Computer Programming & Robotics (Semester)
Grade 7, Career & Technical Education

Developed By: Mrs. Linda McDonnell & Mr. Vincent Vicchiariello
Effective Date: Fall 2022
Scope and Sequence

Month	Unit
September	• Introduction to the Technological World • Design Challenges • Digital Citizenship
October	• Computer Programming using Scratch.com
November	• Computer Programming using Scratch.com continued • Robotics Design
December	• Robotics Design challenges
January	• Artificial Intelligence
February	• Introduction to the Technological World • Design Challenges • Digital Citizenship
March	• Computer Programming using Scratch.com
April	• Computer Programming using Scratch.com continued • Robotics Design
May	• Robotics Design challenges
June	• Artificial Intelligence

Unit 1
Introduction to Technology and the Design World, Digital Citizenship
Summary and Rationale
In this unit students will be introduced to current and future advances in technology, participate in hands-on activities using the design process, and understand their role and responsibilities as digital citizens. The design process is a series of steps that are used to create a solution to an inquiry. Students will use the design process as they work through unplugged computer programming steps. Students will build communication skills, collaboration skills and think creatively to solve a series of problems. As they begin to understand the impact of technology on daily lives they will also recognize the impact of their actions online and learn what is necessary to be a good digital citizen. At the end of each unit students will reflect on the challenge and the problem solving process.
Recommended Pacing
3 weeks (and ongoing during the semester)
Standards

Impacts of Computing

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.

Engineering Design

8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

Effects of Technology on the Natural World

8.2.8.ETW.3	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.

Ethics & Culture	
8.2.8.EC.1	Explain ethical issues that may arise from the use of new technologies
Digital Citizenship	
9.4.8.DC.3	Describe tradeoffs between allowing information to be public (e.g., within online games) versus keeping information private and secure.
9.4.8.DC.4	Explain how information shared digitally is public and can be searched, copied, and potentially seen by public audiences.
9.4.8.DC.5	Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
9.4.8.DC.6	Analyze online information to distinguish whether it is helpful or harmful to reputation
Information and Media Literacy	
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose
Interdisciplinary Connections	
English Language Arts	
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
NJSLSA.W6	Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
Science	
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
Engineering Design	
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Instructional Focus

Enduring Understandings:	Essential Questions:
- Introduce students to the nature of technology and discuss its importance on society. - Introduce students to the Design World. - Introduce students to the 8 Pillars of Digital Citizenship	- How can you use the design process to complete a task? - What does Digital Citizenship mean to you?

Evidence of Learning (Assessments)

Includes but is not limited to:
- Individual and group projects on problem solving in the form of Design Challenges
- Critique of innovative technologies
- Digital Citizenship comic
- Reflections on the process

Objectives (SLO)

Students will know:	Students will be able to:
- The key elements of the design process - The impact of new technologies can have on the world and everyday life. - How to think critically and creatively to solve problems. - How to model Digital Citizenship	- Work with a team to solve problems. - Use the decision making process to solve problems - Use digital tools to complete a task. - Organize one's self for success

Suggested Resources/Technology Tools

- Graph Paper -Programming - https://code.org/curriculum/course2/1/
- Teacher Unplugged Activities - http://www.edutopia.org/blog/15-ways-teaching-students-coding-vicki-davis
- CS Unplugged Activities - http://csunplugged.org/
- Digital Citizenship - http://www.digitalcitizenship.net/Nine_Elements.html
- Code.Org - https://studio.code.org/s/20-hour

Modifications

Special Education/IEP/504 - Modifications and accommodations must be aligned to the stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to CTE include, but are not limited to:
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- Extended/Additional time for assessments
- Behavior management support
- Assignments/resources in electronic and physical format
- Break down assignments with oral directions, written directions, and visuals.

- Provide frequent reminders to stay on task and reinforce on-task behavior
- Work on organizational skills
- Provide visual supports
- Word banks
- Partnering/Grouping of students
- Peer learning
- Coding diagrams
- Re-teaching and review
- Multi-media approach to accommodate various learning styles
- Decrease/Modify number of project requirements
- Teacher/Aide/Para assistance
- Demonstrations of techniques on an individual level

ELL - Teachers identify the modifications that they will use in the unit as related to the needs of their student population. Examples specific to CTE include, but are not limited to:
- Work with district language specialist.
- Allow the use of Google Translate where appropriate.
- Provide alternate ways for the student to respond (verbal/pictographic answers instead of written)
- Substitute a hands-on activity or use of different media in projects for a written activity
- Prepare and distribute advance notes
- Provide model sentence frames and sentence starters for both oral responses and written responses
- Provide additional time to complete assessments and assignments
- Model and use gestures to aid in understanding
- Model tasks by giving one or two examples before releasing students to work independently
- Present instructions both verbally and visually
- Simplify written and verbal instructions
- Speak clearly and naturally, and try to enunciate words, especially their ending sounds.
- Provide Visual, Graphic, Interactive, and/or Sensory Supports
- Simplify the language, format, and directions of the assessment
- Allow for alternate seating for proximity to peer helper or teacher as necessary
- When showing videos, use Closed Captioning.
- Support use of student's primary language by translating key words in directions, or key vocabulary terms or giving students opportunities to communicate in their primary language (written or orally)

Gifted and Talented/Enrichment - Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples specific to CTE include, but are not limited to:
- Complex, in-depth research assignments
- Independent study where applicable
- Provide a variety of individualized work centers or student choice
- Lead demonstrations for class
- Create additional project(s) in a different medium, exploring a different technique, style, or subject.
- Individual presentation
- Multiple mediums in project

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

❏ Act as a responsible and contributing citizen and employee.
❏ Apply appropriate academic and technical skills.
❏ Attend to personal health and financial well being.
❏ Communicate clearly and effectively and with reason.
❏ Consider the environmental, social and economic impacts of decisions.
❏ Demonstrate creativity and innovation.
❏ Employ valid and reliable research strategies.
❏ Utilize critical thinking to make sense of problems and persevere in solving them.
❏ Model integrity, ethical leadership, and effective management.
❏ Plan education and career paths aligned to personal goals.
❏ Use technology to enhance productivity.
❏ Work productively in teams while using cultural global competence.

Unit 2
Computer Programming with Block Coding
Summary and Rationale
In this unit, students will enter the world of computer science by learning how to create animations, computer games, and interactive projects. Using a graphical programming language, students learn fundamental programming concepts such as variables, loops, conditional statements, and event handling. Students will learn how to use critical thinking and computer coding to think creatively. The unit will show students how to make and import objects, create audio recordings, test and revise code to develop interactive projects.
Recommended Pacing
Ongoing: content will be addressed throughout the course
Standards

Algorithms & Programming	
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 subproblems 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
Information and Media Literacy	
9.4.8.IML.12	Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
Technology Literacy	
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.
9.4.8.TL.6	Collaborate to develop and publish work that p-rovides presp-ectives on a real-world problem.
Interdisciplinary Connections	
Science	
MS-ESTI-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
Engineering Design	
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
English Language Arts	
NJSLSA.SL5	Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
Math	
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
- Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge. - By working through the design process, students become researchers and innovators who are technologically literate in today's society.	- How are algorithms used in coding? - What computational devices do people use in their everyday life? - What are the basics of computer programming? - What are the skills needed to become technologically literate in the 21st century? - How does the design process allow us to become more technologically literate?

Evidence of Learning (Assessments)

Can include, but is not limited to:
- Maze project
- Special Day animations (Fall, New Year's around the world, Earth Day, Star Wars Day)
- Music Video project
- Capstone Design project: You are a programmer. Design a product/process/ game that solves a problem or presents information electronically. Your task is to use the appropriate technology tools to design the product.

Objectives (SLO)

Students will know:	Students will be able to:
- How to use digital media and environments to communicate and work collaboratively. - How to use computational thinking and computer programming as tools to design a system or product. - How to recognize a problem and apply critical thinking and problem solving skills to solve the problem. - How to plan and manage activities to complete a project.	- Use brainstorming activities to enhance creative, and innovative thinking in individual and group problem solving. - Work collaboratively in teams to achieve common goals with greater efficiency - Demonstrate the use of creative thinking, construct knowledge, and develop innovative processes using technology to perform a task. - Use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. - Understand computational thinking and computer programming as tools used in design and engineering. - Synthesize and assimilate knowledge to help them better understand complex problems, and to develop effective strategies to achieve workable solutions.

Suggested Resources/Technology Tools

- Scratch.mit.edu
- Junior Achievement of NJ's Crack the Code Workshop
- Tomorrow corporation - https://tomorrowcorporation.com/humanresourcemachine

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Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

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- ❏ Apply appropriate academic and technical skills.
- ❏ Attend to personal health and financial well being.
- ❏ Communicate clearly and effectively and with reason.
- ❏ Consider the environmental, social and economic impacts of decisions.
- ❏ Demonstrate creativity and innovation.
- ❏ Employ valid and reliable research strategies.
- ❏ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❏ Model integrity, ethical leadership, and effective management.
- ❏ Plan education and career paths aligned to personal goals.
- ❏ Use technology to enhance productivity.
- ❏ Work productively in teams while using cultural global competence.

Unit 3

Robotics Design

Summary and Rationale

In this unit students will be able to understand the attributes of design and the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving using the Lego Mindstorm EV3 Robotics kit. Students will work in small teams to build, program, test and evaluate a robotic model while applying concepts, as well as developing and using 21st Century Skills.

The Robotics unit will use hands-on methods for the design and development of robotic devices whose function is to accomplish prescribed tasks. Each individual will experiment with a variety of configurations while writing programs that allow the robot to navigate intelligently and autonomously. The unit will utilize models and methods that facilitate student understanding. An emphasis will be placed on simple machines in terms of moving, turning, lifting, sensing the environment in terms of color, contact and proximity, monitoring interval states; and most importantly, solving problems that occur in everyday life. The entire program and lab experience is both kinesthetic and computer-based, to maximize student learning and understanding.

Recommended Pacing

Approximately 6 weeks

Standards

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

Algorithms & Programming	
8.1.8.AP.1	Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.
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 subproblems 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.

Critical Thinking & Problem Solving	
9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

Interdisciplinary Connections	
Science	
MS-ESTI-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved
MS-ESTI-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
English Language Arts	
NJSLSA.W2	Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
Engineering Design	
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Instructional Focus

Enduring Understandings:	Essential Questions:
- The design process requires workers to constantly improve on products and solutions that may already exist through the process of researching, testing, designing, and building. It is this method that allows current ideas and products to be improved upon and new innovations to be developed. - Success in the exploration of technology, computer science requires the identification, development, and use of 21st Century Skills. It is important to acquire the necessary skills in information and media literacy in order to	- How does the evolution of technology require computer innovations to meet the needs of society? - What 21st Century Skills are required for success in engineering and design? (teamwork, collaboration, trial & error, innovation, etc.) - What steps are involved in designing and building a product? - How has robotics changed how products are manufactured?

navigate the ever changing digital resources available.
- Life and career skills such as flexibility and adaptability, initiative and self-direction, productivity and accountability, and leadership and responsibility become lifelong attributes towards success. Developing these skills through work in teams, negotiation and problem-solving are critical to all content areas.
- Creativity, innovation, critical thinking, problem solving, communication and collaboration are valuable skills when working with others to achieve a common goal. Combining these skills in a product driven environment extends the learning.

Evidence of Learning (Assessments)

Includes but is not limited to:
- Weekly robotic challenges
- Journal/ Process/Reflection entries
- Sumo Wrestling robot challenge

Objectives (SLO)

Students will know:
- What a robot is and how it is used in the world.
- The role humans play in making a robot successful.
- How to manipulate the various EV3 Mindstorms components
- How to use programming blocks to solve a real world problem.

Students will be able to:
- Work in teams to solve problems that closely align with real world issues and needs using robotic technology.
- Manage projects by successfully completing a variety of performance-based robotics tasks.
- Configure programming blocks to result in a variety of movements.
- Synthesize and assimilate knowledge to better understand complex problems, and to develop effective strategies to achieve workable solutions.
- Evaluate the effect of a robot's speed, direction, color sensor position, and the sensitivity in terms of the robot's effectiveness to accurately track lines.
- Write a reflection on the process involved in meeting various robot challenges and how teamwork was used to solve each challenge.

Suggested Resources/Technology Tools

- Lego Mindstorms EV3 app

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- Re-teaching and review
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- Independent study where applicable
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- ❏ Demonstrate creativity and innovation.
- ❏ Employ valid and reliable research strategies.
- ❏ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❏ Model integrity, ethical leadership, and effective management.
- ❏ Plan education and career paths aligned to personal goals.
- ❏ Use technology to enhance productivity.
- ❏ Work productively in teams while using cultural global competence.

Unit 4
Artificial Intelligence
Summary and Rationale
In the age of Alexa, YouTube recommendations, and Spotify playlists, artificial intelligence has become a way of life, improving marketing and advertising, e-commerce, and more. But what are the ethical implications of technology that collects and learns personal information? How should society navigate these issues and shape the future? In this unit, students participate in a range of hot-topic discussions and hands-on, creative activities to learn about how artificial intelligence is impacting society today. Students will see how A.I. is being used in the automotive industry with sensors and self-driving cars. They will work through various machine learning tasks to train a computer to gather data and make them more intelligent.
Recommended Pacing
2 weeks
Standards

Impacts of Computing	
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.
Algorithms & Programming	
8.1.8.AP.8	Systematically test and refine programs using a range of test cases and users
Interaction of Technology and Humans	
8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
Ethics & Culture	

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

Technology Literacy

9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem .

Interdisciplinary Connections

English Language Arts

NJSLSA.W6	Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

Engineering Design

MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Instructional Focus

Enduring Understandings:	Essential Questions:
● Artificial intelligence is the most significant development of the modern era. The solution to every problem involves a big dataset in every industry. Young people must understand AI and its effect on people and societies.	● How does AI work? ● What is machine learning and how does a computer use data to learn? ● What is the difference between machine learning and AI? ● What are the ethical implications of using AI? ● How will AI impact all areas of society?

Evidence of Learning (Assessments)

● AI Experiments activity
  ○ https://docs.google.com/document/d/1YdLV4fZL4DRVgWD2ycXEVslA_fAjpXyoO2xzHgufvzA/edit
● Cars of the Future activity
  ○ https://docs.google.com/document/d/1M1oTL8B_bzAuKWavh72ZdVDpVDQyY_U9/edit

Objectives (SLO)

Students will know:
- The impact of AI on our society.
- How sensors and cameras are used to develop self-driving cars.
- The human considerations when building and programming a self-driving car.

Students will be able to:
- Understand the basic mechanics of artificial intelligence systems.
- Program a machine to learn to perform certain tasks while gathering data.

Suggested Resources/Technology Tools

- Teachable Machine by Google Creative Lab
- Cars of the Future Virtual Field Trip
- https://studio.code.org/s/coursef-2021/lessons/18

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- Multiple mediums in project

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

- ❏ Act as a responsible and contributing citizen and employee.
- ❏ Apply appropriate academic and technical skills.
- ❏ Attend to personal health and financial well being.
- ❏ Communicate clearly and effectively and with reason.
- ❏ Consider the environmental, social and economic impacts of decisions.
- ❏ Demonstrate creativity and innovation.
- ❏ Employ valid and reliable research strategies.
- ❏ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❏ Model integrity, ethical leadership, and effective management.
- ❏ Plan education and career paths aligned to personal goals.
- ❏ Use technology to enhance productivity.
- ❏ Work productively in teams while using cultural global competence.