Pascack Valley Regional High School District

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

Course Name: Robotics and Game Design
Grades 9 - 12

Born On: August 2019
Revised On: July 2022
Current Revision: August 2023
Board Approved: 8/28/2023

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.

Robotics & Game Design			
Unit 1: Robotics and Introduction to Electronics			
Time Allotted: Approximately 2-3 Weeks			
New Jersey Student Learning Standards (NJSLS)			
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. 8.2.12.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.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.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.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.1: Explain how different groups can contribute to the overall design of a product.			
Essential Questions	**Student Learning Objectives**	**Suggested Tasks/Activities**	**Evidence of Learning (Assessment)**
➢ How has robotics developed over the years? ➢ What are robotics, and where do they appear in everyday life? ➢ What is Ohm's Law?	➢ Describe the basic uses of robotics in our everyday lives and society ➢ Demonstrate the basic workings of a robot ➢ Demonstrate the relationship between voltage, current and resistance?	➢ View media to demonstrate how robotics are used by professionals and in corporations (i.e. IBM programmed a robotic arm to deal cards) ➢ Project: Build a circuit (Hands-on and Virtual)	➢ Presentation to demonstrate the uses of robotics in our everyday lives and society ➢ Product will be assessed using a teacher-developed rubric
Resources/Materials	- Online breadboard simulator, Electronic components, CircuitLab, TinkerCAD		
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.		
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	Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. 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 parts of a circuit. ● Restate project design steps aloud before hands-on work. ● Assign a native language partner.	● Provide adequate space and time for circuit creation. ● Provide additional steps/scaffolds. . ● Utilize graphics to enhance descriptions.	● Incorporate student choice. ● Consistent daily structured routine. ● Provide peer mentoring to improve techniques.	● Create a more complex circuit. ● Deconstruct a more complex circuit. ● Conduct more in-depth research in the uses of robotics.

Robotics & Game Design
Unit 2: Introduction to Programming Electronics
Time Allotted: 2-3 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.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.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.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.
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.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 do you initialize a program? ➢ What are the parts of a simple program and correct syntax? ➢ How does the Arduino software communicate with the boards?	➢ Draw and describe a working circuit ➢ Differentiate Text/Line Code vs. Block code ➢ Define and use methods and comments ➢ Program a robot using 'block' and 'line' code ➢ Code written to include methods, loops and comment each line of code ➢ Learn to code and 'de-bug' their program (syntax errors)	➢ Draw a schematic with electronic symbols ➢ Program a Robot ➢ Program an Arduino to make an LED blink or a buzzer sound	➢ Teacher-developed rubrics to assess the schematics and products
Resources/Materials	- Arduinos, Robots, Virtual Circuit Online Program		
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.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.		
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
● Use sentence/paragraph frames to assist with writing reports and project designs. ● Assign a native language partner. ● Create a world wall with programming vocabulary.	● Provide extended time for written responses and reports. ● Scaffolded explanations for proper use of equipment. ● Get a written list of instructions. ● Receive large project as smaller tasks with individual deadlines.	● Provide an outline for programming tasks. ● Provide extended time for written responses and reports. ● Encourage student choice.	● Create an original program. ● Compare and contrast different coding program. ● Lead the class in the deciphering of new learning.

Robotics & Game Design			
Unit 3: Using Motors and Servos to Create Movement			
Time Allotted: 2-3 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.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.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.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. 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.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 use motors and servos to create movement?	➢ Control an output device with code ➢ Code a board (i.e. Arduino) that can be connected to a robot ➢ Use a shield to control a motor or Servo to increase/decrease the motor's revolutions per minute	➢ Incorporate a motor into a circuit to perform a specific movement ➢ Incorporate a shield (hardware) into an Arduino	➢ Device will be assessed using a teacher-generated rubric
Resources/Materials	- Arduinos, Servo Motors, Multimeters, Breadboards		
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.		
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. 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**
● Usual visual displays and demonstrations to enhance verbal instructions. ● Provide extended time for written responses and reports. ● Assign a native language partner.	● Use sentence/paragraph frames to assist with writing reports. ● Provide extended time for written responses and reports.	● Provide an outline for projects and research tasks. ● Provide extended time for projects.	● Compare and contrast two programming methodologies. ● Interview a professional in the field of robotics or programming about what types of projects their work on in their careers.

Robotics & Game Design			
Unit 4: Safety			
Time Allotted: 2-3 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 design process?	➢ Properly and safely use and maintain tools and machinery used in the project design (ex. Exacto Knife, Bandsaw, Drill Press, Belt Sander, Hot Glue Gun, etc.) ➢ Understand OSHA safety regulations ➢ Demonstrate an understanding of clothing requirements, personal protective equipment	➢ Cut an item to size using a sander, bandsaw, drill press ➢ Soldering a circuit board	➢ Written Test on Safety ➢ Product will be assessed using a teacher-generated rubric
Resources/Materials	- Wood - Machinery: Sander, Bandsaw, Drill Press - Solder, soldering irons - 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. NJSLSA.SL2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.		
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. 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**
● Assign a native language partner. ● Provide an outline for safety considerations. ● Display labeled images of designs and parts. ● Restate design steps aloud before project activity.	● Provide adequate space for movement. ● 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	● Break production creation into smaller pieces. ● Conference with teacher during the learning process.	● Write a report highlighting the importance of safety considerations.

Robotics & Game Design
Unit 5: Robotics Task Design Challenge
Time Allotted: Approximately 4-5 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. 8.2.12.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.NT.2: Redesign an existing product to improve form or function.

Essential Questions	**Student Learning Objectives**	**Suggested Tasks/Activities**	**Evidence of Learning (Assessment)**
➢ How do you create and control movement? ➢ How can materials be joined together to allow movement?	➢ Design and create a device with evidence of a system ➢ Demonstrate the relationship between structure and function	➢ Work collaboratively to brainstorm design ideas ➢ Use the design process to construct a robotic system	➢ Ongoing feedback and to assess inputs/processes/ outputs and feedback (loops) ➢ Product and design process

➢ What are the different types of power? ➢ What is a system? ➢ How do systems work together and complement each other?	➢ Utilize pneumatic and hydraulic power in the construction of a device	(examples may include a moving vehicle or hydraulic arm)	assessed using a teacher-generated rubric.
Resources/Materials	- Materials for system construction such as cardboard, syringes		
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.		
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. 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**
● Assign a native language partner. ● Provide an outline documenting the design process.	● Provide adequate space for movement. ● Work with a peer to develop a less complex product. ● Utilize visuals to enhance and simplify descriptions.	● Break project into smaller pieces. ● Conference with teacher during the planning process. ● Use a framework for the design process.	● Develop more complex projects individually and in collaboration with peers. ● Write a report on how technology has impacted robotics.

Robotics & Game Design			
Unit 6: Authentic Robotics Design Challenge			
Time Allotted: Approximately 6-8 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. 8.2.12.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.NT.2: Redesign an existing product to improve form or function.			
Essential Questions	**Student Learning Objectives**	**Suggested Tasks/Activities**	**Evidence of Learning (Assessment)**
➢ What problem(s) can robots solve? ➢ How can robots and controls be used in a 'real world' application? ➢ Can you determine, design and prototype multiple solutions? ➢ How do you control a motor with a gear box?	➢ Utilize robots to solve a real-world problem ➢ Design and prototype multiple solutions to a design challenge	➢ Design and build a gearbox using Lego gears for both speed and torque ➢ Power your device on a flat surface for speed and power device on ramp for torque/power ➢ Students will be given a maze/path for which they must design a robot to move through	➢ Ongoing assessment of prototypes and iterations ➢ Final robot meets design criteria ➢ Performance of device (i.e. is able to complete the challenge course)
Resources/Materials	- Ozobots, Underwater & Land Robots, Vex Kits, Arduinos, Breadboards, Electronic Components, Wire, Solder		
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.
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. 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**
● Assign a native language partner. ● Provide an outline for documenting the design process. ● Use visual to enhance and simplify the design process.	● Provide adequate space for movement. ● Work with a peer to develop a simpler design.	● Conference with teacher during the planning process. ● Break design challenge into smaller pieces.	● Create a more in-depth design/product. ● Revise and reiterate original design.

Robotics & Game Design			
Unit 7: Introduction to Game Design			
Time Allotted: 2-3 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.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.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. 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)**
➢ What is a game? ➢ What are the essential 'elements' to a game design? ➢ What do video game designers do? ➢ Why do we need 'rules' 'concepts' or 'components' in games?	➢ Differentiate between mobile and desktop games/applications ➢ Distinguish between the roles of a 'designer' vs. a 'developer' ➢ Explore the growth potential for the game design profession and industry ➢ Identify leading local, national and global game design companies	➢ Digital presentation(s) ➢ Explore game design programs and provide the benefits and drawbacks of each ➢ Guest speakers/professionals both in-school and field trips to various businesses	➢ Assess projects and presentations using a teacher- developed rubric.
Resources/Materials	- Python, Unity, 3D Studio Max, Blender, Photoshop, Illustrator, Stencyl and various other applications		
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.
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	Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. 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**
● Assign a native language partner.	● Provide additional time for project creation. ● Provide alternative projects. .	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to attend class performances. ● Provide peer mentoring to improve techniques.	● Lead the class in the creation of a game concept. ● Create a more complex game concept that includes multiple components.

Robotics & Game Design			
Unit 8: Application of Game Design			
Time Allotted: Approximately 6-8 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.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.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. 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 use storyboards to create and communicate game design concepts? ➢ How can we use computer applications to create a game and its components?	➢ Design and create a concept of a game (treatment and script to the game) ➢ Utilize 'action' blocks, arguments and nesting ➢ Create 2D and 3D assets ➢ Utilize a computer application to design an avatar and virtual game environment	➢ Work in teams to develop game concepts ➢ Create and present a storyboard to depict a game concept ➢ Create/compile a digital portfolio to document the game-design process.	➢ Completed storyboard will be assessed using teacher-developed rubrics. ➢ Digital Portfolio will be assessed using teacher-developed rubrics.
Resources/Materials	- Python, Unity, 3D Studio Max, Blender, Photoshop, Illustrator, Stencyl and various other applications		
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.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.		

	NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
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	Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. 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**
● Use sentence/paragraph frames to assist with project and portfolio creation. . ● Assign a native language partner. ● Provide extended time for written responses and reports.	● Provide extended time for written responses and reports.	● Provide an outline for journal entries and research tasks. ● Provide extended time for written responses and reports. ● Encourage student choice of topics.	● Engage a more complex iteration or programming methodology.

Scope and Sequence: Robotics & Game Design

Unit Title	Unit Length	Unit Summary
(1) Robotics & Introduction to Electronics	2-3 Weeks	Students will discuss the basic uses of robotics in our everyday lives as well as demonstrate the basic workings of a robot. They will learn about Ohm's Law and create simple circuits (both hands-on and virtual). 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) ➢ Project: Build a circuit (Hands-on and Virtual)
(2) Introduction to Programming Electronics	2-3 Weeks	Students will learn about the parts of a program and how to use Arduino software. They will explore schematic drawing, circuit creation, and digital programming (Ozobot robot and Arduino). Activities/Projects: - Draw a schematic with electronic symbols - Program a Robot - Program an Arduino to make an LED blink or a buzzer sound
(3) Using Motors and Servos to Create Movement	2-3 Weeks	Students will explore using motors to create movement by controlling an Arduino board's outputs with code. Activities/ Projects: - Incorporate a motor into a circuit to perform a specific movement - Incorporate a shield (hardware) into an Arduino
(4) Safety	2-3 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, Soldering Iron 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 orally how to use the equipment, and will complete a hands-on assessment with a single-point grading rubric. Activities/Projects: - Cut an item to size using a sander, bandsaw, drill press - Soldering a circuit board
(5) Robotics Task Design Challenge	4-5 Weeks	Students will use pneumatic and hydraulic power in the design of a device within a system. Activities/Projects: - Work collaboratively to brainstorm design ideas - Use the design process to construct a robotic system (examples may include a moving vehicle or hydraulic arm)

(6) Authentic Design Challenge	6-8 Weeks	Students will focus on designing, prototyping, and building a robot to solve a problem in a real- world application. Activities/Projects: - Design and build a gearbox using Lego gears for both speed and torque - Power your device on a flat surface for speed and power device on ramp for torque/power - Students will be given a maze/path for which they must design a robot to move through
(7) Introduction to Game Design	2-3 Weeks	Students will learn about the professional field of game design as well as the essential elements that are necessary when designing a game. Activities/Projects: - Digital presentation(s) - Explore game design programs and provide the benefits and drawbacks of each - Guest speakers/professionals both in-school and field trips to various businesses
(8) Application of Game Design	6-8 Weeks	Students will design and create a concept of a game and will utilize computer applications to create their avatar and game environment. They will program it using action blocks, arguments, and nesting as well as create 2-D and 3-D assets. The final portfolio will document their design process. Activities/Projects: - Work in teams to develop game concepts - Create and present a storyboard to depict a game concept - Create/compile a digital portfolio to document the game-design process

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 all of the established criteria.	
	I used the tools and applications correctly, handled them with care, and demonstrated professionalism.	