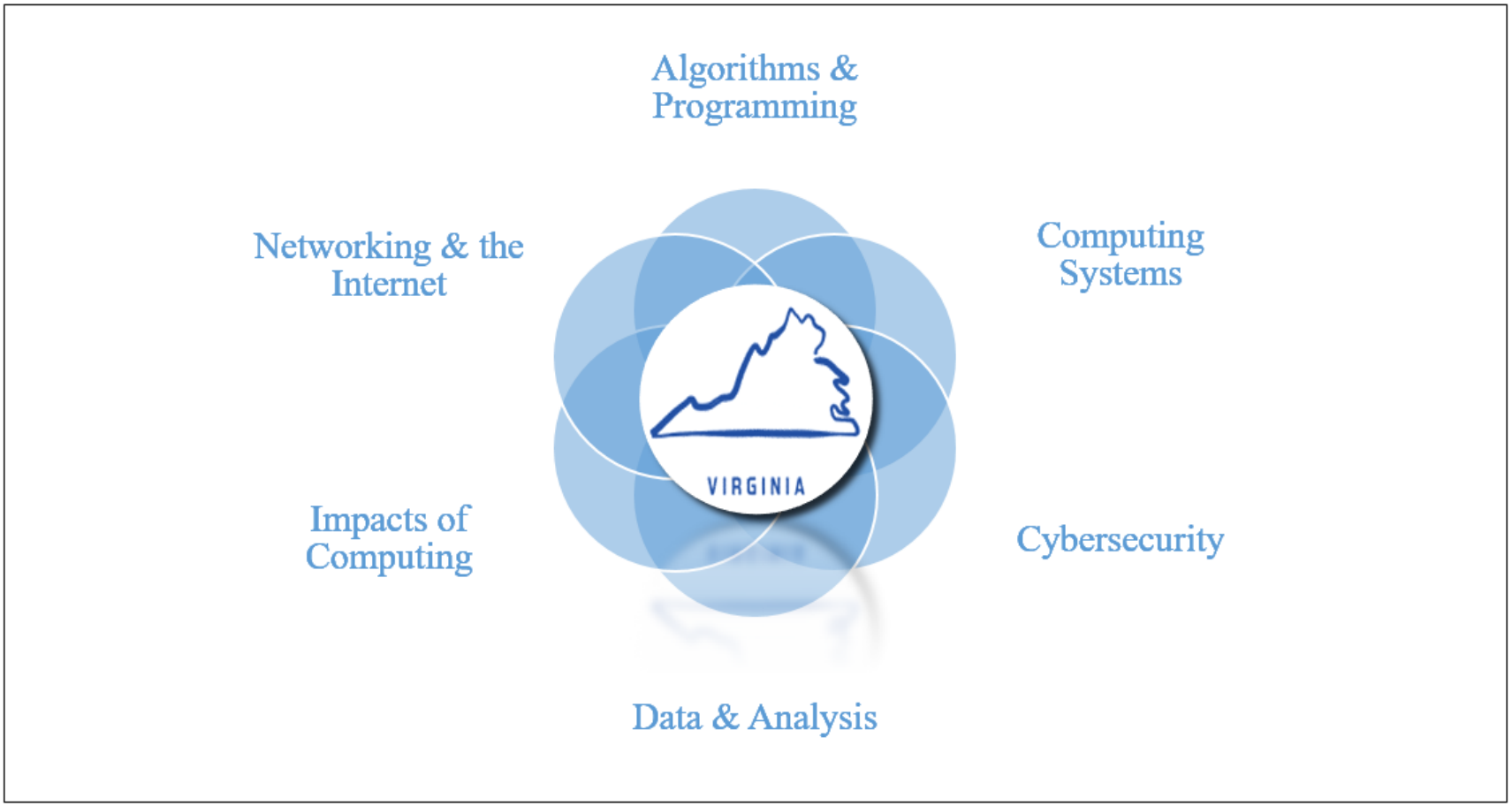
Computer Science Standards of Learning

Curriculum Framework



Board of Education
Commonwealth of Virginia

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The 2017 *Computer Science Curriculum Framework* can be found on the Virginia Department of Education's Web site.

Introduction

The *Computer Science Standards of Learning* Curriculum Framework amplifies the *Computer Science Standards of Learning for Virginia Public Schools* and defines the content knowledge, skills, and understandings that are measured by the Standards of Learning. The Computer Science Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers as they plan their lessons by identifying essential questions and vocabulary to drive instruction and defining the essential skills students should demonstrate. This supplemental framework delineates in greater specificity the minimum content that all teachers should teach and all students should learn.

School divisions should use the *Computer Science Curriculum Framework* as a resource for developing sound curricular and instructional programs. This framework should not limit the scope of instructional programs. Additional knowledge and skills that can enrich instruction and enhance students' understanding of the content identified in the Standards of Learning should be included as part of quality learning experiences.

Each topic in the *Computer Science Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by broadening the context of the standards and identifying essential student skills that should be the focus of instruction for each standard.

Context of the Standard

The Context of the Standard provides educators an explanation of the standard, including a description and the vertical development of the concept. This context will support teachers in incorporating computer science content into discipline-specific lessons. The intention of the Computer Science standards in grades K-8 is that Computer Science principles be integrated throughout content area instruction.

Essential Skills

The Essential Skills define student performance expectations aligned to each standard. The intent of the K-8 computer science standards is that the concepts are integrated into existing disciplines and this will result in these skills being emphasized differently in each content area. The expectation is that these Essential Skills are partnered with content area performance expectations as appropriate in instruction. At the high school level, the expectations in the 2017 *Computer Science Standards of Learning Curriculum Framework* are to be used in the support of standalone computer courses; the essential skills outlined in the document are not intended to be integrated into other coursework unless a teacher chooses to use the content to support discipline practices.

Essential Questions
Each standard has identified key questions to drive classroom instruction. These questions lead teachers and students toward the big ideas of each concept and provide a more holistic viewpoint used to lead instruction relating to the context of each standard.

Essential Vocabulary
In order to effectively communicate Computer Science concepts, essential vocabulary terms are defined in grade-level appropriate terms. These definitions are found in the glossary (Appendix A).

Grade Four

The fourth-grade standards place emphasis on constructing programs and utilizing algorithms to accomplish a task. Students continue to decompose larger problems into smaller tasks. In fourth grade, students begin to think about the impacts of computing and computing devices. The accurate use of terminology as well as the responsible use of technology will continue to be built upon. The foundational understanding of computing and the use of technology will be an integral component of successful acquisition of skills across content areas.

Algorithms and Programming

4.1 The student will construct sets of step-by-step instructions (algorithms) both independently and collaboratively

a. using sequencing;
b. using loops;
c. using variables to store and process data; and
d. performing number calculations on variables (e.g., addition, subtraction, multiplication and division).

Context of the Standard
Algorithms are commonly used in school and at home as students engage in step-by-step activities that are done on a routine basis. Students can create algorithms as they describe and sequence tasks that are part of daily activities. Students can also use loops to repeat steps when a task requires a repeated action or actions. In third grade, the construction of loops becomes more complex as students use a wide variety of patterns to include repeating and growing patterns. In a repeating pattern the units of the pattern repeat and remain the same. In a growing pattern, an addition is added to the pattern causing the pattern to change every time it repeats. Growing patterns involve a progression from step to step which make them more difficult for students than repeating patterns. In fourth grade, algorithms become more complex through the addition of variables. Variables in a computer program are analogous to "Buckets" or "Envelopes" where information can be maintained and referenced. On the outside of the bucket is a name. When referring to the bucket, we use the name of the bucket, not the data stored in the bucket. Many programming languages provide variables, which are used to store and modify data. The data type determines the values and operations that can be performed on that data. *In fourth grade, understanding how to use variables to conduct number calculations (e.g., addition, subtraction, multiplication and division) is sufficient. Manipulation on non-numeric data types is not expected.*

Context of the Standard
Teacher note: the use of the term variable is used across disciplines in fourth grade and students should be aware of how this term can be interpreted or applied differently depending on the discipline context.

Essential Skills	**Essential Questions**	**Essential Vocabulary**
Students should *demonstrate* these skills: • Identify and describe algorithms used to accomplish a variety of tasks. • Describe when a variable can be used. • Identify a variable in an algorithm. • Construct algorithms that use loops and variables. • Apply the use of variables in a math calculation.	Students should *investigate* these concepts: • What are the kinds of tasks that you can write an algorithm to complete? • What is a variable? • Why do we use variables in algorithms? • How can you write an algorithm to complete basic mathematical calculations?	Students should *apply* these terms in context: • Algorithm • Loop • Variable

4.2 The student will construct programs to accomplish a task as a means of creative expression using a block- or text-based programming language, both independently and collaboratively

a. using sequencing;
b. using loops;
c. using variables; and
d. performing number calculations (e.g., addition, subtraction, multiplication and division) on variables.

Context of the Standard
Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. A computational artifact is anything created by a human using a computer. Examples of computation artifacts include programs, images, audio, videos, presentations, or web page files. Computing has the potential to provide students opportunities to extend their *creative expression* to solve problems, create computational artifacts, and develop new knowledge. As students create block- and text-based programs, they move from being mere consumers of content to engaging in the subject matter by creating computational artifacts. In fourth grade, students are expected to use block-based or text-based programming to develop basic programs that include sequences, loops, and variables.

Essential Skills	**Essential Questions**	**Essential Vocabulary**
Students should *demonstrate* these skills: • Construct a program to accomplish an activity. • Modify algorithms to use loops when appropriate. • Declare a variable to store values when appropriate in an algorithm.	Students should *investigate* these concepts: • What is the role of a variable in a program? • How do you decide when to use a loop in your algorithm? • How do you decide when to use a variable in your algorithm?	Students should *apply* these terms in context: • Algorithm • Loop • Variable

Essential Skills	Essential Questions	Essential Vocabulary
• Apply the use of variables in a math calculation.		

4.3 The student will analyze, correct, and improve (debug) an algorithm that includes sequencing, events, loops and variables.

Context of the Standard
In order to determine if an algorithm is an appropriate reflection of the steps that must occur in order to complete a task, the students should review the sequence of steps and any embedded loops that compose the algorithm to determine if it works as intended. During the review stage, the design and implementation are checked for adherence to program requirements, correctness, and usability. This review could lead to changes in implementation and possibly design, which demonstrates the iterative nature of the process. If the algorithm does not work as intended, the students should determine what changes could be made to the algorithm in order to complete the task. These changes may include adding, deleting, rearranging, or changing a step in order to obtain the intended outcome. The process of revising a program so that is works as intended is called debugging.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Describe how an algorithm did not work (e.g., character is not moving as intended). • Analyze a sequence of steps that is flawed and determine possible solution(s). • Implement a proposed adjustment to a sequence that did not work as intended.	Students should *investigate* these concepts: • If your algorithm is not working, how could you find the error? • Once you have found an error in your algorithm, how do you decide what adjustment needs to be made? • How can the order of your steps affect what happens? • What aspects of a variable could cause problems with your algorithms?	Students should *apply* these terms in context: • Bug • Debug

4.4 The student will create a plan as part of the iterative design process, independently and/or collaboratively using a variety of strategies (e.g., pair programming, storyboard, flowchart, pseudocode, story map).

Context of the Standard
An iterative design process is a process in which there is repetition of steps of a process in order to generate a sequence of outcomes. Many occupations and content areas use an iterative design process, including computer science and engineering. In computer science, the development of programs uses an iterative process involving design, implementation, and review. The design stage occurs before writing code. The planning stage is when the programmers gather information about the problem and sketch out a solution. This design process may include the use of pseudocode – a process that involves writing out the steps of a program in English to make sure the flow of control and logic make sense. During the implementation stage, the planned design is expressed in a programming language (code) that can be made to run on a computing device. During the review stage, the design and implementation are checked for adherence to program requirements, correctness, and usability. This review could lead to changes in implementation and possibly design, which demonstrates the iterative nature of the process. This standard focuses on the planning portion of the iterative design process.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Design a program using a planning tool. • Review and revise a plan align to the expectations of a task. • Communicate how an iterative design process can improve a program.	Students should *investigate* these concepts: • How can you use planning tools to create a program (just like you would for a story)? • Why is reviewing and revising your work important? • Why is planning a story or program an important part of the writing process?	Students should *apply* these terms in context: • Planning tool • Storyboard • Graphic organizer • Pseudocode

4.5 The student will classify and arrange a group of items based on the attributes or actions.

Context of the Standard
Objects and actions have attributes; these attributes allow people to group items. Attributes may be physical properties, behaviors, or actions. Actions in computer science can be seen in step-by-step sequences (algorithms). Categorizing of attributes or actions relies on careful observation of patterns and similarities and differences. In this standard, students are expected to analyze groups of items and compare and contrast the attributes that led to the development of the group. In block-based programming environments, commands are grouped into categories based on function. In higher level programming languages, data are often classified by the information held within.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Name multiple ways to sort a set of objects. • Sort and group (classify) objects into appropriate sets (categories) based on multiple attributes. • Classify objects into subsets based on a secondary attribute. • Label attributes of a set of objects that has been sorted.	Students should *investigate* these concepts: • Why is it useful to sort objects into sets and why is it helpful in our daily lives? • (Given a set of objects) How many different ways can you find to organize these objects? • How are items organized with multiple attributes/actions? • What attributes/actions can you use take a set of things that you have sorted and then sort them into subsets?	Students should *apply* these terms in context: • Subset

4.6 The student will break down (decompose) a larger problem into smaller sub-problems, both independently and collaboratively.

Context of the Standard
When approaching a task it is sometimes easier to break the problem down into manageable chunks. Programs can also be broken down into smaller parts to facilitate their design, implementation, and review; this is referred to as decomposition. Decomposition helps in addressing aspects of program development, such as testing, by allowing people to focus on one piece at a time. Decomposition also enables different people to work on different parts at the same time. An example of decomposition at this level is creating an animation by separating a story into different scenes. For each scene, a background needs to be selected, characters placed, and actions programmed. The instructions required to program each scene may be similar to instructions in other programs. Programs can also be built by adding together smaller components to complete a task. When breaking problems into subproblems, these subproblems should be named or described accurately to allow the programmer to easily reconstruct a program.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Analyze a problem and determine sets of smaller problems. • Explain how decomposition can be helpful when planning or testing a program?	Students should *investigate* these concepts: • If you have a big job to do, what are ways you can break it down to make it easier? • Why does breaking a problem down into smaller problems make the overall task easier?	Students should *apply* these terms in context: • Decompose

4.7 The student will give credit to sources when borrowing or changing ideas (e.g., using information, pictures created by others, using music created by others, remixing programming projects).

Context of the Standard
As students start to work with different artifacts (reference materials, resources, etc.) they should understand that these sources of information were created by others. Authors, illustrators, and programmers are responsible for the creation of many sources of information that are used in the classroom and at home. As students choose to use some of these sources in their own work, they are expected to recognize the original creator of the source. This practice should be reiterated throughout a student's K-12 education and beyond. Ethical complications arise from the opportunities provided by computing. The ease of sending and receiving copies of media on the Internet, such as video, photos, and music, creates the opportunity for unauthorized use, such as online piracy, and disregard of copyrights, such as lack of attribution. Other topics related to copyright are plagiarism, fair use, and properly citing online sources. Knowledge of specific copyright laws is not an expectation at this level. This standard supports English standards as they learn about plagiarism in writing. *Students are not responsible for specific copyright laws or using citing practices in fourth grade.*

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Review a program they created and identify any portions that were created by others. • Explain why it is important to give credit to authors. • Describe when it is acceptable to use people's work, and how to give credit to sources.	Students should *investigate* these concepts: • How can you locate creator information on an artifact? • What are examples of artifacts that need to need to have their creators credited? • Why is important to give credit for using someone else's idea, even if you aren't quoting them directly?	Students should *apply* these terms in context: • Author • Illustrator • Composer

Computing Systems

4.8 The student will model how a computing system works including input and output, processors, and sensors.

Context of the Standard
A system is defined as a regularly interacting or interdependent group of items forming a unified whole. Computing systems require inputs and outputs. Input and output, also referred to as I/O, is the communication between an information processing system, such as a computer, and the outside world, possibly a human or another information processing system. Inputs are the signals or data received by the system. There is a wide variety of digital collection tools used for gathering and inputting digital data. Tools are chosen based upon the type of measurement they use as well as the type of data people wish to observe. These collection tools include the movements and clicks of your mouse and the keys you type on a keyboard. Sensors are also used in computing systems, such as in robotics, to detect information and serve as input devices for the system. A sensor that is be used with robotic devices is a light sensor that detects changes in brightness. An output is whatever comes out of the system; for example, outputs include data and what can be seen on the computer screen or how the robotic device responds based on the input from the sensor.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Describe how a computing system may use different components to receive input including sensors. • Identify the processor as the component which manipulates input into output. • Describe how a computing system may produce output. • Model a simple computing system indicating inputs and outputs. • Describe the role of a processor in a computing system.	Students should *investigate* these concepts: • What are examples of sensors that take in input? • What kind of input can a computer take in, and what is required to take in the different types? • What are the main components of a computing system? • When you input information into a computer, what path does it take to become output? • What are the different types of output that a computer can produce?	Students should *apply* these terms in context: • Input • Output • Processor • Sensor

4.9 The student will identify, using accurate terminology, simple hardware and software problems that may occur during use, and apply strategies for solving problems (e.g., rebooting the device, checking for power, checking for network availability, closing and reopening an app).

Context of the Standard
As with any system, there are times that a computer system does not work as intended. Although computing systems may vary, common troubleshooting strategies can be used on them, such as checking connections and power or swapping a working part in place of a potentially defective part. Rebooting a machine is commonly effective because it resets the computer. Since computing devices are composed of an interconnected system of hardware and software, troubleshooting strategies may need to address both. Students in fourth grade are expected to use accurate terminology to describe simple problems with computer hardware and software. Common troubleshooting strategies, such as checking that power is available, checking that physical and

Context of the Standard
wireless connections are working, and clearing out the working memory by restarting programs or devices, are effective for many systems.

Essential Skills	**Essential Questions**	**Essential Vocabulary**
Students should *demonstrate* these skills: • Identify when a device or program is not working properly. • Communicate that a device or program is not working. • Perform simple troubleshooting tasks (e.g., rebooting the computer).	Students should *investigate* these concepts: • How can you tell a computer is not working as intended? • How can you find out specifically why your computer is not working? • What are different troubleshooting tactics you should try if a program is not working? • Why is it important to be as specific as possible when you are describing a problem?	Students should *apply* these terms in context: • Reboot • Troubleshoot

Cybersecurity

4.10 The student will identify and explain problems that relate to inappropriate use of computing devices and networks.

Context of the Standard
Computer networks, including the Internet, can be used to connect people to other people, places, information, and ideas. In order to keep students safe, schools and divisions have rules on the appropriate use of technology. As students increase their use of the

Context of the Standard
networks and interact with others outside of the school or home environment, digital safety is an increasing concern. Students should be aware of what is allowed and not allowed when using division/school technology. Appropriate use of technology as well as school and division rules when using technology should be reviewed with students on a regular basis. Consistent monitoring of students when engaged with technology should be conducted at all times.

Essential Skills	**Essential Questions**	**Essential Vocabulary**
Students should *demonstrate* these skills: • Identify and explain causes and effects related to inappropriate use of computing devices. • Identify real-life situations they encounter while using computing devices that could cause problems in school or at home. • Describe how a technology-related problem could be avoided or prevented.	Students should *investigate* these concepts: • What is appropriate use of technology? • If you see someone using technology inappropriately in school, how should you notify the proper person? • What are some consequences of inappropriate use of computing technology? • What are examples from the news concerning inappropriate use of technology?	Students should *apply* these terms in context:

4.11 The student will create examples of strong passwords, explain why strong passwords should be used, and demonstrate proper use and protection of personal passwords.

Context of the Standard
Connecting devices to a network or the Internet provides great benefit, but care must be taken to protect private information such as a student's name, phone number, and address. Passwords are used to protect devices and information from unauthorized access. Computer programs can be used to guess passwords; therefore, strong passwords have characteristics that make them more difficult to guess. Many sites have rules as to the length and composition of passwords; these rules help create stronger passwords. The practice of not sharing passwords should be emphasized in the classroom and at home. At the elementary level, students are encouraged to use passwords. These passwords may not be as complex as those used by adults in protecting information. Suggestions for creating strong passwords for students include: 1. Use uppercase and lowercase letters. 2. Use numbers. 3. Use symbols. 4. Use at least 8 characters. 5. Don't use words from a dictionary. 6. Don't use the same password twice. 7. Don't use personal information.

Essential Skills	**Essential Questions**	**Essential Vocabulary**
Students should *demonstrate* these skills: • Explain how a password helps protect the privacy of information. • Respect other students' password privacy.	Students should *investigate* these concepts: • What are the attributes of a strong password? • Why should you change your password periodically?	Students should *apply* these terms in context: • Password

Essential Skills	Essential Questions	Essential Vocabulary
• Explain how logging off devices can protect your information. • Classify passwords as strong or weak. • Create strong passwords to be used at school or at home.	• Why should you have a different password for different accounts?	

Data and Analysis

4.12 The student will use a computer to observe, analyze, and manipulate data in order to draw conclusions and make predictions.

Context of the Standard
When answering questions about text in history or English or investigating a question in science, evidence should be used to support your answer. Data are a form of evidence that can be used when answering questions or in making predictions. Data is often sorted or grouped to provide additional clarity. The same data could be manipulated in different ways to emphasize particular aspects or parts of the data set. Computers can be used to obtain, store, and manipulate data. Computers also are used to construct tables and graphs from data collected in class as well as existing data sets that have been compiled by others. The ability to determine what type of data is needed to answer a question and use a computer to find these data are skills needed in many career and academic fields.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Use a computer to organize data using various forms of data collection. • Conduct simple manipulations of data using the computer. • Analyze a data set to identify a pattern or make a prediction. • Use the data to answer a question or make a prediction.	Students should *investigate* these concepts: • How can you use the data you have collected to make a prediction or answer a question? • How does a computer help you to look at data in different ways? • What can you learn from looking at your data in different ways? • What does a computer allow you to do with data that is more difficult on paper?	Students should *apply* these terms in context: • Data • Prediction

4.13 The student will create an artifact using computing systems to model the attributes and behaviors associated with a concept (e.g., solar system).

Context of the Standard
Scientists, computer scientists, mathematicians, and programmers construct and use models to better conceptualize and understand phenomena under investigation or to develop a possible solution to a proposed problem. Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Create an artifact to model a concept using a computing system. • Describe how a model reflects the attributes or behaviors of a concept.	Students should *investigate* these concepts: • What are examples of models that we see and use regularly? • What are examples of things in the world that you can model? • What information do you need to construct a model? • How does a computer model help us learn and predict things about systems?	Students should *apply* these terms in context: • Model

4.14 The student will use numeric values to represent non-numeric ideas in the computer (binary, ASCII, pixel attributes such as RGB).

Context of the Standard
Computers use numeric values to store information and perform operations. Information inputted into the computer from various components must be converted into numeric values in order for the computer to use the information and perform functions. Once the function is completed, the numeric values must be converted to a form of output that the user can understand. This output may be in the form of words, images, videos, or sounds. Examples of different ways non-numeric information such as letters or colors can be expressed include the use of different protocols such as binary, ASCII, or RGB. *Students are not expected to apply these protocols in fourth grade.*

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Understand that computers use numeric values to represent non-numeric ideas. • Give an example of when numeric values can be used to represent non-numeric ideas. • Apply using numeric values to represent non-numeric ideas to in a real-world example.	Students should *investigate* these concepts: • What is a numeric value? • Why are numbers used to represent non-numeric ideas in the computer? • Why does a computer convert input into a different format? • What are some examples of how numbers are used to represent non-numeric ideas in the computer?	Students should *apply* these terms in context: • Binary • Pixel • ASCII

Impacts of Computing

4.15 The student will give examples of computing technologies that have changed the world and express how those technologies influence, and are influenced by, cultural practices.

Context of the Standard
Societal and cultural problems provide a demand for the development of new technologies. These new computing technologies are created and existing technologies are modified in order to increase their benefits (for example, Internet search recommendations), decrease their risks (for example, autonomous cars), and meet societal demands (for example, smartphone apps). Increased Internet access and speed have allowed people to share cultural information but have also affected the practice of traditional cultural customs. An example of this is that people collaborate and communicate in different ways than they did decades ago. Storytelling and the sharing of information that was conducted between people in a face to face environment now happens virtually much of the time.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Identify computing technologies that have changed the world. • Explain how the technology is influenced by society. • Explain how the culture can affect the technology.	Students should *investigate* these concepts: • What are examples of computing technologies that changed the world? • How has technology, like mobile phones, changed society? • How does society influence the technology that we invent? • If you could design a new computing technology, what would it do, and why?	Students should *apply* these terms in context: • Internet

4.16 The student will describe the positive and negative impacts of the pervasiveness of computers and computing in daily life (e.g., downloading videos and audio files, electronic appliances, wireless Internet, mobile computing devices, GPS systems, wearable computing).

Context of the Standard
The use of technology, including computers, has allowed for global communication and has revolutionized the everyday access of information, whether for business, scientific or personal use. Although there are many positive impacts in using technology, there are also times when computer use has impacted us in undesirable ways. As computer technology continues to advance and new generations of machines grow faster and have greater capabilities, the machines become more deeply fixed in daily life, magnifying both the benefits and the downside risks. Positive impacts include easy access to information, automated machinery, and fast and accurate data processing. Negative impacts include an increase in sedentary lifestyles, family and leisure interruption, and loss of privacy.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Identify how the use of computers and computing positively influences daily life. • Identify how the use of computers and computing negatively influences daily life.	Students should *investigate* these concepts: • How do computing devices make your life easier? • How have computing devices made people's lives more complicated? • What are ways to limit the negative influences of computing devices?	Students should *apply* these terms in context:

4.17 The student will describe social and ethical issues that relate to computing devices and networks.

Context of the Standard
People can work in different places and at different times to collaborate and share ideas when they use technologies that reach across the globe. These social interactions affect how local and global groups interact with each other. As with any social interaction, there are manners that people should use when interacting with others. The use of manners when collaborating or interacting with others through computing devices or networks is more complex since many times the communication is done without seeing the person on the other side of the communication. For example, communications should be clear and concise and should never represent the words and actions of others as your own. Care should be taken when sharing information so that the intent of the message is not misunderstood by the person on the other end of the communication. In addition, due to the anonymous nature of online communication, intimidating and inappropriate behavior in the form of cyberbullying may occur. Cyberbullying is a form of bullying that occurs when online communications are sent that are intimidating or threatening in nature.

Essential Skills	Essential Questions	Essential Vocabulary
Students should *demonstrate* these skills: • Describe problems that arise from computer use. • Practice the use of good computer ethics when interacting with others.	Students should *investigate* these concepts: • What is cyberbullying? • How could computing technology make it easier for people to engage in negative behavior? • What should you do if you see other people using a computer to do harm to others?	Students should *apply* these terms in context: • Cyberbullying

Networking and the Internet

4.18 The student will identify and explain different ways information can be transmitted using computing devices via a network (e.g., email, images, and videos).

Context of the Standard
Information can be transmitted through both physical and wireless pathways; these pathways are referred to as a network. Network pathways allow communications to occur between computers within the same building or to different locations around the world. These communications exist in a variety of forms to include emails, blogs, images, videos, and through social media platforms. The use of wireless technology allows people to communicate and collaborate, to support work, and to maintain friendships. *Students are not expected to know the exact mechanisms for conducting electronic transmissions in fourth grade.*

Essential Skills	**Essential Questions**	**Essential Vocabulary**
Students should *demonstrate* these skills: • Identify types of electronic communications (e.g., email, blogging, text messaging, and video messaging). • Discuss the different types of information that can be communicated through different transmission media. • Explain that networks are needed to transfer information within computing systems.	Students should *investigate* these concepts: • What are the different types of electronic communication? • How do you decide which method of communication is best for a particular situation? • How does information travel from computing device to computing device? • How does electronic communication allow for greater collaboration between people? • What is meant by a network?	Students should *apply* these terms in context: • Network • Email • Blog • Text message • Video conferencing

Grade 4

Term	Definition
Algorithm	Sequence of steps that completes a task
ASCII	A conversion chart for representing different characters in numeric form
Attribute	Physical description of an object (e.g., color, shape, size)
Author	The creator of a book, image, song, or object
Binary	The number system used by computers to represent all messages and commands
Blog	An informal website that is regularly updated by an individual or group
Bug	An error or flaw in a program that causes it to give the wrong answer or crash
Composer	The creator of an audio artifact (e.g., song)
Cyberbullying	The use of electronic communication to bully a person
Data	Individual facts and information
Debug	Find and fix problems in a program
Decompose	Breaking a complex problem into parts that are easier to understand and solve
Email	Program used to communicate online
Graphic organizer	A visual display of facts, terms, and ideas
Illustrator	Creator of a visual artifact (e.g., image or painting)
Input	Data that is taken in by a computer for processing

Term	Definition
Internet	A global computer network that allows people to communicate, create, and share content
Loop	A set of actions repeated until a condition is met
Model	Creating a representation of an idea, object, or a process
Network	A group of computers that can communicate directly with each other
Output	Data that is produced by a computer as a result of a program
Password	A secret word or phrase that must be used to gain admission to something
Pixel	Small colored dots that make up an image
Planning tool	A document or other resource to help organize thoughts in the creation of a product
Prediction	Making a guess of what will happen based on current facts
Processor	Computing component that performs the manipulation to change input into output
Reboot	Turn off a computer and then turn it on again
Sensor	Computing component that collects data that would otherwise be difficult to collect by hand
Storyboard	A sequence of drawings that represent the order of a program happening
Subset	A group within a group
Text message	Electronic communication usually sent between mobile phones
Troubleshoot	Identify and correct faults in a computing system
Variable	Programming element that can hold a value

Term	Definition
Video conferencing	Communicating with someone on the Internet with both audio and video