TO: P-12 Education Committee

FROM: Kimberly Young Wilkins

SUBJECT: Approval of the K-12 Learning Standards for Computer Science and Digital Fluency

DATE: December 3, 2020

AUTHORIZATION(S):

SUMMARY

Issue for Decision

Should the Board of Regents approve the K-12 Computer Science and Digital Fluency Learning Standards?

Reason(s) for Consideration

Review of Policy.

Proposed Handling

The Computer Science and Digital Fluency learning standards are presented to the P-12 Education Committee for approval at the December 2020 meeting of the Board of Regents (Attachment A.)

Procedural History

The draft Computer Science and Digital Fluency learning standards were presented to the P-12 Education Committee for conditional approval at the January 2020 meeting of the Board of Regents. Conditional approval was granted upon condition that NYSED staff:

(1) engage further with early learning experts to ensure the K-2 grade band standards are developmentally appropriate;
(2) return to the Board of Regents for final adoption of the standards; and
(3) begin to develop resources and guidance to aid the field in implementing the standards in accordance with the implementation timeline.

Background Information

Overview of the New Computer Science and Digital Fluency Standards

The NYS K-12 Computer Science and Digital Fluency Standards are organized into five Concepts: Impacts of Computing, Computational Thinking, Networks and Systems Design, Cybersecurity, and Digital Literacy.

Each Concept contains two or more Sub-Concepts. Within the Sub-Concepts are a number of standards. The standards are grouped into grade-bands: K-1, 2-3, 4-6, 7-8, and 9-12. Students are expected to master the standards by the end of the last year of the grade band (i.e., end of third grade for the 2-3 grade band).

Stakeholder Input and Feedback

The NYS K-12 Computer Science and Digital Fluency Standards were developed and revised in partnership with numerous stakeholders (Attachment B). Care was taken to ensure participation by representatives of the regions of New York State, as well as key stakeholder groups, including teachers; administrators; business and industry experts; parents; representatives from higher education, BOCES, Big 4 school districts, and NYC Department of Education; and members of various professional organizations, including New York State United Teachers (NYSUT), Computer Science Teachers Association (CSTA), and NYS Association for Computers and Technologies in Education (NYSCATE).

The draft standards were published to solicit broad stakeholder feedback from October 15 to November 15, 2019. NYSED received 410 survey responses representing 839 individuals and members of organizations across New York, with 564 leaving specific comments. The majority of responses were from K-12 educators and administrators; feedback was also received from higher education, advocacy groups, business/industry, nonprofit organizations, parents, students, and school board members. Approximately 60 percent of respondents indicated that they either moderately or strongly supported the standards overall; however, several themes emerged as priorities for revision.

Conditional Approval

Draft NYS K-12 Computer Science and Digital Fluency Standards were presented to the Board of Regents for conditional approval at its January 2020 meeting.

While it was recognized that tremendous effort by New York State educators and stakeholders had been made to ensure the new K-12 Computer Science and Digital Fluency Standards were high-quality, rigorous, and aligned to the Guiding Principles, it was also recognized that, based on stakeholder feedback, and in order to ensure the new standards meet the needs of all students, additional work was needed.

The Board of Regents granted conditional approval of the draft standards, with the expectation that NYSED staff:

1. Engage further with early learning experts to ensure the K-2 grade band standards are developmentally appropriate, and that both the clarifying statements and provided examples are helpful and relevant to K-2 teachers.
2. Return to the Board of Regents for final adoption of the standards.
3. Begin to develop resources and guidance to aid the field in implementing the standards in accordance with the implementation timeline.

In addition, it was indicated that revisions to the standards should include grade 3 under the umbrella of "Early Learning," in accordance with the Early Childhood policy of the Board of Regents.

Early Learning Standards Review and Revision

In January 2020, NYSED sent requests to the field for educators with expertise in early learning to assist with reviewing and revising the early grade band standards. The Early Learning Review Committee was formed and included NYS-certified teachers and experts in early learning from across the State, as well as representation from New York State United Teachers (NYSUT). The Committee convened its first meeting in February 2020 to begin reviewing the standards.

In early March 2020, the Early Learning Committee reviewed the standards and submitted feedback. The feedback was analyzed and synthesized into a set of suggested revisions to the early learning standards to better meet the needs of New York's youngest learners. Work on the standards was paused due to the COVID-19 pandemic, as the majority of the early learning experts assisting with the revision work were New York State teachers. Out of respect for the incredible circumstances facing our teachers and schools during that time, and with the firm belief that the expertise of New York State educators was vital to the revision process, an extension was granted on the timeline to deliver revised standards to the Board of Regents for final approval.

The Early Learning Committee met weekly in August and September to revise the Early Learning Standards. In October 2020, additional revisions were made to ensure alignment with the upper grade bands. The draft Standards were presented to the Executive Standards Committee in November 2020 for final feedback and to ensure the standards carry their recommendation.

The draft standards presented to the Commissioner of Education and NYS Board of Regents include the following changes from the draft presented in January 2020:

Priority for Revision, Defined by Stakeholder Feedback	Actions Taken by Revision Workgroup, Reflected in December 2020 Draft Standards
1. More attention needed in the K-2 band, specifically looking at developmental appropriateness, ability to meet the standards without the use of a device, and ensuring clarifying language and examples are relevant to K-2 classrooms.	• The Early Learning Workgroup, which included New York State Early Learning Teachers, with input from subject matter experts, revised the Early Learning Standards for developmental appropriateness, flexibility for meeting the standards, and to emphasize thinking, creativity and problem solving. • They also reviewed the clarifying language and examples for relevance in K-3 classrooms and suggested new language, where appropriate.
2. Third grade should be included with the K-2 grade band.	• Third grade is included with K-2 under the umbrella of Early Learning, in alignment with the Policy of the Board of Regents. • The middle grade bands (3-5 and 6-8) were also adjusted to 4-6 and 7-8. The 9-12 grade band remains. • This required new standards, clarifying statements, and examples to be written for the added grade band.
3. The K-3 band should be split to reflect developmental needs of young students.	• Grade band (K-3) was split into two (K-1 and 2-3) at the recommendation of Early Learning experts.
4. Ensure the guiding principle of coherence is maintained.	• A few adjustments were made to the upper grade standards to ensure logical progression and vertical alignment. • Reduced number of standards from 35 to 34 by combining redundant standards and focusing on the most important knowledge and skills.
5. Examples included with the standards are too limiting.	• The examples, which were intended to be illustrative only, have been pulled out of the standards document, and will be made available as a supplemental resource.

Related Regents Items

January 2020: Conditional Approval of the Learning Standards for Computer Science and Digital Fluency
(https://www.regents.nysed.gov/common/regents/files/120p12a4.pdf)

Recommendation

It is recommended that the Board of Regents take the following action:

VOTED: That the Board of Regents approve the learning standards for the new discipline of Computer Science and Digital Fluency.

Timetable for Roll-out and Implementation

The following timetable for implementation was approved at the January 2020 meeting of the Board of Regents.

Dates	Phase	Activities
Adoption – Aug. 2021	Awareness-Building	Roll-out and building awareness of the new standards and timeline for implementation
Sept. 2021 – Aug. 2023	Capacity-Building	Focus on curriculum development, resource acquisition, professional development
Sept. 2023 – Aug. 2024	Year 1 Implementation	All credit-bearing computer science courses will be aligned with NYS CS&DF Standards
September 2024	Full Implementation	CS&DF Standards implemented in all grade bands K-12

Attachment A:

New York State

Computer Science and Digital Fluency Learning Standards

GRADES K-12

December 2020

New York State EDUCATION DEPARTMENT
Knowledge › Skill › Opportunity

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Introduction

For New York State students to lead productive and successful lives upon graduation, they must understand and know how to use digital technologies. Technology knowledge and skills are vital for full participation in 21st Century life, work, and citizenship.

In 2018, the New York State Legislature passed, and the Governor signed into law[1], legislation requiring the New York State Education Department (NYSED) to create a workgroup and present draft NYS K-12 Computer Science Learning Standards to the Commissioner of Education and the Board of Regents for approval.

The Standards reflect the expertise, deep thinking, advocacy, and hard work of many New York State educators, administrators, parents, and representatives of professional organizations. The related areas of computer science and digital fluency have been combined under one "umbrella" to create a comprehensive, cohesive set of learning standards that represent the essential knowledge and skills in these areas that students should possess upon graduation in order to be successful in college, careers, and citizenship in the 21st Century.

According to the United States Department of Labor Bureau of Labor Statistics, "Employment of computer and information technology occupations is projected to grow 13 percent from 2016 to 2026, faster than the average for all occupations. These occupations are projected to add about 557,100 new jobs." And these hundreds of thousands of new jobs offer significantly higher-than-average pay; the median wage for computer and information technology occupations is higher than all other occupations.[2]

NYSED understands and respects the fact that not all students will pursue a career in technology. It is important to note, however, that for all other occupations, the number of jobs that require medium- to high-level technology skills are growing, and the number of jobs requiring no technology skill are shrinking.[3]

As New Yorkers, we must prepare all students to live and work in our dynamic, technology-driven 21st-Century world. This imperative is the basis of the vision for the draft New York State K-12 Computer Science and Digital Fluency Standards.

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[1] Part R of Chapter 56 of the Laws of 2018

[2] https://www.bls.gov/ooh/computer-and-information-technology/home.htm 5/10/19.

[3] https://www.cfr.org/report/the-work-ahead/report/findings.html#_edn14, https://www.brookings.edu/wp-content/uploads/2017/11/mpp_2017nov15_digitalization_full_report.pdf, 5/10/19

Vision for the CS & DF Standards

Every student will know how to live productively and safely in a technology-dominated world. This includes understanding the essential features of digital technologies, why and how they work, and how to communicate and create using those technologies.

Background

NYSED views digital fluency as vital to success in college, careers, and citizenship. The NY Statewide Learning Technology Plan (2010) identifies that "technology is a path for teaching and learning, but it is also a body of practices, skill, and knowledge to be learned," and expresses the Board of Regents' expectation that "all New York State learners will develop technological literacy to enter college, become productive members of the workforce, and succeed as citizens."[4] In addition, New York's approved Every Student Succeeds Act (ESSA) Plan includes the expectation that NYSED "will work with stakeholders to provide guidance regarding digital literacy for students."[5]

The Board of Regents approved amendments to the education regulations to establish a new certification area and tenure area for computer science in March 2018. The Department began engaging in conversations on developing computer science learning standards shortly thereafter, and when the law requiring standards was passed in April 2018, plans for development began in earnest.

Process for Developing the Standards

In September 2018, NYSED convened a group of statewide experts on computer science and educational technology to assist in thinking through matters related to the creation of computer science and digital fluency standards for New York State. The group of experts recommended NYSED combine computer science and digital fluency under one "umbrella," as has been done in several other states, and developed Guiding Principles for the development of the new standards.

[4] USNY Statewide Technology Plan
[5] NYS Approved ESSA Plan, p. 188

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 horizonal 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 increasing influenced and shaped by technological advancements.

In October 2018, NYSED formed Authoring Workgroup and Review Panels with representation from all NYS regions, community types, and stakeholder groups, including teachers; administrators; business and industry experts; parents; representatives from higher education, BOCES, Big 4 school districts, and the NYC Department of Education; and members of various professional organizations, including NYSUT, the Computer Science Teachers Association (CSTA), and the NYS Association of Computers and Technology in Education (NYSCATE). NYSED also formed an Executive Standards Committee, comprised of state and national experts and leaders to provide final recommendations to NYSED Senior Leadership.

From October 2018 through March 2019, the Authoring Workgroup worked to produce a first draft of the new standards, which was reviewed by Review Panel members through the following "lenses" (perspectives):

Lenses	Description
Clarity and Focus	Standards should be limited in number and should be focused on the most important concepts and skills that should be acquired by students. High-quality standards are clearly written and presented in an error-free, legible, easy-to-use format that is accessible to both the targeted instructors and the general public.
Coherence and Progression	Standards should be organized as progressions that support student learning of content and practices over multiple grades. Coherence refers to how well a set of standards conveys a unified vision, establishing connections among the major areas of study, and shows a meaningful progression of content across grade spans.
Equity	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).
Interdisciplinary Connections	The standards should complement other NYS Learning Standards and promote learning across disciplines.
Rigor	Standards should establish and articulate the appropriate level of rigor to prepare all students for success in college and careers. "Rigor" in this context can be understood as "challenge;" a rigorous standard should challenge students to increase their knowledge and skills.
Relevant and Engaging	Standards should be connected to appropriate real-world challenges, should motivate and empower students, promote individual growth and life-long learning, and prepare students to adapt and prosper in a world that is increasingly influenced and shaped by technological advancements.
Specificity	Standards should be neither too broad nor too specific, and the "granularity," or the degree of specificity, should be consistent across the standards. High-quality standards are precise and provide sufficient detail to convey the level of performance expected without being overly prescriptive or limiting.

The Review Panel feedback was used to revise the standards per Department policy and expectations. The draft was presented to the Executive Standards Committee and NYSED Senior Leadership in September. Revisions were made based on their input, and the Standards were released for public feedback in October 2019. NYSED convened a workgroup in December 2019 to address the stakeholder feedback priorities and revise the standards accordingly, while still adhering to the Guiding Principles and ensuring the standards are rigorous and focus on the most important knowledge and skills.

At the January 2020 meeting of the New York State Board of Regents, the Board of Regents granted the draft NYS K-12 Computer Science and Digital Fluency Standards Conditional Approval, with the expectation that NYSED staff engage further with early learning experts to ensure the K-2 grade band standards are developmentally appropriate, and that both the clarifying statements and provided examples are helpful and relevant to K-2 teachers.

The Early Learning Review Committee was formed, and included NYS Certified teachers and experts in Early Learning from across the state, as well as representation from the New York State United Teachers (NYSUT). The Committee convened its first meeting in February 2020 to begin reviewing and revising the Early Learning standards. The updated draft Standards were presented to the Executive Standards Committee in November 2020 for final feedback.

The updated Draft NYS K-12 Computer Science and Digital Fluency Standards were presented for approval at the December meeting of the NYS Board of Regents.

Supplemental Resources and Additional Guidance

Parallel to efforts to revise the Early Learning Standards, NYSED began the process of developing resources and guidance to aid the field in implementing the standards in accordance with the implementation timeline. This work will continue over the coming months and years in partnership with stakeholders.

Supplemental Resources are available on NYSED's Computer Science and Digital Fluency Standards webpage. Additional resources and guidance will be added to the site as they are developed.

Computer Science and Digital Fluency Standards for All Learners

Digital Equity

The COVID-19 Pandemic, and the responsive shift to remote and/or hybrid learning, brought forth a new understanding of the need to address digital equity in New York State. Sufficient access to a computing device and high-speed broadband is essential for educational equity. Devices and internet access alone will not ensure digital equity, however. Individuals must have an understanding of technology and the ability to use it effectively, safely, and productively, in order to pursue extended learning opportunities, including college and trades, enter the workforce, and fully participate in 21st Century life and citizenship. The NYS K-12 Computer Science and Digital Fluency Standards provide students with this critical foundation.

As with all facets of the work of the New York State Education Department, Equity has been a Guiding Principle during the Standards development process. The Executive Committee, Authoring Workgroup, and Review Panels reviewed every standard through a lens of equity and diversity. The Standards were crafted to allow for engagement by all students and provide 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).

English Language Learners

The need to promote computer science and digital fluency education among all students comes at a time when the system is already charged with building up language skills among an increasingly diverse student population. Students who are English Language Learners (ELLs) now comprise over 20% of the school-age population, which reflects significant growth in the past several decades.

ELLs, language minority learners, and students acquiring academic English often struggle to access the language, and therefore the knowledge, that fills the pages of academic texts, despite their linguistic assets. In turn, these students are over-represented among students identified with disabilities. There is a pressing need to provide instruction that not only meets, but exceeds standards, and to provide multiple ways for students to demonstrate understanding and skills, as part of system-wide initiative to promote equal

access to learning for all students while capitalizing on linguistic and cultural diversity. Additional guidance on working with linguistically diverse learners can be accessed on the Office of Bilingual Education and English as a New Language's website.

Students with Disabilities

One of the fundamental tenets guiding educational legislation (the *No Child Left Behind Act*, and the *Every Student Succeeds Act*) and related policies over the past 15-years, is that all students, including students with disabilities, can achieve high standards of academic performance. A related trend is the increasing knowledge and skill expectations for PreK-Grade 12 students required for success in postsecondary education and 21st Century careers.

Each student's individualized education program (IEP) must be developed in consideration of the State learning standards and should include information for teachers to effectively provide supports and services to address the individual learning needs of the student as they impact the student's ability to participate and progress in the general education curriculum. In addition to supports and services, special education must include specially designed instruction, which means adapting, as appropriate, the content, methodology or delivery of instruction to address the unique needs that result from the student's disability. By so doing, the teacher ensures each student's access to the general education curriculum so that he or she can meet the learning standards that apply to all students. The *Blueprint for Improved Results for Students with Disabilities* focuses on seven core evidence-based principles for students with disabilities to ensure they have the opportunity to benefit from high quality instruction and to reach the same academic standards as all students.

Early Learning

As with all NYS Learning Standards, the Computer Science and Digital Fluency Standards should be implemented with careful understanding of child development and developmentally appropriate practice, especially for our youngest learners. The academic foundation that is set in the early years is essential, and the social emotional needs and environment for learning are key ingredients for student success. As these standards are implemented, it is important to meet the needs of the "whole child," recognizing that a well-rounded education, positive learning environment, strong home-school connection, and high expectations all contribute to student success.

Great care has been taken to ensure the new K-12 Computer Science and Digital Fluency Learning Standards align to developmentally appropriate expectations and practices for our youngest students. Educators will note that the Early Learning standards, especially the K-1 Standards, focus on familiar key skills and concepts: Recognizing and extending patterns; Problem Solving; Sequencing; Sorting, classifying, and labelling; Creating and following procedures; Learning and following rules; Predicting what will happen next. As these knowledge and skills areas are already central to early learning programs, teachers will find numerous ways to connect the Computer Science and Digital Fluency Standards to existing curricula and learning activities.

In addition, it is important to note that all standards in the early grades can be taught either with or without a computing device, to allow teachers the freedom to choose the most appropriate means to teach a specific concept or skill. It is undeniable that technology is a part of children's lives, and the ability to understand and use technology safely and effectively to learn, communicate, and create is critical for life in the 21st Century. In the early grades, however, teachers should utilize technology as one of many tools available to help children learn. As the Standards do not require students to utilize technology, the decisions on how best to incorporate it in intentional and developmentally appropriate ways can be made by the teacher and school.

Defining Terms

Computer science can be defined as "the study of computers and algorithmic processes, including their principles, their hardware and software design, their applications, and their impact on society."[6] In other words, computer science is the study of why and how computers work.[7] Computer science emphasizes problem solving and pushes students to be active creators – rather than passive consumers – of computer technologies. Programming, or **coding**, is one aspect of the computer science field of study, but is not the sole focus.

Digital Literacy can be defined as the knowledge of, and the ability to use digital technologies to create, research, communicate, collaborate, and share information and work. **Digital citizenship**, or the ability to understand and act in safe, ethical, legal, and positive ways in online environments, is often viewed as one aspect of digital literacy. Digital literacy is not a teacher certification area, nor is it expected to be or become a "class" students take. Rather, digital literacy should be taught in all subjects and reinforced as students use technology in everyday learning, across all subjects.

[6] Tucker et. al, 2003, p. 6
[7] https://k12cs.org/defining-computer-science/ (30 July 2019)

Under recommendation from the field, NYSED is identifying the Standards as the Computer Science and **Digital Fluency** Standards. **Digital Fluency** implies an ability to evaluate technologies, transfer understanding to move fluidly between technologies, and create something new with technology. In recent years, digital fluency has emerged as a term to describe the "next level" of understanding and skill beyond digital literacy. As there are areas where computer science and digital literacy overlap, a mastery of both areas is necessary to be considered digitally fluent.

Educational technology, sometimes referred to as instructional technology, is the use of technology to facilitate and enhance teaching and learning. While there is a certification in this area (the Educational Technology Specialist Certification), educational technology, like digital literacy, is not a "class" students take.

Technology education, in New York, evolved from the subject area called industrial arts. Although technology education programs offer students many opportunities to apply their mathematics and science skills, programs at the high school level offer additional opportunities to explore technology-related careers under the Career and Technical Education (CTE) umbrella. Technology education classes may teach how to use computing hardware and software within a focus on career skills.

There exist many other terms for describing various aspects of computing, computer education, and technology-related fields. Some schools have computer labs, for instance, or offer Computer Classes. These terms are broad, and the curriculum varies by school and district. All curriculum decisions are made at the district level.

Concept Areas

Impacts of Computing

Computing affects many aspects of the world at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions. In turn, computing influences new cultural practices. Informed citizens understand the ethical and social implications of the digital world, including equity and access to computing and computing technologies.

The Impacts of Computing standards promote an understanding of the evolving impact of computing technologies on society through many lenses, including personal, social, cultural, accessibility, legal, economic, and ethical.

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.

Computational Thinking

Computational thinking involves thinking about and solving problems in ways that can be carried out by a computer. Computational thinking not only underpins all theory and application of computer science, but also influences many other subject areas. Computational thinking includes both core concepts, such as algorithms and variables, and core practices, such as abstraction, decomposition, data analysis, modeling, and simulation, that are vital not only to the design and development of computer programs but also to the strategic use of computational power to solve problems across disciplines. The process of creating meaningful and efficient solutions, often done in collaboration with others, typically involves these steps: defining the problem, breaking apart large problems into smaller ones, recombining existing solutions, analyzing different solutions, using data to inform new potential solutions, and looking at information in new ways to develop innovative solutions.

Computational thinking plays an important role in supporting the creation of solutions to problems, both large and small. Algorithms, programs, simulations, and data are essential to all computing systems, empowering people to communicate and collaborate with others around the world. The standards promote development of foundational skills, knowledge, and experience to solve problems by creating solutions that utilize computational thinking concepts and practices.

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.

Networks and Systems Design

Computing devices typically do not operate in isolation. Networks connect computing devices to share data and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication, and facilitating innovation.

Individuals interact with data using a variety of input and output devices that are part of a more complex computing system. The hardware and software that make up a computing system process data in digital form. A basic understanding of hardware and software is useful when troubleshooting a computing system that does not work as intended.

The Networks and Systems Design standards aim to prepare students to understand the basic functioning of the computing systems and networks that are used as fundamental tools in our personal and professional lives.

Hardware & 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 & 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.

Cybersecurity

In a digital world, all individuals have a responsibility to protect data and the computing resources they access. Cybersecurity encompasses the physical, digital, and behavioral actions that can be taken to increase this security. These measures are meant to ensure the confidentiality and integrity of data and computing resources, as well as ensure that they are accessible to the users who are supposed to have access to them. Digital security includes understanding and identifying risks, implementing appropriate safeguards, and being prepared to respond to potential attacks.

The Cybersecurity standards prepare students to understand why data and computing resources need to be protected, who might access them, and why they might do so whether intentionally malicious or not. It is important that students know how to employ basic safeguards to protect data and computing resources and how to appropriately respond if a breach occurs.

Risks	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.

Digital Literacy

Digital literacy is a multifaceted concept that extends beyond skills-based activities and incorporates both cognitive and technical skills. It refers to the ability to leverage computer technology to appropriately access digital information; to create, share, and modify artifacts, and to interact and collaborate with others. Digital literacy includes understanding the benefits and implications of using digital technologies to be successful in our contemporary world.

Digital Use	Digital technologies 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.

Organization of the Standards

The NYS K-12 Computer Science and Digital Fluency Standards are organized into five Concepts: Impacts of Computing, Computational Thinking, Networks and Systems Design, Cybersecurity, and Digital Literacy.

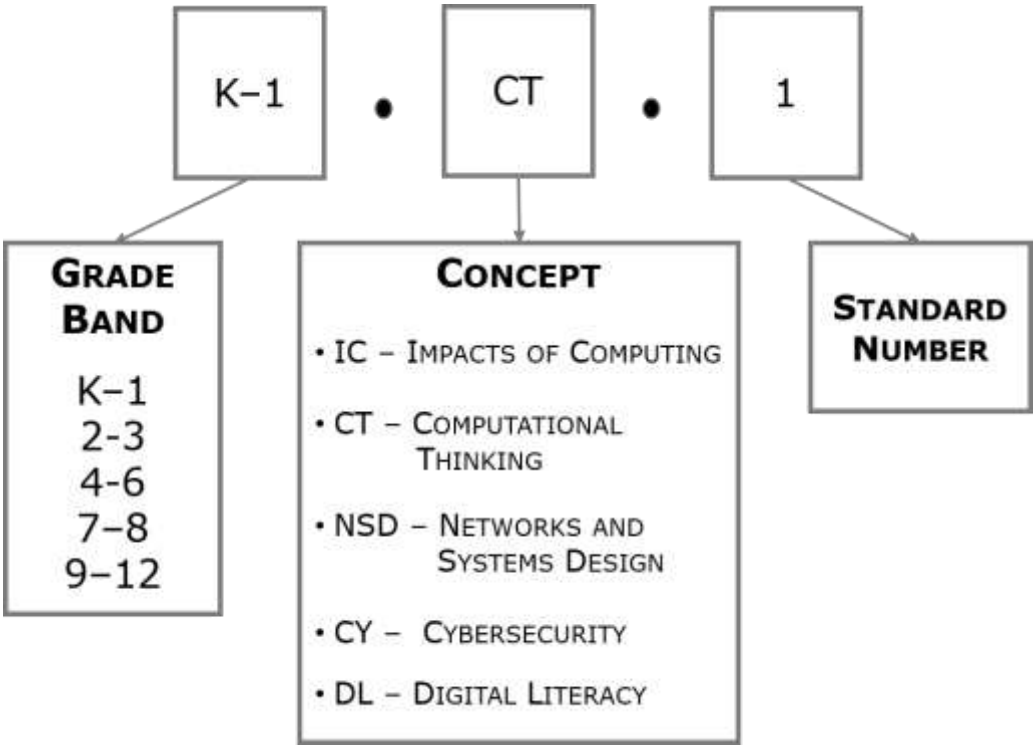
Each Concept contains two or more Sub-Concepts. Within the Sub-Concepts are a number of standards. The standards are grouped into grade-bands: K-2, 3-5, 6-8, and 9-12. Students are expected to master the standards by the end of the last year of the grade band (i.e. end of second grade for the K-2 grade band).

Concept	Sub-Concepts	Standards
Impacts of Computing	Society	1, 2
	Ethics	3, 4, 5
	Accessibility	6
	Career Paths	7
Computational Thinking	Modeling and Simulation	1
	Data Analysis and Visualization	2, 3
	Abstraction and Decomposition	4, 5
	Algorithms and Programming	6, 7, 8, 9, 10
Networks and Systems Design	Hardware and Software	1, 2, 3
	Networks and the Internet	4, 5
Cybersecurity	Risks	1
	Safeguards	2, 3, 4
	Response	5
Digital Literacy	Digital Use	1, 2, 3, 4, 5
	Digital Citizenship	6, 7

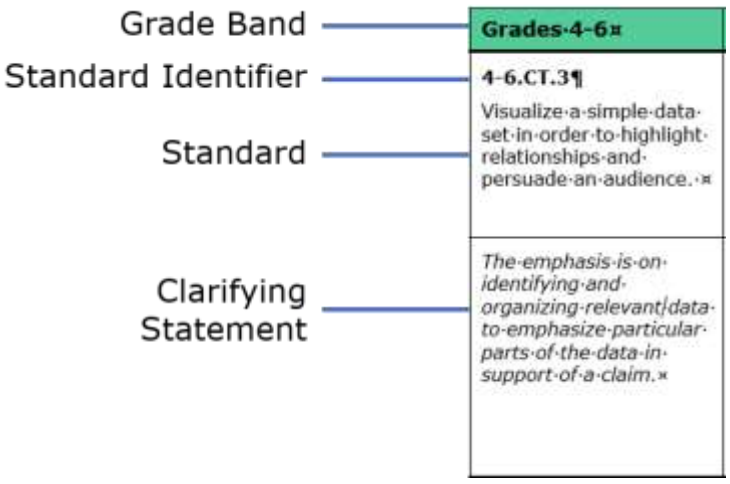
Please note that the organization is *not intended as a sequence*. Concepts, Sub-Concepts, and individual Standards may be taught in any order.

How to Read the Standards

The standards are identified by grade band, followed by the concept area, and finally the standard number.



Each standard is presented with an additional clarifying statement.



NYS K-12 Computer Science and Digital Fluency Standards

Impacts of Computing

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Society	**K-1.IC.1** Identify and discuss how tasks are accomplished with and without computing technology.	**2-3.IC.1** Identify and analyze how computing technology has changed the way people live and work.	**4-6.IC.1** Describe computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.	**7-8.IC.1** Compare and contrast tradeoffs associated with computing technologies that affect individuals and society.	**9-12.IC.1** Evaluate the impact of computing technologies on equity, access, and influence in a global society.
	Common tasks include sending a letter by email vs. post, taking a picture with a smart phone vs. camera, buying something with an app vs. with cash at a store.	*The focus should be on how advancements in computing technology have changed careers and lives.*	*The focus should be on how computing technologies both influence and are influenced by society and culture.*	*Topics that could be addressed include, but are not limited to, free speech, communication, and automation.*	*The focus should be on how computing technologies can both perpetuate inequalities and help to bring about equity in society.*
	K-1.IC.2 Identify and explain classroom and home rules related to computing technologies.	**2-3.IC.2** Compare and explain rules related to computing technologies and digital information.	**4-6.IC.2** Explain how laws impact the use of computing technologies and digital information.	**7-8.IC.2** Evaluate the impact of laws or regulations on the development and use of computing technologies and digital information.	**9-12.IC.2** Debate laws and regulations that impact the development and use of computing technologies and digital information.
	Rules could include when it's okay to use a device, what programs or apps are okay to use, how to treat the equipment, etc.	*The focus is on having students understand why rules around computing technology can change depending upon the setting.*	*The focus is on how laws regulate the use of computing technologies and what might happen if those laws did not exist.*	*The focus is on the potential consequences of laws related to computing technologies.*	*The focus is on developing and defending a claim about how a specific law related to computing technologies impacts different stakeholders.*

Impacts of Computing

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Ethics	**K-1.IC.3** Identify computing technologies in the classroom, home, and community.	**2-3.IC.3** Discuss and explain how computing technology can be used in society and the world.	**4-6.IC.3** Explain current events that involve computing technologies.	**7-8.IC.3** Identify and discuss issues of ethics surrounding computing technologies and current events.	**9-12.IC.3** Debate issues of ethics related to real world computing technologies.
	The focus should be on recognizing familiar computing technologies that we use in our lives.	*The focus is on examples of computing technology that were invented to solve broader problems in society, or existing technology platforms that can have many purposes.*	*Explanations should be grade level appropriate to ensure understanding of current events and the related computing technologies.*	*At this level, students may require teacher support to discuss the possible ethical implications of computing technologies.*	*The focus is on developing and defending a claim about a specific ethical dilemma related to computing technologies.*
	K-1.IC.4 Identify public and private spaces in our daily lives.	**2-3.IC.4** Identify public and private digital spaces.	**4-6.IC.4** Explain who has access to data in different digital spaces.	**7-8.IC.4** Identify and discuss issues related to the collection and use of public and private data.	**9-12.IC.4** Assess personal and societal trade-offs related to computing technologies and data privacy.
	The focus is on recognizing the difference between a public shared space versus a private space.	*The focus is on identifying digital spaces in the context of sharing or accessing information, such as an online platform where students submit work (private) versus public websites that anyone can access.*	*The focus is on identifying different groups who might have access to data stored or posted in different places, including companies.*	*The focus is on exploring the impacts of data collection, including biases in data collection, and its use by different stakeholders for a range of purposes.*	*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.*

Impacts of Computing

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Ethics	This Standard begins in Grade Band 2-3	**2-3.IC.5** Identify and discuss how computers are programmed to make decisions without direct human input in daily life.	**4-6.IC.5** Explain how computer systems play a role in human decision-making.	**7-8.IC.5** Analyze potential sources of bias that could be introduced to complex computer systems and the potential impact of these biases on individuals.	**9-12.IC.5** Describe ways that complex computer systems can be designed for inclusivity and to mitigate unintended consequences.
		The focus is on describing computing technology that relies on a program, settings, and data to make decisions without direct human involvement.	*The focus is on explaining a range of ways that humans interact with AI to make decisions.*	*The focus is on understanding different factors that introduce bias into an AI system and how those biases affect people.*	*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	**K-1.IC.6** With teacher support, identify different ways people interact with computers and computing devices.	**2-3.IC.6** Identify and discuss factors that make a computing device or software application easier or more difficult to use.	**4-6.IC.6** Identify and explain ways to improve the accessibility and usability of a computing device or software application for the diverse needs and wants of users.	**7-8.IC.6** Assess the accessibility of a computing device or software application in terms of user needs.	**9-12.IC.6** Create accessible computational artifacts that meet standard compliance requirements or otherwise meet the needs of users with disabilities.
	The focus is on the features of computers and other devices, and the things that make them easier to use (i.e. drop-down menus, buttons, areas to type).	*The focus is on identifying choices developers make when designing computing devices and software and considering the pros and cons when making those choices.*	*The focus is on identifying the needs and wants of diverse end users and purposefully considering potential perspectives of users with different backgrounds, ability levels, points of view, and abilities.*	*The focus is on testing and discussing the usability and accessibility of various technology tools (e.g., apps, games, and devices) with teacher guidance.*	*At this level, considering accessibility becomes part of the design process and awareness of professionally accepted accessibility standards.*

Impacts of Computing

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Career Paths	**K-1.IC.7** Identify multiple jobs that use computing technologies.	**2-3.IC.7** Identify a diverse range of roles and skills in computer science.	**4-6.IC.7** Identify a diverse range of role models in computer science.	**7-8.IC.7** Explore a range of computer science-related career paths.	**9-12.IC.7** Investigate the use of computer science in multiple fields.
	The focus is on identifying jobs that utilize computing technology and how technology impacts a range of industries. Doctors, business owners, police officers, auto repair technicians, farmers, architects, and pilots use computing technology in their jobs.	*The focus is not just on jobs in computer science, but also the skills and practices that are important for careers in the field of computer science.*	*The emphasis of this standard is the opportunity to personally identify with a range of diverse people in the field of computer science.*	*At this level, the focus is on building awareness of the many different computer science-related careers.*	*At this level, the focus is on making connections between computer science and the fields of interest of individual students.*

NYS K-12 Computer Science and Digital Fluency Standards

Computational Thinking

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Modeling and Simulation	**K-1.CT.1** Identify and describe one or more patterns (found in nature or designed) and examine the patterns to find similarities and make predictions.	**2-3.CT.1** Create a model of an object or computational process in order to identify patterns and essential elements of the object or process.	**4-6.CT.1** Develop a computational model of a system that shows changes in output when there are changes in inputs.	**7-8.CT.1** Compare the results of alternative models or simulations to determine and evaluate how the input data and assumptions change the results.	**9-12.CT.1** Create a simple digital model that makes predictions of outcomes.
	The emphasis is on identifying patterns and then making predictions based on the pattern.	*The emphasis is on essential components represented in the model to achieve desired results and assist in identifying patterns in the world around us, such as cycles in nature or tessellations.*	*The emphasis is on understanding, at a conceptual level, that models or simulations can be created to respond to deliberate changes in inputs.*	*The focus is on understanding that models or simulations are limited by the data that they use, rather than understanding specifically how they use that data.*	*The focus is on using data to build alternative numerical models that can best represent a data set.*
Data Analysis and Visualization	**K-1.CT.2** Identify different kinds of data that can be collected from everyday life.	**2-3.CT.2** Identify and describe data collection tools from everyday life.	**4-6.CT.2** Collect digital data related to a real-life question or need.	**7-8.CT.2** Collect and use digital data in a computational artifact.	**9-12.CT.2** Collect and evaluate data from multiple sources for use in a computational artifact.
	The emphasis is on understanding what is data and identifying different types of data, while exploring how data can be collected and sorted.	*The emphasis is on identifying various tools in everyday life that collect, sort and store data, such as surveys, spreadsheets and charts.*	*The emphasis is on using digital tools to collect and organize multiple data points.*	*The emphasis is on designing and following collection protocols. Data sources include, but are not limited to sensors, surveys, and polls.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Computational Thinking

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Data Analysis and Visualization	**K-1.CT.3** Identify ways to visualize data, and collaboratively create a visualization of data.	**2-3.CT.3** Present the same data in multiple visual formats in order to tell a story about the data.	**4-6.CT.3** Visualize a simple data set in order to highlight relationships and persuade an audience.	**7-8.CT.3** Refine and visualize a data set in order to persuade an audience.	**9-12.CT.3** Refine and visualize complex data sets to tell different stories with the same data set.
	Ways to visualize data include tables, graphs, and charts.	*The emphasis is on using the visual representation to make the data meaningful. Options for presenting data visually include tables, graphs, and charts.*	*The emphasis is on identifying and organizing relevant data to emphasize particular parts of the data in support of a claim.*	*Refining includes, but is not limited to, identifying relevant subsets of a data set, deleting unneeded data, and sorting and organizing data to highlight trends.*	*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	**K-1.CT.4** Identify a problem or task and discuss ways to break it into multiple smaller steps.	**2-3.CT.4** Identify multiple ways that the same problem could be decomposed into smaller steps.	**4-6.CT.4** Decompose a problem into smaller named tasks, some of which can themselves be decomposed into smaller steps.	**7-8.CT.4** Write a program using functions or procedures whose names or other documentation convey their purpose within the larger task.	**9-12.CT.4** Implement a program using a combination of student-defined and third-party functions to organize the computation.
	The focus is on identifying a complex (for the age group) task or problem to break apart into smaller steps. The focus should be on understanding why this process is helpful.	*The focus is on identifying how to break apart a problem into smaller steps, while understanding that there can be multiple valid sequences of steps that solve the same problem.*	*The focus is on identifying smaller steps that solve a larger problem, recognizing that some of those steps must be broken down further until each step is manageable.*	*The focus is on identifying where there is potential to use a function or procedure to create a reusable computation.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Computational Thinking

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Abstraction and Decomposition	**K-1.CT.5** Recognize that the same task can be described at different levels of detail.	**2-3.CT.5** Identify the essential details needed to perform a general task in different settings or situations.	**4-6.CT.5** Identify and name a task within a problem that gets performed multiple times while solving that problem, but with slightly different concrete details each time.	**7-8.CT.5** Identify multiple similar concrete computations in a program, then create a function to generalize over them using parameters to accommodate their differences	**9-12.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.
	Instructions to perform a task can be given with more or less detail but still achieve the same result.	*Some details are essential to performing a task, while others are not (E.g., some may be so common that they don't need to be stated).*	*The focus is on recognizing that the same general steps are often repeated while solving a problem, even though some of the details may differ.*	*The focus is on identifying similar expressions or sequences in code and abstracting them into functions that generalize over the similarities.*	*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	**K-1.CT.6** Follow an algorithm to complete a task.	**2-3.CT.6** Create two or more algorithms for the same task.	**4-6.CT.6** Compare two or more algorithms and discuss the advantages and disadvantages of each for a specific task.	**7-8.CT.6** Design, compare and refine algorithms for a specific task or within a program.	**9-12.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.
	The task can be a familiar, daily activity or can be designed by the teacher. Algorithms at this stage may be short, though must contain at least three steps, and should focus on sequencing.	*The task can be a familiar activity or more abstract. The focus is on finding more than one way to reach the same goal.*	*Tasks can be unplugged or related to a computer program and reflect a task with a specific result that can be checked.*	*Algorithms can be represented in a range of formats, including flowcharts, pseudocode, or written steps. Planning the output of a program, such as with a storyboard or wireframe, is not sufficient on its own.*	*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.*

Computational Thinking

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Algorithms and Programming	**K-1.CT.7** Identify terms that refer to different concrete values over time.	**2-3.CT.7** Name/label key pieces of information in a set of instructions, noting whether each name/label refers to a fixed or changing value.	**4-6.CT.7** Identify pieces of information that might change as a program or process runs.	**7-8.CT.7** Design or remix a program that uses a variable to maintain the current value of a key piece of information.	**9-12.CT.7** Design or remix a program that utilizes a data structure to maintain changes to related pieces of data.
	The focus is on observing that people use certain terms/labels to refer to a concept (E.g., Today's Date, Today's Weather, Word of the Week, Today's Line Leader) whose specific value can change depending on the day or time.	*The focus is on identifying key pieces of information, labelling them with a descriptive name, and observing which labels refer to different values each time the instructions are given, and which values stay the same.*	*The focus is on identifying information that needs to be updated as a computation progresses.*	*The focus is on understanding that variables can be used to track the value of a concept in a program as it changes over time.*	*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.*
	K-1.CT.8 Identify a task consisting of steps that are repeated, and recognize which steps are repeated.	**2-3.CT.8** Identify steps within a task that should only be carried out under certain precise conditions.	**4-6.CT.8** Develop algorithms or programs that use repetition and conditionals for creative expression or to solve a problem.	**7-8.CT.8** Develop or remix a program that effectively combines one or more control structures for creative expression or to solve a problem.	**9-12.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.
	The focus should be on short tasks where there is repetition and having students identify and describe the repetition.	*The focus should be on recognizing that some steps in a task only get carried out some of the time, and that the conditions can be precisely described.*	*The focus is on having students work with each of conditionals and repetition (loops or iteration), but without having to use them in conjunction with one another.*	*The focus is on having students combine control structures, such as conditionals and loops, in such a way that they work together to achieve an outcome that could not be achieved using only one of them.*	*The focus is on combining different forms of repetition and conditionals, including conditionals with complex Boolean expressions.*

NYS K-12 Computer Science and Digital Fluency Standards

Computational Thinking

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Algorithms and Programming	**K-1.CT.9** Identify and fix (debug) errors within a simple algorithm.	**2-3.CT.9** Identify and debug errors within an algorithm or program that includes sequencing or repetition.	**4-6.CT.9** Explain each step of an algorithm or program that includes repetition and conditionals for the purposes of debugging.	**7-8.CT.9** Read and interpret code to predict the outcome of various programs that involve conditionals and repetition for the purposes of debugging.	**9-12.CT.9** Systematically test and refine programs using a range of test cases, based on anticipating common errors and user behavior.
	The focus should be on identifying small errors within a simple algorithm and fixing the errors collaboratively.	*The focus should be on having students identify error(s) in an algorithm and suggest changes to fix the algorithm.*	*Debugging frequently involves stepping or tracing through a program as if you were the computer to reveal errors.*	*Programs can be debugged in numerous ways, including tracing and trying varying inputs. Perseverance is important in finding errors.*	*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.*
	K-1.CT.10 Collaboratively create a plan that outlines the steps needed to complete a task.	**2-3.CT.10** Develop and document a plan that outlines specific steps taken to complete a project.	**4-6.CT.10** Describe the steps taken and choices made to design and develop a solution using an iterative design process.	**7-8.CT.10** Document the iterative design process of developing a computational artifact that incorporates user feedback and preferences.	**9-12.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.
	The focus should be on collaboratively identifying a planning process which can be written, drawn, or spoken.	*The focus should be on developing and documenting a plan in writing, using appropriate tools (such as a storyboard or story map).*	*An iterative design process involves defining the problem or goal, developing a solution or prototype, testing the solution or prototype, and repeating the process until the problem is solved or desired result is achieved. Describing can include speaking or writing.*	*At this level, the emphasis is on using the iterative design process to create a solution or prototype with the end user in mind and to document the steps taken by the student to gather and incorporate information about the user into the computational artifact.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Networks and Systems Design

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Hardware and Software	**K-1.NSD.1** Identify ways people provide input and get output from computing devices.	**2-3.NSD.1** Describe and demonstrate several ways a computer program can receive data and instructions (input) and can present results (output).	**4-6.NSD.1** Propose improvements to the design of a computing technology based on an analysis of user interactions with that technology.	**7-8.NSD.1** Design a user interface for a computing technology that considers usability, accessibility, and desirability.	**9-12.NSD.1** Design a solution to a problem that utilizes embedded systems to automatically gather input from the environment.
	The emphasis is on understanding that humans and computers interact through inputs and outputs and identifying examples in their daily lives.	*The focus is on choosing and demonstrating different computing technologies to receive and present results depending on the task.*	*The emphasis is on thinking about how the user interface could be optimized for the purpose of the computing technology and user interactions.*	*The emphasis is on designing (but not necessarily creating) a user interface. Designs could include things like written descriptions, drawings, and/or 3D prototypes.*	*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.*
	K-1.NSD.2 Identify basic hardware components that are found in computing devices.	**2-3.NSD.2** Explain the function of software in computing systems, using descriptive/precise language.	**4-6.NSD.2** Model how computer hardware and software work together as a system to accomplish tasks.	**7-8.NSD.2** Design a project that combines hardware and software components.	**9-12.NSD.2** Explain the levels of interaction existing between the application software, system software, and hardware of a computing system.
	Basic hardware components are the parts that students can see, such as monitor/screen, keyboard, mouse, etc.	*The focus is on understanding how software helps to complete computing tasks.*	*A model should only include the basic elements of a computer system, including input, output, processor, and storage.*	*The focus is on designing (but not necessarily creating) a system that involves collecting and exchanging data including input, output, storage, and processing.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Networks and Systems Design

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Hardware and Software	**K-1.NSD.3** Identify basic hardware and/or software problems.	**2-3.NSD.3** Describe and attempt troubleshooting steps to solve a simple technology problem.	**4-6.NSD.3** Determine potential solutions to solve hardware and software problems using common troubleshooting strategies.	**7-8.NSD.3** Identify and fix problems with computing devices and their components using a systematic troubleshooting method or guide.	**9-12.NSD.3** Develop and communicate multi-step troubleshooting strategies others can use to identify and fix problems with computing devices and their components.
	The focus is on identifying the source of a common hardware/software problem (such as low battery, speakers not connected) with teacher guidance.	*The focus is on building problem solving techniques for self-help, such as making sure speakers are turned on or headphones are plugged in or making sure that the caps lock key is not on, to narrow down a problem.*	*The focus is on trying multiple strategies to troubleshoot problems, including rebooting the device, checking for power, checking network availability, closing and reopening an application, try using a different browser, and checking settings within an application.*	*The focus is on identifying the source of a problem by using a structured process such as a checklist or flowchart to systematically try solutions that may fix the problem.*	*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	**K-1.NSD.4** Identify how protocols/rules help people share information over long distances.	**2-3.NSD.4** Recognize that information can be communicated using different representations that satisfy different rules.	**4-6.NSD.4** Model how data is structured to transmit through a network.	**7-8.NSD.4** Design a protocol for transmitting data through a multi-point network.	**9-12.NSD.4** Describe the components and design characteristics that allow data and information to be moved, stored and referenced over the Internet.
	The focus is on how information is conveyed from one individual to another and the rules that allow for communication and data sharing, such as envelopes need addresses/emails need email addresses to reach the right person.	*The focus is on understanding that information is converted in a special way so it can be sent through wires or waves through the air.*	*The focus is on understanding that data is broken down into smaller pieces and labeled to travel through a network and reassembled.*	*The focus is on understanding how protocols enable communication and what additional data is necessary for transmission. Knowledge of the details of how specific protocols work is not expected.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Networks and Systems Design

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Networks and the Internet	**K-1.NSD.5** Identify physical devices that can store information.	**2-3.NSD.5** Describe and navigate to various locations where digital information can be stored.	**4-6.NSD.5** Describe that data can be stored locally or remotely in a network.	**7-8.NSD.5** Summarize how remote data is stored and accessed in a network.	**9-12.NSD.5** Describe how emerging technologies are impacting networks and how they are used.
	The focus is on recognizing that common computing devices can store information, including computers, tablets, phones, and calculators.	*The focus is being able to navigate and save a file to a specific location.*	*The focus is on describing that data must be stored on a physical device. Access to remotely stored data is restricted by the networks, and to access non-local data a connection to the network is required.*	*The focus is on explaining where the data associated with different apps, devices, and embedded systems is stored, how the data is synchronized, and how to connect to it.*	*The focus is on discussing how specific emerging technologies impact networks in terms of scale, access, reliability, and security, and user behavior.*

NYS K-12 Computer Science and Digital Fluency Standards

Cybersecurity

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Risks	**K-1.CY.1** Identify reasons for keeping information private.	**2-3.CY.1** Compare reasons why an individual should keep information private or make information public.	**4-6.CY.1** Explain why different types of information might need to be protected.	**7-8.CY.1** Determine the types of personal information and digital resources that an individual may have access to that needs to be protected	**9-12.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.
	The focus should be on discussing the reasons to keep certain information public (information you share with others) or private (information you keep to yourself or only share with your family).	*The focus should be on potential effects, both positive and negative, for making information public.*	*The emphasis is on discussing different reasons that adversaries may want to obtain, compromise, or leverage different types of information. At this stage, students should be focused on general concepts.*	*The emphasis is on identifying personal information and devices that an individual may have access to and that adversaries may want to obtain or compromise. At this stage, students should focus on specific data and devices that they have access to.*	*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	**K-1.CY.2** Identify simple ways to help keep accounts secure.	**2-3.CY.2** Compare and contrast behaviors that do and do not keep information secure.	**4-6.CY.2** Describe common safeguards for protecting personal information.	**7-8.CY.2** Describe physical, digital, and behavioral safeguards that can be employed in different situations.	**9-12.CY.2** Describe physical, digital, and behavioral safeguards that can be employed to protect the confidentiality, integrity, and accessibility of information.
	The emphasis is on having a basic understanding of ways to keep accounts secure, such as having passwords/pass codes.	*The emphasis is on recognizing and avoiding potentially harmful behaviors, such as sharing private information online or not logging off a public computer.*	*The emphasis is on describing common safeguards such as protecting devices and accounts with strong passwords, keeping software updated, and not sending sensitive information over SMS.*	*The emphasis is on recommending different types of security measures, including physical, digital, and behavioral, for a given situation.*	*The emphasis is on considering the CIA Triad when recommending safeguards for a specific application or device.*

NYS K-12 Computer Science and Digital Fluency Standards

Cybersecurity

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Safeguards	This Standard begins in Grade Band 2-3	**2-3.CY.3** Identify why someone might choose to share an account, app access, or devices.	**4-6.CY.3** Describe trade-offs between allowing information to be public and keeping information private and secure.	**7-8.CY.3** Describe trade-offs of implementing specific security safeguards.	**9-12.CY.3** Explain specific trade-offs when selecting and implementing security recommendations.
		The focus is on explaining how user habits and behaviors should be adjusted based on who shares a device and/or application.	*The focus is on considering the trade-offs of data sharing in different contexts.*	*The focus is on thinking about how a specific safeguard impacts the confidentiality, integrity, and access of information. Additionally, there should be a focus on discussing whether strengthening one specific safeguard adversely affects another.*	*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.*
	K-1.CY.4 Decode a word or short message using a simple code.	**2-3.CY.4** Encode and decode a short message or phrase.	**4-6.CY.4** Model and explain the purpose of simple cryptographic methods.	**7-8.CY.4** Describe the limitations of cryptographic methods.	**9-12.CY.4** Evaluate applications of cryptographic methods.
	The focus is on having students look at a string of symbols and giving them a key to substitute letters for the symbols to spell a word.	*The focus is on having one student encode a word or message, and a different student, using the same key, decode it. You might encourage students to develop their own coding scheme.*	*The focus is on using ciphers to encrypt and decrypt messages as a means of safeguarding data.*	*The focus is on recognizing that cryptography provides a level of security for data, and some types of encryption are weaker than others.*	*The focus is on analyzing the role that cryptography and data security play in events that have shaped history and impact the future.*

NYS K-12 Computer Science and Digital Fluency Standards

Cybersecurity

	Grades K-1	Grades 2-3	Grades 4-6	Grades 7-8	Grades 9-12
Response	**K-1.CY.5** Identify when it is appropriate to open and/or click on links or files.	**2-3.CY.5** Identify unusual activity of applications and devices that should be reported to a responsible adult.	**4-6.CY.5** Explain suspicious activity of applications and devices.	**7-8.CY.5** Describe actions to be taken before and after an application or device reports a security problem or performs unexpectedly.	**9-12.CY.5** Recommend multiple actions to take prior and in response to various types of digital security breaches.
	The emphasis is on recognizing when it is safe and appropriate for students to open links, with teacher guidance.	*The emphasis is on recognizing situations in which students should notify a trusted adult when a device or application does not perform as expected (pop-ups, authentication and/or loading issues).*	*The emphasis is on describing simple forms of suspicious behavior in common applications and devices, including suspicious data/links, viruses and malware.*	*The emphasis is on explaining appropriate actions to prevent and address common security issues for common situations.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Digital Literacy

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Digital Use	**K-1.DL.1** Identify and explore the keys on a keyboard.	**2-3.DL.1** Locate and use the main keys on a keyboard to enter text independently.	**4-6.DL.1** Type on a keyboard while demonstrating proper keyboarding technique.	**7-8.DL.1** Type on a keyboard while demonstrating proper keyboarding technique, with increased speed and accuracy.	**9-12.DL.1** Type proficiently on a keyboard.
	The focus is on exploring physical and/or touchscreen keyboards, and for students to be able to identify specific keys such as arrow keys, enter, space bar, backspace.	*Students should be introduced to keyboarding and identify in second grade and begin to receive direct instruction in keyboarding in third grade, with a focus on form over speed and accuracy.*	*The focus is on direct instruction in keyboarding. Instruction should focus on form over speed and accuracy.*	*The emphasis is on continuing to improve keyboarding skills, with a focus on increasing speed as well as accuracy.*	*The focus is to demonstrate proficient keyboarding skills by the end of 12th grade.*
	K-1.DL.2 Communicate and work with others using digital tools.	**2-3.DL.2** Communicate and work with others using digital tools to share knowledge and convey ideas.	**4-6.DL.2** Select appropriate digital tools to communicate and collaborate while learning with others.	**7-8.DL.2** Communicate and collaborate with others using a variety of digital tools to create and revise a collaborative product.	**9-12.DL.2** Communicate and work collaboratively with others using digital tools to support individual learning and contribute to the learning of others.
	The focus should be on teaching students that people use digital tools to share ideas and work together. Communication and collaboration should be with teacher guidance.	*The focus is on using digital tools to communicate and collaborate in order to expand knowledge and effectively convey ideas.*	*Students progress from understanding that people use digital tools to communicate and collaborate to how they use the tools. Communication and collaboration should be purposeful and, when possible and appropriate, with an authentic audience.*	*Students connect with others (students, teachers, families, the community, and/or experts) to further their learning for a specific purpose, give and receive feedback, and created a shared product.*	*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.*

NYS K-12 Computer Science and Digital Fluency Standards

Digital Literacy

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Digital Use	**K-1.DL.3** Conduct a basic search based on a provided keyword.	**2-3.DL.3** Conduct basic searches based on student-identified keywords.	**4-6.DL.3** Conduct and refine advanced multi-criteria digital searches to locate content relevant to varied learning goals.	**7-8.DL.3** Compare types of search tools, choose a search tool for effectiveness and efficiency, and evaluate the quality of search tools based on returned results.	*No Standard; Mastery reached by Grade 8*
	The teacher will provide the keyword to help students conduct basic searches using appropriate tools.	*Students will identify key words with which to perform an internet search using teacher-approved tool(s), to obtain information.*	*Focus should be on the quality of results a search generates, and how to improve search results based on the task or purpose by defining multiple search criteria and using filters.*	*Mastery of this standard implies an understanding of how different search tools work, why different search tools provide different results, and how and why some websites rise to the top of a search.*	
	K-1.DL.4 Use a least one digital tool to create a digital artifact.	**2-3.DL.4** Use a variety of digital tools and resources to create digital artifacts.	**4-6.DL.4** Use a variety of digital tools and resources to create and revise digital artifacts.	**7-8.DL.4** Select and use digital tools to create, revise, and publish digital artifacts.	**9-12.DL.4** Independently select advanced digital tools and resources to create, revise, and publish complex digital artifacts or collection of artifacts.
	The focus is on students using at least one digital tool to create a digital artifact, with teacher guidance.	*Different digital tools are used for different purposes, such as communicating, collaborating, researching, and creating original content.*	*The focus is on understanding the editing process when creating digital artifacts on multiple platforms.*	*Teachers should designate a school-approved location for students to publish artifacts for an audience to view. Advanced digital tools may refer to the tool itself (i.e. the tool is more advanced) or to utilization of more advanced features on a tool.*	*Mastery of this standard implies an ability to choose and use the technology tool or resource best suited for a task or purpose.*

NYS K-12 Computer Science and Digital Fluency Standards

Digital Literacy

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Digital Use	This Standard begins in Grade Band 4-6.	This Standard begins in Grade Band 4-6.	**4-6.DL.5** Identify common features of digital technologies.	**7-8.DL.5** Transfer knowledge of technology in order to explore new technologies.	**9-12.DL.5** Transfer knowledge of technology in order to use new and emerging technologies on multiple platforms.
			Many digital technologies have similar features and functionalities. The focus is on identifying the similarities between different programs or applications, such as word processing tools on different platforms.	*New technologies could include different tools for collaboration, creation, etc. that the student has not used before.*	*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	This Standard begins in Grade Band 2-3.	**2-3.DL.6** Describe ways that information may be shared online.	**4-6.DL.6** Describe persistence of digital information and explain how actions in online spaces can have consequences.	**7-8.DL.6** Explain the connection between the persistence of data on the Internet, personal online identity, and personal privacy.	**9-12.DL.6** Actively manage digital presence and footprint to reflect an understanding of the permanence and potential consequences of actions in online spaces.
		The focus is on how personal information, both public and private, becomes available online and understand ways their information can be shared.	*In order for students to be able to effectively manage their digital identities, it should be understood that online information doesn't "go away," and that information posted online can affect their real lives, even years in the future.*	*A focus should be on learning about privacy settings on social media accounts, exploring the concept of a positive online presence/identity, and identifying behaviors and information that could potentially affect them now and in the future.*	*Active management implies an understanding of how intentional and unintentional actions can affect a digital presence.*

NYS K-12 Computer Science and Digital Fluency Standards

Digital Literacy

	Grades K 1	Grades 2 3	Grades 4 6	Grades 7 8	Grades 9 12
Digital Citizenship	**K-1.DL.7** Identify actions that promote good digital citizenship, and those that do not.	**2-3.DL.7** Understand what it means to be part of a digital community and describe ways to keep it a safe, respectful space.	**4-6.DL.7** Identify and describe actions in online spaces that could potentially be unsafe or harmful.	**7-8.DL.7** Describe safe, appropriate, positive, and responsible online behavior and identify strategies to combat negative online behavior.	**9-12.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.
	Students are able to identify the basic concept of being a "good digital citizen", and know what actions are and are not safe, responsible and ethical when using technologies.	*The focus is on describing actions with students and having them discuss whether those actions would be safe, responsible, respectful, and/or ethical using technology and/or online spaces.*	*The focus is on identifying and describing potentially unsafe behaviors, and actions to take if they are witnessed or experienced, including cyberbullying.*	*Students are able to strategize ways to keep online spaces safe. Identify types of negative online behaviors including cyberbullying, harassment, trolling/flaming, excluding, outing, dissing, masquerading, and impersonation.*	*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.*

Attachment B:
2018 – 2020 Computer Science and Digital Fluency Standards Workgroups

Thank you to all the individuals involved in the authoring, review, and revision of the New York State Computer Science and Digital Fluency Standards. Additional thanks to all the individuals who provided feedback through NYSED's Stakeholder Feedback Survey.

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