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FORM 5 -- NOTICE OF AGENCY ADOPTION OF A PROCEDURAL OR INTERPRETIVE RULE OR A LEGISLATIVE RULE EXEMPT FROM LEGISLATIVE REVIEW

AGENCY **Education**

RULE TYPE **Legislative Exempt** AMENDMENT TO EXISTING RULE **Yes** TITLE-SERIES **126-044N**

RULE NAME **West Virginia College- and Career-Readiness Standards for Technology and Computer Science (Policy 2520.14)**

CITE AUTHORITY **W. Va. Code §§29A-3B-1, et seq.; W. Va. Board of Education v. Hechler, 180 W. Va. 451; 376 S.E.2d 839 (1988)**

RULE IS LEGISLATIVE EXEMPT

Yes

CITE STATUTE(S) GRANTING EXEMPTION FROM LEGISLATIVE REVIEW

W. Va. Code §§29A-3B-1, et seq.; W. Va. Board of Education v. Hechler, 180 W. Va. 451; 376 S.E.2d 839 (1988)

THE ABOVE RULE IS HEREBY ADOPTED AND FILED WITH THE SECRETARY OF STATE. THE EFFECTIVE DATE OF THIS RULE IS

Saturday, July 01, 2017

BY CHOOSING 'YES', I ATTEST THAT THE PREVIOUS STATEMENTS ARE TRUE AND CORRECT.

Yes

Jill M Newman -- By my signature, I certify that I am the person authorized to file legislative rules, in accordance with West Virginia Code §29A-3-11 and §39A-3-2.

Title-Series: 126-044N

Rule Id: 10379

Document: 49277

126CSR44N

TITLE 126
LEGISLATIVE RULE
BOARD OF EDUCATION

SERIES 44N
WEST VIRGINIA COLLEGE- AND CAREER-READINESS STANDARDS FOR TECHNOLOGY AND COMPUTER SCIENCE (2520.14)

§126-44N-1. General.

1.1. Scope. -- W. Va. 126CSR42, West Virginia Board of Education (hereinafter WVBE) Policy 2510, Assuring the Quality of Education: Regulations for Education Programs (hereinafter Policy 2510), provides a definition of a delivery system for, and an assessment and accountability system for, a thorough and efficient education for West Virginia public school students. Policy 2520.14 defines the content standards for Technology and Computer Science as required by Policy 2510.

1.2. Authority. -- W. Va. Constitution, Article XII, §2, W. Va. Code §18-2-5 and §18-9A-22.

1.3. Filing Date. -- April 13, 2017.

1.4. Effective Date. -- July 1, 2017.

1.5. Repeal of former rule. -- This legislative rule repeals and replaces W. Va. 126CSR44N WVBE Policy 2520.14 "21st Century Learning Skills and Technology Tools Content Standards and Objectives for West Virginia Schools" filed November 15, 2006 and effective July 1, 2008.

§126-44N-2. Purpose.

2.1. This policy defines the content standard for the programs of study required by Policy 2510 in *Technology and Computer Science.*

§ 126-44N-3. Incorporation by Reference.

3.1. A copy of the West Virginia College- and Career-Readiness Standards for Technology and Computer Science is attached and incorporated by reference into this policy. Copies may be obtained in the Office of the Secretary of State and in the West Virginia Department of Education (hereinafter WVDE).

§126-44N.4. Summary of the Content Standards.

4.1. The WVBE has the responsibility of establishing high quality standards pertaining to all educational standards pertaining to all education programs (W. Va. Code §18-9A-22). The content standards provide a focus for teachers to teach and students to learn those skills and competencies essential for future success in the workplace and further education. The document includes content standards for technology and computer science that are both rigorous and challenging.

§126-44N-5. Severability.

5.1. If any provision of this rule or the application thereof to any person or circumstance is held invalid,

such invalidity shall not affect other provisions or applications of this rule.

Introduction

West Virginia's College- and Career-Readiness Standards (hereinafter WVCCR) have been developed with the goal of preparing students for a wide range of high-quality post-secondary opportunities. Specifically, college- and career-readiness refers to the knowledge, skills, and dispositions needed to be successful in higher education and/or training that lead to gainful employment. The WVCCR establish a set of knowledge and skills that all individuals need to transition into higher education or into the workplace, as both realms share many expectations. All students throughout their educational experience, should develop a full understanding of the career opportunities available, the education necessary to be successful in their chosen pathway, and a plan to attain their goals.

West Virginia's College- and Career-Readiness Standards for Technology and Computer Science promote proficiency in foundational technology skills, digital literacy, digital citizenship, and computer science. College- and career-readiness is supported in Technology and Computer Science as students acquire and develop their abilities to engage and thrive in a connected, digital world. The standards are designed in grade bands (e.g. K-2, 3-5, 6-8, and 9-12), with a goal of cultivating these skills throughout a student's academic career and challenge them to enhance learning with technology and challenge them to be agents of their own learning.

The overarching goal is to build a rigorous, relevant, challenging, and developmentally appropriate technology and computer science curriculum that prepares students for college- and career-readiness. West Virginia educators play a key role in shaping the content standards to align with the best practices in the field of technology and computer science education. The contributions of these professionals are critical in creating a policy that is meaningful to classroom teachers and appears in a format that can easily be used and understood.

Explanation of Terms

Clusters are the broad components that make up a content area; e.g., Information and Communication, Computational Thinking, Digital Citizenship, Collaboration, Empowered Learning, and Innovation and Design make up the Technology and Computer Science content area.

Standards are the expectations for what students should know, understand, and be able to do; standards represent educational goals.

Numbering of Standards
The numbering for each standard is composed of three parts, each part separated by a period:

- the content area code (e.g., TCS for Technology and Computer Science),
- the grade band or course, and
- the standard.

Illustration:

- TCS.K-2.1 refers to Technology and Computer Science, grades K-2, standard 1.
- TCS.DCS.1 refers to Technology and Computer Science, Discovery Computer Science, standard 1.

Technology and Computer Science Clusters for Grades K-5
Cluster 1: Information and Communication - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

Cluster 2: Computational Thinking - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Cluster 3: Digital Citizenship - Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal, and ethical. They will recognize the community, global, and ethical impacts technology and computer science have on society and the world.

Technology and Computer Science Clusters for Grades 6-12
Cluster 1: Information and Communication - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

Cluster 2: Computational Thinking - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Cluster 3: Digital Citizenship - Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal, and ethical. They will recognize the community, global, and ethical impacts technology and computer science have on society and the world.

Cluster 4: Collaboration - Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
Cluster 5: Empowered Learning - Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

Cluster 6: Innovation and Design - Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

Computer Science Clusters for Grades 6-12
Cluster 1: Computational Thinking - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Cluster 2: Collaboration - Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

Cluster 3: Computing Practice & Programming – Students use and create webpages, databases, and their own coded programs to solve algorithmic and computational problems. This cluster is specific for secondary Computer Science courses.

Cluster 4: Computers & Communication Devices – Students understand the elements of computer systems and communication devices and networks, including the internet, and use them effectively, ethically and safely. This cluster is specific for secondary Computer Science courses.

Cluster 5: Community, Global and Ethical Impacts – Students understand and practice ethical and responsible use of computer systems and networks, particularly as they impact their community and the world at large. This cluster is specific for secondary Computer Science courses.

College- and Career-Readiness Indicators for Technology and Computer Science

Computer science has a wide range of specialties. These include computer architecture, software systems, programming and coding, graphics design, music technology, robotics & artificial intelligence, web design, security & privacy, computational science, and software engineering. Drawing from a core of computer science knowledge, each specialty area focuses on particular challenges.

All West Virginia K-12 teachers are responsible for classroom instruction that integrates the West Virginia College- and Career-Readiness Standards for Technology and Computer Science content standards, foundational skills, literacy, learning skills and technology tools. The teachers of the specific computer science courses are responsible for the standards for that specific course.

Technology and Computer Science K-2

Students in kindergarten through grade 2 will advance through an integrated, developmentally appropriate progression of standards. By the end of the 2nd grade, students should demonstrate competency in all Technology and Computer Science K-2 standards. The following chart represents the components of technology integration that will be developed in grades K-2.

K-2 Technology and Computer Science Indicators
• Use a variety of age-appropriate technologies to assist with the learning process. • Deepen learning across a variety of content areas through the use of age-appropriate technologies. • Integrate technology responsibly and with consideration to screen time limitations outlined in WVBE Policy 2510 per recommendations from the American Academy of Pediatrics.

Kindergarten – Grade 2 Standards

In these earliest grades students are exposed to basic technology through creative activities that will enhance their learning skills. Young children learn best through interactions with their caregivers, teachers and other children. While it is important to begin their exposure to the variety of media that surround them, it is essential that this exposure be carefully guided to support children's imagination, creativity, and thinking skills. These standards encourage the use of technology as a support to the varied types of learning the students experience in other areas.

Information and Communication	
TCS.K-2.1	Explore a variety of age-appropriate technologies that can assist with the learning process.
TCS.K-2.2	Recognize and utilize the features, terminology, and functions of a variety of technology tools.
TCS.K-2.3	Create original work through the use of age-appropriate technology and digital resources.
TCS.K-2.4	Organize evidence of learning through the use of age-appropriate technology and digital resources.
TCS.K-2.5	Explore multiple ways to share ideas and information about themselves and the things around them.
TCS.K-2.6	Demonstrate creativity and learning through technology (i.e., digital storytelling, portfolio creation, digital media displays, etc.).
TCS.K-2.7	Communicate with others through the use of technology.
TCS.K-2-8	Connect with others and explore different points of view on various topics through the use of age-appropriate technology resources.

Computational Thinking	
TCS.K-2.9	Research information on topics of interest through the use of age-appropriate technology and digital resources provided by the classroom teacher.
TCS.K-2.10	With support and guidance, deepen learning across content areas through the use of age-appropriate technology and digital resources.
TCS.K-2.11	With support and guidance, select appropriate technology tools to solve problems and communicate information.

TCS.K-2.12	Break down problems into smaller parts, identify key information, and propose solutions through the use of age-appropriate technology and digital resources.
TCS.K-2.13	With support and guidance, create a product using a step-by-step process through the use of age-appropriate digital and non-digital resources.
TCS.K-2.14	With support and guidance, revise and redesign ongoing work as applicable.

Digital Citizenship	
TCS.K-2.15	Demonstrate responsible use of technology (i.e., seek guidance and appropriate support when selecting digital content, understand how to be safe online, follow safety rules when using media, etc.).
TCS.K-2.16	Practice using safe, legal, and ethical behavior when using technology.
TCS.K-2.17	Collaborate with peers, teams, and individuals within their communities and home through the use of age-appropriate technology.

Technology and Computer Science 3-5

All West Virginia teachers are responsible for classroom instruction that integrates content standards, foundational skills, literacy, learning skills and technology tools. Students in grades three through five will advance through an integrated, developmentally appropriate progression of standards. By the end of the 5th grade, students should demonstrate competency in all Technology and Computer Science K-5 standards. The following chart represents the components of technology integration that will be developed in grades 3-5.

3-5 Technology and Computer Science Indicators
• Use a variety of age-appropriate technologies to assist with the learning process. • Deepen learning across a variety of content areas through the use of age-appropriate technologies. • Integrate technology responsibly.

Grades Three – Five Standards

In the later elementary grades students spend more time interacting with technology. As they develop their critical thinking skills across the curriculum they begin to use those technologies that support their learning. Students enhance their communication and research skills via the Internet and become familiar with programs that allow them to create original works as well as to record, analyze and graph various kinds of data. Students deepen their understanding of safe technology use and the importance of maintaining privacy—both their own and others'.

Information and Communication	
TCS.3-5.1	Explore a variety of appropriate technologies and research techniques that can assist with the learning process.
TCS.3-5.2	Recognize and utilize the features, terminology, and functions of a variety of technology tools.
TCS.3-5.3	Evaluate digital sources for accuracy, perspective, credibility, and relevance.
TCS.3-5.4	Create original work through the use of age-appropriate technology and digital tools.
TCS.3-5.5	Utilize embedded digital tools for feedback.
TCS.3-5.6	Organize and represent data for data analysis, modeling, and algorithmic thinking.
TCS.3-5.7	Use appropriate technology to transfer learning to a variety of tools or learning environments.
TCS.3-5.8	Demonstrate creativity and learning through technology (e.g., digital storytelling, keyboarding, portfolio creation, digital media displays, and other media, etc.).
TCS.3-5.9	Explore multiple ways to share ideas and information about themselves and the world around them, considering the expected audience.
TCS.3-5.10	Communicate with others through the use of technology.
TCS.3-5.11	Connect with others and explore different points of view on various topics through the use of age-appropriate technology resources.

Computational Thinking	
TCS.3-5.12	Research information on topics of interest through the use of age-appropriate technology and digital resources.
TCS.3-5.13	Deepen learning across content areas through the use of age-appropriate technology

	and digital resources.
TCS.3-5.14	Select appropriate technology tools to solve problems and communicate information.
TCS.3-5.15	Break down problems into smaller parts, identify key information, and propose solutions through the use of age-appropriate technology and digital resources.
TCS.3-5.16	Use appropriate digital and non-digital tools to plan and manage a design process.
TCS.3-5.17	Revise and repurpose ongoing work as applicable.
TCS.3-5.18	Understand and explore basic concepts related to automation, patterns, and algorithmic thinking.

Digital Citizenship	
TCS.3-5.19	Demonstrate responsible use of technology (i.e., seek guidance and appropriate support when selecting digital content, understand how to be safe online, follow safety rules when using media, etc.).
TCS.3-5.20	Practice using safe, legal, and ethical behavior when using technology and interacting online.
TCS.3-5.21	Collaborate with peers, teams, and individuals within their communities, homes, and in a global society through the use of age-appropriate technology.
TCS.3-5.22	Demonstrate an understanding of the role an online identity plays in the digital world and learn the permanence of decisions made when interacting online.
TCS.3-5.23	Demonstrate appropriate methods of sharing personal data online and how to keep personal data private.
TCS.3-5.24	Demonstrate responsible use of technology by respecting intellectual property with both print and digital media when using and sharing the work of others.

Technology and Computer Science 6-8

All West Virginia teachers are responsible for classroom instruction that integrates content standards, foundational skills, literacy, learning skills and technology tools. Students in grades six through eight will advance through an integrated, developmentally appropriate progression of standards. By the end of the 8th grade, students should demonstrate competency in all Technology and Computer Science 6-8 standards. The following chart represents the components of technology and computer science that will be developed in grades 6-8.

6-8 Technology and Computer Science Indicators
• Use a variety of age-appropriate technologies to support the learning process. • Deepen learning across a variety of content areas through the use of age-appropriate technologies. • Integrate technology responsibly.

Grades Six – Eight Standards

Middle school students increase their technological literacy through exposure to real-worlds issue and problems. They become increasingly aware of the variety of technologies and programs available, understand their varied uses across content areas, and learn which technologies as most useful in given situations. Students use technology to enhance their creativity, strengthen their ability to communicate and collaborate, and expand their critical thinking and problem-solving skills in a wide variety of situations. They continue to deepen their understanding of digital citizenship including privacy and security issues, copyright laws and cyberbullying.

Information and Communication	
TCS.6-8.1	Demonstrate and practice the ability to effectively utilize research strategies to locate appropriate digital resources in support of their learning.
TCS.6-8.2	Practice and demonstrate the ability to evaluate resources for accuracy, perspective, credibility and relevance.
TCS.6-8.3	Locate and collect resources from a variety of sources and organize assets into collections for a wide range of projects and purposes.
TCS.6-8.4	Explore real-world issues and problems and actively pursue an understanding of them and solutions for them.
TCS.6-8.5	Select appropriate platforms and tools to create, share and communicate their work effectively.
TCS.6-8.6	Create original works or responsibly repurpose other digital resources into new creative works.
TCS.6-8.7	Communicate complex ideas clearly using various digital tools to convey the concepts textually, visually, graphically, etc.
TCS.6-8.8	Publish or present content designed for specific audiences and select platforms that will effectively convey their ideas to those audiences.

Computational Thinking	
TCS.6-8.9	Practice defining problems to solve by computing for data analysis, modeling or algorithmic thinking.
TCS.6-8.10	Find or organize data and use technology to analyze and represent it to solve problems

	and make decisions.
TCS.6-8.11	Break problems into component parts, identify key pieces and use that information to problem solve.
TCS.6-8.12	Demonstrate an understanding of how automation works and use algorithmic thinking to design and automate solutions.

Digital Citizenship	
TCS.6-8.13	Manage their digital identities and reputations within school policy, including demonstrating an understanding of how digital actions are never fully erasable.
TCS.6-8.14	Demonstrate and advocate for positive, safe, legal and ethical habits when using technology and when interacting with others online.
TCS.6-8.15	Demonstrate and advocate for an understanding of intellectual property with both print and digital media-including copyright, permission and fair use by creating a variety of media products that include appropriate citation and attribution elements.
TCS.6-8.16	Demonstrate an understanding of what personal data is and how to keep it private and secure, including the awareness of terms such as encryption, HTTPS, password, cookies and computer viruses; they also understand the limitations of data management and how data-collection technologies work.

Collaboration	
TCS.6-8.17	Use digital tools to interact with others to develop a richer understanding of different perspectives and cultures.
TCS.6-8.18	Use collaborative technologies to connect with others, including peers, experts and community members, to learn about issues and problems or to gain broader perspective.
TCS.6-8.19	Determine their role on a team to meet goals, based on their knowledge of technology and content, as well as personal preference.
TCS.6-8.20	Select collaborative technologies and use them to work with others to investigate and develop solutions related to local and global issues.

Empowered Learning	
TCS.6-8.21	Articulate personal learning goals, select and manage appropriate technologies to achieve them, and reflect on their successes and areas of improvement in working toward their goals.
TCS.6-8.22	Identify and develop online networks within school policy, and customize their learning environments in ways that support their learning, in collaboration with an educator.
TCS.6-8.23	Actively seek performance feedback from people, including teachers, and from functionalities embedded in digital tools to improve their learning process, and select technology to demonstrate their learning in a variety of ways.
TCS.6-8.24	Navigate a variety of technologies and transfer their knowledge and skills to learn how to use new technologies.

Innovation and Design	
TCS.6-8.25	Engage in a design process and employ it to generate ideas, create innovative products or solve authentic problems.
TCS.6-8.26	Select and use digital tools to support a design process and expand their understanding to identify constraints and trade-offs and to weight risks.

TCS.6-8.27	Engage in a design process to develop, test and revise prototypes, embracing the cyclical process of trial and error and understanding problems or setbacks as potential opportunities for improvement.
TCS.6-8.28	Demonstrate an ability to persevere and handle greater ambiguity as they work to solve open-ended problems.

Technology and Computer Science 9-12

All West Virginia teachers are responsible for classroom instruction that integrates content standards, foundational skills, literacy, learning skills and technology tools. Students in grades nine through twelve will advance through an integrated, developmentally appropriate progression of standards. By the end of the 12th grade, students should demonstrate competency in all Technology and Computer Science K-12 standards. The following chart represents the components of technology and computer science that will be developed in grades 9-12.

9-12 Technology and Computer Science Indicators
• Use a variety of age-appropriate technologies to support the learning process. • Deepen learning across a variety of content areas through the use of age-appropriate technologies. • Integrate technology responsibly.

Grades Nine – Twelve Standards

High school students perfect their understanding of the myriad ways technology is used to share information, communicate, collaborate and create. They use technology to solve higher-order real-world problems, apply it to complex tasks, develop their own technology and explore career options that are technology-based. Students explore the benefits and limitations of social media, discuss the ramifications of the improper use of technology and media, and grasp the importance of checking facts, distinguishing points of view, confirming the reliability of sources, and verifying information obtained via electronic and social media.

Information & Communication	
TCS.9-12.1	Utilize research strategies effectively to locate appropriate digital resources across all content areas.
TCS.9-12.2	Practice and demonstrate the ability to evaluate resources for accuracy, perspective, credibility and relevance.
TCS.9-12.3	Locate and collect resources from a variety of sources and organize assets into collections for a wide range of projects and purposes.
TCS.9-12.4	Explore real-world issues and problems and actively pursue an understanding of them and solutions for them.
TCS.9-12.5	Select appropriate platforms and tools to create, share and communicate their work effectively.
TCS.9-12.6	Create original works or responsibly repurpose other digital resources into new creative works.
TCS.9-12.7	Communicate complex ideas clearly using various digital tools to convey the concepts textually, visually, graphically, etc.
TCS.9-12.8	Publish, present, and defend content designed for specific audiences and select platforms that will effectively convey their ideas to those audiences.

Computational Thinking	
TCS.9-12.9	Define problems easily solved with technology-assisted methods such as data analysis, modeling or algorithmic thinking.
TCS.9-12.10	Find or organize relevant data and use technology to analyze and represent it in various

	ways to solve problems and make decisions.
TCS.9-12.11	Break problems into component parts, identify key pieces and use that information to problem solve.
TCS.9-12.12	Demonstrate an understanding of how automation works and use algorithmic thinking to develop a sequence of steps to design and test automated solutions.

Digital Citizenship	
TCS.9-12.13	Understand how to manage their digital identities and reputations within school policy, including demonstrating an understanding of how digital actions are never fully erasable.
TCS.9-12.14	Demonstrate and advocate for positive, safe, legal and ethical habits when using technology and when interacting with others online.
TCS.9-12.15	Demonstrate and advocate for an understanding of intellectual property with both print and digital media-including copyright, permission and fair use-by creating a variety of media products that include appropriate citation and attribution elements.
TCS.9-12.16	Keep personal data private and secure, including the awareness of terms such as encryption, HTTPS, password, cookies and computer viruses; understand the limitations of data management and how data-collection technologies work.

Empowered Learning	
TCS.9-12.17	Articulate personal learning goals, select and manage appropriate technologies to achieve them, and reflect on their successes and areas of improvement in working toward their goals.
TCS.9-12.18	Develop online networks within school policy, and customize their learning environments in ways that support their learning.
TCS.9-12.19	Actively seek performance feedback from people, including teachers, and from functionalities embedded in digital tools to improve their learning process, and select technology to demonstrate their learning in a variety of ways.
TCS.9-12.20	Utilize a variety of technologies efficiently and transfer their knowledge and skills to learn how to use new technologies.

Innovation and Design	
TCS.9-12.21	Engage in a design process and employ it to generate ideas, create innovative products or solve authentic problems.
TCS.9-12.22	Select and use digital tools to support a design process and expand their understanding to identify constraints and trade-offs and to weight risks.
TCS.9-12.23	Design, develop, test and revise prototypes, embracing the cyclical process of trial and error and understanding problems or setbacks as potential opportunities for improvement.
TCS.9-12.24	Demonstrate an ability to persevere and handle greater ambiguity while working in collaborative teams to solve open-ended problems.

Collaboration	
TCS.9-12.25	Use digital tools to interact with others to mutually develop a richer understanding of different perspectives and cultures.
TCS.9-12.26	Use collaborative technologies to connect with others, including peers, experts and community members, to learn about issues and problems or to gain broader

	perspective.
TCS.9-12.27	Determine their role on a team to meet goals, based on their knowledge of technology and content, as well as personal preference.
TCS.9-12.28	Explore local and global issues and select collaborative technologies use to work with others to investigate and develop solutions.

Specific Computer Science Courses

The following pages reflect the specific Computer Science courses standards for middle and high school students. Counties may continue to create additional computer science courses through the approval process outlined in Policy 2510.

Middle School: *Discovering Computer Science*
Discovering Computer Science is designed for students in grades 6-8 and will provide them with opportunities to explore the many facets of Computer Science. This may be taught in a single class in one grade level or divided into sections and taught over a three-year period.

High School: *Computer Science in the Modern World*
Computer Science in the Modern World is a course designed for all students in grades 9-12 and includes the essential skills that all high school students should have upon graduation.

High School: *Computer Science & Mathematics*
Computer Science & Mathematics may be counted as a fourth math elective credit course and must be taught by a certified 9-12 math teacher.

High School: *Computer Science - Introduction to Geographic Information Systems*
Computer Science – Introduction to Geographic Information Systems may be counted as a third science elective credit course and must be taught by a certified 9-12 science teacher.

Middle School: Discovering Computer Science

Discovering Computer Science is designed for students in grades 6-8 and will provide them with opportunities to explore the many facets of Computer Science. Students will discover how Computer Science effects them personally, how it effects the world around them, and how it impacts society. This may be taught in a single class in one grade level or divided into sections and taught over a three-year period.

The learning expectations covered by these standards support middle school students in the use of computational thinking as a problem-solving tool. They begin to appreciate the ubiquity of computing and the ways in which computer science facilitates communication and collaboration. Students begin to experience computational thinking as a means of addressing issues relevant, not just to them, but to the world around them. The learning experiences created from these standards should be relevant to the students and should promote their perceptions of themselves as proactive and empowered problem solvers within their community. They should be designed with *a focus on active learning and exploration* that can be taught either as an explicit computer science course or as units embedded in other curricular areas such as social science, language arts, mathematics, and science.

Computational Thinking	
TCS.DCS.1	Use the basic steps in algorithmic problem solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).
TCS.DCS.2	Describe the process of parallelization as it relates to problem solving.
TCS.DCS.3	Define an algorithm as a sequence of instructions that can be processed by a computer.
TCS.DCS.4	Evaluate ways that different algorithms may be used to solve the same problem.
TCS.DCS.5	Act out searching and sorting algorithms.
TCS.DCS.6	Describe and analyze a sequence of instructions being followed (e.g., describe a character's behavior in a video game as driven by rules and algorithms).
TCS.DCS.7	Represent data in a variety of ways including text, sounds, pictures, and numbers.
TCS.DCS.8	Use visual representations of problem states, structures, and data (e.g., graphs, charts, network diagrams, flowcharts).
TCS.DCS.9	Interact with content-specific models and simulations (e.g., ecosystems, epidemics, molecular dynamics) to support learning and research.
TCS.DCS.10	Evaluate what kinds of problems can be solved using modeling and simulation.
TCS.DCS.11	Analyze the degree to which a computer model accurately represents the real world.
TCS.DCS.12	Use abstraction to decompose a problem into sub problems.
TCS.DCS.13	Understand the notion of hierarchy and abstraction in computing including high level languages, translation, instruction set, and logic circuits.
TCS.DCS.14	Examine connections between elements of mathematics and computer science including binary numbers, logic, sets and functions.
TCS.DCS.15	Provide examples of interdisciplinary applications of computational thinking.

Collaboration	
TCS.DCS.16	Apply productivity/multimedia tools and peripherals to group collaboration and support learning throughout the curriculum.
TCS.DCS.17	Collaboratively design, develop, publish, and present products (e.g., videos, podcasts, websites) using technology resources that demonstrate and communicate curriculum

	concepts.
TCS.DCS.18	Use collaborative practices such as pair programming, working in project teams, and participating in group active learning activities.
TCS.DCS.19	Demonstrate characteristics necessary for collaboration: providing useful feedback, integrating feedback, understanding and accepting multiple perspectives, socialization.

Computing Practice & Programming	
TCS.DCS.20	Select appropriate tools and technology resources to accomplish a variety of tasks and solve problems.
TCS.DCS.21	Use a variety of multimedia tools and peripherals to support personal productivity and learning throughout the curriculum.
TCS.DCS.22	Design, develop, publish, and present products (e.g., webpages, mobile applications, animations) using technology resources that demonstrate and communicate curriculum concepts.
TCS.DCS.23	Demonstrate an understanding of algorithms and their practical application.
TCS.DCS.24	Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.
TCS.DCS.25	Demonstrate good practices in personal information security, using passwords, encryption, and secure transactions.
TCS.DCS.26	Identify interdisciplinary careers that are enhanced by computer science.
TCS.DCS.27	Demonstrate characteristics used in open ended problem solving and programming (e.g., comfort with complexity, persistence, brainstorming, adaptability, patience, propensity to tinker, creativity, accepting challenge).
TCS.DCS.28	Collect and analyze data that is output from multiple runs of a computer program.

Computers & Communications Devices	
TCS.DCS.29	Recognize that computers are devices that execute programs.
TCS.DCS.30	Identify a variety of electronic devices that contain computational processors.
TCS.DCS.31	Demonstrate an understanding of the relationship between hardware and software.
TCS.DCS.32	Use developmentally appropriate, accurate terminology when communicating about technology.
TCS.DCS.33	Apply strategies for identifying and solving routine hardware problems that occur during everyday computer use.
TCS.DCS.34	Describe the major components and functions of computer systems and networks.
TCS.DCS.35	Describe what distinguishes humans from machines focusing on human intelligence versus machine intelligence and ways we can communicate.
TCS.DCS.36	Describe ways in which computers use models of intelligent behavior (e.g., robot motion, speech and language understanding, and computer vision).

Community, Global, and Ethical Impacts	
TCS.DCS.37	Demonstrate legal and ethical behaviors when using information and technology and discuss the consequences of misuse.
TCS.DCS.38	Demonstrate knowledge of changes in information technologies over time and the effects those changes have on education, the workplace, and society.
TCS.DCS.39	Analyze the positive and negative impacts of computing on human culture.
TCS.DCS.40	Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems.

High School: Computer Science in the Modern World

Computer Science in the Modern World is a course designed to expose all students to the interdisciplinary nature of computer science in today's dynamic and globally connected society. Students will have the opportunity to explore the uses of computer science as a tool in creating effective solutions to complex contemporary problems. The hands-on nature of the course is intended to provide students with the opportunity to explore conceptual understanding in a practical learning environment. This course is recommended for all students as it provides an overview of computer sciences and its applications in various disciplines, professions, and personal activities. In this course, students will learn to use computational thinking to develop algorithmic solutions to real-world problems. They will begin to understand the different levels of complexity in problem solving and to determine when team projects might generate more effective problem solutions than individual efforts. Students will learn and use a programming language(s) and related tools, as well as appropriate collaboration tools, computing devices, and network environments. Finally, they will demonstrate an understanding of the social and ethical implications of their work and exhibit appropriate communication behavior when working as a team member.

Computer Science in the Modern World is course designed for all students in grades 9-12, and is built around the essential skills that all high school students should have upon graduation. It also provides the necessary skills needed for more advanced computer science courses, including AP® Computer Science Principles, AP® Computer Science A and IB Computer Science. It is recommended that this course be required of all students.

Computational Thinking	
TCS.MW.1	Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.
TCS.MW.2	Describe a software development process used to solve software problems (e.g., design, coding, testing, verification).
TCS.MW.3	Explain how sequence, selection, iteration, and recursion are building blocks of algorithms.
TCS.MW.4	Compare techniques for analyzing massive data collections.
TCS.MW.5	Describe the relationship between binary and hexadecimal representations.
TCS.MW.6	Analyze the representation and trade-offs among various forms of digital information.
TCS.MW.7	Describe how various types of data are stored in a computer system.
TCS.MW.8	Use modeling and simulation to represent and understand natural phenomena.
TCS.MW.9	Discuss the value of abstraction to manage problem complexity.
TCS.MW.10	Describe the concept of parallel processing as a strategy to solve large problems.
TCS.MW.11	Describe how computation shares features with art and music by translating human intention into an artifact.

Collaboration	
TCS.MW.12	Work in a team to design and develop a software artifact.
TCS.MW.13	Use collaborative tools to communicate with project team members (e.g., discussion threads, wikis, blogs, version control, etc.).
TCS.MW.14	Describe how computing enhances traditional forms and enables new forms of experience, expression, communication, and collaboration.

TCS.MW.15	Identify how collaboration influences the design and development of software products.

Computing Practice and Programming	
TCS.MW.16	Create and organize Web pages through the use of a variety of web programming design tools.
TCS.MW.17	Use mobile devices/emulators to design, develop, and implement mobile computing applications.
TCS.MW.18	Use various debugging and testing methods to ensure program correctness (e.g., test cases, unit testing, white box, black box, integration testing).
TCS.MW.19	Apply analysis, design, and implementation techniques to solve problems (e.g., use one or more software lifecycle models).
TCS.MW.20	Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.
TCS.MW.21	Select appropriate file formats for various types and uses of data.
TCS.MW.22	Describe a variety of programming languages available to solve problems and develop systems.
TCS.MW.23	Explain the program execution process.
TCS.MW.24	Explain the principles of security by examining encryption, cryptography, and authentication techniques.
TCS.MW.25	Explore a variety of careers to which computing is central.
TCS.MW.26	Describe techniques for locating and collecting small and large-scale data sets.
TCS.MW.27	Describe how mathematical and statistical functions, sets, and logic are used in computation.

Computers and Communication Devices	
TCS.MW.28	Describe the unique features of computers embedded in mobile devices and vehicles (e.g., cell phones, automobiles, airplanes).
TCS.MW.29	Develop criteria for purchasing or upgrading computer system hardware.
TCS.MW.30	Describe the principal components of computer organization (e.g., input, output, processing, and storage).
TCS.MW.31	Compare various forms of input and output.
TCS.MW.32	Explain the multiple levels of hardware and software that support program execution (e.g., compilers, interpreters, operating systems, networks).
TCS.MW.33	Apply strategies for identifying and solving routine hardware and software problems that occur in everyday life.
TCS.MW.34	Compare and contrast client-server and peerto-peer network strategies.
TCS.MW.35	Explain the basic components of computer networks (e.g., servers, file protection, routing, spoolers and queues, shared resources, and fault-tolerance).
TCS.MW.36	Describe how the Internet facilitates global communication.
TCS.MW.37	Describe the major applications of artificial intelligence and robotics.

Community, Global, and Ethical Impacts	
TCS.MW.38	Compare appropriate and inappropriate social networking behaviors.
TCS.MW.39	Discuss the impact of computing technology on business and commerce (e.g., automated tracking of goods, automated financial transactions, e-commerce, cloud computing).

TCS.MW.40	Describe the role that adaptive technology can play in the lives of people with special needs.
TCS.MW.41	Compare the positive and negative impacts of technology on culture (e.g., social networking, delivery of news and other public media, and intercultural communication).
TCS.MW.42	Describe strategies for determining the reliability of information found on the Internet.
TCS.MW.43	Differentiate between information access and information distribution rights.
TCS.MW.44	Describe how different kinds of software licenses can be used to share and protect intellectual property.
TCS.MW.45	Discuss the social and economic implications associated with hacking and software piracy.
TCS.MW.46	Describe different ways in which software is created and shared and their benefits and drawbacks (commercial software, public domain software, open source development).
TCS.MW.47	Describe security and privacy issues that relate to computer networks.
TCS.MW.48	Explain the impact of the digital divide on access to critical information.

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High School: Computer Science & Mathematics

This introduction to programming course is designed to provide students with the opportunity to explore the uses of mathematics and computer programming as tools in creating effective solutions to complex problems. Students will develop and refine fundamental skills of computer science within a mathematical context.

Computer Science & Mathematics may be counted as a fourth math elective credit course and must be taught by a certified 9-12 math teacher. Any reference to an algorithm or algorithms in this document includes both mathematics and computer science contexts. Throughout the course, students will use developmentally appropriate and accurate terminology when communicating about technology. Teachers are responsible for including the eight Standards for Mathematical Practice. The teacher or local district may select the object-oriented programming language(s) used in the course.

Prerequisite:
Successful completion of High School Math II or High School Geometry before starting this course. No previous computer science course is required.

Computational Thinking	
Evaluate different data representations to solve problems.	
TCS.M.1	Analyze the various mathematical bases (e.g., binary, decimal, hexadecimal) and convert between them.
TCS.M.2	Describe the relationship between binary and hexadecimal representations.
TCS.M.3	Convert information between various encoding formats (e.g., ASCII, Unicode, hexadecimal, binary).
TCS.M.4	Compare techniques (e.g., sorting, statistics, searching) for analyzing massive data collections.
Connect the development cycle of algorithm construction to problem solving.	
TCS.M.5	Describe how mathematical and statistical functions, sets, and logic are used in computation.
TCS.M.6	Utilize predefined mathematical functions and parameters to divide a complex problem into simpler parts, including parallel processing.
TCS.M.7	Interpret truth tables from basic statements using Boolean operators (AND, OR, XOR, and NOT).
TCS.M.8	Explain ways in which sequence, selection, iteration, and recursion are building blocks of algorithms.
TCS.M.9	Create systems of equations based on real-world situations.
TCS.M.10	Analyze decisions and strategies using probability and statistical concepts.
Create and evaluate algorithms to solve problems.	
TCS.M.11	Utilize modeling and simulation techniques to represent and understand natural phenomena.
TCS.M.12	Examine classical algorithms (e.g., searching, sorting, shortest path).
TCS.M.13	Manipulate formulas and equations and apply them to algorithm development.
TCS.M.14	Apply algorithm analysis and design techniques to solve problems.
TCS.M.15	Write algorithms to solve mathematical problems using formulas, equations, and functions.
TCS.M.16	Implement conditional statements that include if/then, if/then/else, case statements,

	and Boolean logic, in the design of algorithms.
TCS.M.17	Represent algorithms using flowcharts and pseudocode.
TCS.M.18	Combine standard function types using arithmetic operations.
TCS.M.19	Analyze algorithms for correctness, clarity, and efficiency.

Computing Practice and Programming	
Evaluate the use of programming languages to solve problems and develop systems.	
TCS.M.20	Compare and contrast computer programming languages and paradigms (e.g., compiled and interpreted languages, procedural and object-oriented paradigms).
TCS.M.21	Diagram the program execution process.
TCS.M.22	Determine the output of a given sample program without the use of a computer.
Create, test, and use computer programs to solve problems.	
TCS.M.23	Implement computing applications using the following software development tools and techniques • branching (if, if-else) • declare, define, and reference variables • lists/arrays • looping (for, while, do/while) • recursion • sequencing
TCS.M.24	Use various debugging and testing methods to ensure program correctness.
TCS.M.25	Cite evidence to support or refute the correctness of software solutions.

Computers and Communication Devices	
Classify electronic devices containing computational processors that execute programs.	
TCS.M.26	Recognize that computers are devices that execute programs.
TCS.M.27	Identify a variety of electronic devices (e.g., cell phones, desktops, laptops, vehicles, programmable thermostats, programmable kitchen appliances) that contain computational processors.
TCS.M.28	Describe unique features of computers embedded in mobile devices and vehicles.
TCS.M.29	Investigate the history of computers, identifying contributors and major milestones (e.g., Alan Turing, Charles Babbage, Ada Lovelace, Grace Hopper, analytical machine, ENIAC, IBM PC).
Analyze the relationship between hardware and software.	
TCS.M.30	Demonstrate an understanding of the relationship between hardware and software.
TCS.M.31	Develop criteria for purchasing or upgrading computer system hardware.
TCS.M.32	Describe primary components of computer systems (e.g., input, output, processing, storage).
TCS.M.33	Explain multiple levels of hardware and software that support program execution (e.g., compilers, interpreters, operating systems, networks).
TCS.M.34	Apply strategies for identifying and solving routine hardware problems that occur during everyday computer use.
Describe the major components and functions of networks.	
TCS.M.35	Describe how the Internet facilitates global communication.
TCS.M.36	Describe issues that impact network functionality (e.g., latency, bandwidth, firewalls, server capability).

Social and Ethical Impacts of Computing	
Evaluate appropriate and inappropriate uses of technology.	
TCS.M.37	Summarize appropriate and inappropriate technological behaviors, including issues of privacy, copyright, security, legalities, and politics.
TCS.M.38	Explore the ramifications of inappropriate uses of technology.
TCS.M.39	Investigate the national and global economic impact of cybercrime.
Investigate social and ethical issues relating to digital information.	
TCS.M.40	Discuss accessibility issues (e.g., adaptive technology for special needs individuals, censorship, geographical locations, economically-disadvantaged populations).
TCS.M.41	Compare the reliability of various online sources.
TCS.M.42	Investigate information ownership topics • access • distribution rights • hacking • licensure • open source • public domain • software piracy
TCS.M.43	Describe security and privacy issues that relate to computer networks.
Will explore security and privacy techniques.	
TCS.M.44	Explain principles of network security and techniques that protect stored and transmitted data (e.g., encryption, cryptography, authentication).

Computer Science - Introduction to Geographic Information Systems

Introduces fundamental concepts of geographic map interpretation, creation and analysis. Technologies employed include geographic information systems (hereinafter GIS), global positioning systems (hereinafter GPS), basic remote sensing, geo-visualization and interpretation, Internet mapping, and spatial statistics. Explores how geospatial technologies and tools are used in data collection, analysis, presentation, and problem solving.

The goals of this course are threefold: 1) to help students to think spatially, analytically, and critically; 2) to help students become better problem solvers; and 3) to teach students the fundamentals of Geographic Information Science and Technology. Geospatial technology might be used to find wetlands that need protection from pollution; help track the spread of a disease; or be used by a company to site a new business location. Ultimately, geospatial technology helps you answer questions and solve problems.

Computer Science – Introduction to Geographic Information Systems may be counted as a third science elective credit course and must be taught by a certified 9-12 science teacher.

Computational Thinking	
TCS.GIS.1	Demonstrate an understanding of the basics of cartography.
TCS.GIS.2	Demonstrate a basic proficiency in map reading; an understanding of scale; an understanding of the power of analysis; and an understanding of the history of map creation and use.
TCS.GIS.3	Analyze GIS data to identify spatial relationships or display results of analyses, using maps, graphs, or tabular data.

Collaboration	
TCS.GIS.4	Collect data using a student-created online data collection technology.
TCS.GIS.5	Identify a community need related to a human impact on the environment; create a capstone mapping project that describes a solution for that human impact using student collected and generated GIS data; and evaluate competing solutions in terms of effectiveness at mitigating the human impact.
TCS.GIS.6	Create an internet-based map product (story map application or web application) that describes a solution for mitigating a human impact on the environment using students collected and generated GIS data.
TCS.GIS.7	Use a student-created online data collection technology to groundtruth basemap orthophotographs.
TCS.GIS.8	Create a presentation using an online map system displaying a student-created map with a purpose of educating the public on a community, state or national social issue.

Computing Practice and Programming	
TCS.GIS.9	Use a web-based GIS to answer questions about the earth and the environment.
TCS.GIS.10	Demonstrate basic proficiency in map creation, including adding layers, adding additional data, changing data symbology, configuring pop-up, saving and sharing maps.
TCS.GIS.11	Use geospatial technology to explore and investigate environmental problems such as: • resource management • impact assessment
TCS.GIS.12	Use geospatial technology to explore and investigate rural and urban issues such as:

	• urban planning • transportation • logistics • emergency planning to calculate emergency response times in the event of a natural disaster.
TCS.GIS.13	Explore uses of geospatial technology by law enforcement to map, visualize, and analyze crime incident patterns.
TCS.GIS.14	Use geospatial technology to explore and investigate business problems related to asset management.
TCS.GIS.15	Use geospatial technology to explore and investigate problems related to medical geography and epidemiology.
TCS.GIS.16	Research a career related to GIS and present a career summary, projected job outlook, and roles and responsibilities.

Computers and Communication Devices	
TCS.GIS.17	Demonstrates an understanding of GPS technology, data collection, and data layer creation in an online mapping system.
TCS.GIS.18	Collect GPS data using a GPS unit, compile it into a .cvs file, and add it to a saved web map.

Community, Global and Ethical Impacts	
TCS.GIS.19	Use geospatial technology to explore and investigate the history of cartography.
TCS.GIS.20	Demonstrate an awareness of the ethical and social implications of the use of GIS and GPS system, including system reliability, privacy, legal issues, and the social and ethical ramifications of their use.
TCS.GIS.21	Identify the impacts GIS and GPS systems have on individuals, society, commercial markets, and innovation.