NEW YORK STATE TEACHER CERTIFICATION EXAMINATIONS™

FIELD 194: COMPUTER SCIENCE

TEST FRAMEWORK

DRAFT

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Authorized for Distribution by the New York State Education Department

This document is a working draft. The information in this document is subject to change, and any changes will fully supersede the information contained in this draft.

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TEST DESIGN

This test consists of selected-response items measuring content knowledge and one extended constructed-response item measuring pedagogical content knowledge. The constructed-response item is scenario-based and requires candidates to describe an instructional strategy to help students achieve a specific learning goal, assess student understanding, and identify students' strengths and needs.

The selected-response items count for 80% of the total test score and the constructed-response item counts for 20% of the total test score, as indicated in the table that follows. Each selected-response item counts the same toward the total test score. The percentage of the total test score derived from the constructed-response item is also indicated in the table that follows.

The total testing time is 195 minutes. Candidates are free to set their own pace during the test administration. The following estimates were used to determine the total test time:

- The selected-response items are designed with the expectation of a response time up to 135 minutes.
- The constructed-response item is designed with the expectation of a response time up to 60 minutes.

Further information regarding the content of each competency can be found in the test framework.

Competency	Selected-Response		Constructed-Response	
	Approximate Number of Items	Approximate Percentage of Test Score	Number of Items	Approximate Percentage of Test Score
0001 Impacts of Computing	21	19%	--	--
0002 Computational Thinking and Programming	27	23%	--	--
0003 Networks, the Internet, and System Design	21	19%	--	--
0004 Cybersecurity	21	19%	--	--
0005 Pedagogical Content Knowledge	--	--	1	20%
Total	**90**	**80%**	**1**	**20%**

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Impacts of Computing
Computational Thinking and Programming
Networks, the Internet, and System Design
Cybersecurity
Pedagogical Content Knowledge

The New York State Computer Science teacher has the knowledge and skills necessary to teach effectively in New York State public schools. The teacher has a deep understanding of the concepts, principles, methods, and skills related to the discipline of computer science education. The teacher understands the impact of computing on society, how society influences computing technologies, and issues of digital equity and access. The teacher has a strong foundation in computational thinking and programming, including modeling and simulation, data analysis and visualization, abstraction and decomposition, and algorithms. The teacher is knowledgeable about the components and functions of computer systems, networks, and the Internet and how the components work together to process and transmit data. The teacher understands concepts and principles of cybersecurity and knows appropriate responses to threats to digital information and devices. The teacher is able to plan, design, implement, and evaluate developmentally appropriate learning experiences that are aligned with New York State Learning Standards and that promote equity, access, and engagement for all students.

COMPETENCY 0001—IMPACTS OF COMPUTING

Performance Expectations

The New York State Computer Science teacher demonstrates knowledge of how individuals and communities influence computing and that computing technologies influence cultural practices. The teacher demonstrates knowledge of ethical implications of computing in society, including those related to equity and access, and applies knowledge of laws and regulations related to computing technologies and digital information. The teacher demonstrates knowledge of the development and design of computing systems to help those systems address the diverse needs of all users. The teacher has a broad perspective of career paths in computer science.

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Performance Indicators

a. demonstrates knowledge of applications of computing technologies in the classroom, home, community, and broader society

b. demonstrates understanding of the impacts of computing technologies on individuals and society (e.g., in business, education, entertainment, government, or health care) and of how technologies influence and are influenced by society and culture

c. evaluates the impact of computing technologies on equity, access, and influence in a global society and the personal and societal trade-offs associated with computing technologies

d. demonstrates understanding of ways computer systems are used in human decision-making, including how the design of the systems may promote inclusivity or introduce bias

e. demonstrates knowledge of features of technology devices and software (e.g., alternative text for images, screen reader, text-to-speech, web accessibility tools) that improve accessibility and usability to address the diverse needs of all users and meet standard compliance requirements

f. demonstrates knowledge of rules, laws, and regulations related to the development and use of computing technologies and digital information (e.g., with respect to privacy, intellectual property rights, licensing, or hacking), including those that apply in educational settings (e.g., CIPA, COPPA, FERPA), and their impact on various stakeholders

g. analyzes ethical issues related to computing technologies, data collection, and their use

h. demonstrates knowledge of the safe and responsible use of technology

i. demonstrates knowledge of applications of computing technologies and computer science in various careers and industries; computer science–related career paths; and the importance of building appropriate habits of mind and skills needed for careers that use computing technologies

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COMPETENCY 0002—COMPUTATIONAL THINKING AND PROGRAMMING

Performance Expectations

The New York State Computer Science teacher has comprehensive knowledge of the core concepts and practices involved in designing and developing computer programs and strategically using computational power to solve problems. The teacher applies knowledge of foundational skills and supports the development of computational thinking. The teacher applies knowledge of modeling and simulation, data analysis and visualization, abstraction and decomposition, and algorithms and programming. The teacher is familiar with the features common among various types of programming languages. The teacher demonstrates knowledge of tools and resources for working with data and developing programs and can apply the iterative process for designing, developing, and refining computational artifacts.

Performance Indicators

a. applies knowledge of the development and use of models and simulations to represent patterns and processes and to make predictions

b. demonstrates knowledge of data collection protocols (e.g., what is being collected, how it is being stored, whom it is being shared with) and digital tools (e.g., sensors, surveys, web scrapers)

c. demonstrates knowledge of tools (e.g., databases, spreadsheets) and techniques (e.g., search, filter, transform) for processing, visualizing, and analyzing data

d. applies knowledge of decomposing a problem into sub-problems and implementing solutions using self-developed and third-party-developed procedures and functions

e. demonstrates knowledge of abstraction and its role in managing complexity

f. applies knowledge of sequencing, selection, iteration, reusability, recursion, and data structures in developing algorithms

g. demonstrates knowledge of characteristics of various programming paradigms (e.g., functional, procedural, object-oriented)

h. applies knowledge of data types; the use of variables, objects, and classes in different contexts; and data structures (i.e., one- and two-dimensional arrays, associative arrays, and lists)

i. applies knowledge of formats for representing algorithms (e.g., flowcharts, pseudocode, block-based visuals)

j. applies knowledge of expressions and operators (e.g., arithmetical, relational, logical)

k. analyzes algorithms to predict outcomes, compare advantages and disadvantages of two or more differing implementations, and determine trade-offs

l. demonstrates knowledge of concepts related to object-oriented programming (e.g., modularization, classes, encapsulation, inheritance)

m. applies knowledge of the iterative process of designing, developing, and refining algorithms and programs to meet a particular need

n. demonstrates knowledge of common programming errors and methods for systematically testing and debugging programs

o. applies knowledge of structuring code for performance, styling code for readability, and documenting code for reference

p. demonstrates knowledge of tools, resources, and techniques related to the independent and collaborative development of software, including code reuse, libraries, application programming interfaces (APIs), and integrated development environments (IDEs)

COMPETENCY 0003—NETWORKS, THE INTERNET, AND SYSTEM DESIGN

Performance Expectations

The New York State Computer Science teacher demonstrates knowledge of the main components of computing systems, their functions, and troubleshooting strategies for common problems. The teacher understands features of computer networks, including the Internet; where data are stored and how data are transferred through networks from one device to another; and factors that affect networks.

Performance Indicators

a. demonstrates knowledge of how computing systems receive input and provide output, features of user interfaces, and factors considered in the design of interfaces (e.g., usability, accessibility)

b. demonstrates knowledge of basic elements of computing devices and their functions (e.g., input, output, processing, storage), as well as interactions between application software, operating systems, and hardware

c. applies knowledge of common strategies for preventing and troubleshooting hardware and software problems

d. demonstrates knowledge of the components and topologies of networks that contribute to the scalability and reliability of a network

e. demonstrates knowledge of the protocols for connecting devices and transmitting data over the Internet

f. demonstrates knowledge of data storage devices and locations; how data are stored, synchronized, and accessed locally or through a network; and advantages and disadvantages of storing data locally or remotely

g. analyzes factors that affect existing networks in terms of scale, access, reliability, security, and user behavior

h. demonstrates knowledge of number systems (e.g., binary, hexadecimal) and their application in computing systems

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COMPETENCY 0004—CYBERSECURITY

Performance Expectations

The New York State Computer Science teacher understands threats to computing resources and information and how unauthorized users may attempt to obtain, compromise, or leverage those assets. The teacher applies knowledge of methods for protecting information and resources and understands trade-offs associated with particular solutions in various contexts. The teacher recognizes signs that a device or software application may be compromised or poses a potential security risk and understands actions to prevent and respond to digital security breaches.

Performance Indicators

a. demonstrates knowledge of personal or organizational information and digital resources that an individual may have access to and ways unauthorized users may attempt to obtain, compromise, or leverage that information or those resources

b. applies knowledge of physical, digital, and behavioral safeguards for protecting and maintaining data integrity and availability

c. analyzes trade-offs associated with selecting and implementing various security safeguards

d. demonstrates knowledge of purposes, applications, and limitations of cryptographic methods in data security

e. demonstrates knowledge of types of security vulnerabilities in software and computing devices

f. applies knowledge of actions to prevent or respond to digital security breaches

COMPETENCY 0005—PEDAGOGICAL CONTENT KNOWLEDGE

Performance Expectations

The New York State Computer Science teacher effectively applies pedagogical content knowledge to design instruction that helps students achieve a specific learning goal. The teacher applies concepts and principles associated with the practice of computer science education in order to plan learning experiences that promote students' application of computational thinking and computer science concepts and skills. The teacher applies knowledge of how students learn in order to develop effective instructional strategies that support the diverse assets and needs of all learners. The teacher understands methods of effective assessment of student learning in computer science and how to apply assessment results in order to inform future instructional strategies and methods. The teacher understands how to create a safe, inclusive learning environment that provides equity, access, and support for all students in computer science.

Performance Indicators

a. identifies the skills and conceptual understanding necessary for students to achieve a stated learning goal in computer science

b. demonstrates knowledge of how to assess student readiness for the learning goal

c. applies knowledge of appropriate and effective instructional strategies to connect students' prior learning and experiences to the learning goal in a culturally relevant way

d. describes an appropriate, effective, research-based instructional strategy or activity designed to promote all students' achievement of the learning goal, including the use of appropriate computer science tools, resources, and examples

e. provides a clear and logical explanation of how the strategy or activity described supports the stated learning goal and promotes students' knowledge and skills related to the learning goal

f. applies knowledge of effective assessment and data analysis in order to inform future instructional decisions

g. applies knowledge of issues related to the diverse assets and needs of all learners in computer science and strategies for creating an inclusive learning environment that promotes equity and access for all students