Montclair State University K12 Computer Science Education

**9-12 Computert Science Curriculum Map**

| **Grades 9-12** | | **Performance Range** | | |
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| **NJ Core Concept** | **Standards** | **Introduction** | **Familiar** | **Proficient** |
| **Computing Systems**  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. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form. | The usability, dependability, security, and  accessibility of devices within integrated  systems are important considerations in their  design as they evolve.  ***Performance Expectation:***  **8.1.12.CS.1: Describe ways in which integrated systems hide underlying implementation details**  **to simplify user experiences.** | Define hardware. Explain the difference between internal and external hardware.  (peripheral devices, I/O devices).  Define software. Explain the different categories of software.  Select one component and explain how it helps the user.  Given a task, select the best type of software to use. For example, I want to learn how to keyboard. I would be looking for a type of educational software program or app like typing.com.  Make recommendations based on how the user interacts with the device | Identify the main parts (hardware) of a computer.  Explain how each part of the computer works.  Select one component and explain how it aids the user.  Select one app that students are familiar with (Word Processing) and propose an improvement (something the app should do that it doesn’t already).  Propose design improvements that consider usability through different lenses (accessibility, ergonomics, learnability, safety). | Label each part of a computer.  Recommend design  improvements based on analysis of user interactions and other lenses.  Advanced:  Virtual program (game) that allows students to assemble a computer. If all the parts are in the right place it works otherwise they have to start again.  -  Teacher Resources:  **Introductory video** that explains the (1) emphasis of unit (2) review definitions (3) outline target projects/takeaways (4) exemplars of projects, and (5) recommendation for modifications for at-risk and ELL students.  [Computer Hardware & Software](https://docs.google.com/presentation/d/1tIZRjy3GEgcFi4SK8GF-E8TvSshJn0Iozqgkf-ZI6b0/edit?usp=sharing)  [Design Project Hardware/Software](https://docs.google.com/document/d/10Va0kpbLA6s7H7Oo7-HmVelGmcZubuVYyUbyhNYudP0/edit?usp=sharing) |
| A computing system involves interaction  among the user, hardware, application  software, and system software.  ***Performance Expectation:***  • 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. | Identify and describe functions of hardware and software  Define software. Explain the different categories of software.  Explain why you need hardware and software in order for your computer system to function properly. | Identify and describe functions of hardware and software and select components to design a simple computing system made of these components. | Explain the functions of the hardware and software components of a computer system. Design and improve a system that includes these components to process, store, gather, and exchange data. |
| Successful troubleshooting of complex  problems involves multiple approaches  including research, analysis, reflection,  interaction with peers, and drawing on past  experiences.  ***Performance Expectation:***  8.1.12.CS.4: Develop guidelines that convey systematic troubleshooting strategies that others can  use to identify and fix errors. | Explain BIOS, RAM, etc. and how to Define software. Explain the different categories of software.  Describe basic hardware and software problems and propose and attempt to solve the problem. | Identify and troubleshoot basic hardware and software problems that may occur during use. | Systematically identify and fix problems with computing systems by using a structured system such as a troubleshooting flow diagram.  [Pre & Post Test Hardware & Software](https://docs.google.com/forms/d/e/1FAIpQLSc2J1RmN4Nxe0O69KBV9h0JzHvZv_yjDGjb5p4Ic45XpByleg/viewform?usp=sf_link) |
| **Networks and the Internet**  Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world. | The scalability and reliability of the Internet  are enabled by the hierarchy and redundancy  in networks.  Network topology is determined by many  characteristics.  ***Performance Expectation:***  **8.1.12.NI.1: Evaluate the scalability and reliability of networks, by describing the relationship**  **between routers, switches, servers, topology, and addressing.** | **8.1.8.NI.1:** Describe how information is broken down into packets that are transmitted through networks and the Internet, and reassembled at its destination.  **8.1.8.NI.2:** Identify parts of a network and the protocol to transmit data from its origin to destination. | **8.1.8.NI.1:** Explain how information is broken down into packets that are transmitted through networks and the Internet, and reassembled at its destination.  **8.1.8.NI.2:**  Describe how protocols are used in networks on the Internet to transmit data. | **8.1.8.NI.1:** Explain how information is broken down into packets that are transmitted the fastest way through networks and the Internet, and reassembled at its destination.  **8.1.8.NI.2:** Model how protocols are used in transmitting data across networks and the Internet and how they enable secure and errorless communication. |
| Network security depends on a combination of  hardware, software, and practices that protect  data while it is at rest, in transit, and in use.  The needs of users and the sensitivity of data  determine the level of security implemented.  Advanced attacks take advantage of common  security vulnerabilities.    ***Performance Expectation***  • 8.1.12.NI.2: Evaluate security measures to address various common security threats.  • 8.1.12.NI.3: Explain how the needs of users and the sensitivity of data determine the level of  security implemented.  • 8.1.12.NI.4: Explain how decisions on methods to protect data are influenced by whether the data  is at rest, in transit, or in use. |  |  | **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. |
| **Impacts of Computing**  Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.  <https://code.org/careers-with-cs#videos>  [Culturally relevant](https://static.raspberrypi.org/files/research/Guide+to+culturally+relevant+and+responsive+computing+in+the+classroom.pdf)  [pedagogy and culturally](https://static.raspberrypi.org/files/research/Guide+to+culturally+relevant+and+responsive+computing+in+the+classroom.pdf)  [responsive teaching](https://static.raspberrypi.org/files/research/Guide+to+culturally+relevant+and+responsive+computing+in+the+classroom.pdf)  <https://www.kaporcenter.org/equitablecs/our-work/> | The design and use of computing technologies  and artifacts can positively or negatively affect  equitable access to information and  opportunities.  ***Performance Expectation***  **• 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and**  **cultural practices.**  **• 8.1.12.IC.2: Test and refine computational artifacts to reduce bias and equity deficits.**  **• 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger**  **social, economic, and political structures, using evidence from credible sources.** | **8.1.8.IC.1**: Compare the trade-offs associated with computing technologies that affect an individual's everyday activities and career options.  **8.1.8.IC.2**: Describe issues of bias and accessibility in the design of existing technologies. | **8.1.8.IC.1**: Compare the trade-offs associated with computing technologies that affect an individual's everyday activities and career options.  **8.1.8.IC.2**: Describe issues of bias and accessibility in the design of existing technologies. | **8.1.8.IC.1**: Compare the trade-offs associated with computing technologies that affect an individual's everyday activities and career options.  **8.1.8.IC.2**: Describe issues of bias and accessibility in the design of existing technologies. |
| **Data & Analysis**  Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions. | Individuals select digital tools and design  automated processes to collect, transform,  generalize, simplify, and present large data  sets in different ways to influence how other  people interpret and understand the underlying  information.  ***Performance Expectation***  **8.1.12.DA.1: Create interactive data visualizations using software tools to help others better**  **understand real world phenomena, including climate change.** | **8.1.8.DA.1**:**:** Collect and transform data using a digital device. | **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable. | **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose. |
| Choices individuals make about how and  where data is organized and stored affects cost,  speed, reliability, accessibility, privacy, and  integrity.  ***Performance Expectation***  **• 8.1.12.DA.2: Describe the trade-offs in how and where data is organized and stored.**  **• 8.1.12.DA.3: Translate between decimal numbers and binary numbers.**  **• 8.1.12.DA.4: Explain the relationship between binary numbers and the storage and use of data in**  **a computing device.** | **8.1.8.DA.2**: Identify bits and describe the difference between stored data and displayed data.  **8.1.8.DA.3**: Identify the appropriate tool to access data based on its file format | **8.1.8.DA.2**: Describe 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.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 |
| Large data sets can be transformed,  generalized, simplified, and presented in  different ways to influence how individuals  interpret and understand the underlying  information.    ***Performance Expectation:***  **8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and**  **support different interpretations of real-world phenomena.** | **8.1.8.DA.4**: Identify a way to transform data to remove errors and improve the accuracy of the data for use. | **8.1.8.DA.4**: Describe how to transform data to remove errors and improve the accuracy of the data for a specific use. | **8.1.8.DA.4**: Develop a process to transform data to remove errors and improve the accuracy of the data for different applications. |
| The accuracy of predictions or inferences  made from a computer model is affected by  the amount, quality, and diversity of data.  ***Performance Expectation***  **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.** | **8.1.8.DA.5**: Test computational models.  **8.1.8.DA.6**: Analyze climate change computational models and propose refinements with assistance. | **8.1.8.DA.5**: Test and analyze computational models.  **8.1.8.DA.6**: Analyze climate change computational models and propose refinements. | **8.1.8.DA.5**: Test, analyze, and refine computational models.  **8.1.8.DA.6**: Analyze climate change computational models and propose refinements. |
| **Algorithms & Programming**  An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems. | Individuals evaluate and select algorithms  based on performance, reusability, and ease of  implementation.  ***Performance Expectation***  **8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original**  **and existing algorithms.** | **8.1.8.AP.1**: Use an algorithm that solve complex problems using flowcharts and/or pseudocode. | **8.1.8.AP.1**: Select and modify an algorithm that solve complex problems using flowcharts and/or pseudocode. | **8.1.8.AP.1**: Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode. |
| Programmers choose data structures to manage  program complexity based on functionality,  storage, and performance trade-offs.  ***Performance Expectation***  **8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly**  **using simple variables.** | **8.1.8.AP.2**: Identify and describe the function of variables that represent different data types and perform operations on their values. | **8.1.8.AP.2**: Create variables that represent different data types and perform operations on their values. | **8.1.8.AP.2**: Create clearly named variables that represent different data types and perform operations on their values. |
| Trade-offs related to implementation,  readability, and program performance are  considered when selecting and combining  control structures.  ***Performance Expectation***  **• 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.** | **8.1.8.AP.3**: Design a program that combines different data types to control structures, including nested loops and compound conditionals. | **8.1.8.AP.3**: Design a secure program that combines different data types to control structures, including nested loops and compound conditionals. | **8.1.8.AP.3**: Design and improve programs that combine different data types to control structures, including nested loops and compound conditionals. |
| 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.  ***Performance Expectation***  **• 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.** | **8.1.8.AP**.4: Decompose problems and subproblems into parts to design and improve a program.  **8.1.8.AP.5**: Identify procedures with parameters to organize code and make it easier to reuse. | **8.1.8.AP**.4: Decompose problems and subproblems into parts to facilitate the design, implementation of programs.  **8.1.8.AP.5**: Create procedures to organize code and make it easier to reuse. | **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. |
| Complex programs are developed, tested, and  analyzed by teams drawing on the members’  diverse strengths using a variety of resources,  libraries, and tools.  ***Performance Expectation***  **• 8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by**  **incorporating feedback from users.**  **• 8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and**  **accessible.**  **• 8.1.12.AP.9: Collaboratively document and present design decisions in the development of**  **complex programs.** | **8.1.8.AP.6**: Test and improve a solution that meets users’ needs.  **8.1.8.AP.7**: Design programs, incorporating existing code, media, and libraries, and give attribution.  **8.1.8.AP.8:** Test and refine programs.  **8.1.8.AP.9**: Document programs in order to make them easier to follow and test. | **8.1.8.AP.6**: Improve 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:** 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. | **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 and improve 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 complex programs in order to make them easier to follow, test, and debug. |

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