Computer Science and Digital Fluency Standard Concept Areas

Impacts of Computing	Computational Thinking	Networks and Systems Design	Cybersecurity	Digital Literacy

NYS K-12 Computer Science and Digital Fluency Standards
Grades 9-12
Glossary of Terms

Guiding Principles

1. **EQUITY AND ACCESS:** Equity and diversity should be attended to, allowing for engagement by all students and flexibility in how students may demonstrate proficiency. The standards support a cultural view of learning and human development in which multiple expressions of diversity are recognized and regarded as assets for teaching and learning—otherwise referred to as Culturally Responsive-Sustaining Education (CR-S).

2. **INTERDISCIPLINARY CONNECTIONS:** The standards will complement and promote learning across disciplines.

3. **COHERENCE:** The standards will be focused on the most important knowledge and skills that all students need to know. The standards will be clearly written, demonstrate vertical and horizontal alignment, and articulate a clear learning progression.

4. **RELEVANCE AND ENGAGEMENT:** The standards will motivate and empower students, allow for a focus on appropriate real-world challenges, and will prepare students to adapt and prosper in a world that is increasingly influenced and shaped by technological advancements.

Impacts of Computing

Society	Computing can change or reinforce cultural practices and equity within society. Human social structures that support education, work, and communities have been affected by the ease of communication facilitated by computing. Governments enact laws to influence the impact of computing technologies on society.
Ethics	Computing is not done in a vacuum. The question of ethics in computing is for both creators and users of technology. If computer scientists and end users do not take into account biases and ethics of what has been built, algorithms and programs may have unintended impacts on societies.
Accessibility	The development and design of computing systems needs to take into account the needs and wants of diverse end users and purposefully consider potential perspectives of users with different backgrounds and ability levels. Identifying potential personal bias during the design and implementation process maximizes accessibility in product design, and awareness of professionally accepted accessibility standards helps to evaluate computational artifacts for accessibility.
Career Paths	The increased connectivity between people in different cultures and in different career fields has impacted the variety and types of careers that are possible. There are also many possible career paths within computer science itself, as well as different specialties within each field, that make computer science a broad and encompassing opportunity.

Society.1	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
IC.1 Evaluate the impact of computing technologies on equity, access, and influence in a global society.		
Clarifying Statement The focus should be on how computing technologies can both perpetuate inequalities and help to bring about equity in society.		
Society.2	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
IC.2 Debate laws and regulations that impact the development and use of computing technologies and digital information.		
Clarifying Statement The focus is on developing and defending a claim about how a specific law related to computing technologies impacts different stakeholders.		

Ethics.3	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics...
IC.3 Debate issues of ethics related to real world computing technologies.		
Clarifying Statement The focus is on developing and defending a claim about a specific ethical dilemma related to computing technologies.		
Ethics.4	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics...
IC.4 Assess personal and societal tradeoffs related to computing technologies and data privacy.		
Clarifying Statement 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.		

Ethics.5	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
IC.5 Describe ways that complex computer systems can be designed for inclusivity and to mitigate unintended consequences.		
Clarifying Statement 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.		
Accessibility.6	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
IC.6 Create accessible computational artifacts that meet standard compliance requirements or otherwise meet the needs of users with disabilities.		
Clarifying Statement At this level, considering accessibility becomes part of the design process and awareness of professionally accepted accessibility standards.		

Career Paths.7	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
IC.7 Investigate the use of computer science in multiple fields.		
Clarifying Statement At this level, the focus is on making connections between computer science and the fields of interest of individual students.		

Computational Thinking

Modeling and Simulation	Modeling is the process of representing a system to allow one to observe, understand, or simulate it. Models can be used to simulate real world phenomena that are not easy to observe or reproduce, and often generate simulated data that can further understanding of the system or make predictions.
Data Analysis and Visualization	Data analysis is the process of cleaning, transforming, organizing, clustering, and categorizing data to discover useful information, draw conclusions, and aid in making decisions. Data can be visualized in a variety of ways (including graphs and charts) to aid in and communicate the results of the analysis.
Abstraction and Decomposition	Abstraction is the process of reducing complexity by focusing on key elements. The study of a complicated system often starts by simplifying it and addressing just the most important parts. Complex computer programs also rely on abstraction to isolate particular routines or tasks, especially if those tasks are common. A programmer can then call on that routine, often written by others, without needing to understand its details. Decomposition is the process of strategically breaking complicated problems or tasks into smaller parts that are simpler to understand, program, and debug.
Algorithms and Programming	An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms can be translated into programs, or code, to provide instructions for computing devices. Algorithms are central to programming. Programming is the process of designing and developing code to perform a specific task. It includes the transformation of an algorithm into a specific language that a computer can read and execute, testing code under controlled conditions to ensure its accuracy, debugging the code to resolve errors, and producing documentation both for end users to understand how to use the program and for other developers to assist in following the logic within the program.

Modeling and Simulation.1	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
CT.1 Create a simple digital model that makes predictions of outcomes.		
Clarifying Statement The focus is on using data to build alternative numerical models that can best represent a data set.		
Data Analysis and Visualization.2	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
CT.2 Collect and evaluate data from multiple sources for use in a computational artifact.		
Clarifying Statement 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.		

Data Analysis and Visualization.3	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
CT.3 Refine and visualize complex data sets showing how to tell different stories with the same data set.		
Clarifying Statement 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.		
Abstraction and Decomposition.4	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics…
CT.4 Implement a program using a combination of student-defined and third-party functions to organize the computation.		
Clarifying Statement 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.		

Abstraction and Decomposition.5	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CT.5 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.		
Clarifying Statement 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.		
Algorithms and Programming.6	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CT.6 Demonstrate how at least two classic algorithms work and analyze the trade-offs related to two or more algorithms for completing the same task.		
Clarifying Statement The focus of this standard is a high-level understanding that algorithms involve tradeoffs, especially related to memory use and speed. Students should understand that classic algorithms are solved problems that can be reused.		

Algorithms and Programming.7	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CT.7 Design or remix a program that utilizes a data structure to maintain changes to related pieces of data.		
Clarifying Statement 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.		
Algorithms and Programming.8	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CT.8 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.		
Clarifying Statement The focus is on combining different forms of repetition and conditionals, including conditionals with complex Boolean expressions.		

Algorithms and Programming.9	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CT.9 Systematically test and refine programs using a range of test cases, based on anticipating common errors and user behavior.		
Clarifying Statement 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.		
Algorithms and Programming.10	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CT.10 Collaboratively design and develop a program or computational artifact for a specific audience and create documentation outlining implementation features to inform collaborators and users.		
Clarifying Statement 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.		

Networks & System Design

Hardware and Software	A computing system is composed of hardware, software, and the individuals who use them. Hardware refers to the physical components that make up a computing device. Software refers to the program instructions that operate on such hardware.
Networks and the Internet	Networks are formed by connecting individual devices in a variety of ways. Data is stored on one or more devices in a network and transferred between devices using a set of protocols or rules. The internet is an example of a global network that transmits data between many devices around the world.

Hardware and Software.1	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
NSD.1 Design a solution to a problem that utilizes embedded systems to automatically gather input from the environment.		
Clarifying Statement 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.		

Hardware and Software.2	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics...
NSD.2 Explain the levels of interaction existing between the application software, system software, and hardware of a computing system.		
Clarifying Statement 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.		
Hardware and Software.3	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
NSD.3 Develop and communicate multi-step troubleshooting strategies others can use to identify and fix problems with computing devices and their components.		
Clarifying Statement 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.		

Networks and the Internet.4	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
NSD.4 Describe the components and design characteristics that allow data and information to be moved, stored and referenced over the Internet.		
Clarifying Statement 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.		
Networks and the Internet.5	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
NSD.5 Describe how emerging technologies are impacting networks and how they are used.		
Clarifying Statement The focus is on discussing how specific emerging technologies impact networks in terms of scale, access, reliability, and security, and user behavior.		

Cybersecurity

Risk	Risk is a combination of a vulnerability, the likelihood that the vulnerability will be exploited, and the severity of consequences if the vulnerability is exploited. It is important to understand why data and resources need to be protected and how they might be compromised so the correct safeguards can be put into place
Safeguards	Programmers and individuals must know how to protect their data and computing resources with common safety measures. When combined, various physical, digital, and behavioral precautions can create a level of digital security.
Response	When a security breach occurs, individuals must decide what actions to take. This takes into account what type of breach occurred and how to improve security moving forward.

RISKS.1	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CY.1 Determine the types of personal and organizational information and digital resources that an individual may have access to that needs to be protected.		
Clarifying Statement 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.		

SAFEGUARDS.2	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CY.2 Describe physical, digital, and behavioral safeguards that can be employed to protect the confidentiality, integrity, and accessibility of information.		
Clarifying Statement The emphasis is on considering the CIA Triad when recommending safeguards for a specific application or device.		
SAFEGUARDS.3	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CY.3 Explain specific trade-offs when selecting and implementing security recommendations.		
Clarifying Statement The focus is on making security recommendations and discussing tradeoffs 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.		

SAFEGUARDS.4	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CY.4 Evaluate applications of cryptographic methods.		
Clarifying Statement The focus is on analyzing the role that cryptography and data security play in events that have shaped history and impact the future.		
RESPONSE.5	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
CY.5 Recommend multiple actions to take prior and in response to various types of digital security breaches.		
Clarifying Statement 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.		

Digital Literacy

Digital Use	Computers are a part of everyday life. A variety of digital tools exist to create, revise, and publish digital artifacts, as well as communicate and collaborate with others.
Digital Citizenship	Digital citizenship focuses on empowering learners to use online resources, applications, and spaces to improve communities, make their voice heard, and curate a positive and effective digital footprint. It encourages students to engage respectfully online with people with different beliefs and better determining the validity of online sources of information.

Digital Use.1	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
DL.1 Type proficiently on a keyboard.		
Clarifying Statement The focus is to demonstrate proficient keyboarding skills by the end of 12th grade.		

Digital Use.2	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
DL.2 Communicate and work collaboratively with others using digital tools to support individual learning and contribute to the learning of others.		
Clarifying Statement 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.		
Digital Use.3	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
DL.3 *No standard. Mastery reached by grade 8.		
Clarifying Statement		

Digital Use.4	This can be integrated into my content area(s) in the following ways...?	This standard applies to the following transdisciplinary lessons/topics. ..
DL.4 Independently select advanced digital tools and resources to create, revise, and publish complex digital artifacts or collection of artifacts.		
Clarifying Statement Mastery of this standard implies an ability to choose and use the technology tool or resource best suited for a task or purpose.		
Digital Use.5	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
DL.5 Transfer knowledge of technology in order to use new and emerging technologies on multiple platforms.		
Clarifying Statement 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.		

Digital Citizenship.6	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
DL.6 Actively manage digital presence and footprint to reflect an understanding of the permanence and potential consequences of actions in online spaces.		
Clarifying Statement Active management implies an understanding of how intentional and unintentional actions can affect a digital presence.		
Digital Citizenship.7	This can be integrated into my content area(s) in the following ways...	This standard applies to the following transdisciplinary lessons/topics. ..
DL.7 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.		
Clarifying Statement 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.		