Coding 8
Grades 6-8

Ewing Public Schools
2099 Pennington Road
Ewing, NJ 08618

Board Approval Date: September 19, 2022 Michael Nitti, Superintendent
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In accordance with The Ewing Public Schools' Policy 2230, Course Guides, this curriculum has been reviewed and found to be in compliance with all policies and all affirmative action criteria.

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Course Description and Rationale

Coding 8 students will continue to develop computational thinking skills and knowledge of coding concepts. In addition to learning about programming and algorithms, students build career awareness, recognize the role and impact of programming, and strengthen their digital skills.

Computer science and design thinking education prepares students to succeed in today's knowledge-based economy by providing equitable and expanded access to high-quality, standards-based computer science and technological design education.

Students receive computer science and design thinking instruction. The study of these disciplines focuses on deep understanding of concepts that enable students to think critically and systematically about leveraging technology to solve local and global issues. Authentic learning experiences that enable students to apply content knowledge, integrate concepts across disciplines, develop computational thinking skills, acquire and incorporate varied perspectives, and communicate with diverse audiences about the use and effects of computing prepares New Jersey students for college and careers.

Students will benefit from opportunities to engage in high-quality technology programs that foster their ability to:

- Develop and apply computational and design thinking to address real-world problems and design creative solutions;
- Engage as collaborators, innovators, and entrepreneurs on a clear pathway to success through postsecondary education and careers;
- Navigate the dynamic digital landscape to become healthy, productive, 21st century global-minded individuals; and
- Participate in an inclusive and diverse computing culture that appreciates and incorporates perspectives from people of different genders, ethnicities, and abilities.

Students will learn computer science fundamentals and the basics of robotic systems to complete a certain task. Students will use collaboration, critical thinking and problem solving skills to synthesize knowledge and apply it to a design challenge. Students will know how digital tools and devices are used to collect and analyze information. Students will also learn that computer models and data analysis can be represented in many different ways. All students will develop an understanding of the nature and impact of technology, engineering, technological design and the designed world, as they relate to the individual, global society and the environment.

Unit 1: Introduction to Coding & Robotics

Why Is This Unit Important?

Students are expected to learn and have a strong working knowledge of computer programming basics and concepts. Students will utilize this knowledge to control, problem solve, and critically think.

Enduring Understandings:

- The study of human–computer interaction can improve the design of devices and extend the abilities of humans.
- Software and hardware determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple considerations and potential trade-offs.
- Troubleshooting a problem is more effective when knowledge of the specific device along with a systematic process is used to identify the source of a problem.
- Protocols, packets, and addressing are the key components for reliable delivery of information across networks.
- The information sent and received across networks can be protected from unauthorized access and modification in a variety of ways.
- The evolution of malware leads to understanding the key security measures and best practices needed to proactively address the threat to digital data.

Essential Questions:

- How have computers extended human abilities?
- How can hardware and software determine a computing system's capability to store and process information?
- How does one troubleshoot problems?
- How is data delivered across networks?
- What types of cybersecurity is used in robotics?
- What types of threats are possible in robotics?

Acquired Knowledge:

- Computer Science Vocabulary
- VEX IQ Introduction
- Computer Science
    - Functions: code reusability; Variables: declare, types, and initial value (set)
    - Comparison, mathematical, and logic operators
    - A review of coding concepts introduced in Cyber Robotics 101
- Robotics
    - Motion planning: power, speed, distance, braking
    - Turns: screw, pivot, and curves
    - A review of robotics concepts introduced in Cyber Robotics 101

- Physics
  - Momentum: Accelerate, stop, overshoot; mass and gravitational force, stability
- Engineering
  - Control systems: Open/closed loop, 2 and 3 state controls, proportional control
- Computational Thinking
  - Decomposition, pattern recognition, algorithm design, abstraction, iteration

Acquired Skills:

- Collaboration
- Identification of VEX IQ Parts and Systems
- Troubleshooting Errors in Code & Mechanical Systems

Assessments:

Formative

- Do Now's
- Quizzes
- Guided Notes
- Classwork / Homework
- Exit Tickets

Summative

- Unit Test
- Class Competitions
- Projects

Suggested Learning Experiences and Instructional Activities:

- Students explore how the mechanical advantages of torque and speed are related to gear ratios, where gear ratios can be found in daily life, and how they can be applied to their builds. Students will learn how to calculate different gear ratios.
- Students will learn about computation, automation, artificial intelligence and robotics.

Instructional Materials (including, but not limited to):

- CoderZ Cyber Robotics 101 subscription
- VEX IQ Classroom Bundle
- Individual student Chromebooks
- Canvas Learning Management System
- Google Workspace

Standards:

8.1.8.CS.1: Recommend improvements to computing devices in order to improve the ways users interact with the devices.

8.1.8.CS.2: Design a system that combines hardware and software components to process data.

8.1.8.CS.3: Justify design decisions and explain potential system trade-offs.

8.1.8.CS.4: Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.

8.1.8.NI.1: Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.

8.1.8.NI.2: Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.

8.1.8.NI.3: Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems.

8.1.8.NI.4: Explain how new security measures have been created in response to key malware events.

Unit 2: Computing Systems in Society

Why Is This Unit Important?

Being crucially important to the human race, computers have ultimately altered the way today's society works, communicates, entertains, and educates. There is hardly any field of career left where technology isn't essential.

Enduring Understandings:

- Advancements in computing technology can change individuals' behaviors.
- Society is faced with trade-offs due to the increasing globalization and automation that computing brings.

Essential Questions:

- How have advancements in computing technologies changed individuals' behaviors?
- What are some trade-offs associated with globalization and automation of computers and robotics?
- How are robots programmed to complete a specific task?

Acquired Knowledge:

- Simple Machines
- Gear Ratio Calculations
- Mechanical Advantage

Acquired Skills:

- Discussion Management
- Collaboration
- Team Collaboration
- Problem analysis
- Logical thinking programming skills
- Essential vocabulary
- Engineering design process
- Invention, innovation and experimentation in problem solving

Assessments:

Formative

- Do Now's
- Quizzes
- Guided Notes
- Classwork / Homework
- Exit Tickets

Summative

- Unit Test
- Class Competitions
- Projects
- Completed robot
- Complete building robot design by following design diagrams and run robot
- challenge
- Design, build and test a robot to successfully accomplish a given task

Suggested Learning Experiences and Instructional Activities:

- Students will learn about basic syntax, loops, and coding sequences.
- Students will use a block-based visual programming language to strengthen their typing, syntax, and debugging skills.

Instructional Materials (including, but not limited to):

- CoderZ Cyber Robotics 101 subscription
- VEX IQ Classroom Bundle
- Individual student Chromebooks
- Canvas Learning Management System
- Google Workspace

Standards:

8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options.

8.1.8.IC.2: Describe issues of bias and accessibility in the design of existing technologies.

Unit 3: Robotic Systems

Why Is This Unit Important?

This unit is intended to develop knowledge and capability to build prototypes and implement design solutions with the use of the proper tools, machinery, and materials.

Enduring Understandings:

- Robot with a standard 2-motor drivetrain that can move forward/reverse and turn. This build is used as the foundation for other robot builds.
- People use digital devices and tools to automate the collection, use, and transformation of data.
- The manner in which data is collected and transformed is influenced by the type of digital device(s) available and the intended use of the data.
- Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals.
- Data is organized and accessible based on the application used to store it.
- The purpose of cleaning data is to remove errors and make it easier for computers to process.
- Computer models can be used to simulate events, examine theories and inferences, or make predictions.

Essential Questions:

- What software and hardware does a robot consist of?
- How is information processed using the robot cortex microcontroller to understand the commands?

Acquired Knowledge:

- Robotic Movements
- Claw
- Scouting
- Robotic Arm
- Motor Group
- Data-Driven Decision Making
- Programming
    - Drive Forward
    - Drive Backwards

Acquired Skills:

- Teamwork and collaboration, giving/receiving feedback
- Inquiry, investigation, prediction, and creativity
- Critical and computational thinking for problem solving
- Problem analysis
- Logical thinking programming skills
- Essential vocabulary
- Engineering design process
- Invention, innovation and experimentation in problem solving

Assessments:

Formative

- Do Now's
- Quizzes
- Guided Notes
- Classwork / Homework
- Exit Tickets

Summative

- Unit Test
- Class Competitions
- Projects
- Completed robot
- Complete building robot design by following design diagrams and run robot
- challenge
- Design, build and test a robot to successfully accomplish a given task

Suggested Learning Experiences and Instructional Activities:

- Students will be introduced to the Treasure Hunt competition, build the simple clawbot, and code it to achieve a certain task.
- Students will use the drive train and motion VEXcode IQ blocks to collect and move cubes in the Clawbot Collector Challenge.
- Students will code the optical sensor to detect, collect, and move a cube in the Treasure Mover Challenge.
- Students will compete in the Treasure Hunt Challenge and investigate various STEM careers.
- VEXIQ Build - Clawbot
- Students will learn about the importance of data in solving problems and highlight how computers can help in this process. Students will explore different systems used to represent information in a computer and the challenges and tradeoffs posed by using them.
- Students will learn how collections of data are used to solve problems, and how computers help to automate the steps of this process.

Instructional Materials (including, but not limited to):

- CoderZ Cyber Robotics 101 subscription
- Code.org
- VEX IQ Classroom Bundle
- Individual student Chromebooks
- Canvas Learning Management System
- Google Workspace

Standards:

8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

8.1.8.DA.2: Explain the difference between how the computer stores data as bits and how the
data is displayed.

8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.

8.1.8.DA.4: Transform data to remove errors and improve the accuracy of the data for analysis.

8.1.8.DA.5: Test, analyze, and refine computational models.

8.1.8.DA.6: Analyze climate change computational models and propose refinements.

Unit 4: Robotic Applications

Why Is This Unit Important?

This unit is designed to expand on the knowledge and capability to build prototypes and implement design solutions with the use of the proper tools, machinery, and materials.

Enduring Understandings:

- Individuals design algorithms that are reusable in many situations.
- Algorithms that are readable are easier to follow, test, and debug.
- Programmers create variables to store data values of different types and perform appropriate operations on their values.
- Control structures are selected and combined in programs to solve more complex problems.
- Programs use procedures to organize code and hide implementation details.
- Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.
- Individuals design and test solutions to identify problems taking into consideration the diverse needs of the users and the community.

Essential Questions:

- How does one create an algorithm for a robot to follow?
- What do computer programmers do?
- How are control systems used to solve complex problems?
- What are computer programs and how can they be used to program hardware?

Acquired Knowledge:

- Robotic Movements
  - Claw Design
  - Arm Design
  - Motor Groups
  - Gear Train
  - Chain & Sprocket
  - 2 Motors sharing a shaft
  - Motors spinning in the same direction
  - Motors spinning in opposite directions
- Programming
  - VEX IQ Python
  - Drive Forward
  - Drive Backwards

Acquired Skills:

- Teamwork and collaboration, giving/receiving feedback
- Inquiry, investigation, prediction, and creativity
- Critical and computational thinking for problem solving
- Problem analysis
- Logical thinking programming skills
- Essential vocabulary
- Engineering design process
- Invention, innovation and experimentation in problem solving

Assessments:

Formative

- Do Now's
- Quizzes
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Summative

- Unit Test
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- Complete building robot design by following design diagrams and run robot
- challenge
- Design, build and test a robot to successfully accomplish a given task

Suggested Learning Experiences and Instructional Activities:

- Introduction: Students will build the Clawbot and be introduced to the challenge of Up and Over.
- Claw Design: Students will learn about what a claw is, how an effective claw works, as they practice moving cubes with their robot. They will also learn about the concept of 'Scouting' and how scouting can benefit their team's design and strategy.
- Arm Design: Students will learn about different elements of robotic arms, how they work, and what makes an effective arm as they practice stacking cubes with their robot.
- Motor Groups: Student groups will learn about what motor groups are, and how they can be helpful, as well as how to configure a motor group in VEXcode IQ, as they practice lifting cubes up and over a barrier on the Field. They will also learn about used data-driven decision making to choose a driver for their team in a fair and effective way.

- Up and Over Competition: Students will continue to use the engineering design process to iterate on their robots and game strategy as they prepare to compete in the Up and Over competition. In this competition, students will drive their robots to move cubes into their scoring zone on the Field, to score the most points at the end of the match.
- Conclusion: Wrap up the Unit by introducing students to STEM careers related to the learning they did in this Unit, like Biomedical Engineer, then engages students in a debrief conversation to share their learning, and reflect on their experiences.

Instructional Materials (including, but not limited to):

- CoderZ Cyber Robotics 101 subscription
- VEX IQ Classroom Bundle
- Individual student Chromebooks
- Canvas Learning Management System
- Google Workspace
- Scratch

Standards:

8.1.8.AP.1: Design and illustrate algorithms that solve complex problems using flowcharts and/ or Pseudocode.

8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.

8.1.8.AP.3: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.

8.1.8.AP.4: Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.

8.1.8.AP.5: Create procedures with parameters to organize code and make it easier to reuse.

8.1.8.AP.6: Refine a solution that meets users' needs by incorporating feedback from team members and users.

8.1.8.AP.7: Design programs, incorporating existing code, media, and libraries, and give
attribution.

8.1.8.AP.8: Systematically test and refine programs using a range of test cases and users.

8.1.8.AP.9: Document programs in order to make them easier to follow, test, and debug.

Unit 5: Robot Ethics & Careers

Why Is This Unit Important?

Ethics in technology refers to moral principles that govern how technologies should be used. These principles include accountability, digital rights, privacy, freedom, data protection, online behavior, and more.

Enduring Understandings:

- Technological disparities have consequences for public health and prosperity.
- There are a variety of resources available to help navigate the career planning process.
- Employee benefits can influence your employment choices.
- Communication skills and responsible behavior in addition to education, experience, certifications, and skills are all factors that affect employment and income.
- There are resources to help an individual create a business plan to start or expand a business.

Essential Questions:

- What are some ethical considerations for robots on society?
- What types of careers are possible in the field of robotics?

Acquired Knowledge:

- Exploring STEM Careers
- Ethics of Robotics
- Robotics Influence on Society

Acquired Skills:

- Discussion Management
- Collaboration
- Team Collaboration
- Problem analysis
- Logical thinking programming skills
- Essential vocabulary
- Critical thinking

Assessments:

Formative

- Do Now's
- Quizzes
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Summative

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Suggested Learning Experiences and Instructional Activities:

- STEM Career Exploration Inventory
- Ethical Debate / Multimedia Presentation

Instructional Materials (including, but not limited to):

- CoderZ Cyber Robotics 101 subscription
- VEX IQ Classroom Bundle
- Individual student Chromebooks
- Canvas Learning Management System
- Google Workspace
- Scratch

Standards:

8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.

8.2.8.EC.2: Examine the effects of ethical and unethical practices in product design and development.

9.2.8.CAP.10: Evaluate how careers have evolved regionally, nationally, and globally.

9.2.8.CAP.11: Analyze potential career opportunities by considering different types of resources, including occupation databases, and state and national labor market statistics.

9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.

9.2.8.CAP.13: Compare employee benefits when evaluating employment interests and explain the possible impact on personal finances.

9.2.8.CAP.14: Evaluate sources of income and alternative resources to accurately compare employment options.

9.2.8.CAP.15: Present how the demand for certain skills, the job market, and credentials can determine an individual's earning power.

9.2.8.CAP.16: Research different ways workers/ employees improve their earning power through education and the acquisition of new knowledge and skills.

9.2.8.CAP.17: Prepare a sample resume and cover letter as part of an application process.

9.2.8.CAP.18: Explain how personal behavior, appearance, attitudes, and other choices may impact the job application process.

9.2.8.CAP.19: Relate academic achievement, as represented by high school diplomas, college degrees, and industry credentials, to employability and to potential level

9.2.8.CAP.20: Identify the items to consider when estimating the cost of funding a business

Accommodations

Special Education Students

Peer to peer assistance; reduce / revise assignments as per IEP; use manipulatives; calculators; extra time to complete task; provide individual & small group help; notes, and study guides; provide background knowledge; flexible grouping; peer grouping; visual demonstration; text magnification; color coding; repetition; pre-teaching; chunking; differentiating content; preferential seating; rephrasing of directions

English Language Learners

Use consistent, simplified language; provide bilingual partner; provide cooperative learning opportunities; use modeling; use visual aids & manipulatives; scaffolding; chunking the content; subtitles for videos

Students at Risk of Failure

Foster positive relationships; use mental models; provide help formulating specific questions; scaffolding; targeted support

Gifted Students

Provide additional enrichment activity involving demonstration of knowledge, or complementary assignments; independent practice; extension activities

Suggested Pacing

Unit (topic)	Anticipated time frame (days)	Essential questions	Enduring understandings
Unit 1 Introduction to Coding and Robotics	5	How have computers extended human abilities? How can hardware and software determine a computing system's capability to store and process information? How does one troubleshoot problems? How is data delivered across networks? What types of cybersecurity is used in robotics? What types of threats are possible in robotics?	The study of human–computer interaction can improve the design of devices and extend the abilities of humans. Software and hardware determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple considerations and potential trade-offs. Troubleshooting a problem is more effective when knowledge of the specific device along with a systematic process is used to identify the source of a problem. Protocols, packets, and addressing are the key components for reliable delivery of information across networks. The information sent and received across networks can be protected from unauthorized access and modification in a variety of ways. The evolution of malware leads to understanding the key security measures and best practices needed to proactively address the threat to digital data.
Unit 2 Computing Systems on Society	9	How have advancements in computing technologies changed individuals' behaviors? What are some trade-offs associated with globalization and automation of computers and robotics? How are robots programmed to complete a specific task?	Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.

Unit (topic)	Anticipated time frame (days)	Essential questions	Enduring understandings
Unit 3 Robotic Systems	8	What software and hardware does a robot consist of? How is information processed using the robot cortex microcontroller to understand the commands?	Robot with a standard 2-motor drivetrain that can move forward/ reverse and turn. This build is used as the foundation for other robot builds. People use digital devices and tools to automate the collection, use, and transformation of data. The manner in which data is collected and transformed is influenced by the type of digital device(s) available and the intended use of the data. Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals. Data is organized and accessible based on the application used to store it. The purpose of cleaning data is to remove errors and make it easier for computers to process. Computer models can be used to simulate events, examine theories and inferences, or make predictions.
Unit 4 Robotic Applications	8	How does one create an algorithm for a robot to follow? What do computer programmers do? How are control systems used to solve complex problems? What are computer programs and how can they be used to program hardware?	Individuals design algorithms that are reusable in many situations. Algorithms that are readable are easier to follow, test, and debug. Programmers create variables to store data values of different types and perform appropriate operations on their values. Control structures are selected and combined in programs to solve more complex problems. Programs use procedures to organize code and hide implementation details. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability. Individuals design and test solutions to identify problems taking into consideration the diverse needs of the users and the community.
Unit 5 Robot Ethics & Careers	10	What are some ethical considerations for robots on society? What types of careers are possible in the field of robotics?	Technological disparities have consequences for public health and prosperity. There are variety of resources available to help navigate the career planning process. Employee benefits can influence your employment choices. Communication skills and responsible behavior in addition to education, experience, certifications, and skills are all factors that affect employment and income. There are resources to help an individual create a business plan to start or expand a business.

Sample Standards Integration

During this course, in addition to the New Jersey Student Learning Standards for Computer Science and Design Thinking, students will work on developing, to an age appropriate level, standards across content areas, including:

Career Readiness, Life Literacies, and Key Skills
9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.
Students will connect the concepts and skills in this course to potential future careers.

Social Studies
6.1.12.EconNE.16.b: Evaluate the economic, political, and social impact of new and emerging technologies on individuals and nations.
Students will discuss the positive and negative impacts of technological advancements.

Science
MS-PS1-6: Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
Students will employ the design cycle to complete projects based on specific guidelines.

Mathematics
NJSLS-M.8.SP.A.2: Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit (e.g. line of best fit) by judging the closeness of the data points to the line.
Students will interpret, analyze, and discuss data on diversity in technology careers and education.

English Language Arts
NJSLSA.W6: Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
Students will engage in written discussion utilizing the district's digital learning environment.

Diversity, Equity & Inclusion

All students deserve equitable access (N.J.A.C. 6A:7) to a high-quality education that is inclusive and reflective of the rich diversity of our state. This curriculum will include learning activities that meet the legislative requirements of the 2019 History and Contributions of Individuals with Disabilities and LGBT (N.J.S.A. 18A:35-4.35-6) and Diversity and Inclusion statutes (N.J.S.A. 18A:35-4.36a) that may include:

- Students work in groups to develop a slide deck highlighting LGBTQ+ pioneers of computer science, such as Alan Turing, Edith Windsor, etc.
- Students will interpret, analyze, evaluate, and discuss data involving diversity in STEM fields (this may include the number of women enrolled in technology education programs, representation of people with disabilities in video games, etc.).