

# K-12 Computer Science and Digital Fluency Learning Standards



## Grades 9-12

Impacts of Computing



Computational Thinking



Networks & System Design



Cybersecurity



Digital Literacy



New York State  
Education  
Department



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## IMPACTS OF COMPUTING

<b>Society</b>	<b>9-12.IC.1</b> Evaluate the impact of computing technologies on equity, access, and influence in a global society.	<b>Clarifying Statement</b> The focus should be on how computing technologies can both perpetuate inequalities and help to bring about equity in society.
	<b>9-12.IC.2</b> Debate laws and regulations that impact the development and use of computing technologies and digital information.	<b>Clarifying Statement</b> The focus is on developing and defending a claim about how a specific law related to computing technologies impacts different stakeholders.
<b>Ethics</b>	<b>9-12.IC.3</b> Debate issues of ethics related to real world computing technologies.	<b>Clarifying Statement</b> The focus is on developing and defending a claim about a specific ethical dilemma related to computing technologies.
	<b>9-12.IC.4</b> Assess personal and societal trade-offs related to computing technologies and data privacy.	<b>Clarifying Statement</b> The focus is on discussing the personal and societal benefits and drawbacks of different types of data collection and use, in terms of ethics, policy, and culture.
	<b>9-12.IC.5</b> Describe ways that complex computer systems can be designed for inclusivity and to mitigate unintended consequences.	<b>Clarifying Statement</b> The focus is on applying an understanding of bias and ethical design in order to make recommendations for designing with inclusivity and social good in mind.
<b>Accessibility</b>	<b>9-12.IC.6</b> Create accessible computational artifacts that meet standard compliance requirements or otherwise meet the needs of users with disabilities.	<b>Clarifying Statement</b> At this level, considering accessibility becomes part of the design process and awareness of professionally accepted accessibility standards.
<b>Career Paths</b>	<b>9-12.IC.7</b> Investigate the use of computer science in multiple fields.	<b>Clarifying Statement</b> At this level, the focus is on making connections between computer science and the fields of interest of individual students.

## COMPUTATIONAL THINKING

<b>Modeling and Simulation</b>	<p><b>9-12.CT.1</b> Create a simple digital model that makes predictions of outcomes.</p>	<p><b>Clarifying Statement</b> The focus is on using data to build alternative numerical models that can best represent a data set</p>
<b>Data Analysis and Visualization</b>	<p><b>9-12.CT.2</b> Collect and evaluate data from multiple sources for use in a computational artifact.</p>	<p><b>Clarifying Statement</b> The emphasis is on designing and following collection protocols. Data sources include, but are not limited to sensors, web or database scrapers, and human input.</p>
	<p><b>9-12.CT.3</b> Refine and visualize complex data sets showing how to tell different stories with the same data set.</p>	<p><b>Clarifying Statement</b> The emphasis is on refining large data sets to create multiple narratives depending upon the audience. Large data sets require use of a software tool or app to cross-reference, analyze, refine, and visualize subsets of the data.</p>
<b>Abstraction and Decomposition</b>	<p><b>9-12.CT.4</b> Implement a program using a combination of student-defined and third-party functions to organize the computation.</p>	<p><b>Clarifying Statement</b> The focus is on having students think about how to decompose a programming problem into functions and procedures, including working around the constraints imposed by specific functions or features provided in a library.</p>
	<p><b>9-12.CT.5</b> Modify a function or procedure in a program to perform its computation in a different way over the same inputs, while preserving the result of the overall program.</p>	<p><b>Clarifying Statement</b> The focus is on understanding that the same abstract concept can be performed in different ways in a program, as long as the same inputs yield the same results.</p>
<b>Algorithms And Programming</b>	<p><b>9-12.CT.6</b> Demonstrate how at least two classic algorithms work and analyze the trade-offs related to two or more algorithms for completing the same task.</p>	<p><b>Clarifying Statement</b> The focus of this standard is a high-level understanding that algorithms involve trade-offs, especially related to memory use and speed. Students should understand that classic algorithms are solved problems that can be reused.</p>
	<p><b>9-12.CT.7</b> Design or remix a program that utilizes a data structure to maintain changes to related pieces of data.</p>	<p><b>Clarifying Statement</b> The focus is on updating the elements or components within a named instance of a data structure, without changing the value associated with the name itself.</p>
	<p><b>9-12.CT.8</b> Develop a program that effectively uses control structures in order to create a computer program for practical intent, personal expression, or to address a societal issue.</p>	<p><b>Clarifying Statement</b> The focus is on combining different forms of repetition and conditionals, including conditionals with complex Boolean expressions.</p>
	<p><b>9-12.CT.9</b> Systematically test and refine programs using a range of test cases, based on anticipating common errors and user behavior.</p>	<p><b>Clarifying Statement</b> The emphasis is on perseverance and the ability to use different test cases on their programs and identify what issues are being tested in each case.</p>

	<p><b>9-12.CT.10</b> Collaboratively design and develop a program or computational artifact for a specific audience and create documentation outlining implementation features to inform collaborators and users.</p>	<p><b>Clarifying Statement</b> The focus is on the collaborative aspect of software development, as well as the importance of documenting the development process such that the reasons behind various development decisions can be understood by other software developers.</p>
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## NETWORKS & SYSTEM DESIGN

<b>Hardware and Software</b>	<p><b>9-12.NSD.1</b> Design a solution to a problem that utilizes embedded systems to automatically gather input from the environment.</p>	<p><b>Clarifying Statement</b> The emphasis is on designing (but not necessarily creating) solutions with embedded systems. Systems can be biological, mechanical, social, or some other type of system. Designs could include written descriptions, drawings, and/or 3D prototypes.</p>
	<p><b>9-12.NSD.2</b> Explain the levels of interaction existing between the application software, system software, and hardware of a computing system.</p>	<p><b>Clarifying Statement</b> Knowledge of specific advanced terms of computer architecture and how specific levels work is not required. Rather the progression, in general terms, from voltage to binary signal to logic gates and so on to the level of human interaction, should be explored.</p>
	<p><b>9-12.NSD.3</b> Develop and communicate multi-step troubleshooting strategies others can use to identify and fix problems with computing devices and their components.</p>	<p><b>Clarifying Statement</b> Some examples of multi-step troubleshooting problems include resolving connectivity problems, adjusting system configurations and settings, ensuring hardware and software compatibility, and transferring data from one device to another.</p>
<b>Networks and the Internet</b>	<p><b>9-12.NSD.4</b> Describe the components and design characteristics that allow data and information to be moved, stored and referenced over the Internet.</p>	<p><b>Clarifying Statement</b> The focus is on understanding the design decisions that direct the coordination among systems composing the Internet that allow for scalability and reliability. Discussions should consider historical, cultural, and economic decisions related to the development of the Internet, as well as the core components of servers and routers.</p>
	<p><b>9-12.NSD.5</b> Describe how emerging technologies are impacting networks and how they are used.</p>	<p><b>Clarifying Statement</b> The focus is on discussing how specific emerging technologies impact networks in terms of scale, access, reliability, and security, and user behavior.</p>

## CYBERSECURITY

<b>Risks</b>	<p><b>9-12.CY.1</b> Determine the types of personal and organizational information and digital resources that an individual may have access to that needs to be protected.</p>	<p><b>Clarifying Statement</b> The emphasis is on identifying both personal information and organizational information, and devices and embedded systems, that an individual may have access to and that adversaries may want to compromise, obtain, or leverage.</p>
<b>Safeguards</b>	<p><b>9-12.CY.2</b> Describe physical, digital, and behavioral safeguards that can be employed to protect the confidentiality, integrity, and accessibility of information.</p>	<p><b>Clarifying Statement</b> The emphasis is on considering the CIA Triad when recommending safeguards for a specific application or device.</p>
	<p><b>9-12.CY.3</b> Explain specific trade-offs when selecting and implementing security recommendations.</p>	<p><b>Clarifying Statement</b> The focus is on making security recommendations and discussing trade-offs between the degree of confidentiality, the need for data integrity, the availability of information for legitimate use, and assurance that the information provided is genuine.</p>
	<p><b>9-12.CY.4</b> Evaluate applications of cryptographic methods.</p>	<p><b>Clarifying Statement</b> The focus is on analyzing the role that cryptography and data security play in events that have shaped history and impact the future.</p>
<b>Response</b>	<p><b>9-12.CY.5</b> Recommend multiple actions to take prior and in response to various types of digital security breaches.</p>	<p><b>Clarifying Statement</b> The emphasis is on analyzing different types of breaches and planning appropriate actions that might be taken to prevent and respond to a security breach.</p>

## DIGITAL LITERACY

<b>Digital Use</b>	<b>9-12.DL.1</b> Type proficiently on a keyboard.	<b>Clarifying Statement</b> The focus is to demonstrate proficient keyboarding skills by the end of 12th grade.
	<b>9-12.DL.2</b> Communicate and work collaboratively with others using digital tools to support individual learning and contribute to the learning of others.	<b>Clarifying Statement</b> Digital tools and methods should include both social and professional (those predominantly used in college and careers). Collaboration should occur in real time and asynchronously, and there should be opportunities for students to both seek and provide feedback on their thoughts and products.
	<b>9-12.DL.3</b> <i>*No standard. Mastery reached by grade 8.</i>	
	<b>9-12.DL.4</b> Independently select advanced digital tools and resources to create, revise, and publish complex digital artifacts or collection of artifacts.	<b>Clarifying Statement</b> Mastery of this standard implies an ability to choose and use the technology tool or resource best suited for a task or purpose.
	<b>9-12.DL.5</b> Transfer knowledge of technology in order to use new and emerging technologies on multiple platforms.	<b>Clarifying Statement</b> New technologies could include different tools for collaboration, creation, etc. that the student has not used before. Platforms could include devices running different operating systems or could be emerging STEAM technologies. Digitally fluent individuals can move between platforms and can use that knowledge when encountering new technology.
<b>Digital Citizenship</b>	<b>9-12.DL.6</b> Actively manage digital presence and footprint to reflect an understanding of the permanence and potential consequences of actions in online spaces.	<b>Clarifying Statement</b> Active management implies an understanding of how intentional and unintentional actions can affect a digital presence.
	<b>9-12.DL.7</b> Design and implement strategies that support safety and security of digital information, personal identity, property, and physical and mental health when operating in the digital world.	<b>Clarifying Statement</b> Strategies that support positive mental health in the digital world include both ways to avoid or handle cyberbullying and ways to interact positively and constructively with others in connected spaces.