Randolph Township Schools
Randolph Middle School
Introduction to Programming Curriculum

"If someone had told me that software is really about humanity, that it's really about helping people by using computer technology, it would have changed my outlook earlier."
-Vanessa Hurst

STEM Department
Melissa Strype, Supervisor

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Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Affirmative Action Statement
Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

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EDUCATIONAL GOALS
VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

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Introduction

Introduction to Programming is a marking period course that fulfills New Jersey requirements for computer science and design thinking. The study of these disciplines focuses on a deep understanding of concepts that enable students to think critically and systematically about leveraging technology to solve local and global issues. In this course, students will be introduced to computer science principles such as bits and networks while considering the relationship of technology and society. Students will then use programming constructs in Scratch to creatively solve complex problems through the framework of computational thinking by decomposing problems and developing algorithms for solutions. The final unit of this course will integrate computational thinking and design thinking through an authentic learning experience by constructing a proposal and model for a sustainable technology. By the end of this cycle class, students will have gained important computer science and design thinking skills relevant to their current and future endeavors in academics, computing, and society. This course will be guided by the current New Jersey Learning Standards in Computer Science and Design Thinking, Science, Mathematics, and English.

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Curriculum Pacing Chart

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
2 weeks	**I**	**Computer Science Principles**
3 weeks	**II**	**Designing with Programming Constructs**
4 weeks	**III**	**Coding for Change**

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Unit I: Computer Science Principles

<table>
<tr><td colspan="3">TRANSFER: Students will be able to mobilize the engineering design process and domain knowledge to create an original model given limitations and constraints.</td></tr>
<tr><td rowspan="6">STANDARDS / GOALS:

NJ 2020 SLS: Computer Science and Design Thinking
8.1.8.CS.1: Recommend improvements to computing devices in order to improve the ways users interact with the devices.

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.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.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively.</td><td>• How can computational thinking change the way we solve problems?</td></tr>
<tr><td>Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.</td><td>• How does the way we use and organize data change as technology and society advance?</td></tr>
<tr><td>Networks connect computing devices to share information and resources and are an increasingly integral part of computing.</td><td>• How does sharing information change the way we interact?</td></tr>
<tr><td><u>KNOWLEDGE</u>
Students will know:</td><td><u>SKILLS</u>
Students will be able to:</td></tr>
<tr><td>Computers require a system for storing information that is reliable and fast.</td><td>Describe how a binary system represents information using just two possible states.</td></tr>
</table>

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Unit I: Computer Science Principles

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.	Software tools translate the low-level representation of bits into a form understandable by individuals.	Model how binary is used in computing with a physical object that has two states, such as a light. Identify the appropriate tool to access data based on its file format.
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.		Describe the difference between how the computer stores data as bits and how the data is displayed.
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.		Create a binary code sequence to represent black and white images and ASCII characters.
8.1.8.NI.4: Explain how new security measures have been created in response to key malware events.	The study of human–computer interaction can improve the design of devices and extend the abilities of humans.	List computer interactions that improve everyday life.
8.2.8.ITH.1: Explain how the development and use of technology influences economic, political, social, and cultural issues.		Recommend improvements to computing devices, apps, software, or code, in order to improve the ways users interact with it.
8.2.8.ITH.2: Compare how technologies have influenced society over time.	Society is faced with trade-offs due to the increasing globalization and automation that computing brings.	Describe issues of bias and accessibility in the design of existing technologies.

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Unit I: Computer Science Principles

NJ 2016 SLS: Literacy in History, Social Studies, & Technical Subjects RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. **NJ 2016 SLS: Mathematical Practices** MP1: Make sense of problems and persevere in solving them. MP2: Reason abstractly and quantitatively. MP4: Model with mathematics. MP5: Use appropriate tools strategically.	Technology and society interact with and affect each other as societal needs drive development of new technological products, and new technology influences human social behavior. Protocols, packets, and addressing are the key components for reliable delivery of information across networks.	Analyze the trade-offs associated with computing technologies that affect individual's everyday activities and career options. Identify the origin and purpose of a technology, such as the Internet, and how its technical structure and design contributes to a social dilemma. Analyze how the development and use of technology influences economic, political, social, and cultural issues. Define the role of addressing, protocols, and packets in computer networking. Illustrate how computing devices can be connected to form a network. Demonstrate how packet numbering and re-ordering can allow for large messages to reliably be sent even if packets are dropped or arrive out of order.

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		Model the role of TCP and UDP protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.
	The information sent and received across networks can be protected from unauthorized access and modification in a variety of ways.	Analyze how network security depends on a combination of hardware, software, and practices that control access to data and systems.
	The evolution of malware leads to understanding the key security measures and best practices needed to proactively address the threat to digital data.	Investigate how new security measures have been created in response to key malware events.
	VOCABULARY: technology, data, trade-off, bias, accessibility, security **KEY TERMS:** computing, computational thinking, binary, file format, network, packets, protocol, hardware, software, malware	

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Unit I: Computer Science Principles

ASSESSMENT EVIDENCE: Students will show their learning by:

- Reflecting on present and past learning through prompts in a OneNote journal
- Manipulating binary code to produce digital artifacts
- Creating a digital product to represent the correlation between technology and society
- Demonstrating data transmission and security through networking using a representative model

KEY LEARNING EVENTS AND INSTRUCTION:

- Students will model binary code in an online simulator
- Students will research how they interact with technology and how some technology is biased or not equitable
- Students will model how information is sent across networks in packets
- Students will investigate network security and how it evolves over time due to security breaches

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Unit I: Computer Science Principles

SUGGESTED TIME ALLOTMENT	**2 weeks**
SUPPLEMENTAL UNIT RESOURCES	Required Supplies/Activities/Software: Computers with Internet access Microsoft OneNote Suggested Supplies/Activities/Software: https://curriculum.code.org/csp-20/unit2/ "Building a Network" "Packets" https://studio.code.org/courses/csd-2021?section_id=3071346 "Binary"

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Unit II: Designing with Programming Constructs

<table>
<tr><td colspan="3">TRANSFER: Students will be able to mobilize the engineering design process and domain knowledge to create an original model given limitations and constraints.</td></tr>
<tr><td rowspan="5">STANDARDS / GOALS:

NJ 2020 SLS: Computer Science and Design Thinking
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.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.</td><td>• How can the design of an algorithm help describe the function that it performs?</td></tr>
<tr><td>The ability to understand and have a procedural method that will help one solve a problem is a valuable life skill.</td><td>• How can you solve a problem?</td></tr>
<tr><td><u>KNOWLEDGE</u>
Students will know:</td><td><u>SKILLS</u>
Students will be able to:</td></tr>
<tr><td>An algorithm is a series of steps that can be followed to carry out a task.</td><td>Describe an algorithm of an everyday task, such as brushing your teeth.

Deconstruct a multi-step task, such as multiplying two three-digit numbers, into individual steps.</td></tr>
</table>

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Unit II: Designing with Programming Constructs

8.1.8.CS.4: Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.		Evaluate the efficiency of an algorithm and recommend improvements.
8.1.8.DA.5: Test, analyze, and refine computational models.	Computer scientists design algorithms, then construct programs in a high-level language such as Scratch to carry out those algorithms on a computer.	Recognize the difference between a high-level language such as Scratch and low-level language such as binary.
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.		Manipulate an existing Scratch program to make changes to the output such as moving the sprite around the canvas.
8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.	Computer scientists use a process to identify, plan, design, test, and redesign programs like the engineering design process.	Identify the steps computer scientists use to solve a problem.
NJ 2016 SLS: Literacy in History, Social Studies, & Technical Subjects RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.		Evaluate the design of a Scratch program from the perspective of a user and the producer.
	Readable algorithms can be reused in many situations and are easier to follow, test, and debug.	Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.
		Create a Scratch program using multiple readable algorithms.

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Unit II: Designing with Programming Constructs

RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **NJ 2016 SLS: Mathematical Practices** MP1: Make sense of problems and persevere in solving them. MP2: Reason abstractly and quantitatively. MP4: Model with mathematics. MP5: Use appropriate tools strategically. MP7: Look for and make use of structure. MP8: Looking for and expressing regularity in repeated reasoning.	Complex problems can be decomposed into efficient algorithms by organizing code to generalize behavior and increase reusability. Control structures are selected and combined in programs to solve more complex problems. Programmers create variables to store data values of different types and perform appropriate operations on their values.	Decompose problems and sub-problems into parts to design a more efficient algorithm. Evaluate other relatable problems that can be solved using a decomposing process. Describe the function of an if statement, if-else statement, loop, and nested loops. Design and iteratively develop a Scratch program that combines control structures, including nested loops and compound conditionals. Identify multiple variables in existing programs and their functions. Create clearly named variables that represent different data types and perform operations on their values.

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	Functions are code sets that allow us to reuse code more efficiently. 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. Computer models can be used to simulate events, examine theories and inferences, or make predictions.	Create procedures with parameters to organize code and make it easier to reuse. Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems such as debugging. Test, analyze, and refine computational models.
	VOCABULARY: efficiency, binary, output, computer science, flowchart, user **KEY TERMS:** algorithm, high-level language, low-level language, Scratch, sprite, canvas, pseudocode, decomposition, if statement, if-else statement, loops, nested loops, control structure, variable, functions, parameters, debugging, computational models	

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Unit II: Designing with Programming Constructs

ASSESSMENT EVIDENCE: Students will show their learning by:

- Reflecting on present and past learning through prompts in a OneNote journal
- Designing algorithms in pseudocode for a process that solves a problem
- Constructing efficient programs to meet the criteria of a task

KEY LEARNING EVENTS AND INSTRUCTION:

- Students will break down problems into smaller manageable tasks
- Students will design and test algorithms for completing a task
- Students will create a program to carry out an algorithm while considering efficiency

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Unit II: Designing with Programming Constructs

SUGGESTED TIME ALLOTMENT	**3 weeks**
SUPPLEMENTAL UNIT RESOURCES	Required Supplies/Activities/Software: Computer with internet connection OneNote Class Notebook Scratch Suggested Supplies/Activities/Software: https://creativecomputing.gse.harvard.edu/guide/curriculum.html Creative Computing Curriculum: About Me Creative Computing Curriculum: Debug it! Creative Computing Curriculum: Maze Creative Computing Curriculum: Pong

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Unit III: Coding for Change

<table>
<tr><td colspan="3">TRANSFER: Students will be able to mobilize the engineering design process and domain knowledge to create an original model given limitations and constraints.</td></tr>
<tr><td rowspan="5">STANDARDS / GOALS:

NJ 2020 SLS: Computer Science and Design Thinking
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.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Technology can have positive or negative effects on society and the natural world.</td><td>• How can technology change the world?</td></tr>
<tr><td>The engineering design process allows engineers to move from finding "a" solution to finding "the best" solution to a problem.</td><td>• What makes a solution the best one?</td></tr>
<tr><td><u>KNOWLEDGE</u>
Students will know:</td><td><u>SKILLS</u>
Students will be able to:</td></tr>
<tr><td>Technology is developed to make the completion of tasks easier, safer, and/or more efficient and can have positive and negative effects on the economy and environment.</td><td>Research and analyze the design of products that negatively impact the environment or society.</td></tr>
</table>

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Unit III: Coding for Change

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. 8.2.8.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. 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.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.	Resources need to be utilized wisely to have positive effects on the environment and society. Alternative technologies are created to reduce consumption of resources and combat climate change. Technological choices and opportunities vary due to socioeconomic factors and can lead to inequities in technological access and development. Engineering design requirements and specifications involve making trade-offs between competing requirements and desired design features.	Brainstorm existing technologies and products that potentially can be improved or repurposed through modifying resources. Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs. Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best. Describe ethical issues that may arise in the design, development, and use of new products and technologies. Develop a proposal for a sustainable solution that addresses a real-world problem using a model with hardware and software. Justify design decisions and explain potential system trade-offs.

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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). 8.2.8.ETW.1: Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs. 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital). 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. 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.	Individuals design and test solutions to identify problems taking into consideration the diverse needs of the users and the community. Identifying the characteristics of the best performing design that can provide useful information for the redesign process. After a solution is created, evaluation of the system can lead to new insights into the function that can be used in another area. **VOCABULARY:** resources, inequity, trade-off, solution, troubleshoot	Design programs, incorporating existing code, media, and libraries, and give attribution. Document programs in order to make them easier to follow, test, and debug. Systematically test and refine programs based on feedback using a range of test cases and users. Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team. Examine a system, consider how each part relates to other parts, and redesign it for another purpose.

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8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or system. 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. 8.2.8.NT.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem. 8.2.8.NT.2: Analyze an existing technological product that has been repurposed for a different function. 8.2.8.NT.3: Examine a system, consider how each part relates to other parts, and redesign it for another purpose.	**KEY TERMS:** upcycling, alternative technology, sustainability, engineering design process, hardware, software, program, debug, redesign	

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8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product. **NJ 2020 SLS: Science** MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused climate change over the past century. ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		

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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. **NJ 2020 SLS: Science – Crosscutting Concepts 6-8** • Cause and effect • Structure and function • Systems and system models **NJ 2020 SLS: Science – Science and Engineering Practices 6-8** • Asking questions and defining problems • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking		

Unit III: Coding for Change

• Constructing explanations and designing solutions **NJ 2020 SLS: Science – Disciplinary Core Ideas 6-8** ETS1.A: Defining and Delimiting Engineering Problems ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **NJ 2016 SLS: Literacy in History, Social Studies, & Technical Subjects** RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **NJ 2016 SLS: Mathematical Practices** MP1: Make sense of problems and persevere in solving them. MP2: Reason abstractly and quantitatively. MP4: Model with mathematics.		

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Unit III: Coding for Change

MP5: Use appropriate tools strategically. MP7: Look for and make use of structure. MP8: Looking for and expressing regularity in repeated reasoning.		

ASSESSMENT EVIDENCE: Students will show their learning by:

- Reflecting on present and past learning through prompts in a OneNote journal
- Developing code in a high-level programming language for a sustainable design solution addressing a real-world problem
- Constructing a physical model of a sustainable design solution integrating hardware and software components
- Documenting the development of a program and the iterative design process in a digital format

KEY LEARNING EVENTS AND INSTRUCTION:

- Students will investigate factors that influence the design and accessibility of technological products
- Students will create a model of a sustainably designed product to reduce the impact of a technology on the environment or society
- Students will test and refine a product through the iterative design process and systematic troubleshooting

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Unit III: Coding for Change

SUGGESTED TIME ALLOTMENT	**4 weeks**
SUPPLEMENTAL UNIT RESOURCES	Required Supplies/Activities/Software: Computers with Internet access Microsoft OneNote Suggested Supplies/Activities/Software: Scratch Microbits Newsela Flocabulary