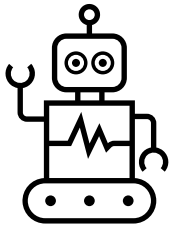
RIVER DELL REGIONAL SCHOOL DISTRICT



Content: STEM
Course: Robotics
Alignment: 2020 NJSLS
BOE Born On: August 21, 2023

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Introduction

In this elective course students will learn, through the use of robotics, about high level programming languages (in particular Java), the Engineering process, and the importance of communicating their ideas and results to others.

Mission

River Dell's curricula is designed to promote student achievement through the development of college and career readiness skills with a focus on equal access, inclusivity, and students' individuality. The mission of the curriculum is to prepare students to live and to work in a global society as active citizens and as contributing responsible community members. The program outlined in this curriculum engages students in broad-based, experiential learning that will enhance the development of critical thinking, communication, and analytical/relational skills. This curriculum is constructed to meet students at their developmental level and to support their progression through varied levels of engagement, skill attainment, exploration, inquiry, and analysis assisting them to mature into their authentic selves.

Vision

To succeed in this course, students will have to learn self awareness, relationship skills required for working in a group setting, responsible decision making, and self management in regards to their collaborative Robotic projects/designs.

Scope and Sequence

Overall:

Unit 1: Introductory Programming (10 Weeks)
Unit 2: Robot Drivetrain (4 Weeks)
Unit 3: Robot Interactions with its Surroundings (10 Weeks)
Unit 4: Capstone Competition (16 Weeks)

Technology

Technology integration is the seamless and effective use of 21st Century technology within an instructional setting to support students and teachers in the learning process with administrative support and evaluation:

Standards 8.1 Computer Science

- Computer Science, previously a strand entitled 'Computational Thinking: Programming' in standard 8.2 of the 2014 NJSLS-Technology, outlines a comprehensive set of concepts and skills, such as data and analysis, algorithms and programming, and computing systems.

Standard 8.2 Design Thinking

- This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts.

New Jersey Administrative Code Summary and Statues:

The following sections outline skills and special categories mandated by the state of New Jersey for all K-12 curriculum.

Integration of 21st Century Skills and Themes and Interdisciplinary Connections
District Boards of Education shall be responsible for the review and continuous improvement of curriculum and instruction based upon changes in knowledge, technology, assessment results, and modifications to the NJSLS, according to N.J.A.C. 6A:8-2.

1. District Boards of Education shall include interdisciplinary connections throughout the K–12 curriculum.
2. District Boards of Education shall integrate into the curriculum 21st Century themes and skills (N.J.A.C. 6A:8-3.1(c). Twenty-first Century themes and skills integrated into all content standards areas (N.J.A.C. 6A:8-1.1(a)3).

"Twenty-first Century themes and skills" means themes such as global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; learning and innovation skills, including creativity and innovation, critical thinking and problem solving, communication and collaboration; information, media, technology skills; and life and career skills, including flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility

Dissection Law: N.J.S.A. 18A:35-4.25 and N.J.S.A. 18A:35-4.24 authorizes parents or guardians to assert the right of their children to refuse to dissect, vivisect, incubate, capture or otherwise harm or destroy animals or any parts thereof as part of a course of instruction.

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.

Holocaust Law: N.J.S.A. 18A:35-28 Every Board of Education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

LGBT and Disabilities Law: N.J.S.A. 18A:35-4.35 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 (N.J.S.A.18A:35-4.36). A Board of Education shall have policies and procedures in place pertaining to the selection of instructional materials to implement the requirements of N.J.S.A. 18A:35-4.35.

Asian Americans and Pacific Islanders: N.J.S.A. S4021 This will ensure that the contributions, history, and heritage of Asian Americans and Pacific Islanders (AAPI) are included in the New Jersey Student Learning Standards for Social Studies for students in kindergarten through Grade 12.

Career Readiness, Life Literacies, and Key Skills (NJSLS-CLKS):

- Standard 9.1 Personal Financial Literacy: This standard outlines the important fiscal knowledge, habits, and skills that must be mastered for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially secure, and successful careers.
- Standard 9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.
- Standard 9.3 This standard outlines what students should know and be able to do upon completion of a CTE Program of Study.

- Standard 9.4 Life Literacies and Key Skills. This standard outlines key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Climate Change *(This will be modified based off of content)*
Standards in Action: Climate Change Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. Global climate change has already resulted in a wide range of impacts across New Jersey and in many sectors of its economy. The addition of academic standards that focus on climate change is important so that all students will have a basic understanding of the climate system, including the natural and human-caused factors that affect it. The underpinnings of climate change span across physical, life, as well as Earth and space sciences. The goal is for students to understand climate science to inform decisions that improve quality of life for themselves, their community, globally and to know how engineering solutions can allow us to mitigate impacts, adapt practices, and build resilient systems.

The topic of climate change can easily be integrated into science classes. At each grade level in which systems thinking, managing uncertainty, and building arguments based on multiple lines of data are included, there are opportunities for students to develop essential knowledge and skills that will help them understand the impacts of climate change on humans, animals, and the environment. For example, in the earlier grades, students can use data from firsthand investigations of the school-yard habitat to justify recommendations for design improvements to the school-yard habitat for plants, animals, and humans. In the middle grades, students use resources from New Jersey Department of Environmental Protection, the National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA), to inform their actions as they engage in designing, testing, and modifying an engineered solution to mitigate the impact of climate change on their community. In high school, students can construct models they develop of a proposed solution to mitigate the negative health effects of unusually high summer temperatures resulting from heat islands in cities across the globe and share in the appropriate setting.

Unit I: Introductory Programming (10 Weeks)	
Core Ideas	A computing system involves interaction among the user, hardware, application software, and system software. Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences. Choices individuals make about how and where data is organized and stored affects cost, speed, reliability, accessibility, privacy and integrity. Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks.
Essential Questions	What strategies can I use to become a more effective problem solver? How do computers help people solve problems? How do people and computers approach problems differently?
Enduring Understanding	Multiple levels of abstraction are used to write programs or create other computational artifacts. Computing facilitates exploration and the discovery of connections in information. Computing enables people to use creative development processes to create computational artifacts for creative expressions or to solve a problem.
Practice	• Collaborating around computing design • Recognizing and defining computational problems
Performance Expectations	• Compare the functions of application software, system software, and hardware. • Develop guidelines that convey systemic troubleshooting strategies that others can use to identify and fix errors. • Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue. • Decompose problems into smaller components through systematic analysis using consructs such as procedures, modules, and/or objects. • Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. • Evaluate and refine computational artifacts to make them more usable and accessible.

NJ Standards	Student Learning Objectives	Suggested Tasks/Activities	Resources/Materials
8.1.12.CS.3 8.1.12.CS.4 8.1.12.AP.4 8.1.12.AP.5 8.1.12.AP.6 8.1.12.AP.8	Students will be able to write Java programs and then apply that skill to affect a robot's behavior. The programming concepts to be covered are: • basic syntax • variables • data types • conditionals • loops • methods • objects	• As each new programming concept is presented a programming project will be assigned to test the students' proficiency. • Programming assignments will be graded based on a rubric distributed at the beginning of the year which emphasizes product delivery, understanding, code maintence, and reusability. • Students will also receive a bi-weekly grade evaluating career readiness skills.	Replit.com First Tech Challenge Programming Resourses STEM Robotics

Key Vocabulary	Progamming Language, Java, Flow Control, Loops, Algorithm, Methods, Functions, Variables, Data Types, Comments
Evidence of Learning	• Programming assignments will be graded based on a rubric distributed at the beginning of the year which emphasizes product delivery, understanding, code maintence, and reusability. • Students will also receive a bi-weekly grade evaluating career readiness skills.
Interdisciplinary Connections	English Language Arts • SL.9-10.1.A: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and *other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.* • SL.9-10.1.C: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. *Propel conversations* by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. Mathematics • A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. • A.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). Science • HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. • 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.
Diversity, Equity, & Inclusion	Amistad Law: N.J.S.A. 18A 52:16A-88: Students will learn how various people, particularly people of African American descent, have contributed to the field of robotics. LGBT and Disabilities Law: NJSA 18A: 34-4:35: Students will learn about how robotics have impacted the lives of those with disabilities and other physical afflictions.
Computer Science and Design Thinking	8.1.12.CS.3: Compare the functions of application software, system software, and hardware. 8.1.12.CS.4: Develop guidelines that convey systemic troubleshooting strategies that others can use to identify and fix errors. 8.1.12.AP.3: 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 consructs such as procedures, modules, and/or objects. 8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. 8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and accessible.
Career Readiness, Life Literacies, and 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.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Social Emotional Learning	SELF MANAGEMENT: Students are assessed periodically on their classroom behavior and work ethic. In particular, the instructor will be evualating characteristics such as the student's impulse control, self-dicipline, self-motivation, and organizational skills.

Differentiation

Resources/Materials	ELL (English Language Learners)	Special Education	At Risk	Enrichment
	• Provide translated notes and key vocabulary terms • Provide images of key vocabulary terms and concepts • Word banks • Bilingual dictionaries • Assistive translator technology • Sentence frames • Simplified notes • Reduced homework • Simplified word problems • Graphic organizers • Matched sentences or procedures with pictures • Alternative presentation options • 1-2 sentence short responses • Shortened written assignments • Modified tests • Provide notes when student request • Reduce project workload • Short summaries	• Display reminders • Checklist of materials and tasks (printed out or digitally accessible) • Timelines and Calendar for benchmark goals for assignments/assessments/short-term goals (Planner Microsoft) • Assistive technology (dictation, immersive reader, etc…) • Flash cards • Teacher notes • Graphic organizer • Clear parameters and student workspace • Timer to monitor task and duration • Study guides • Guided notes • Choices for alternative assignments • Students are asked to come for extra help to review/retake assessment and homework assignments • Students are allowed time and a half on assessments • Provide the student with frequent check-ins during class-time work • Visual cue or signs • Rephrase of questions and directions • Partner or group work on skill development • Assistance by instructional videos or curated videos online	• Students are asked to come for extra help to review/retake assessment and homework assignments • Students are allowed time and a half on assessments • Provide the student with frequent check-ins during class-time work • Scaffolding assignments • Chunking of materials • Allow for errors • Pre-teach materials • Supply teacher demo • Rephrase of questions and directions • Visual cue or signs • Small group assistance or collaboration • Partner or group work on skill development • Assistance by instructional videos or curated videos online • Guide with options for student goal setting • Use of timer or a clock to monitor time of student activity	• Provide students with extra problem sets that challenge and involve higher level thinking • Inquiry lead discussions and activities • More complex tasks and projects • Higher level questioning and techniques • Student demoing and explanation • Provide opportunities for students to set personal goals, keep records and monitor their own learning progress • Multiple assessments given in different domains, that showcase student interests, strengths, and needs • Use multiple approaches to accelerate learning within and outside of the school setting • Use enrichment options to extend and deepen learning opportunities within and outside of the school setting • Use individualized learning options such as mentorships, internships, online courses, and independent study

Unit II : Robot Drivetrain (4 Weeks)

Core Ideas	The usability, dependability, security, and accessibility of devices within integrated systems are important considerations in their design as they evolve. A computing system involves interaction among the user, hardware, application software, and system software. Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences. Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
Essential Questions	How can autonomous robots be designed and used to perform manual and repetitive tasks safely? In the workforce? In the home? And is it good or bad that these automated machines are replacing human labor? Do robots have an important place in our world? Or will they one day take over like in apocalyptic movies? How does the environment that the robot will operate in affect design decisions?
Enduring Understanding	The drivetrain serves not only as the means of locomotion but also as the platform upon which all other functionality will be installed.
Practice	• Fostering an inclusive computing an design culture. • Developing and using abstractions • Creating computational artifacts
Performance Expectations	• Describe ways in which integrated systems hide underlying implementation details to simplify user experiences. • Model interactions between application software, system software, and hardware. • Compare the functions of application software, system software, and hardware. • Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors. • Use research to design and create a product or system that addresses a problem and make modifications based on input from potential customers.

NJ Standards	Student Learning Objectives	Suggested Tasks/Activities	Resources/Materials
8.1.12.CS.1 8.1.12.CS.2 8.1.12.CS.3 8.1.12.CS.4 8.2.12.ED.1	Students will be able to: • assemble all mechanical aspects of the drivetrain. • wire the motors to the robot controller. • program the robot to respond to joystick input or execute a set of pre-programmed instructions.	• Students will build a working drivetrain for a robot. This will include completing all mechanical, electrical, and programming aspects of the drivetrain.	First Tech Challenge Programming Resourses STEM Robotics

Key Vocabulary	Drivetrain, Direct Drive, Indirect Drive, Joystick, Robot Controller, Driver Station, U-Channel, C-Channel, Extrusion, Bearing, Motor, Gears, Sprockets
Evidence of Learning	• Robots will be built using a set of provided instructions and graded based on a rubric provided prior to the lesson. • A set of activities will be assigned. Robots will be graded on their ability to complete these activities.
Interdisciplinary Connections	English Language Arts • SL.9-10.1.A: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and *other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.* • SL.9-10.1.C: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. *Propel conversations* by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. Mathematics • A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. • A.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). Science • HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

	• 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.
Diversity, Equity, & Inclusion	Amistad Law: N.J.S.A. 18A 52:16A-88: Students will learn how various people, particularly people of African American descent, have contributed to the field of robotics. LGBT and Disabilities Law: NJSA 18A: 34-4:35: Students will learn about how robotics have impacted the lives of those with disabilities and other physical afflictions.
Computer Science and Design Thinking	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 customers.
Career Readiness, Life Literacies, and Key Skills	9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice. 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving. 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others (e.g., political. economic, cultural). 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
Social Emotional Learning	RELATIONSHIP SKILLS: Students will build collaborative and coroporative skills through group projects and decision making when developing their robots.

Differentiation

Resources/Materials	ELL (English Language Learners)	Special Education	At Risk	Enrichment
	• Provide translated notes and key vocabulary terms • Provide images of key vocabulary terms and concepts • Word banks • Bilingual dictionaries • Assistive translator technology • Sentence frames • Simplified notes • Reduced homework • Simplified word problems • Graphic organizers • Matched sentences or procedures with pictures • Alternative presentation options • 1-2 sentence short responses • Shortened written assignments • Modified tests • Provide notes when student request • Reduce project workload	• Display reminders • Checklist of materials and tasks (printed out or digitally accessible) • Timelines and Calendar for benchmark goals for assignments/assessments/short-term goals (Planner Microsoft) • Assistive technology (dictation, immersive reader, etc...) • Flash cards • Teacher notes • Graphic organizer • Clear parameters and student workspace • Timer to monitor task and duration • Study guides • Guided notes • Choices for alternative assignments • Students are asked to come for extra help to review/retake assessment and homework assignments	• Students are asked to come for extra help to review/retake assessment and homework assignments • Students are allowed time and a half on assessments • Provide the student with frequent check-ins during class-time work • Scaffolding assignments • Chunking of materials • Allow for errors • Pre-teach materials • Supply teacher demo • Rephrase of questions and directions • Visual cue or signs • Small group assistance or collaboration • Partner or group work on skill development	• Provide students with extra problem sets that challenge and involve higher level thinking • Inquiry lead discussions and activities • More complex tasks and projects • Higher level questioning and techniques • Student demoing and explanation • Provide opportunities for students to set personal goals, keep records and monitor their own learning progress • Multiple assessments given in different domains, that showcase student interests, strengths, and needs • Use multiple approaches to accelerate learning within

	• Short summaries	• Students are allowed time and a half on assessments • Provide the student with frequent check-ins during class-time work • Visual cue or signs • Rephrase of questions and directions • Partner or group work on skill development • Assistance by instructional videos or curated videos online	• Assistance by instructional videos or curated videos online • Guide with options for student goal setting • Use of timer or a clock to monitor time of student activity	and outside of the school setting • Use enrichment options to extend and deepen learning opportunities within and outside of the school setting • Use individualized learning options such as mentorships, internships, online courses, and independent study

Unit III : Interacting with the World (10 Weeks)			
Core Ideas	The accuracy of predictions or inferencesmade from a computer model is affected by the amount, quality, and diversity of the data. Individuals evaluate and select algorithms based on performance, reusability, and ease of implementation. Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks. Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization. Engineering design evaluation, a process for determining how well a solution meets requirements, involvs systematic comparisons between requirements, spedifications, and constraints.		
Essential Questions	Why is the relationship between sensors and robot design crucial to the successful implementation of an autonomus robot? How does robotic software interact with robotic hardware?		
Enduring Understanding	A robot is of limited or no use if it cannot interact with its environment.		
Practice	Recognizing and defining computational problems. Developing and using abstractions.		
Performance Expectations	• Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. • Design algorithms to solve computational problems using a combination of original and existing algorithms. • Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice. • Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue. • Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. • Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis. • 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). • Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).		
NJ Standards	**Student Learning Objectives**	**Suggested Tasks/Activities**	**Resources/Materials**

8.1.12.DA.6 8.1.12.AP.1 8.1.12.AP.3 8.1.12.AP.4 8.2.12.ED.1 8.2.12.ED.3 8.2.12.ED.5 8.2.12.ED.6	Students will be able to: • assemble and attach a claw device to the robot. • program the robot to manipulate objects in its environment. • modify the robot to detect and avoid an obstacle based on proximity. • modify and program the robot to make decisions based on color detected.	Students will learn how to make their robot evaluate and interact with the world around them through a series of activities, which will require them to • build and actuator that will move/manipulate objects in its vicinity • identify objects based on color • measure distance to an object/impediment	First Tech Challenge Programming Resourses STEM Robotics

Key Vocabulary	Sensor, Servo, i2c, Encoder, Linear Motion, Single Jointed Arm, Four Bar Linkage, Color Sensor, Distance Sensor, Touch Sensor, Object Oriented Programming
Evidence of Learning	• Robots will be built using a set of provided instructions and graded based on a rubric provided prior to the lesson. • A set of activities will be assigned. Robots will be graded on their ability to complete these activities.
Interdisciplinary Connections	English Language Arts • SL.9-10.1.A: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and *other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.* • SL.9-10.1.C: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. *Propel conversations* by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. Mathematics • A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. • A.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). Science • HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. • 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.
Diversity, Equity, & Inclusion	Amistad Law: N.J.S.A. 18A 52:16A-88: Students will learn how various people, particularly people of African American descent, have contributed to the field of robotics. LGBT and Disabilities Law: NJSA 18A: 34-4:35: Students will learn about how robotics have impacted the lives of those with disabilities and other physical afflictions.
Computer Science and Design Thinking	8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. 8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms. 8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice. 8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue. 8.2.12.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.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	9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice. 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving. 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others (e.g., political. economic, cultural).
Social Emotional Learning	RESPONSIBLE DECISION MAKING: As projects become more complex, it becomes more important to analyze data, facts and information to make a reasoned decision and then evaluate the benefits and consequences of those decisions for all stake holders.

Differentiation

Resources/Materials	ELL (English Language Learners)	Special Education	At Risk	Enrichment
	• Provide translated notes and key vocabulary terms • Provide images of key vocabulary terms and concepts • Word banks • Bilingual dictionaries • Assistive translator technology • Sentence frames • Simplified notes • Reduced homework • Simplified word problems • Graphic organizers • Matched sentences or procedures with pictures • Alternative presentation options • 1-2 sentence short responses • Shortened written assignments • Modified tests • Provide notes when student request • Reduce project workload • Short summaries	• Display reminders • Checklist of materials and tasks (printed out or digitally accessible) • Timelines and Calendar for benchmark goals for assignments/assessments/short-term goals (Planner Microsoft) • Assistive technology (dictation, immersive reader, etc...) • Flash cards • Teacher notes • Graphic organizer • Clear parameters and student workspace • Timer to monitor task and duration • Study guides • Guided notes • Choices for alternative assignments • Students are asked to come for extra help to review/retake assessment and homework assignments • Students are allowed time and a half on assessments • Provide the student with frequent check-ins during class-time work • Visual cue or signs • Rephrase of questions and directions • Partner or group work on skill development • Assistance by instructional videos or curated videos online	• Students are asked to come for extra help to review/retake assessment and homework assignments • Students are allowed time and a half on assessments • Provide the student with frequent check-ins during class-time work • Scaffolding assignments • Chunking of materials • Allow for errors • Pre-teach materials • Supply teacher demo • Rephrase of questions and directions • Visual cue or signs • Small group assistance or collaboration • Partner or group work on skill development • Assistance by instructional videos or curated videos online • Guide with options for student goal setting • Use of timer or a clock to monitor time of student activity	• Provide students with extra problem sets that challenge and involve higher level thinking • Inquiry lead discussions and activities • More complex tasks and projects • Higher level questioning and techniques • Student demoing and explanation • Provide opportunities for students to set personal goals, keep records and monitor their own learning progress • Multiple assessments given in different domains, that showcase student interests, strengths, and needs • Use multiple approaches to accelerate learning within and outside of the school setting • Use enrichment options to extend and deepen learning opportunities within and outside of the school setting • Use individualized learning options such as mentorships, internships,

				online courses, and independent study

Unit IV : Capstone Competition (16 Weeks)	
Core Ideas	The usability, dependability, security, and accessibility of devices within integrated systems are important considerations in their design as they evolve. A computing system involves interaction among the user, hardware, application software, and system software. Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences. Individuals evaluate and select algorithms based on performance, reusability, and ease of implementation. Programmers choose data structures to manage program complexity based on functionality, storage, and performance trade-offs. Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks. Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
Essential Questions	How do multiple robotic systems interact when one robot is assigned multiple tasks? How can we understand the problem(s) of how our robot will compete in the game? How do we use algorithmic thinking to develop output based on input and processing? How do we use pseudocode to develop algorithms?
Enduring Understanding	In order to deliver a product on a scheduled timeline, all members of a team must be able to work independently while keeping in mind the final, agreed upon goal.
Practice	• Forstering an inclusive computing and design culture • Collaboration around computing and design • Creating computational artifacts • Testing and refining computational artifacts • Communicating about computing and design
Performance Expectations	• Describe ways in which integrated systems hide underlying implementation details to simplify user experiences. • Model interactions between application software, system software, and hardware. • Compare the functions of application software, system software, and hardware. • Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors. • Design algorithms to solve computational problems using a combination of original and existing algorithms. • Create generalized computational solutions using collections instead of repeatedly using simple variables. • Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. • Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. • Communicate the function of a product or device. • Select and use appropriate tools and materials to build a product using the design process.

NJ Standards	Student Learning Objectives	Suggested Tasks/Activities	Resources/Materials

8.1.12.CS.1 8.1.12.CS.2 8.1.12.CS.3 8.1.12.CS.4 8.1.12.AP.1 8.1.12.AP.2 8.1.12.AP.5 8.1.12.AP.6 8.2.12.ED.1 8.2.12.ED.3	Students will be able to: • decompose a complex problem into a series of simpler problems. • work in groups and each will be responsible for part of the robot. • present a plan of action with timelines for completion.	This last unit is a capstone project in the form of a competition. Students will be presented with rules and objectives of a competition and then must build a working robot within a 12 to 14 week period. This then culminates in a class wide competition.	First Tech Challenge Programming Resourses STEM Robotics

Key Vocabulary	Algorithms, Decomposition, Sequence, Iteration, Conditional, Flowcharts, Autonomous, Telemetry, Craftsmanship
Evidence of Learning	• Presentation of a plan of action. • Periodic presentations of progress made. • Maintaince of Engineering Notebook. • Performance of robot in competition.
Interdisciplinary Connections	English Language Arts • SL.9-10.1.A: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and *other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.* • SL.9-10.1.C: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. *Propel conversations* by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. Mathematics • A.CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. • A.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). Science • HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. • 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.
Diversity, Equity, & Inclusion	Amistad Law: N.J.S.A. 18A 52:16A-88: Students will learn how various people, particularly people of African American descent, have contributed to the field of robotics. LGBT and Disabilities Law: NJSA 18A: 34-4:35: Students will learn about how robotics have impacted the lives of those with disabilities and other physical afflictions.
Computer Science and Design Thinking	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.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.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. 8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. 8.2.12.ED.1: Communicate the function of a product or device. 8.2.12.ED.3: Select and use appropriate tools and materials to build a product using the design process.

Career Readiness, Life Literacies, and Key Skills	9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice. 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving. 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others (e.g., political. economic, cultural).
Social Emotional Learning	SOCIAL AWARENESS: By working in groups and assigning ownership of different building tasks to each student, in order to succeed students will have to take into account and respect the point of view and design choices of their peers.

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