Literacies, and Key Skills	
9.1.12.CFR.3	Research companies with corporate governance policies supporting the common good and human rights.
9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, and drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
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 (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)
9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
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 (e.g., 7.1.AL.IPERS.6).
Intercultural Statements (Amistad, Holocaust, LGBT, etc...)	
LGBTQ and Disabilities NJSA 18A:35-4.35	Explore engineers in the LGBTQ community, including but not limited to Allan Hellman, Sally Ride, Alan Joyce, Peter Landin, and Christopher Strachey
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Interdisciplinary Connection	
Math - MP1	Make sense of problems and persevere in solving them
Math - MP5	Use appropriate tools strategically
Science 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.
Science HS-ETS1-3	Evaluate a solution to a complext real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, realiablity, and aesthetics, as well as possible social, cultural, and environmental impacts.
History 6.1.12.SE.14.a	Explore the various ways women, racial and ethnic minorities, the LGBTQ community, and individuals with disabilities have contributed to the American economy, politics and society
Companion Standards	
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.
Social and Emotional Learning	
Self-Awareness	● Examining prejudices and biases ● Having a growth mindset
Self-Management	● Exhibiting self-discipline and self-motivation ● Using planning and organizational skills
Social Awareness	● Taking others' perspectives ● Understanding the influences of organizations/systems on behavior
Relationship Skills	● Communicating effectively ● Practicing teamwork and collaborative problem-solving ● Showing leadership in groups
Responsible Decision-Making	● Demonstrating curiosity and open-mindedness ● Recognizing how critical thinking skills are useful both inside & outside of school

Unit Essential Question(s):	**Unit Enduring Understandings:**
● How can we apply the design process to our designs? ● How can we use design software to create designs for laser or Cricut cutting and or 3d printing? ● How can we use our gained technology knowledge to create meaningful design?	● Understand how the design process can be used when we are designing ● Be able to create designs for the laser cutter, Cricut and 3d printer ● Be able to use the laser cutter, Cricut and 3d printer to print our designs ● Start creating designs that have meaning or purpose

Evidence of Learning

Formative Assessments:

- Do Now
- Teacher observations
- Questioning
- Quizzes
- Practice Programs
- Entry tickets
- Exit tickets
- Online games
- Discussions

- Homework

Summative/Benchmark Assessment(s):
- Projects
- Tests
- Chapter Review / Quizzes
- Chapter Assignments
- Labs
- Final Project

Alternative Assessments:
- Portfolio
- Projects
- Online tests / assignments

Resources/Materials:
Paper, Rulers, Tape, Colored Markers, Wood Machinery: Sander, Laser Cutter, 3D printer, Hot Glue Gun, Heat Press
Design Technology: Adobe Photoshop, Adobe Illustrator, Onshape (or similar CAD program), Canva
https://tryengineering.org/teachers/lesson-plans/
https://www.onshape.com/en/

Key Vocabulary: Vector drawings, Gemoetric shapes, Outlines, SVG file type, Document, View Cube, Zoom, Pan, Rotate, Assembly, Mate, Plane, View Cube, Add, Extrude, Feature, Loft, Remove, Revolve, Revolve Mate, Sweep, Interference, Dimension, Sketch, Constrained, Diameter, Radius, Origin, Midpoint, Mirror, Offset, Construction. Metric units, Bearing, Design Intent

Suggested Pacing Guide

Lesson Name/Topic	Student Learning Objective(s)	Suggested Tasks/Activities:	Day(s) to Complete
SVG Files	• Learn how to create SVG files using Adobe Illustrator • Be able to use the laser cutter with SVG files • Be able to use the Cricut machine with SVG files • Create designs from given specifications	• Create a logo that can be used for both machines. • Create a "shipping" box that can be cut on the laser cutter • Create a custom shirt/and or cup on the Cricut	2 weeks
3D Printing	• Learn about the CAD software environment that will be used • Be able to create designs to be 3d printed • Create rapid-prototypes from given specifications	• Welcome to Cad - Learning the environment • Design your first 3d print • Learn More Tools in Cad • Design more complex 3d printable items	3 weeks

Teacher Notes: The 3d Printing curriculum will depend on what CAD environment is being used.

Additional Resources:

Differentiation/Modification Strategies

Students with Disabilities	English Language Learners	Gifted and Talented Students	Students at Risk	504 Students
• Allow errors	• Assign a buddy, same language or English speaking	• Provide extension activities	• Provide extended time to complete tasks	• Allow errors

• Rephrase questions, directions, and explanations • Allow extended time to answer questions and permit drawing as an explanation • Accept participation on any level, even one word • Consult with Case Managers and follow IEP accommodations/ modifications	• Allow errors in speaking • Rephrase questions, directions, and explanations • Allow extended time to answer questions • Accept participation at any level, even one word	• Build on students' intrinsic motivation • Consult with parents to accommodate students' interests in completing tasks at their level of engagement	• Consult with Guidance Counselors and follow I&RS procedures/action plans • Consult with other members of the 7th grade team for specific behavior interventions • Provide rewards as necessary	• Rephrase questions, directions, and explanations • Allow extended time to answer questions and permit drawing as an explanation • Accept participation on any level, even one word • Consult with Case Managers and follow IEP accommodations/ modifications • Assign a buddy, same language or English speaking

Unit 3 - Overview	
Content Area: Computer Science	
Unit Title: Renable Energy and Sustainable Design	
Grade Level: 9-12	
Core Ideas: Students will learn about renable energy and sustainable design. Inventions made from this unit are representations of energy collected from renewable resources through simulated reproduction while consuming responsibly. Throughout this unit students will learn about sustainable design and how technology can help the environment	
Unit 3 - Standards	
Standards (Content and Technology)**:**	
CPI#:	**Statement:**
Computer Science and Design Thinking	
8.1.12.AP.6	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated problems.
8.1.12.AP.9	Collaboratively document and present design decisions in the development of complex programs.
8.2.12.ED.1	Use research to design and create a product or system and make modifications to increase optimization based on feedback
8.2.12.ED.4	Design a product 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.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of chosen product.
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.
Career Readiness, Life Literacies, and Key Skills	
9.1.12.CFR.3	Research companies with corporate governance policies supporting the common good and human rights.
9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, and drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3	Investigate new challeneges 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 (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources approriately
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
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 (e.g., 7.1.AL.IPERS.6).
Intercultural Statements (Amistad, Holocaust, LGBT, etc...)	
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Interdisciplinary Connection	
Math - MP1	Make sense of problems and persevere in solving them

Math - MP5	Use appropriate tools strategically
Science HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
History 6.1.12.SE.14.a	Explore the various ways women, racial and ethnic minorities, the LGBTQ community, and individuals with disabilities have contributed to the American economy, politics and society
Companion Standards	
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.
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Self-Management	● Exhibiting self-discipline and self-motivation ● Using planning and organizational skills
Social Awareness	● Taking others' perspectives ● Understanding the influences of organizations/systems on behavior
Relationship Skills	● Communicating effectively ● Practicing teamwork and collaborative problem-solving ● Showing leadership in groups
Responsible Decision-Making	● Demonstrating curiosity and open-mindedness ● Recognizing how critical thinking skills are useful both inside & outside of school

Unit Essential Question(s):	**Unit Enduring Understandings:**
● How can Hydroelectricity, Wind Energy and Solar Power be used with technology? ● How can technology help with climate change? ● Why is sustainability so important in the design process? ● What meaningful problems need to be and can be solved by technological innovation?	● Understand how technology can be used with hydroelectric, Wind energy, and Solar Power ● How technology can help with climate change ● Why sustainablity is important to the design process.

Evidence of Learning

Formative Assessments:

- Do Now
- Teacher observations
- Questioning
- Quizzes
- Practice Programs
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- Exit tickets
- Online games
- Discussions
- Homework

Summative/Benchmark Assessment(s):

- Projects
- Tests
- Chapter Review / Quizzes

- Chapter Assignments
- Labs
- Final Project

Alternative Assessments:
- Portfolio
- Projects
- Online tests / assignments

Resources/Materials:	**Key Vocabulary:**
● Paper, Rulers, Tape, Colored Markers, Wood, Strawbees, Microbits ● Machinery: Sander, Laser Cutter, 3D printer, Hot Glue Gun, Heat Press Design Technology: Adobe Photoshop, Adobe Illustrator, Onshape (or similar CAD program), Canva ● https://tryengineering.org/teachers/lesson-plans/ ● https://www.onshape.com/en/	Sustainable design, Hydroelectricty Energy, Hydroelectricity, Kinetic Energy, Potential Energy, Renewable Energy, Reservoir, Persevere, Iteration, Crop Rotation, Irrigation, Decompose, Spillway, Turbine, Laborious, Intake, Precipitation, Submerged, Indigenous Wind Engergy,, Air Masses, Beautiful Wind Scale, Gale, Trade Winds, Westerlies, Latitude, Non-Renewable, Vertical, Horizontal, Solar Power, Solar Energy, Photovoltaic Effect, Solar Array, Nuclear Fusion, Photosphere, Photosynthesis, Fossil Fuels, Habitable, Passive, Concentrate

Suggested Pacing Guide

Lesson Name/Topic	**Student Learning Objective(s)**	**Suggested Tasks/Activities:**	**Day(s) to Complete**
Renewable Energy - Hydroelectricy	● Explain the importance of inventions and inventing in human society. ● Explore old mechanical inventions using water power as a source of renewable energy for laborious tasks. ● Evaluate the advantages and disadvantages of hydroelectric power. ● Experiment with friction to create a spinning machine to move a structure to simulate a grindstone for grain. ● Invent a design to address the Sustainable Development Goals.	● Create and research Hydropower Inventions ● Reflect upon your inventions using the engineering design process ● How does this help with sustainable design	2 days
Renewable Energy - Wind Energy	● Recognize that fossil fuels are derived from the earth and that their use affects the environment. ● Make an argument for wind energy as a sustainable alternative to fossil fuels. ● Explain the process of energy transfer from the wind to another object through the use	● Create and research Wind Power Inventions ● Reflect upon your inventions using the engineering design process ● How does this help with sustainable design	2 days

	of windmills and/or wind turbines. ● Articulate ways that people have utilized wind energy throughout history. ● Compare and contrast various wind zones on earth. ● Describe how wind energy helps to address climate change. ● Create wind turbine prototypes that harness wind energy. ● Evaluate future uses and applications of wind energy. ● Differentiate between careers in wind energy.		
Renewable Energy - Solar Energy	● Understand that light transfers energy from place to place. ● Investigate solar energy as a possible solution for fossil fuel dependence. ● Explore the transformation of energy from one form to another. ● Recognize that energies and fuels come from natural sources and these affect our environment. ● Compare types of energy solutions and describe how some energies are renewable and some are limited.	● Create and research Solar Power Inventions ● Reflect upon your inventions using the engineering design process ● How does this help with sustainable design	2 days

Teacher Notes:

Additional Resources:

Differentiation/Modification Strategies

Students with Disabilities	English Language Learners	Gifted and Talented Students	Students at Risk	504 Students
• Allow errors • Rephrase questions, directions, and explanations • Allow extended time to answer questions and permit drawing as an explanation • Accept participation on any level, even one word	• Assign a buddy, same language or English speaking • Allow errors in speaking • Rephrase questions, directions, and explanations • Allow extended time to answer questions	• Provide extension activities • Build on students' intrinsic motivation • Consult with parents to accommodate students' interests in completing tasks at their level of engagement	• Provide extended time to complete tasks • Consult with Guidance Counselors and follow I&RS procedures/action plans • Consult with other members of the 7th grade team for specific behavior interventions	• Allow errors • Rephrase questions, directions, and explanations • Allow extended time to answer questions and permit drawing as an explanation • Accept participation on any level, even one word • Consult with Case Managers and follow

• Consult with Case Managers and follow IEP accommodations/ modifications	• Accept participation at any level, even one word		• Provide rewards as necessary	IEP accommodations/ modifications • Assign a buddy, same language or English speaking

Unit 4 - Overview	
Content Area: Computer Science	
Unit Title: Design Challenge	
Grade Level: 9-12	
Core Ideas: 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.	
Unit 4 - Standards	
Standards (Content and Technology)**:**	
CPI#:	**Statement:**
Computer Science and Design Thinking	
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.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.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.2	Redesign an existing product to improve form or function
8.2.12.EC.3	Synthesize data, analyze trends and draw conclusions regarding the effect of technology on the individual, culture, society, and environment and share this information with the appropriate audience.
Career Readiness, Life Literacies, and Key Skills	
9.1.12.CFR.3	Research companies with corporate governance policies supporting the common good and human rights.
9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, and drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3	Investigate new challeneges 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 (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)
9.4.12.IML.4	Assess and critique the appropriateness and impace 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.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
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 (e.g., 7.1.AL.IPERS.6).
Intercultural Statements (Amistad, Holocaust, LGBT, etc...)	
LGBTQ and Disabilities NJSA 18A:35-4.35	Explore engineers in the LGBTQ community, including but not limited to Allan Hellman, Sally Ride, Alan Joyce, Peter Landin, and Christopher Strachey
Amistad Law NJSA 18A:35-4.43	Explore African-American engineers, including but not limited to Annie Easley, Elijah McCoy, Jerry Lawson, Ursula Burns, and Guion Bluford
Holocaust Law NJSA 18A:35-28	Explore Jewish engineers, including but not limited to Marjem Chatterton, Judith Love Cohen, Umberto Colombo, Ralph Baer, Yossi Gross, and Walter Freud

AAPI Law NJSA 18A:25-4.44	Explore Asian-American/Pacific Islander engineers, including but not limited to Ven te Chow, Rustum Roy, Fujio Matsuda, Thomas Lee and King-Sun Fu
Interdisciplinary Connection	
Math - MP1	Make sense of problems and persevere in solving them
Math - MP5	Use appropriate tools strategically
Science HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
History 6.1.12.SE.14.a	Explore the various ways women, racial and ethnic minorities, the LGBTQ community, and individuals with disabilities have contributed to the American economy, politics and society
Companion Standards	
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.
Social and Emotional Learning	
Self-Awareness	● Examining prejudices and biases ● Having a growth mindset
Self-Management	● Exhibiting self-discipline and self-motivation ● Using planning and organizational skills
Social Awareness	● Taking others' perspectives ● Understanding the influences of organizations/systems on behavior
Relationship Skills	● Communicating effectively ● Practicing teamwork and collaborative problem-solving ● Showing leadership in groups
Responsible Decision-Making	● Demonstrating curiosity and open-mindedness ● Recognizing how critical thinking skills are useful both inside & outside of school

Unit Essential Question(s):

- How can we solve a meaningful problem by using the design process to meet the needs of the population/consumer?
- What is Design Thinking and how does it incorporate empathy into the design process?
- What real-world adaptive and assistive technologies currently exist, and what improvements are being made?

Unit Enduring Understandings:

- Use the design process in creating a prototype that meets the needs of a meaningful problem.

Evidence of Learning

Formative Assessments:

- Do Now
- Teacher observations
- Questioning
- Quizzes
- Practice Programs
- Entry tickets
- Exit tickets
- Online games
- Discussions
- Homework

Summative/Benchmark Assessment(s):
- Projects
- Tests
- Chapter Review / Quizzes
- Chapter Assignments
- Labs
- Final Project

Alternative Assessments:
- Portfolio
- Projects
- Online tests / assignments

Resources/Materials:	**Key Vocabulary:**
● Paper, Rulers, Tape, Colored Markers, Wood, Strawbees, Microbits ● Machinery: Sander, Laser Cutter, 3D printer, Hot Glue Gun, Heat Press Design Technology: Adobe Photoshop, Adobe Illustrator, Onshape (or similar CAD program), Canva ● https://tryengineering.org/teachers/lesson-plans/ ● https://www.onshape.com/en/	Sustainable design, Prototype, Rapid prototype, Engineering Design process

Suggested Pacing Guide

Lesson Name/Topic	**Student Learning Objective(s)**	**Suggested Tasks/Activities:**	**Day(s) to Complete**
Design Project	● 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	● Research a population and design a device/game/puzzle that would benefit them (i.e. create an assistive techology for Parkinson's patiends; puzzle for preschool students, a device to help with climate change etc) ● Create a dynamic prototype of the device/game/puzzle using the design process ● Create a graphic and oral presentation of the design	3 weeks

Teacher Notes: Project options should be avaliable for students

Additional Resources:

Differentiation/Modification Strategies

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