2024 Virginia Computer Science *Standards of Learning* (SOL) – Overview of Revisions

April 2024

This document provides an overview of the revisions to the 2017 Computer Science *Standards of Learning*, including a summary of the content embedded in each content strand, a comparison chart of the 2017 Computer Science SOL and the 2024 Computer Science SOL, and summary charts documenting the changes.

Kindergarten Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to identify patterns and sort items into categories based on an attribute
- Plan and implement algorithms that include sequential order

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Identify components of a computing device
- Identify when a device might not work as expected

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Describe the importance of protecting personal information online
- Describe the importance of protecting personal information online

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Gather and record data with or without a computing device
- Create representations of data to make predictions and draw conclusions

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Discuss how computing technologies impact people's lives
- Discuss and describe how different careers use computing technologies

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Describe how people can communicate with others by connected computing devices and the Internet

Comparison of Kindergarten Computer Science *Standards of Learning* – 2017 to 2024

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Algorithms and Programming**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Algorithms and Programming (AP)**
K.1 The student will construct sets of step-by-step instructions (algorithms) either independently or collaboratively including sequencing, emphasizing the beginning, middle, and end.	**[Included in K.AP.2]**
K.2 The student will construct programs to accomplish tasks as a means of creative expression using a block-based programming language or unplugged activities, either independently or collaboratively, including sequencing, emphasizing the beginning, middle, and end.	**K.AP.2 The student will plan and implement algorithms that include sequential order.** a. Identify tasks that are completed using sequential step-by-step instructions. b. Recall and state thoughts, ideas, and stories in the form of sequential steps. c. Create a design document to illustrate thoughts, ideas, and stories in a sequential manner. d. Create and test a sequential algorithm emphasizing beginning, middle, and end. e. Create and test a sequential algorithm to accomplish a predetermined task.
K.3 The student will create a design document to illustrate thoughts, ideas, and stories in a sequential (step-by-step) manner (e.g., story map, storyboard, and sequential graphic organizer.	**[Included in K.AP.2]**
K.4 The student will categorize a group of items based on one attribute or the action of each item, with or without a computing device.	**[Included in K.AP.1]**
	K.AP.1 The student will apply computational thinking to identify patterns and sort items into categories based on an attribute. a. Identify attributes of a set of objects. b. Compare two objects and list attributes they have in common. c. Sort and classify concrete objects based on one attribute.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Computing Systems**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Computing Systems (CSY)**
K.5 The student will identify components of computing systems (e.g., keyboard, mouse, desktop computer, laptop computer, tablet, and printer).	**K.CSY.1 The student will identify components of a computing device.** a. Identify and locate components of a computing device, including sensors. b. Describe the function of common components in a computing device. c. Demonstrate proper use of computing devices.
K.6 The student will identify, using accurate terminology, simple hardware and software problems that may occur during use (e.g., app or program is not working as expected, no sound is coming from a device, device will not turn on).	**K.CSY.2 The student will identify when a computing device might not work as expected.** a. Identify a problem with a computing device when it is not working as expected. b. Explain what to do when a computing device is not working as expected.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Cybersecurity**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Cybersecurity (CYB)**
K.7 The student will identify what is allowed and what is not allowed at school when using technology.	**K.CYB.1 The student will demonstrate safe and responsible use of computing technologies.** a. Identify safe and responsible uses of computing technologies based on the school rules and acceptable use policy (AUP). b. Demonstrate safe and responsible uses of computing technologies. c. Communicate process for reporting behaviors that do not comply with school rules or acceptable use policy.
K.8 The student will identify personal information (e.g., address, telephone number, and name) and the importance of protecting personal information online.	**K.CYB.2 The student will describe the importance of protecting personal information online.** a. Describe what personal information should be shared and not shared. b. Determine to whom personal information should be shared. c. Identify safe practices to keep personal information private.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Data and Analysis**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Data and Analysis (DA)**
K.9 The student will gather and display data and organize it in a chart or graph in order to answer questions about the data, with or without a computing device.	**K.DA.1 The student will gather and record data with or without a computing device.** a. Discuss the importance of data. b. Identify numeric and non-numeric data. c. Record data and communicate possible patterns.
	K.DA.2 The student will create representations of data to make predictions and draw conclusions. a. Create tables, object graphs, picture graphs, and/or models. b. Describe the information in a data visualization. c. Use data to answer questions, make predictions, and draw conclusions.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Impacts of Computing**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Impacts of Computing (IC)**
K.10. The student will identify responsible behaviors associated with using information and technology.	**K.IC.1 The student will discuss how computing technologies impact people's lives.** a. List computing technologies found in the classroom, home, and the community. b. Identify how computing technologies are used in daily tasks. c. Discuss healthy habits for using computing technologies.
	K.IC.2 The student will discuss and describe how different careers use computing technologies. a. Describe how computing technologies are used in various careers. b. Discuss the advantages of using computing technologies in different careers. c. Identify local jobs that utilize computer technologies.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Networking and the Internet**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Networking and the Internet (NI)**
K.11 The student will discuss, in a whole class setting, how information can be communicated electronically (e.g., email, social media).	**K.NI.1 The student will describe how people can communicate with others by connected computing devices and the Internet.** a. Identify ways to communicate with others using connected computing devices and the Internet. b. Describe the benefits of communicating with others using connected devices and the Internet.

Draft 2024 Kindergarten Computer Science SOL – Summary of Changes

Kindergarten (2017 SOL to 2024 SOL Numbering)
• K.1 → [Included in K.AP.2] • K.2 → K.AP.2 • K.3 → [Included in K.AP.2] • K.4 → [Included in K.AP.1] • K.5 → K.CSY.1 • K.6 → K.CSY.2 • K.7 → K.CYB.1 • K.8 → K.CYB.2 • K.9 → K.DA.1 • K.10 → K.IC.1 • K.11 → K.NI.1

Deletions from Kindergarten (2017 SOL)	Additions to Kindergarten (2024 SOL)
None	• K.AP.1 - The student will apply computational thinking to identify patterns and sort items into categories based on an attribute. • K.DA.2 - The student will create representations of data to make predictions and draw conclusions.

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 1 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking by sorting items into categories based on multiple attributes and create patterns
- Plan and implement algorithms that include the use of sequence and an event based on a predetermined task
- Use the iterative design process to construct, test, and debug algorithms that include sequencing and an event

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Describe how computing components work together to create a computing system
- Use accurate terminology to describe when a computing system might not work as expected

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Demonstrate safe and responsible use of computing technologies
- Discuss the importance of using a password to protect private information

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Explore how data can be stored and retrieved from various computing devices
- Create representations of data to make predictions and draw conclusions

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Describe how computing technologies impact daily tasks and communication
- Explain how computing technologies improve the efficiency of work

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Explain that computing devices and the use of the Internet allow people the ability to gather information and connect with others

Comparison of Grade 1 Computer Science *Standards of Learning* – 2017 to 2024

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Algorithms and Programming**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Algorithms and Programming (AP)**
1.1 The student will construct sets of step-by-step instructions (algorithms) either independently or collaboratively, including a. sequencing (including ordinal numbers); and; b. simple loops (patterns and repetition).	**1.AP.2 The student will plan and implement algorithms that include the use of sequence and an event based on a predetermined task.** a. Plan and create a design document that illustrates thoughts, ideas, and stories in a sequential manner. b. Construct step-by-step instructions that include decision-making and repetition. c. Identify and explain the role of events that are used in an algorithm. d. Test algorithms that are sequential and contain an event.
1.2. The student will construct programs to accomplish tasks as a means of creative expression using a block-based programming language or unplugged activities, either independently or collaboratively including a. sequencing, ordinal numbers; and b. simple loops (patterns and repetition).	**[Included in 1.AP.2 - Sequencing, ordinal numbers]** **[Included in 2.AP.2 - Loops]**
1.3 The student will analyze, correct, and improve (debug) an algorithm that includes sequencing.	**1.AP.3 The student will use the iterative design process to construct, test, and debug algorithms that include sequencing and an event.** a. Discuss and describe the concept of debugging. b. Analyze and explain the results of an algorithm. c. Revise and improve an algorithm to produce desired outcomes.
1.4. The student will plan and create a design document to illustrate thoughts, ideas, and stories in a sequential (step-by-step) manner (e.g., story map, storyboard, sequential graphic organizer).	**[Included in 1.AP.2]**

1.5 The student will categorize a group of items based on one or two attributes or the actions of each item, with or without a computing device.	**[Included in 1.AP.1]**
1.6 The student will acknowledge that materials are created by others (e.g., author, illustrator).	**[Moved to Grade 3. Refer to 3.IC.3]**
	1.AP.1 The student will apply computational thinking by sorting items into categories based on multiple attributes and create patterns. a. Describe attributes of a set of objects. b. List the attributes a set of objects have in common. c. Sort and classify concrete objects based on multiple attributes. d. Create repeating and increasing patterns.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Computing Systems**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Computing Systems (CSY)**
1.7 The student will identify components of computing systems that are common among different types of computing devices including desktop and laptop computers, tablets, and mobile phones.	**1.CSY.1 The student will describe how computing components work together to create a computing system.** a. Identify and define hardware, software, and computing systems. b. Identify common components of computing systems in different types of computing devices. c. Describe how hardware and software work together to form a computing system.
1.8 The student will identify, using accurate terminology, simple hardware and software problems that may occur during use (e.g., app or program is not working as expected, no sound is coming from the device, the device won't turn on).	**1.CSY.2 The student will use accurate terminology to describe when a computing system might not work as expected.** a. Identify and describe a problem with a device or computing system when it does not work as expected. b. Propose a solution to simple hardware or software issues.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Cybersecurity**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Cybersecurity (CYB)**
1.9 The student will describe what is allowed and what is not allowed at school associated with the use of technology.	**1.CYB.1 The student will demonstrate safe and responsible use of computing technologies.** a. Describe safe and responsible uses of computing technologies based on the school rules and acceptable use policy (AUP). b. Classify appropriate and inappropriate uses of technology at school or at home. c. Explain the consequences of inappropriate uses of computing technologies. d. Discuss the process for reporting inappropriate technology use at school or home. e. Demonstrate safe and responsible behaviors when using computing technologies and online communication.
1.10 The student will identify and use strong passwords, explain why strong passwords should be used (e.g., protect name, address, and telephone number).	**1.CYB.2 The student will discuss the importance of using a password to protect private information.** a. Describe the purpose of usernames and passwords. b. Discuss how passwords are private information and are used to protect the privacy of information.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Data and Analysis**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Data and Analysis (DA)**
	1.DA.1 The student will explore how data can be stored and retrieved from various computing devices. a. Identify data formats used for various purposes, including audio, images, text, and video. b. Explore and identify computing devices that collect, store, and/or display data.
1.11 The student will identify and interpret data and organize it in a chart or graph in order to make a prediction, with or without a computing device.	**1.DA.2 The student will create representations of data to make predictions and draw conclusions.** a. Collect and organize data with or without a computing device.

	b. Create tables, object graphs, picture graphs, and models using abstraction. c. Identify patterns and describe trends in data visualizations of various formats. d. Use data to answer questions, draw conclusions, and make predictions.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Impacts of Computing**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Impacts of Computing (IC)**
1.12 The student will identify and explain responsible behaviors associated with using information and technology.	**[Included in 1.CYB.1]**
	1.IC.1 The student will describe how computing technologies impact daily tasks and communication. a. Determine when tasks should be completed with or without computing devices. b. Describe how computing devices are used in communication. c. Describe healthy habits for using computing technologies.
	1.IC.2 The student will explain how computing technologies improve the efficiency of work. a. List computing technology used in various careers. b. Compare and contrast the ways people work with and without computing technologies. c. Describe how the appropriate use of computing technologies can improve efficiency.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Networks and the Internet**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Networks and the Internet (NI)**
1.13 The student will, in a whole class environment, discuss how information can be communicated electronically (e.g., email, social media).	**1.NI.1 The student will explain that computing devices and the use of the Internet allow people the ability to gather information and connect with others.** a. Describe how the Internet can be used to gather information. b. Explain ways people communicate using computing devices and the Internet.

Draft 2024 Grade 1 Computer Science SOL – Summary of Changes

Grade 1 (2017 SOL to 2024 SOL Numbering)
• 1.1 → 1.AP.2 • 1.2 → [Included in 1AP.2- Sequencing, ordinal numbers] [Included in 2.AP.2- Loops] • 1.3 → 1.AP.3 • 1.4 → [Included in 1.AP.2] • 1.5 → [Included in 1.AP.1] • 1.6 → [Moved to Grade 3. Refer to 3.IC.3] • 1.7 → 1.CSY.1 • 1.8 → 1.CSY.2 • 1.9 → 1.CYB.1 • 1.10 → 1.CYB.2 • 1.11 → 1.DA.2 • 1.12 → [Included in 1.CYB.1] • 1.13 → 1.NI.1

Deletions from Grade 1 (2017 SOL)	Additions to Grade 1 (2024 SOL)
• 1.2 - Construct programs to accomplish tasks as a means of creative expression using a block-based programming language or unplugged activities, either independently or collaboratively including [Sequencing, ordinal numbers included in Grade 1. Refer to 1.AP.2] • 1.2 - Construct programs to accomplish tasks as a means of creative expression using a block-based programming language or unplugged activities, either independently or collaboratively [Loops included in Grade 2. Refer to 2.AP.2] • 1.6 - Acknowledge that materials are created by others (e.g., author, illustrator). [Moved to Grade 3. Refer to 3.IC.3]	• 1.AP.1 - The student will apply computational thinking by sorting items into categories based on multiple attributes and create patterns. • 1.DA.1 [KS] The student will explore how data can be stored and retrieved from various computing devices. • 1.IC.1 [KS] The student will describe how computing technologies impact daily tasks and communication. • 1.IC.2 [KS] The student will explain how computing technologies improve the efficiency of work.

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 2 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to identify patterns, and design algorithms to compare and contrast objects based on attributes
- Plan and implement algorithms that consists of events and loops using a block-based programming language
- Use the iterative design process to create, test, and debug a program containing events and loops in a block-based programming tool

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Describe the characteristics of computing systems including hardware, software, input, and output
- Demonstrate an understanding of how to troubleshoot simple hardware and software problems that may occur during use

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Model safe and responsible behaviors when using information and computing technologies
- Explain the importance of using passwords to protect private information

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Create representations of data to make predictions and draw conclusions
- Manipulate data, create representations, and evaluate to solve a problem

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Examine the positive and negative impacts of how using computing technologies has changed the way people live, work, and interact

- Explain how computing technologies have affected the workforce

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Demonstrate the use of the Internet in gathering information to accomplish a task

Comparison of Grade 2 Computer Science *Standards of Learning* – 2017 to 2024

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Algorithms and Programming**	2024 *Standards of Learning* Knowledge and Skills (KS) **Algorithms and Programming (AP)**
2.1 The student will construct sets of step-by-step instructions (algorithms) both independently and collaboratively. a. using sequencing; b. using loops (a wide variety of patterns such as repeating patterns or growing patterns); and c. identifying events.	**2.AP.2 The student will plan and implement algorithms that consists of events and loops using a block-based programming language.** a. Plan and create a design document to guide the construction of a program using plain language or pseudocode. b. Identify a section of repeated actions within an algorithm and replace it with a loop. c. Construct step-by-step instructions that include events and repetition.
2.2 The student will construct programs to accomplish tasks as a means of creative expression using a block-based programming language or unplugged activities, both independently and collaboratively a. using sequencing; b. using loops (a wide variety of patterns, such as repeating patterns or growing patterns); and **c.** identifying events.	**[Included in 2.AP.2]**
2.3 The student will analyze, correct, and improve (debug) an algorithm that includes sequencing and simple loops, with or without a computing device.	**[Included in 2.AP.3]**
2.4 The student will plan and create a design document to illustrate thoughts, ideas, and stories in a sequential (step-by-step) manner (e.g., story map, storyboard, sequential graphic organizer).	**[Included in 2.AP.2]**
2.5 The student will compare and contrast a group of items based on the attributes or actions of each item, with or without a computing device.	**[Included in 2.AP.1]**
2.6 The student will acknowledge that materials are created by others (e.g., author, illustrator, and website).	**[Moved to Grade 3. Refer to 3.IC.3]**

	2.AP.1 The student will apply computational thinking to identify patterns, and design algorithms to compare and contrast objects based on attributes. a. Compare and contrast multiple ways to sort a set of objects. b. Create a table of features to organize objects. c. Design an algorithm to sort objects into categories based on multiple attributes.
	2.AP.3 The student will use the iterative design process to create, test, and debug a program containing events and loops in a block-based programming tool. a. Define program. b. Read and interpret a program expressed in a block-based programming language. c. Analyze and describe the results of a program. d. Create and test a program that uses events and loops. e. Revise and improve a program to produce desired outcomes.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Computing Systems**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Computing Systems (CSY)**
2.7 The student will describe the characteristics of computing systems to include hardware, software, input, and output.	**2.CSY.1 The student will describe the characteristics of computing systems including hardware, software, input, and output.** a. Describe how hardware and software work together to accomplish a task. b. Define and categorize components as inputs and outputs. c. Describe how a computing system receives input and provides output. d. Discuss how computers use binary to communicate and process information.
2.8 The student will identify, using accurate terminology, simple hardware and software problems that may occur during use (e.g., app or program not working as expected, no sound, device won't turn on).	**2.CSY.2 The student will demonstrate an understanding of how to troubleshoot simple hardware and software problems that may occur during use.** a. Propose solutions to simple hardware and software issues. b. Use appropriate steps to perform simple troubleshooting tasks.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Cybersecurity**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Cybersecurity (CYB)**
2.9 The student will explain what is allowed and what is not allowed at school associated with the use of technology (e.g., class rules).	**2.CYB.1 The student will model safe and responsible behaviors when using information and computing technologies.** a. Explain the need for safe and responsible uses of computing technologies. b. Create a flowchart to illustrate the process for reporting inappropriate use of technology at school or at home. c. Demonstrate and model safe and responsible behaviors when using computing technologies and online communication.
2.10 The student will identify and create strong passwords, explain why strong passwords should be used. (e.g., protect name, address, and telephone number).	**[Included in 2.CYB.2- Identify strong passwords]** **[Included in 3.CYB.1- Create strong passwords]**
	2.CYB.2 The student will explain the importance of using passwords to protect private information. a. Identify and classify passwords as strong or weak. b. Explain how a strong password helps protect the privacy of information. c. Explain the risk of sharing passwords.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Data and Analysis**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Data and Analysis (DA)**
2.11 The student will construct and analyze data and organize it in a chart or graph to make a prediction, with or without a computing device.	**2.DA.1 The student will analyze data to make decisions with or without a computing device.** a. Collect and record numeric and non-numeric data and describe possible patterns. b. Create questions that can and cannot be answered by the data. c. Analyze data to draw conclusions and make decisions.
2.12 The student will create a model of a physical object or process in order to show relationships with or without a computing device (e.g., water cycle, butterfly life cycle, seasonal weather patterns).	**[Moved to Grade 3. Refer to 3.DA.3]**

	2.DA.2 The student will manipulate data, create representations, and evaluate data to solve a problem. a. Create charts, graphs, and models using abstraction to represent data. b. Analyze data visualizations to draw conclusions. c. Propose and evaluate a solution to a problem or question based on data and/or data visualization.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Impacts of Computing**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Impacts of Computing (IC)**
2.13 The student will compare and contrast examples of how computing technology has changed and improved the way people live, work, and interact.	**2.IC.1 The student will examine the positive and negative impacts of how using computing technologies has changed the way people live, work, and interact.** a. Identify current uses of computing/emerging technologies and discuss how they impact society. b. Compare and contrast appropriate and inappropriate online behaviors that apply in the physical environment and the online environment. c. Model healthy habits for using computing technologies.
2.14 The student will identify and model responsible behaviors when using information and technology.	**[Included in 2.CYB.2]**
	2.IC.2 The student will explain how computing technologies have affected the workforce. a. Explain how computing technology is used in various careers. b. Identify skills needed for careers that use computing technologies. c. Discuss how computing technologies have changed the workplace.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Networking and the Internet**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Networking and the Internet (NI)**
2.15 The students will discuss, between partners and as a class, how information can be communicated electronically (e.g., email, social media, video conferencing, blogging).	**2.NI.1 The student will demonstrate the use of the Internet in gathering information to accomplish a task.** a. Explore ways information is organized and shared on the Internet. b. Gather information from the Internet. c. Summarize collected information using own words.

Draft 2024 Grade 2 Computer Science SOL – Summary of Changes

Grade 2 (2017 SOL to 2024 SOL Numbering)
• 2.1 → 2.AP.2 • 2.2 → [Included in 2.AP.2] • 2.3 → [Included in 2AP.3] • 2.4 → [Included in 2.AP.2] • 2.5 → [Included in 2.AP.1] • 2.6 → [Moved to Grade 3. Refer to 3.IC.3] • 2.7 → 2.CSY.1 • 2.8 → 2.CSY.2 • 2.9 → 2.CYB.1 • 2.10 → 2.CYB.2 [Included in 2.CYB.2- Identify strong passwords] [Included in 3.CYB.1- Create strong passwords] • 2.11 → 2.DA.1 • 2.12 → [Moved to Grade 3. Refer to 3.DA.3] • 2.13 → 2.IC.1 • 2.14 → [Included in 2.CYB.1] • 2.15 → 2.NI.1

Deletions from Grade 2 (2017 SOL)	Additions to Grade 2 (2024 SOL)
• 2.6 - Acknowledge that materials are created by others (e.g., author, illustrator, and website) [Moved to Grade 3. Refer to 3.IC.3] • 2.12 - Create a model of a physical object or process in order to show relationships with or without a computing device (e.g., water cycle, butterfly life cycle, seasonal weather patterns) [Moved to Grade 3. Refer to 3.DA.3]	• 2.AP.1[KS] The student will apply computational thinking to identify patterns, and design algorithms to compare and contrast objects based on attributes. • 2.AP.2 [KS] The student will plan and implement algorithms that consists of events and loops using a block-based programming language. • 2.DA.2 [KS] The student will manipulate data, create representations, and evaluate to solve a problem. • 2.IC.2 [KS] The student will explain how computing technologies have affected the workforce.

KEY: AP = Algorithms & Programming; ; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 3 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to design algorithms to extend patterns, processes, or components of a problem
- Plan and implement algorithms that consist of events and conditional control structures using a block-based programming language
- Use the iterative design process to create, test, and debug programs containing events, loops, and conditional structures in a block-based programming tool

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Model how computing devices within a computing system work
- Use accurate terminology when troubleshooting problems when a computing system is not working as expected

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Will apply safe practices to protect private information
- Identify the relationship between passwords and security risk
- Define and explain cybersecurity

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Gather, store, and organize data to evaluate trends and identify patterns using a computing device
- Create and evaluate data representations and conclusions
- Create models that can represent a physical object or process

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Identify and examine the positive and negative impacts of the prevalence of computing technologies
- Identify and describe computing technology careers and their impact on society
- Demonstrate how to use information created by others with permission

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Describe computing networks

Comparison of Grade 3 Computer Science *Standards of Learning* – 2017 to 2024

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Algorithms and Programming**	2024 *Standards of Learning* Knowledge and Skills (KS) **Algorithms and programming (AP)**
3.1 The student will construct sets of step-by-step instructions (algorithms), both independently and collaboratively **a. using sequencing;** **b. using loops (a wide variety of patterns such as repeating patterns or growing patterns); and** **c. using events.**	**[Included in 3.AP.2]**
3.2 The student will construct programs to accomplish tasks as a means of creative expression using a block or text-based programming language, both independently and collaboratively **a.** using sequencing; **b.** using loops (a wide variety of patterns such as repeating patterns or growing patterns); and **c.** identifying events.	**3.AP.2 The student will plan and implement algorithms that consist of events and conditional control structures using a block-based programming language.** a. Describe the concept of a conditional control structure. b. Create a design document to plan an algorithm using plain language, pseudocode, or diagrams.
3.3 The student will analyze, correct, and improve (debug) an algorithm that includes sequencing, events, and loops.	**3.AP.3 The student will use the iterative design process to create, test, and debug programs containing events, loops, and conditional structures in a block-based programming tool.** a. Create and test programs that consist of events, loops, and conditional structures. b. Analyze and describe program results to assess validity of outcomes. c. Revise and improve programs to resolve errors or produce desired outcomes.
3.4 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).	**[Included in 3.AP.2]**
3.5 The student will compare and contrast a group of items based on attributes or actions classified into at least two sets and two subsets.	**[Moved to Grade 2. Refer to 2.AP.1]**

3.6 The student will break down (decompose) a larger problem into smaller sub-problems, independently or collaboratively.	**[Included in 3.AP.1]**
3.7 The student will give credit to sources when borrowing or changing ideas (e.g., using information and pictures created by others, using music created by others, remixing programming projects).	**[Included in 3.IC.3]**
	3.AP.1 The student will apply computational thinking to design algorithms to extend patterns, processes, or components of a problem. a. Identify a pattern in an algorithm, process, or a problem. b. Decompose a problem or task into a subset of smaller problems. c. Design an algorithm to extend either a pattern, process, or component of a problem.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Computing Systems**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Computing Systems (CSY)**
3.8 The student will model how a computing system works including input and output.	**3.CSY.1 The student will model how computing devices within a computing system work.** a. Describe the role of a processor in a computing system. b. Explain the relationship between the inputs, processors, and outputs. c. Discuss various types of input data a computer can accept and use. d. Model how a computing system works including input and output, processors, and sensors.
3.9 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 network availability, closing and reopening an app).	**3.CSY.2 The student will use accurate terminology when troubleshooting problems when a computing system is not working as expected.** a. Identify common troubleshooting strategies used to address a variety of hardware and software problems. b. Explain and apply troubleshooting strategies related to simple hardware and software problems.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Cybersecurity**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Cybersecurity (CYB)**
3.10 The student will identify problems that relate to inappropriate use of computing devices and networks.	**[Included in 3.CYB.3.]**
	3.CYB.1 The student will apply safe practices to protect private information. a. Identify and distinguish personal information that should be private. b. Describe the importance of using a strong password. c. Create and use strong passwords to protect private information.
3.11 The student will create examples of strong passwords, explain why strong passwords should be used, and demonstrate proper use and protection of personal passwords.	**[Included in 3.CYB.1]**
	3.CYB.2 The student will identify the relationship between passwords and security risk. a. Describe how authentication and authorization protect private information. b. Identify multiple authentication methods. c. Discuss the security risk posed by not having a strong password.
	3.CYB.3 The student will define and explain cybersecurity. a. Define cybersecurity. b. Research and identify problems and consequences related to inappropriate use of computing devices and networks. c. Model safe and responsible behaviors when using computing technologies and online communication.
2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Data and Analysis**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Data and Analysis (DA)**
3.12 The student will use a computer to observe and analyze data in order to draw conclusions and make predictions.	**3.DA.1 The student will gather, store, and organize data to evaluate trends and identify patterns using a computing device.** a. Formulate questions that require the collection or acquisition of data. b. Gather, organize, sort, and store data.

	c. Examine a labeled dataset to identify potential problems within the data. d. Discuss how data discrepancies or problems impact predictions and results. e. Draw conclusions and make predictions based on observed data.
	3.DA.2 The student will create and evaluate data representations and conclusions. a. Create charts and graphs based on data collection. b. Analyze data to identify patterns, draw conclusions, and make predictions. c. Describe how training data can be labeled when using a machine learning tool.
3.13 The student will create an artifact using computing systems to model the attributes and behaviors associated with a concept (e.g., day and night, animal life cycles, plant life cycles).	**3.DA.3 The student will create models that can represent a physical object or process.** a. Create a model to represent a physical object or process. b. Identify how computing devices are used to create models. c. Discuss the advantages and disadvantages of using computing devices to create models.
2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Impacts of Computing**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Impacts of Computing (IC)**
3.14 The student will identify computing technologies that have changed the world and express how those technologies influence and are influenced by cultural practices.	**[Included in 3.IC.1]**
3.15 The student will identify 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).	**3.IC.1 The student will identify and examine the positive and negative impacts of the prevalence of computing technologies.** a. Identify computing technologies that have changed the world. b. Examine and explain how computing technologies influence and are influenced by culture. c. Identify social and ethical issues related to the use of computing technologies.
	3.IC.2 The student will identify and describe computing technology careers and their impact on society. a. Research computing technology careers.

	b. Describe the impact careers in computing technology have on society.
3.16 The student will identify social and ethical issues that relate to computing devices and networks.	**[Included in 3.IC.1]**
	3.IC.3 The student will demonstrate how to use information created by others with permission. a. Discuss copyright, piracy, and plagiarism. b. Demonstrate how to use information created by others.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Networks and the Internet**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Networks and the Internet (NI)**	
3.17 The students will discuss in partners and as a class that information can be transmitted using computing devices via a network (e.g., email, blogging, video messaging).	**3.NI.1 The student will describe computing networks.** a. Differentiate between a network and the Internet. b. Identify the components of a computing network. c. Describe how a computing device connects to a network. d. Identify ways networks are used to transmit information.	

Draft 2024 Grade 3 Computer Science SOL – Summary of Changes

Grade 3 (2017 SOL to 2024 SOL Numbering)
• 3.1 → [Included in 3.AP.2]] • 3.2 → 3.AP.2 • 3.3 → 3.AP.3 • 3.4 → [Included in 3.AP.2] • 3.5 → [Moved to Grade 2. Refer to 2.AP.1] • 3.6 → [Included in 3.AP.1] • 3.7 → [Included in 3.IC.3] • 3.8 → 3.CSY.1 • 3.9 → 3.CSY.2 • 3.10 → [Included in 3.CYB.3] • 3.11 → [Included in 3.CYB.1] • 3.12 → 3.DA.1 • 3.13 → 3.DA.3 • 3.14 → [Included in 3.IC.1] • 3.15 → 3.IC.1 • 3.16 → [Included in 3.IC.1] • 3.17 → 3.NI.1

Deletions from Grade 3 (2017 SOL)	Additions to Grade 3 (2024 SOL)
• 3.5 – Compare and contrast a group of items based on attributes or actions classified into at least two sets and two subsets [Moved to Grade 2. Refer to 2.AP.1]	• 3.AP.1 - The student will apply computational thinking to design algorithms to extend patterns, processes, or components of a problem. • 3.CYB.1 - The student will apply safe practices to protect private information. • 3.CYB.2 - The student will identify the relationship between passwords and security risk. • 3.CYB.3 -The student will define and explain cybersecurity. • 3.DA.2 - The student will create and evaluate data representations and conclusions. • 3.IC.2 - The student will identify and describe computing technology careers and their impact on society. • 3.IC.3 - The student will demonstrate how to use information created by others with permission.

KEY: AP = Algorithms & Programming; ; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 4 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to identify patterns and design algorithms to compare and contrast multiple algorithms used for the same task
- Plan and implement algorithms that consist of sequencing, loops, variables, user input, and conditional control structures using a block-based programming language
- Use the iterative design process to create, test, and debug programs containing sequencing, loops, variables, user inputs, and conditional control structures in a block-based programming tool

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Model how a computing system works to accomplish a task
- Apply troubleshooting strategies when a computing system is not working as intended
- Identify machine learning approaches that enable a computer to learn from experiences

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Examine the impacts of appropriate and inappropriate use of computing technologies
- Identify and investigate best practices to safeguard information shared online and through online platforms
- Examine how information is shared online and explain the importance of cybersecurity

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Identify the appropriate type of data needed to solve a problem or answer a question
- Create and evaluate data representations to make predictions and conclusions
- Create a computational model that represents attributes and behaviors associated with a concept

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Identify and examine the positive and negative impacts of the prevalence of computing technologies
- Examine the impact of computing technologies in the workforce
- Describe the importance of copyrights and intellectual property rights

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Identify the interrelationship between computing devices and a computing network

Comparison of Grade 4 Computer Science *Standards of Learning* – 2017 to 2024

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Algorithms and Programming**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Algorithms and Programming (AP)**
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).	**[Included in 4.AP.2]**
	4.AP.1 The student will apply computational thinking to identify patterns and design algorithms to compare and contrast multiple algorithms used for the same task. a. Decompose an algorithm, process, or problem into a subset of smaller problems. b. Identify multiple algorithms for the same task. c. Describe patterns within multiple algorithms. d. Determine which algorithm is most effective for a given task.
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.	**4.AP.2 The student will plan and implement algorithms that consist of sequencing, loops, variables, user input, and conditional control structures using a block-based programming language.** a. Identify user input and its role in improving a program. b. Describe the concept of a variable. c. Read and explain a design document to trace and predict an algorithm using plain language, pseudocode, or diagrams. d. Create a design document to plan an algorithm using plain language, pseudocode, or diagrams. e. Write programs that initialize, assign values to, name, and modify variables.
4.3 The student will analyze, correct, and improve (debug) an algorithm that includes sequencing, events, loops and variables.	**4.AP.3 The student will use the iterative design process to create, test, and debug programs containing sequencing, loops, variables,**

	user inputs, and conditional control structures in a block-based programming tool. a. Create and test programs that consist of sequencing, loops, variables, user inputs, and conditional control structures. b. Create and use variables to store and process data. c. Trace and predict the value of variables that change over the course of the program's runtime. d. Analyze and describe program results to assess validity of outcomes. e. Revise and improve programs to resolve errors or produce desired outcomes.
4.4 The student will create a plan as part of the iterative design process, both independently and collaboratively using strategies such as pair programming (e.g., storyboard, flowchart, pseudocode, story map).	**[Included in 4.AP.2]**
4.5. The student will classify and arrange a group of items based on the attributes or actions.	**[Moved to Grade 2. Refer to 2.AP.1]**
4.6 The student will break down (decompose) a larger problem into smaller sub-problems, both independently and collaboratively.	**[Included in 4.AP.1]**
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).	**[Included in 4.IC.3]**

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Computing Systems**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Computing Systems (CSY)**
4.8 The student will model how a computing system works including input and output, processors, and sensors.	**4.CSY.1 The student will model how a computing system works to accomplish a task.** a. Describe how computing systems perceive the world through sensors and other inputs. b. Compare and contrast how humans and computers process information from inputs. c. Explain how computing devices may be used to classify and organize input. d. Diagram and describe a simple computing system indicating processors, inputs, and outputs.

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).	**4.CSY.2 The student will apply troubleshooting strategies when a computing system is not working as intended.** a. Identify hardware, software, and connectivity problems using accurate terminology. b. Apply troubleshooting strategies to address hardware, software, and connectivity problems.
	4.CSY.3 The student will identify machine learning approaches that enable a computer to learn from experiences. a. Identify machine learning approaches: supervised, unsupervised, and reinforcement learning. b. Discuss the role of training data used for machine learning. c. Evaluate how training data is used to make classification predictions.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Cybersecurity**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Cybersecurity (CYB)**
4.10 The student will identify and explain problems that relate to inappropriate use of computing devices and networks.	**4.CYB.1 The student will examine the impacts of appropriate and inappropriate use of computing technologies.** a. Examine and explain scenarios for appropriate and inappropriate use of computing technologies. b. Develop possible solutions involving inappropriate use of computing technologies.
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.	**4.CYB.2 The student will identify and investigate best practices to safeguard information shared online and through online platforms.** a. Classify personal, private, and public information. b. Research and evaluate tradeoffs of sharing information. c. Investigate and communicate best practices to limit unauthorized access to information on a computing device. d. Demonstrate proper use and protection of personal passwords.
	4.CYB.3 The student will examine how information is shared online and explain the importance of cybersecurity. a. Investigate multiple ways people share information online. b. Determine and describe when information should be shared and to whom it should be shared.

	c. Describe how personal information can be collected and shared online. d. Explain the importance of cybersecurity.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Data and Analysis (DA)**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Data and Analysis (DA)**
4.12 The student will use a computer to observe, analyze, and manipulate data in order to draw conclusions and make predictions.	**[Included in 4.DA.2]**
	4.DA.1 The student will identify the appropriate type of data needed to solve a problem or answer a question. a. Analyze a problem to determine the appropriate type of data needed. b. Evaluate the reliability of data sources. c. Use numeric values to represent non-numeric ideas to include binary, American Standard Code for Information Interchange (ASCII), and RGB values. d. Collect, store, clean, and organize data for analysis and to prepare visualizations.
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).	**[Included in 4.DA.3]**
4.14 The student will use numeric values to represent non-numeric ideas in the computer (binary, ASCII, pixel attributes such as RGB).	**[Included in 4.DA.1]**
	4.DA.2 The student will create and evaluate data representations to make predictions and conclusions. a. Formulate questions that require the collection or acquisition of data. b. Collect data to create charts and graphs. c. Recognize and analyze patterns and relationships within data sets. d. Analyze visual representations to make predictions and draw conclusions.
	4.DA.3 The student will create a computational model that represents attributes and behaviors associated with a concept.

	a. Examine models of physical objects and processes. b. Create a computational model that reflects the attributes and behaviors associated with a concept. c. Explain how a computer model illustrates a given concept.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Impacts of Computing**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Impacts of Computing (IC)**
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.	**4.IC.1 The student will identify and examine the positive and negative impacts of the prevalence of computing technologies.** a. Identify computing technologies that have change the world. b. Examine and explain how computing technologies influence and are influenced by culture. c. Identify social and ethical issues related to computing devices and networks.
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).	**[Included in 4.IC.1]**
	4.IC.2 The student will examine the impact of computing technologies in the workforce. a. Research and analyze the skills needed for jobs in computing technology fields. b. Examine the impacts of diversity and inclusivity in computing technology fields.
	4.IC.3 The student will describe the importance of copyrights and intellectual property rights. a. Demonstrate an understanding of copyright and the fair use of information. b. Explain how intellectual property can be protected. c. Give proper attribution to the original author of digital and online content.
4.17 The student will describe social and ethical issues that relate to computing devices and networks.	**[Included in 4.IC.1]**

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Networks and the Internet**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Networks and the Internet (NI)**
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).	**4.NI.1 The student will identify the interrelationship between computing devices and a computing network.** a. Define client and server. b. Describe how packets are used to transmit information on a network. c. Describe factors that may affect the speed of data transmission. d. Differentiate between networking tasks that require Internet access and tasks that do not require Internet access. e. Model how computing devices in a network transmit and receive information.

Draft 2024 Grade 4 Computer Science SOL – Summary of Changes

Grade 4 (2017 SOL to 2024 SOL Numbering)
• 4.1 → [Included in 4.AP.2] • 4.2 → 4.AP.2 • 4.3 → 4.AP.3 • 4.4 → [Included in 4.AP.2] • 4.5 → [Moved to Grade 2. Refer to 2.AP.1] • 4.6 → [Included in 4.AP.1] • 4.7 → [Included in 4.IC.3] • 4.8 → 4.CSY.1 • 4.9 → 4.CSY.2 • 4.10 → 4.CYB.1 • 4.11 → 4.CYB.2 • 4.12 → [Included in 4.DA.2] • 4.13 → [Included in 4.DA.3] • 4.14 → [Included in 4.DA.1] • 4.15 → 4.IC.1 • 4.16 → [Included in 4.IC.1] • 4.17 → [Included in 4.IC.1] • 4.18 → 4.NI.1

Deletions from Grade 4 (2017 SOL)	Additions to Grade 4 (2024 SOL)
• 4.5 - Classify and arrange a group of items based on the attributes or actions. [Moved to Grade 2. Refer to 2.AP.1]	• 4.AP.1 - The student will apply computational thinking to identify patterns and design algorithms to compare and contrast multiple algorithms used for the same task. • 4.CSY.3 - The student will identify machine learning approaches that enable a computer to learn from experiences. • 4.CYB.3 -The student will examine how information is shared online and explain the importance of cybersecurity. • 4.DA.1 - The student will identify the appropriate type of data needed to solve a problem or answer a question. • 4.DA.2 -The student will create and evaluate data representations to make predictions and conclusions. • 4.IC.2 -The student will examine the impact of computing technologies in the workforce.

	• 4.IC.3 - The student will describe the importance of copyrights and intellectual property rights.

KEY: AP = Algorithms & Programming; ; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 5 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to identify patterns, make use of decomposition to break down problems or processes into sub-components, and design algorithms
- Plan and implement algorithms that consist of sequencing, loops, variables, user input, and nested conditional control structures using a block-based programming language
- Use the iterative design process to create, test, and debug programs containing sequencing, loops, variables, user inputs, nested conditional control structures, and two-way branching conditional control structures in a block-based programming tool

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Explain how computing systems are used to collect and exchange data
- Describe automated decision-making process employed by a computing system
- Evaluate and implement troubleshooting strategies when a computing system is not operational

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Identify ways to limit unauthorized access on computing devices
- Explain how cybersecurity policies and laws are designed to protect individuals

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Collect data or use data sets to solve a problem or investigate a topic
- Create multiple data representations to make predictions and conclusions

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Analyze the impact of inappropriate use of computing technologies
- Identify the impact of computing technologies on the workforce, culture, and global society
- Observe and examine intellectual property rights when considering the use of open-source licenses and copyrights
- Examine the effects of social interactions due to computing technologies

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Identify and describe cloud computing

Comparison of Grade 5 *Computer Science Standards of Learning* – 2017 to 2024

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Algorithms and Programming**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Algorithms and Programming (AP)**
5.1 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; d. performing number calculations on variables (addition, subtraction, multiplication and division); and e. using conditionals (if-statements).	**[Included in 5.AP.2]**
5.2 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; d. using mathematical operations (addition, subtraction, multiplication and division) variable to manipulate a variable; and e. using conditionals (if-statements).	**5.AP.2 The student will plan and implement algorithms that consist of sequencing, loops, variables, user input, and nested conditional control structures using a block-based programming language.** a. Describe the concept of nested conditional control structure. b. Create a design document to trace and predict an algorithm using plain language, pseudocode, or diagrams. c. Read, write, and interpret nested conditional control structures: “if -else” and “if-else; if-else" statements.
5.3 The student will analyze, correct, and improve (debug) an algorithm that includes sequencing, events, loops, conditionals, and variables.	**5.AP.3 The student will use the iterative design process to create, test, and debug programs containing sequencing, loops, variables, user inputs, nested conditional control structures, and two-way branching conditional control structures in a block-based programming tool.** a. Use accurate terminology to describe and explain the iterative design process. b. Create and test programs that consist of sequencing, loops, variables, user inputs, nested conditional control structures, and two-way branching conditional control structures. c. Trace and predict outcomes of programs. d. Analyze and describe program results to assess validity of outcomes. e. Revise and improve programs to resolve errors or produce desired outcomes.

5.4 The student will create a plan as part of the iterative design process, both independently and collaboratively using different strategies (e.g., pair programming, storyboard, flowchart, pseudocode, story map).	**[Included in 5.AP.2]**
5.5 The student will break down (decompose) a larger problem into smaller sub-problems, both independently and collaboratively.	**[Included in 5.AP.1]**
5.6 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).	**[Moved to Grade 4. Refer to 4.IC.3]**
	5.AP.1 The student will apply computational thinking to identify patterns, make use of decomposition to break down problems or processes into sub-components, and design algorithms. a. Identify patterns and repeated steps in an algorithm, problem, or process. b. Decompose a problem or process into a subset of smaller problems or groups of sequential instructions. c. Abstract relevant information to identify essential details. d. Design an algorithm to solve a problem.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Computing Systems**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Computing Systems (CSY)**
5.7 The student will model how a computing system works including input and output, processors, sensors, and storage.	**5.CSY.1 The student will explain how computing systems are used to collect and exchange data.** a. Identify and explain how computing systems store data representations, including images and sound. b. Describe the role of processing speed and storage capacity when collecting and exchanging data.
5.8 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 network availability, closing and reopening an app.).	**5.CSY.3 The student will evaluate and implement troubleshooting strategies when a computing system is not operational.** a. Identify and use troubleshooting protocols to resolve hardware, software, and connectivity issues. b. Apply prior troubleshooting practices to new problems as they arise.

	5.CSY.2 The student will describe an automated decision-making process employed by a computing system. a. Explore decision automation and how it is used. b. List outcomes of a process based on automated decisions.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Cybersecurity**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Cybersecurity (CYB)**
5.9 The student will evaluate and solve problems that relate to inappropriate use of computing devices and networks.	**5.CYB.1 The student will identify ways to limit unauthorized access on computing devices.** a. Define virus, malware, and phishing. b. Explain how viruses and malware can put personal information at risk. c. Explain the role of human interactions in social engineering attacks. d. Identify ways to protect personal and private information when using a computing device and the Internet. e. State the importance of doing updates on software.
5.10 The student will determine whether passwords are strong, explain why strong passwords should be used, and demonstrate proper use and protection of personal passwords.	**[Moved to Grade 4. Refer to 4.CYB.2]**
	5.CYB.2 The student will explain how cybersecurity policies and laws are designed to protect individuals. a. Explain the importance of policies and laws related to online use of computing devices and the Internet. b. Research and discuss current cybersecurity policies and laws that protect individuals. c. Explain legal consequences for inappropriate use of computing technologies.
	5.CYB.3 The student will explain how cybersecurity policies and laws are designed to protect individuals. a. Explain the importance of policies and laws related to online use of computing devices and the Internet. b. Research and discuss current cybersecurity policies and laws that protect individuals. c. Explain legal consequences for inappropriate use of computing technologies.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Data and Analysis**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Data and Analysis (DA)**
5.11 The student will use a computer to observe, analyze, and manipulate data in order to draw conclusions and make predictions.	**5.DA.1 The student will collect data or use data sets to solve a problem or investigate a topic.** a. Identify accurate ways data can be collected. b. Evaluate reliability of data source. c. Organize data based on similarities or patterns. d. Compare and contrast various data elements.
5.12 The student will create an artifact using computing systems to model the attributes and behaviors associated with a concept (e.g., plate tectonics).	**[Included in 5.IC.4]**
	5.DA.2 The student will create multiple data representations to make predictions and conclusions. a. Formulate questions that require the collection or acquisition of data. b. Collect data to use in creating charts, graphs, and models. c. Analyze data as evidence to draw conclusions and make predictions. d. Propose solutions to problems or questions based on data analysis.
5.13 The student will use numeric values to represent non-numeric ideas in the computer (e.g., binary, ASCII, pixel attributes such as RGB).	**[Moved to Grade 4. Refer to 4.DA.1]**
2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Impacts of Computing**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Impacts of Computing (IC)**
5.14 The student will give examples and explain how computer science has changed the world and express how computing technologies influence, and are influenced by, cultural practices.	**[Included in 5.IC.4]**
5.15 The student will evaluate and 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).	**5.IC.2 The student will identify the impact of computing technologies on the workforce, culture, and global society.** a. Research and analyze computing technology careers in global society.

	b. Examine the impacts of diversity and inclusivity in computing technology fields globally.
	5.IC.3 The student will observe and examine intellectual property rights when considering the use of open-source licenses and copyrights. a. Distinguish between open-source licenses and copyrights. b. Research risks associated with inappropriate use of various digital information sources. c. Describe and use strategies to protect online digital content and resources.
5.16 The student will explain social and ethical issues that relate to computing devices and networks.	**[Included in 5.IC.4]**
	5.IC.1 The student will analyze the impact of inappropriate use of computing technologies. a. Predict consequences for inappropriate uses of computing technologies. b. Describe how technology-related problems can be avoided or prevented. c. Develop solutions for a scenario involving inappropriate use of computing technologies.
	5.IC.4 The student will examine the effects of social interactions due to computing technologies. a. List and explain how advances in computing technologies impact communication and collaboration. b. Describe how computing technologies can be designed to engage and interact with users including those with diverse needs. c. Evaluate activities conducted in the physical and online environments. d. Create an artifact that illustrates a solution to address the need or want of a user.

2017 *Standards of Learning* Essential Knowledge and Skills (EKS) **Networking and the Internet**	**2024 *Standards of Learning*** Knowledge and Skills (KS) **Networking and the Internet (NI)**
5.17 The student will compare and contrast the difference between a local network and a worldwide network.	**[Moved to Grade 3. Refer to 3.NI.1]**
	5.NI.1 The student will identify and describe cloud computing. a. Define cloud computing. b. List examples of cloud computing. c. List the advantages and disadvantages of cloud computing. d. Identify safe practices and potential security risks when using cloud computing.

Draft 2024 Grade 5 Computer Science SOL – Summary of Changes

Grade 5 (2017 SOL to 2024 SOL Numbering)
• 5.1 → [Included in 5.AP.2] • 5.2 → 5.AP.2 • 5.3 → 5.AP.3 • 5.4 → [Included in 5.AP.2] • 5.5 → [Included in 5.AP.1] • 5.6 → [Moved to Grade 4. Refer to 4.IC.3] • 5.7 → 5.CSY.1 • 5.8 → 5.CSY.3 • 5.9 → 5.CYB.1 • 5.10 → [Moved to Grade 4. Refer to 4.CYB.2] • 5.11 → 5.DA.1 • 5.12 → [Included in 5.IC.4] • 5.13 → [Moved to Grade 4. Refer to 4.DA.1] • 5.14 → [Included in 5.IC.4] • 5.15 → 5.IC.2 • 5.16 → [Included in 5.IC.4] • 5.17 → [Moved to Grade 3. Refer to 3.NI.1]

Deletions from Grade 5 (2017 SOL)	Additions to Grade 5 (2024 SOL)
• 5.6 - 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) [Moved to Grade 4. Refer to 4.IC.3] • 5.10 - Determine whether passwords are strong, explain why strong passwords should be used, and demonstrate proper use and protection of personal passwords [Moved to Grade 4. Refer to 4.CYB.2] • 5.13 - Use numeric values to represent non-numeric ideas in the computer (e.g., binary, ASCII, pixel attributes such as RGB) [Moved to Grade 4. Refer to 4.DA.1] • 5.17 Compare and contrast the difference between a local network and a worldwide network [Moved to Grade 3. Refer to 3.NI.1]	• 5.AP.1 - The student will apply computational thinking to identify patterns, make use of decomposition to break down problems or processes into sub-components, and design algorithms. • 5.CSY.2 - The student will describe automated decision-making process employed by a computing system. • 5.CYB.2 - The student will explain how cybersecurity policies and laws are designed to protect individuals. • 5.CYB.3 - The student will explain how cybersecurity policies and laws are designed to protect individuals. • 5.DA.2 - The student will create multiple data representations to make predictions and conclusions. • 5.IC.1 - The student will analyze the impact of inappropriate use of computing technologies.

	• 5.IC.3 - The student will observe and examine intellectual property rights when considering the use of open-source licenses and copyrights. • 5.IC.4 - The student will examine the effects of social interactions due to computing technologies. • 5.NI.1 - The student will identify and describe cloud computing.

KEY: AP = Algorithms & Programming; ; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 6 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Identify patterns and make use of decomposition to break down problems or processes
- Plan and implement algorithms that include conditional control structures and collection of numeric data
- Use the iterative design process to create, test, and debug programs
- Demonstrate proper attribution when incorporating ideas and works of others.

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Define and explain application software and operating systems of a computing device within a computing system
- Identify and explain hardware, software, and connectivity problems and troubleshooting solutions
- Identify and describe intelligent agents

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Evaluate the risks and benefits associated with sharing personal and public resources or artifacts
- Investigate various usage agreements designed to protect individuals

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Utilize computational tools to collect and organize data
- Utilize computational tools to visualize and evaluate data
- Make predictions and draw conclusions from data visualizations

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Assess the impact of computing technologies on local society
- Explore career pathways and identify how computer science and computational thinking practices align with these pathways
- Identify copyrighted or licensed software material
- Describe the impacts of computing network architecture, including the role of the Internet in society
- Describe and analyze the impact on industries of the advancement of AI technologies

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Explain the advantages and disadvantages of transmitting information over the Internet

Comparison of Grade 6 Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming	2024 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming (AP)
6.1 The student will construct programs to accomplish a task as a means of creative expression or scientific exploration using a block based or text based programming language, both independently and collaboratively, a. Combining control structures such as if-statement and loops; b. Creating clearly named variables that represent different data types, including numeric and non-numeric data, and perform operations on their values.	**6.AP.2 The student will plan and implement algorithms that include conditional control structures and collection of numeric data using a block-based or text-based tool.** a. Create a decision tree diagram to illustrate the decision-making process. b. Read and write programs that initialize Boolean, integer, and decimal number variables. c. Read and write programs that collect numeric data from users. d. Read and write programs that contain nested conditional control structures. e. Predict the results of logic expressions that use Boolean operators: and, or, and not; including expressions that use relational expressions as one or more operands.
6.2 The student will trace programs to predict outcomes and debug (correct and improve) for correctness.	**6.AP.3 The student will use the iterative design process to create, test, and debug programs using a block-based or text-based programming language.** a. Create and test programs that uses multiple conditional control structures. b. Incorporate existing code, media, or libraries into original programs c. Trace and predict outcomes of programs. d. Analyze and describe program results to assess validity of outcomes. e. Analyze the outcomes of programs to identify logic and syntax errors. f. Incorporate feedback from others to refine program. g. Revise and improve programs to resolve errors and produce desired outcomes.

6.3 The student will seek and incorporate feedback from team members and users to refine a program that meets user needs.	**[Included in 6.AP.3]**
6.4 The student will incorporate existing code, media, and libraries into original programs, and give attribution.	**[Included in 6.AP.3]**
	6.AP.1 The student will apply computational thinking to identify patterns, make use of decomposition to break down problems or processes into sub-components, and design algorithms. a. Identify patterns and repeated steps in an algorithm, problem, or process. b. Decompose an algorithm, problem, or process into sub-components. c. Abstract relevant information to identify essential details. d. Design algorithms using abstraction to accomplish a task or express a computational process.
	6.AP.4 The student will demonstrate proper attribution when incorporating ideas and works of others. a. Identify and give proper attribution of information and assets from the Internet and other sources.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems (CSY)**
6.5 The student will design projects that combine hardware and software components to collect and exchange data.	**[Moved to Grade 7. Refer to 7.CSY.1]**
	6.CSY.1 The student will define and explain application software and operating systems of a computing device within a computing system. a. Define and describe the functions of an operating system and application software. b. List advantages and limitations of application software and operating systems based on the needs of the user.
	6.CSY.2 The student will identify and explain hardware, software, and connectivity problems and troubleshooting solutions. a. Identify and explain hardware, software, and connectivity problems and solutions with accurate terminology. b. Identify resources for troubleshooting hardware, software, and connectivity related problems.

	6.CSY.3 The student will identify and describe intelligent agents. a. Define intelligent agents and identify the characteristics of an intelligent agent. b. Describe how intelligent agents obtain knowledge and interact with people.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity (CYB)**
6.6 The student will identify physical and digital security measures used to protect electronic information.	**[Moved to Grade 5. Refer to 5.CYB.1]**
	6.CYB.1 The student will evaluate the risks and benefits associated with sharing personal and public resources or artifacts. a. Identify and explain the difference between personal and public information. b. Discuss the consequences of sharing personal and confidential information online. c. Evaluate risks and benefits associated with sharing information online.
	6.CYB.2 The student will investigate various usage agreements designed to protect individuals. a. Identify laws governing privacy with computing devices and emerging technologies. b. Investigate and describe common components of usage agreements. c. Identify user and company protections in a usage agreement.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Data and Analysis	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Data and Analysis (DA)**
6.7 The student will explain how binary sequences are used to represent digital data. *Exclusion: Conversions between binary and base-ten numbers are beyond the scope of these standards.*	**[Moved to Grade 4. Refer to 4.DA.1]**
6.8 The student will collect data using computational tools then clean and organize to make it more useful and reliable.	**6.DA.1 The student will utilize computational tools to collect and organize data.** a. Select and use appropriate computational tools to collect data.

	b. Organize data to make it easier to understand and use. c. Clean data to remove and correct errors. d. Analyze data sources for accuracy and reliability.
6.9 The student will explain the insight and knowledge gained from digitally processed data by using appropriate visualizations.	**6.DA.2 The student will utilize computational tools to visualize and evaluate data.** a. Identify different types of visual representations of data. b. Compare various visual representations and identify when each should be used. c. Create charts, graphs, models, and simulations to visualize data. d. Describe and synthesize information from a visual representation of data.
6.10 The student will use models and simulations to formulate, refine, and test hypotheses.	**6.DA.3 The student will make predictions and draw conclusions from data visualizations.** a. Visualize data using appropriate graphs, charts, and data visualization techniques to enhance understanding and communicate findings effectively. b. Use computational tools to analyze patterns within data sets and identify trends. c. Draw conclusions and make predictions based on the analysis and interpretation of the data visualization. d. Utilize simulations and models to formulate, refine, and test hypotheses.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing (IC)**
6.11 The student will explain how computing has impacted innovations in other fields.	**6.IC.1 The student will assess the impact of computing technologies on local society.** a. Explain how computing impacts innovation. b. Discuss how computing technologies have influenced various industries and sectors locally. c. Research simple and complex problems that computing systems can be used to solve. d. Analyze the implications of emerging technologies and potential real-world impact in the local community.

6.12 The student will explore careers related to data.	**6.IC.2 The student will explore career pathways and identify how computer science and computational thinking practices align with these pathways.** a. Investigate a career of interest and determine how computer science and computational thinking practices are used in the chosen career.
	6.IC.3 The student will identify copyrighted or licensed software material. a. Identify the roles of software licenses, including open-source software licenses, and why they are used. b. Compare and contrast the positives and negatives of various software licenses.
	6.IC.4 The student will describe the impacts of computing network architecture, including the role of the Internet in society. a. Discuss ethical issues and laws related to accessibility, censorship, privacy, access, and safety while using the Internet. b. Explain the role broadband connectivity has in social life, culture, and global economy.
	6.IC.5 The student will describe and analyze the impact on industries of the advancement of AI technologies. a. Discuss the type of industries that may be impacted by the use and integration of Artificial Intelligence (AI). b. Compare and contrast the evolving nature of work across diverse industries because of the progression and advancement of Artificial Intelligence.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Networking and the Internet	2024 Standards of Learning Essential Knowledge and Skills (EKS) Networking and the Internet (NI)
6.13 The student will explain why the speed of data transmission across the Internet can vary depending on the type of data being transmitted.	**6.NI.1 The student will outline the advantages and disadvantages of transmitting information over the Internet, including speed, reliability, cost, and security.** a. Explain the role of Internet in social life, culture, and the economy. b. Explain data transfer and the impact of connectivity speed when data is going from one device to another.

	c. Compare the speed and reliability of various data transmission media. d. Describe the advantages and disadvantages of transporting information over the Internet.

Draft 2024 Grade 6 Computer Science SOL – Summary of Changes

Grade 6 (2017 SOL to 2024 SOL Numbering)
• 6.1 → 6.AP.2 • 6.2 → 6.AP.3 • 6.3 → [Included in 6.AP.3] • 6.4 → [Included in 6.AP.3] • 6.5 → [Moved to Grade 7. Refer to 7.CSY.1] • 6.6 → [Moved to Grade 5. Refer to 5.CYB.1] • 6.7 → [Moved to Grade 4. Refer to 4.DA.1] • 6.8 → 6.DA.1 • 6.9 → 6.DA.2 • 6.10 → 6.DA.3 • 6.11 → 6.IC.1 • 6.12 → 6.IC.2 • 6.13 → 6.NI.1

Deletions from Grade 6 (2017 SOL)	Additions to Grade 6 (2024 SOL)
• 6.5 - The student will design projects that combine hardware and software components to collect and exchange data. • 6.6 - The student will identify physical and digital security measures used to protect electronic information. [Moved to 5.CYB.1] • 6.7 - The student will explain how binary sequences are used to represent digital data. *Exclusion: Conversions between binary and base-ten numbers are beyond the scope of these standards.* [Moved to 4.DA.1]	• 6.AP.1 - The student will apply computational thinking to identify patterns, make use of decomposition to break down problems or processes into sub-components, and design algorithms. • 6.AP.4 - The student will apply proper methods of attribution when incorporating other sources into original work. • 6.CSY.1 - The student will define and explain application software and operating systems of a computing device within a computing system. • 6.CSY.2 - The student will identify and explain hardware, software, and connectivity problems and troubleshooting solutions. • 6.CSY.3 - The student will identify and describe intelligent agents. • 6.IC.3 - The student will identify copyrighted or licensed software material. • 6.IC.4 - The student will describe the impacts of computing network architecture, including the role of the Internet in society. • 6.IC.5 - The student will describe and analyze the impact on industries of the advancement of AI technologies.

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Grade 7 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to design programs to accomplish a task as a means of creative expression or scientific exploration
- Plan and implement algorithms that include sequencing, loops, variables, user input, conditional control structures, and functions
- Use the iterative design process to create, test, and debug programs
- Apply proper methods of attribution when incorporating other sources into original work

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Design projects that use computing devices to collect and exchange data
- Apply computational thinking to troubleshoot and document hardware and software-related problems.

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Differentiate physical and digital security measures that protect electronic information

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Compare and contrast data collection methods conducted by people and computing technologies
- Utilize computational tools to visualize and evaluate data to draw conclusions and make predictions

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Assess the national and global impact of computing technologies

- Identify individual preferences, skillsets, and experiences and determine how these relate to a chosen computer science career field
- Identify and apply strategies to prevent personal and public works from being pirated and plagiarized
- Evaluate the effect of Artificial Intelligence (AI) in various professions

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Describe and explain why protocols are essential in data transmission

Comparison of Grade 7 Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming	2024 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming (AP)
7.1 The student will construct programs to accomplish a task as a means of creative expression or scientific exploration using a block based or text based programing language, both independently and collaboratively, a. Combining control structures such as if-statements and loops including compound conditionals; and b. Creating clearly named variables that represent different data types, including numeric and non-numeric data, and perform operations on their values.	**7.AP.2 The student will plan and implement algorithms that include sequencing, loops, variables, user input, conditional control structures, and functions using a block-based or text-based programming tool.** a. Describe the concept of functions for use in a computer program. b. Plan an algorithm using plain language, pseudocode, or diagrams. c. Read and write programs that collect and use numeric and text data from users. d. Read and write programs that contain nested conditionals and nested loops.
7.2 The student will document programs to make them easier to follow, test, and debug.	**7.AP.3 The student will use the iterative design process to create, test, and debug programs using a block-based or text-based programming language.** a. Create and test programs that contain multiple control structures. b. Trace and predict outcomes of programs. c. Analyze the outcomes of programs to identify logic and syntax errors. d. Analyze and describe the results of a program to assess validity of outcomes. e. Revise and improve an algorithm to resolve errors or produce desired outcomes.
7.3 The student will distribute tasks and maintain a project timeline when collaboratively developing computational artifacts.	**[Included in 7.CSY.1]**
7.4 The student will decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.	**[Included in 7.AP.1]**
	7.AP.1 The student will apply computational thinking to design programs to accomplish a task as a means of creative expression or scientific exploration.

	a. Identify patterns and repeated steps in an algorithm, problem, or process. b. Decompose an algorithm, problem, or process into sub-components. c. Abstract relevant information to identify essential details. d. Contrast various algorithms to solve reasoning problems when accomplishing a task.
	7.AP.4 The student will apply proper attribution when incorporating other sources into original work. a. Apply proper methods of attribution when using work from the Internet and other sources. b. Incorporate information or assets from the Internet into a program with proper attribution.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems (CSY)**
7.5 The student will describe how the Internet connects devices and networks all over the world. *Exclusion: Specific devices used to implement the Internet are beyond the scope of these standards.*	**[Moved to Grade 3. Refer to 3.NI.1]**
	7.CSY.1 The student will design and create projects that use computing devices to collect and exchange data. a. Apply project management skills to distribute tasks and maintain project timelines. b. Generate ideas combining hardware and software components that can be used to collect and exchange data. c. Describe how hardware and software can be used together to collect and exchange data. d. Evaluate the usability of hardware and software to collect and exchange data. e. Select the hardware and software components for project designs by considering factors such as functionality, cost, size, speed, accessibility, and aesthetics.
	7.CSY.2 The student will apply computational thinking to troubleshoot and document hardware and software-related problems. a. Apply systematic processes to resolve hardware, software, and connectivity-related problems.

	b. Compile and record successful methods used to resolve problems for common hardware, software, and connectivity-related problems.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity	2024 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity (CYB)
7.6 The student will describe how physical and digital security measures protect electronic information.	**7.CYB.1 The student will differentiate physical and digital security measures that protect electronic information.** a. Compare and contrast physical and digital security measures. b. Research and synthesize the tradeoffs between usability and security. c. Identify common threats and vulnerabilities associated with Internet use and Internet-based systems. d. Identify potential solutions to address common threats and vulnerabilities.
7.7 The student will identify existing cybersecurity concerns associated with Internet use and Internet-based systems and potential options to address these issues.	**[Included into 7.CYB.1]**

2017 Standards of Learning Essential Knowledge and Skills (EKS) Data and Analysis	2024 Standards of Learning Essential Knowledge and Skills (EKS) Data and Analysis (DA)
7.8 The student will discuss the correctness of a model representing a system by comparing the model's generated results with data that were observed in the system being modeled.	**[Included in 7.DA.2]**
7.9 The student will refine computational models based on the data they have generated.	**7.DA.2 The student will utilize computational tools to visualize and evaluate data to draw conclusions and make predictions.** a. Develop computational models that simulate real-world phenomena, considering relevant variables and relationships. b. Refine and modify computational models based on observed data and feedback, ensuring alignment with empirical evidence. c. Analyze patterns and trends within observed data, comparing them with the predictions made by computational models. d. Evaluate the effectiveness and accuracy of computational models in capturing and explaining the observed data.

	7.DA.1 The student will compare and contrast data collection methods conducted by people and computing technologies. a. Define and describe machine learning. b. Compare and contrast how people and computing technologies collect, store, and process data. c. Identify similarities and differences on how people and computing technologies infer and extract meaning from data. d. Describe supervised, unsupervised, and reinforcement learning. e. Identify how machines make inferences and decisions from labeled and unlabeled data. f. Create and use training data to explore the decision-making process of machine learning. g. Evaluate the use of data and potential consequences based on the distorted results.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing (IC)**
7.10 The student will explain how advances in technology have contributed to Virginia's prosperity and role in the global economy.	**7.IC.1 The student will assess the national and global impact of computing technologies.** a. Discuss specific examples of how computing technologies have influenced various national and global industries and sectors. b. Analyze the implications of emerging technologies and potential real-world impact on our nation and worldwide. c. Evaluate the environmental impact of computing and technologies nationally and globally.
7.11 The student will describe the development of new technologies in communication, entertainment, and business and their impact on American life.	**[Moved to Grade 6. Refer to 6.IC.1]**
7.12 The student will explore careers related to the Internet.	**7.IC.2 The student will identify individual preferences, skillsets, and experiences and determine how these relate to a chosen computer science career field.** a. Use a career interest assessment to identify and categorize preferences, skillsets, and experiences. b. Evaluate and connect personal skillsets, interests, talents, and values to a computer science career.

	7.IC.3 The student will identify and apply strategies to prevent personal and public works from being pirated and plagiarized. a. Discuss and describe intellectual property protections. b. Research and list safeguards used to prevent intellectual property infringement.
	7.IC.4 The student will evaluate the effect of Artificial Intelligence (AI) in various professions. a. Examine and analyze the impact of job creation and changes in employment needs based on the use of AI. b. Explain the positive and negative effects of the implementation of AI technologies in various professions.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Networking and the Internet	**2024 Standards of Learning Essential Knowledge and Skills (EKS) Networking and the Internet (NI)**
7.13 The student will outline the advantages and disadvantages of transmitting information over the Internet, including speed, reliability, cost, and security.	**[Moved to Grade 6. Refer to 6.NI.1]**
7.14 The student will explain why protocols are necessary in data transmission. Model the role of protocols in transmitting data across networks and the Internet.	**7.NI.1 The student will describe and explain why protocols are essential in data transmission.** a. Define packet, router, and protocol. b. Describe the process of sending a file through a network. c. Explain the role of IP addresses in transmitting information. d. Explain how packets ensure reliable communication among computing devices. e. Model how data is transmitted over networks and the Internet.
7.15 The student will model how information is broken down into smaller pieces, transmitted as packets through multiple devices over networks and the Internet, and reassembled at the destination.	**[Included in 7.NI.1]**

Draft 2024 Grade 7 Computer Science SOL – Summary of Changes

Grade 7 (2017 SOL to 2024 SOL Numbering)
• 7.1 → 7.AP.2 • 7.2 → 7.AP.3 • 7.3 → [Included in 7.CSY.1] • 7.4 → [Included in 7.AP.1] • 7.5 → [Moved to Grade 3. Refer to 3.NI.1] • 7.6 → [Included in 7.CYB.1] • 7.7 → [Included in 7.CYB.1] • 7.8 → [Included in 7.DA.2] • 7.9 → 7.DA.2 • 7.10 → 7.IC.1 • 7.11 → [Moved to Grade 6. Refer to 6.IC.1] • 7.12 → 7.IC.2 • 7.13 → [Moved to Grade 6. Refer to 6.NI.1] • 7.14 → 7.NI.1 • 7.15 → [Included in 7.NI.1]

Deletions from Grade 7 (2017 SOL)	Additions to Grade 7 (2024 SOL)
• 7.5 - The student will describe how the Internet connects devices and networks all over the world. [Moved to Grade 3. Refer to 3.NI.1] • 7.11 - The student will describe the development of new technologies in communication, entertainment, and business and their impact on American life. [Moved to Grade 3. Refer to 6.IC.1] • 7.13 - The student will outline the advantages and disadvantages of transmitting information over the Internet, including speed, reliability, cost, and security. [Moved to Grade 6. Refer to 6.NI.1]	• 7.AP.1- The student will apply computational thinking to design programs to accomplish a task as a means of creative expression or scientific exploration. • 7.AP.4 - The student will apply proper methods of attribution when incorporating other sources into original work. • 7.CSY.1 - The student will design and create projects that use computing devices to collect and exchange data. • 7.CSY.2 - The student will apply computational thinking to troubleshoot and document hardware and software-related problems. • 7.DA.1 - The student will compare and contrast data collection methods conducted by people and computing technologies. • 7.IC.3 - The student will identify and apply strategies to prevent personal and public works from being pirated and plagiarized. • 7.IC.4 - The student will evaluate the effect of Artificial Intelligence (AI) in various professions.

Grade 8 Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to construct programs to accomplish a task as a means of creative expression or scientific exploration
- Plan and implement algorithms that include sequencing, loops, variables, user input, conditional control structures, functions, and various data types
- Use the iterative design process to create, test, and debug programs using a block-based or text-based programming language
- Incorporate work from others into programs and projects

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Recommend and design improvements to computing devices based on the needs of various users
- Apply computational thinking to troubleshoot and document hardware and software related problems

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Investigate and describe ways to protect sensitive data from malware and other attacks
- Investigate and explain how physical and digital security measures can protect electronic information for businesses, governments, and organizations

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Create computational models to simulate events or represent phenomena
- Evaluate computational models to analyze patterns and make recommendations or predictions

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Assess the ethical impacts of computing technologies
- Identify opportunities for education, training, and preparation to enter into a chosen computer science career field

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Model and describe the role of computing devices in transmitting data in and on computing networks and the Internet

Comparison of Grade 8 Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming	2024 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming (AP)
8.1 The student will construct programs to accomplish a task as a means of creative expression or scientific exploration using a block based or text based programming language, both independently and collaboratively, a. Combining control structures such as if-statements and loops including nested conditionals and loops; b. Using clearly named variables that represent different data types, including numeric and non-numeric data, and perform operations on their values; and c. Create procedures with parameters.	**8.AP.2 The student will plan and implement algorithms that include sequencing, loops, variables, user input, conditional control structures, functions, and various data types.** a. Describe the concept of input and output of various data types for use in a computer program. b. Plan an algorithm using plain language, pseudocode, or diagrams. c. Write and test algorithms expressed using block-based or text-based programming languages.
8.2 The student will systematically test and refine programs using a range of test cases.	**8.AP.3 The student will use the iterative design process to create, test, and debug programs using a block-based or text-based programming language.** a. Create and test programs that contain multiple control structures. b. Trace and predict outcomes of programs. c. Analyze the outcomes of programs to identify logic and syntax errors. d. Analyze and describe the results of a program to assess validity of outcomes. e. Revise and improve algorithms to resolve errors or produce desired outcomes.
8.3 The student will explain how effective communication between participants is required for successful collaboration when developing programs.	**[Deleted]**
8.4 The student will use flowcharts and/or pseudocode to address complex programs as algorithms.	**[Included in 8.AP.1 and 8.AP.2]**
	8.AP.1 The student will apply computational thinking to construct programs to accomplish a task as a means of creative expression or scientific exploration. a. Identify patterns and repeated steps in an algorithm, problem, or process.

	b. Decompose an algorithm, problem, or process into sub-components. c. Abstract relevant information to identify essential details. d. Use pseudocode, decision tree diagrams or flowcharts to illustrate complex problems as algorithms.
	8.AP.4 The student will incorporate work from others into programs and projects. a. Explain the role of Creative Commons licensing for the use and modification or "remixing" of information. b. Utilize Creative Commons assets in a programming project. c. Use and remix code from other projects within a programming project and provide proper attribution.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems	2024 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems (CSY)
8.5 The student will, using the elements of computing devices such as primary memory, secondary storage, processor, input and output devices, and network connectivity, analyze the advantages and limitations of a given computing system.	**8.CSY.1 The student will recommend and design improvements to computing devices based on the needs of various users.** a. Analyze existing computing devices for advantages and limitations. b. Recommend and design improvements to computing devices based on user interactions.
	8.CSY.2 The student will apply computational thinking to troubleshoot and document hardware and software related problems. a. Apply systematic processes to resolve hardware, software, and connectivity related problems. b. Design an end-user document/guide to resolve hardware, software, and connectivity related problems.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity	2024 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity (CYB)
8.6 The student will evaluate physical and digital security measures used to protect electronic information.	**8.CYB.2 The student will investigate and explain how physical and digital security measures can protect electronic information for businesses, governments, and organizations.** a. Investigate and explain how physical and digital security measures are used to safeguard electronic information.

	b. Research the advantages and limitations of different security measures in protecting users against security threats.
8.7 The student will identify impacts of hacking, ransomware, scams, fake vulnerability scans, and the ethical and legal concerns involved. ***Exclusion: Students do not need to implement solutions.***	**8.CYB.1 The student will investigate and describe ways to protect sensitive data from malware and other attacks.** a. Identify impacts of hacking, ransomware, scams, phishing, fake vulnerability scans, and the ethical and legal concerns. b. Describe how cyber-attacks can affect a computing system. c. Compare and contrast safe and unsafe computing practices. d. Explore how industries and emerging technologies are addressing cyber solutions. e. Model common prevention practices for cyber-attacks.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Data and Analysis	2024 Standards of Learning Essential Knowledge and Skills (EKS) Data and Analysis (DA)
8.8 The student will **a. Explain the difference between a model and a simulation; and** **b. Create computational models to conduct simulations.**	**8.DA.1 The student will create computational models to simulate events or represent phenomena.** a. Compare and contrast the use of computational models and simulations to analyze patterns and replicate phenomena. b. Design and create complex computational models that simulate dynamic systems (abstraction), incorporating multiple variables and interactions. c. Refine computational models based on generated outcomes. **[Moved to Grade 6. Refer to 6DA.2 – 8.8a]**
	8.DA.2 The student will evaluate computational models to analyze patterns and make recommendations or predictions. a. Define data biases within a dataset and the unintended consequences that may impact data reliability and final analysis. b. Analyze patterns and interpret data generated by computational models and simulations, identifying meaningful patterns and relationships. c. Utilize data visualization techniques to communicate and present findings derived from computational models and simulations.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing	2024 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing (IC)
8.9 The student will describe tradeoffs between allowing information to be public and keeping information private.	**[Moved to Grade 4 and Middle School Elective. Refer to 4.CYB.2 and MSCSE-18.CYB.1]**
8.10 The student will evaluate online and print sources for appropriateness and credibility.	**[Included in 8.IC.1]**
8.11 The student will discuss the social impacts and ethical considerations associated with the field of cybersecurity.	**8.IC.1 The student will assess the social impacts and ethical considerations of computing technologies.** a. Analyze the impact of sharing data through computing technologies. b. Critique the role the Internet plays in social life, the global economy, and culture. c. Evaluate online and print sources for credibility and reliability. d. Research and discuss factors that impact access and availability to computing technologies. e. Discuss ethical issues around cybersecurity and networks: censorship, privacy, safety, and access.
8.12 The student will explore careers related to the field of cybersecurity.	**8.IC.2 The student will identify opportunities for education, training, and preparation to enter into a chosen computer science career field.** a. Identify an education and training plan for a chosen computer science career. b. Outline the use of computer science skills required in a chosen career. c. Develop short- and long-term goals for a chosen career. d. Research emerging trends in a chosen career path.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Networking and the Internet	2024 Standards of Learning Essential Knowledge and Skills (EKS) Networking and the Internet (NI)
8.13 The student will identify existing cybersecurity concerns associated with Internet use and Internet-based systems and potential options to address these issues.	**[Moved to Grade 7. Refer to 7.CYB.1]**
	8.NI.1 The student will model and describe the role of computing devices in transmitting data in and on computing networks and the Internet.

	a. Identify the roles of computing devices: routers, switches, servers, and clients communicating over a network. b. Design a network topology of computing devices. c. Demonstrate how data is transmitted over networks and the Internet. d. Analyze factors that strengthen or weaken network connectivity.

Draft 2024 Grade 8 Computer Science SOL – Summary of Changes

Grade 8 (2017 SOL to 2024 SOL Numbering)
• 8.1 → 8.AP.2 • 8.2 → 8.AP.3 • 8.3 → Deleted. • 8.4 → [Included in 8.AP.1 and 8.AP.2] • 8.5 → [8.CSY.1] • 8.6 → [8.CYB.2] • 8.7 → [Included in 8.CYB.1] • 8.8 → [8.DA.1 and 8.8a - Moved to Grade 6. Refer to 6DA.2] • 8.9 → [Moved to Grade 4 and Middle School Elective. Refer to 4.CYB.2 and MSCSE-18.CYB.1] • 8.10 → [Included in 8.IC.I] • 8.11 → [Included in 8.IC.I] • 8.12 → [Included in 8.IC.2] • 8.13 → [Moved to Grade 7. Refer to 7.CYB.1]

Deletions from Grade 8 (2017 SOL)	Additions to Grade 8 (2024 SOL)
• 8.3 - The student will explain how effective communication between participants is required for successful collaboration when developing programs. • 8.8 - The student will explain the difference between a model and a simulation [Moved to Grade 6. Moved to 6.DA.2] • 8.9 - The student will describe tradeoffs between allowing information to be public and keeping information private. [Moved to Grade 4 and Middle School Elective. Refer to 4.CYB.2 and MSCSE-18.CYB.1] • 8.13 - The student will identify existing cybersecurity concerns associated with Internet use and Internet-based systems and potential options to address these issues. [Moved to Grade 7. Refer to 7.CYB.1]	• 8.AP.1 - The student will apply computational thinking to construct programs to accomplish a task as a means of creative expression or scientific exploration. • 8.AP.4 - The student will incorporate work from others into programs and projects. • 8.CSY.2 - The student will apply computational thinking to troubleshoot and document hardware and software related problems. • 8.DA.2 - The student will evaluate computational models to analyze patterns and make recommendations or predictions**.** • 8.NI.1 - The student will model and describe the role of computing devices in transmitting data in and on computing networks and the Internet.

Middle School Computer Science Elective Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

9 Weeks

- Apply computational thinking to evaluate and solve a problem
- Use iterative design process to create a program
- Plan and implement algorithms that include loops, variables, user input, compound and nested conditional control structures and procedural definitions that accept parameters using block-based or text-based programming
- Use an interactive approach to trace, predict, test, and debug to improve existing programs and solve problems

18 Weeks

- Improve existing solutions to problems to create new programs
- Systematically use multiple test cases to verify the accuracy of a program
- Work collaboratively in an iterative design process to solve problems, including peer review and feedback
- Analyze solve and document a problem-solving process for others to duplicate the solution
- Investigate different coding languages

36 Weeks

- Develop a solution to a real-world problem using programming
- Decompose problems and subcomponents into parts to facilitate the design, implementation, and review of programs
- Design and create algorithms using a text-based programming language

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

9 Weeks

- Explore the structure, function, and interactions and interrelationships of hardware and software
- Implement solutions to problems with computing devices and their components

18 Weeks

- Design projects that utilize hardware and software components to collect and exchange data
- Assess how computers interact with humans, other computing systems, and the environment

36 Weeks

- Analyze user interaction with computing devices and propose design improvements.

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

9 Weeks

- Investigate ways to protect sensitive data from malware and other attacks

18 Weeks

- Analyze tradeoffs between the use of public, privilege, private, and personal information

36 Weeks

- Apply multiple methods of encryption and decryption to model the secure transmission of information

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

9 Weeks

- Collect data and use computational thinking practices to transform and manipulate data

18 Weeks

- Use pattern recognition, decomposition, and abstraction to create and refine models and programs based on the data they have generated

36 Weeks

- Utilize software tools and computer programs to create interactive data visualizations to analyze and better understand the real world

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

9 Weeks

- Examine the impact of computing technologies that affect daily life and society
- Explore careers that utilize computer science skills and practices in Virginia and globally

18 Weeks

- Examine relationships between historical advancements in computer science that influence the development of computing technologies
- Explore computer science related career pathways

36 Weeks

- Assess the societal, environmental, and ethical impacts, and tradeoffs of computing technologies

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

9 Weeks

- Explain that the Internet is a network of computing devices connected physically and/or wirelessly

18 Weeks

- Describe the role of computing devices in transmitting data in computing networks and the Internet

36 Weeks

- Analyze the role of computing devices and network architecture in transmitting data in computing networks and the Internet

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Comparison of MSCSE Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Essential Knowledge and Skills (EKS) 6 – Week Core Module	2024 Standards of Learning Knowledge and Skills (KS)
MSCSE.1 The student will design and iteratively develop programs that combine control structures, including loops and conditionals.	**MSCSE-9.AP.3 The student will plan and implement algorithms that include loops, variables, user input, compound and nested conditional control structures, and procedure definitions that accept parameters using block-based or text-based programming.** a. Read and interpret algorithms expressed using plain language, pseudocode, and block-based or text-based programming languages. b. Create an algorithm using plain language, pseudocode, or diagrams. c. Implement programs that accept input values, use variables, and produce output. d. Write and test algorithms using block-based or text-based programming languages.
MSCSE.2 The student will investigate variables and data types, including simple operations on strings.	**[Included in MSCSE-9.AP.3]**
MSCSE.3 The student will implement a program that accepts input values, stores them in appropriately named variables, and produces output.	**[Included in MSCSE-9.AP.3]**
MSCSE.4 The student will document programs in order to make them easier to trace, test, and debug.	**MSCSE-9.AP.4 The student will use an interactive approach to trace, predict, test, and debug to improve existing programs and solve problems.** a. Trace a program for accuracy. b. Analyze and describe the results of a program for validity. c. Revise and improve an algorithm to resolve errors or produce desired outcomes. d. Document programs to make them easier to trace, test, and debug.

2017 Standards of Learning Essential Knowledge and Skills (EKS) 9 – Week Module	2024 Standards of Learning Knowledge and Skills (KS)
MSCSE.5 The student will discuss issues of bias and accessibility in the design of existing technologies.	**MSCSE-9.IC.1 The student will examine the impact of computing technologies that affect daily life and society.** a. Compare and contrast the benefits and risks of everyday use of computing technologies and their influences on daily life and society. b. Discuss issues of digital citizenship, ethics, bias, and accessibility in relation to computing technologies and the Internet. c. Identify and describe significant historical figures that made an impact in the computer science field.
MSCSE.6 The student will describe and explain the history of computer science, including naming significant historical figures and describing their impact on the field.	**MSCSE-18.IC.1 The student will examine relationships between historical advancements in computer science that influence the development of computing technologies.** a. Identify correlations between historical developments in computing technologies and changes in society, including automated decision-making and emerging computing technologies. b. Explain how computing technologies can positively and negatively impact communities in Virginia and globally. c. Examine how risk and benefits have changed based on the development of computing technologies.
	MSCSE-9.IC.2 The student will explore careers that utilize computer science skills and practices in Virginia and globally. a. Research computer science and information technology career pathways. b. Discuss careers that use computer science skills and practices.

	MSCSE-9.NI.1 The student will explain that the Internet is a network of computing devices connected physically and/or wirelessly. a. Explain the role of networks and the Internet and networks in different computing contexts like gaming, web browsing, communication, streaming, or other common use cases. b. Identify and describe hardware and software components that make up the Internet. c. Explain how hardware and software components can be combined to collect and exchange data. d. Compare and contrast different methods of data transfer.
	MSCSE-9.AP.2 The student will use iterative design process to create a program. a. Identify the goal and objectives of the program. b. Plan for the design or prototype of the program. c. Develop an outline for the program's functionality. d. Engage with peers to collect feedback on relevant aspects.

2017 Standards of Learning Essential Knowledge and Skills (EKS) 18- Week Module	**2024 Standards of Learning Knowledge and Skills (KS)**
MSCSE.7 The student will use flowcharts and/or pseudocode to address complex problems as algorithms.	**MSCSE -9.AP.1 The student will apply computational thinking to evaluate and solve a problem.** a. Decompose a problem or process into sub-components. b. Recognize characteristics or patterns to determine commonalities. c. Abstract relevant information to identify essential details. d. Use pseudocode and/or flowcharts to address complex problems as algorithms.
MSCSE.8 The student will incorporate existing code, media, and libraries into original programs, and give attribution.	**MSCSE-18.AP.1 The student will improve existing solutions to problems to create new programs.**

	a. Categorize problems as classification, prediction, combinational search, or sequential decision problems. b. Determine when problems can be solved with programs and automation. c. Create a variety of programs while considering the needs and preferences of diverse user groups. d. Utilize existing code, media, and libraries into original programs, and give attribution.
MSCSE.9 The student will systematically test and refine programs using a range of test cases.	**MSCSE-36.AP.2 The student will decompose problems and subcomponents into parts to facilitate the design, implementation, and review of programs.** a. Decompose problems into subcomponents to facilitate the creation of a program. b. Use documentation to explain the purpose of a section of code and its relationship to other parts of a program. c. Evaluate the limitations of models, algorithms, and programs considering multiple perspectives. d. Systematically test and refine programs.
MSCSE.10 The student will model the role of protocols in transmitting data across networks and the Internet.	**MSCSE-18.NI.1 The student will analyze the role of computing devices in transmitting data in computing networks and the Internet.** a. Define topology, packet, and protocol. b. Analyze the role of computing devices in transmitting data. c. Model how data is transmitted across networks and the Internet.
MSCSE.11 The student will apply multiple methods of encryption to model the secure transmission of information.	**MSCSE-36.CYB.1 The student will apply multiple methods of encryption and decryption to model the secure transmission of information.** a. Identify different types of data that can be encrypted. b. Use simple encryption and decryption strategies to encode and decode a message.
MSCSE.12 The student will explain how physical and digital security measures protect electronic information.	**MSCSE-9.CYB.1 The student will demonstrate ways to protect sensitive data from malware and other attacks.**

	a. Describe how cyber-attacks can affect a computing system. b. Compare and contrast safe and unsafe computing practices. c. Explore how industries and emerging technologies are addressing cyber solutions. d. Model common prevention practices for cyber-attacks.
MSCSE.13 The student will collect data using computational tools and transform the data to make it more useful and reliable.	**MSCSE-9.DA.1 The student will collect data and use computational thinking practices to transform and manipulate data.** a. Identify and use computing technologies to collect data sets. b. Evaluate data sets and visualizations for limitations, reliability, and bias. c. Identify encoding schemes used to represent similar data. d. Transform data utilizing decomposition, pattern recognition, and abstraction to make inferences, predictions, and decisions about real-world phenomena. e. Explore how machine learning, Artificial Intelligence (AI), and emerging technologies automate data analysis.
MSCSE.14 The student will refine computational models based on the data they have generated	**MSCSE-18.DA.1 The student will use pattern recognition, decomposition, and abstraction to create and refine models and programs based on the data they have generated.** a. Create representations and visualizations of data. b. Assess data reliability and biases in the data collection process, data visualizations, and existing automation. c. Use and evaluate various schemes to represent data. d. Explore how emerging technologies including Artificial Intelligence (AI) organize data, make decisions, and formulate predictions.

MSCSE.15 The student will represent data using multiple encoding schemes.	**[Included in MSCSE-9.DA.1]**
MSCSE.16 The student will compare tradeoffs associated with computing technologies that affect people's everyday activities and career options.	**MSCSE-9.IC.1 The student will examine the impact of computing technologies that affect daily life and society.** a. Compare and contrast the benefits and risks of everyday use of computing technologies and their influences on daily life and society. b. Discuss issues of digital citizenship, ethics, bias, and accessibility in relation to computing technologies and the Internet. c. Identify and describe significant historical figures that made an impact in the computer science field.
MSCSE.17 The student will collaborate with many contributors through strategies such as crowdsourcing or surveys when creating a computational artifact or visualization.	**[Included in MSCSE-18.DA.1]**
MSCSE.18 The student will describe tradeoffs between allowing information to be public and keeping information private and secure.	**MSCSE-36.IC.1 The student will assess the societal, environmental, and ethical impacts, and tradeoffs of computing technologies.** a. Describe tradeoffs between allowing information to be public and keeping information private and secure. b. Evaluate policies, laws, and regulations for computing technologies. c. Propose strategies to mitigate risks and increase benefits of computing technologies. d. Assess the benefits and drawbacks of using Internet technologies by considering factors such as: data storage, cost, speed, reliability, and privacy.
MSCSE.19 The student will systematically identify and correct problems with computing devices and their components.	**MSCSE-9.CSY.2 The student will implement solutions to problems with computing devices and their components.** a. Abstract the problems with computing devices and apply appropriate troubleshooting strategies. b. Propose and implement solutions to a variety of hardware and software problems.
MSCSE.20 The student will explore the relationship between hardware and software using the Internet of Things.	**MSCSE-9.CSY.1 The student will explore the structure, function, interactions, and interrelationships of hardware and software.**

	a. Explain the structure and function of hardware and software in computing devices. b. Describe the interactions of hardware and software in computing systems. c. Evaluate the usability of hardware and software from different perspectives.
MSCSE.21 The student will **a. work in a team to distribute tasks;** **b. maintain a timeline; and** **c. use iterative design to solve problems, including peer review and feedback.**	**MSCSE-18.AP.3 The student will work collaboratively in an iterative design process to solve problems, including peer review and feedback.** a. Collaboratively plan, design, and revise programs. b. Explain design choices, including constraints, and audiences. c. Provide constructive feedback through peer review. d. Reflect on collaborative experiences.
	MSCSE-18.AP.2 The student will systematically use multiple test cases to verify the accuracy of a program. a. Predict and test the outcome or output of multiple test cases. b. Verify and refine the program based on the outcome of multiple test cases.
	MSCSE-18.AP.4 The student will analyze, solve, and document a problem-solving process for others to duplicate the solution. a. Analyze and decompose a problem. b. Use abstraction to determine a solution to a problem.
	MSCSE-18.AP.5 The student will investigate different coding languages. a. Identify characteristics of block-based and text-based coding languages. b. Analyze the advantages and disadvantages of block-based and text-based coding languages.
	MSCSE-18.CYB.1 The student will analyze tradeoffs between the use of public, privilege, private, and personal information. a. Create strategies for protecting information.

	b. Describe the benefits and drawbacks of each type of information. c. Analyze the impact of misclassified information. d. Outline common causes and reasons for data breaches involving information. e. Describe the role of social engineering and human error in data breaches.
	MSCSE-18.IC.2 The student will explore computer science career pathways. a. Identify computer science related careers that relate to the student's interest. b. Evaluate different computer science related careers and develop a career plan.

2017 Standards of Learning Essential Knowledge and Skills (EKS) 36 – Week Module	**2024 Standards of Learning Knowledge and Skills (KS)**
MSCSE.22 The student will decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.	**MSCSE-36.AP.2 The student will decompose problems and subcomponents into parts to facilitate the design, implementation, and review of programs.** a. Decompose problems into subcomponents to facilitate the creation of a program. b. Use documentation to explain the purpose of a section of code and its relationship to other parts of a program. c. Evaluate the limitations of models, algorithms, and programs considering multiple perspectives. d. Systematically test and refine programs.
MSCSE.23 The student will create procedures with parameters to organize code and make it easier to reuse.	**MSCSE-18.CSY.2 The student will assess how computers interact with humans, other computing systems, and the environment.** a. Evaluate design and user operability to assess user accessibility, hardware and software performance, and compatibility.

	b. Develop and apply criteria to evaluate a computing system for a given purpose and its intended environment.
MSCSE.24 The student will recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices.	**MSCSE-36.CSY.1 The student will analyze user interaction with computing devices and propose design improvements.** a. Analyze and evaluate the design of a computing device for the end user. b. Propose recommendations for improvements to a computing device to include accessibility, functionality, cost, size, speed, accessibility, data bias, and aesthetics. c. Investigate additional improvements available through emerging technologies.
MSCSE.25 The student will recommend improvements to the design of computing devices based on an analysis of how users interact with the devices	**[Moved to Grade 8. Refer to 8.CSY.1]**
MSCSE.26 The student will design projects that combine hardware and software components to collect and exchange data.	**MSCSE-18.CSY.1 The student will design projects that utilize hardware and software components to collect and exchange data.** a. Explain the interactions of hardware and software components when collecting and exchanging data. b. Justify the selection of hardware and software components for project designs by considering multiple factors: functionality, cost, size, speed, accessibility, and data bias.
	MSCSE-36.AP.1 The student will develop a solution to a real-world problem using programming. a. Identify problems that can be solved with a program. b. Justify a proposed solution to a problem. c. Use project management tools to support collaboration. d. Engage in peer review and incorporate evaluative feedback through the design process.

	e. Incorporate feedback provided through peer review to refine prototypes.
	MSCSE-36.AP.3 The student will design and create algorithms using a text-based programming language. a. Read and write programs that combine loops and conditional control structures. b. Read and write programs using functions and procedures
	MSCSE-36.DA.1 The student will utilize software tools and computer programs to create interactive data visualizations to analyze and better understand the real world. a. Communicate the significance of data visualizations and computation models in the real world. b. Use existing data visualizations that refresh in real-time to make predictions about real-world phenomena. c. Create interactive data visualizations of real-world phenomena. d. Analyze the impact of data quality, quantity, diversity, and other factors on the accuracy, and reliability of data visualizations.
	MSCSE-36.NI.1 The student will analyze the role of computing devices and network architecture in transmitting data in computing networks and the Internet. a. Define client, server, router, and switches. b. Identify how computing devices collect and exchange data. c. Compare and contrast network topologies. d. Illustrate the arrangement of topology among elements of a network. e. Model how information is transmitted amongst multiple computing devices within a network.

Draft 2017 Middle School Computer Science Elective Computer Science SOL – Summary of Changes

MSCSE (2017 SOL to 2024 SOL Numbering)
• MSCSE.1 → [Included in MSCSE-9.AP.3] • MSCSE.2 → [Included in MSCSE-9.AP.3] • MSCSE.3 → [Included in MSCSE-9.AP.3] • MSCSE.4 → MSCSE-9.AP.4 • MSCSE.5 → MSCSE-9.IC.1 • MSCSE.6 → MSCSE-18.IC.1 • MSCSE.7 → MSCSE-9.AP.1 • MSCSE.8 → MSCSE-18.AP.1 • MSCSE.9 → MSCSE-36.AP.2 • MSCSE.10 → MSCSE-18.NI.1 • MSCSE.11 → MSCSE-36.CYB.1 • MSCSE.12 → MSCSE-9.CYB.1 • MSCSE.13 → [Included in MSCSE-9.DA.1] • MSCSE.14 → [Included in MSCSE-18.DA.1] • MSCSE.15 → [Included in MSCSE-9.DA.1] • MSCSE.16 → MSCSE-9.IC.1 • MSCSE.17 → [Included in MSCSE-18.DA.1] • MSCSE.18 → MSCSE-36.IC.1 • MSCSE.19 → MSCSE-9.CSY.2 • MSCSE.20 → MSCSE-9.CSY.1 • MSCSE.21 → MSCSE-18.AP.3 • MSCSE.22 → MSCSE-36.AP.2 • MSCSE.23 → MSCSE-18.CSY.2 • MSCSE.24 → MSCSE-36.CSY.1 • MSCSE.25 → [Moved to Grade 8. Refer to 8.CSY.1]

Deletions MSCSE (2017 SOL)	Additions to MSCSE (2024 SOL)
• MSCSE.25 - The student will recommend improvements to the design of computing devices based on an analysis of how users interact with the devices. [Moved to Grade 8. Refer to 8.CSY.1]	• MSCSE-9.AP.2 - The student will use the iterative design process to create a program. • MSCSE-18.AP.2 - The student will systematically use multiple test cases to verify the accuracy of a program • MSCSE-18.AP.4 - The student will analyze, solve, and document a problem-solving process for others to duplicate the solution • MSCSE-18.AP.5 - The student will investigate different coding languages

	• MSCSE-36.AP.1 - The student will develop a solution to a real-world problem using programming • MSCSE-36.AP.3 - The student will design and create algorithms using a text-based programming language • MSCSE-18.CYB.1 - The student will analyze tradeoffs between the use of public, privileged, private, and personal information • MSCSE-36.DA.1 - The student will utilize software tools and computer programs to create interactive data visualizations to analyze and better understand the real-world • MSCSE-9.IC.2 - The student will explore careers that utilize computer science skills and practices in Virginia and globally • MSCSE-18.IC.2 - The student will explore computer science related career • MSCSE-9.NI.1 - The student will explain that the Internet is a network of computing devices connected physically and/or wirelessly. • MSCSE-36.NI.1 - The student will analyze the role of computing devices and network architecture in transmitting data in computing networks and the Internet

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Computer Science Foundations *Standards of Learning*: 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to address complex problems
- Use the iterative design process to create, test, and refine programs using a text-based programming language
- Plan and implement algorithms and programs that include loops, variables, and control structures using text-based programming language
- Design programs that use and manipulate data
- Define and describe neural network learning algorithms
- Investigate different coding languages
- Use and search algorithms and sort algorithms

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Illustrate how computers create visual representations
- Illustrate how computers can use visual representations of the world to solve problems
- Describe and explain the methods in which computers learn through the use of machine learning

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Evaluate the methods of protecting data and computing systems, considering the context of the user and other stakeholders, with the level of cybersecurity risk
- Identify typical targets and perpetrators of cyberattacks
- Compare various security measures, considering tradeoffs between the usability and security of a computing system

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Identify specific examples of real-world problems that can be effectively addressed using data analysis
- Evaluate data collection and storage practices, including their impact on the stakeholders involved
- Explain the use of training data in machine learning
- Utilize data analysis to solve computational problems that make an impact and create solutions

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Research and hypothesize the societal, environmental, and ethical impacts of present and future computing technologies
- Identify historical advancements in computer science and their parallels with changes in society
- Explore computer science careers in Virginia and globally

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Model the transmission of data across computing networks and the Internet

Comparison of CS Foundations Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Essential Knowledge and Skills (EKS) Computing Systems	2024 Standards of Learning Knowledge and Skills (KS) Computing Systems (CSY)
CSF.1 The student will **a. Compare the structures, functions, and interactions between application software, system software, and hardware; and** **b. Explore the relationship between hardware and software using the Internet of Things.**	**CSF.CSY.1 The student will explain the use of abstraction to hide underlying implementation of computing systems embedded in everyday objects.** a. Provide real-world examples of abstraction in computing. b. Explain the role of abstraction to simplify complex systems. c. Identify and describe levels of abstraction between application software, system software, and hardware layers.
	CSF.CSY.2 The student will illustrate how computers create visual representations. a. Describe how computers receive visual data from various sensors and tools. b. Describe image processing techniques to include filtering, segmentation, and feature extraction. c. Explain how computers use pattern recognition and classify data to interpret and make decisions. d. Discuss ethical considerations related to the use of visual data and computer vision technologies.
	CSF.CSY.3 The student will illustrate how computers can use visual representations of the world to solve problems. a. Describe the parts of a network diagram and how they are related. b. Explain the relationship between nodes, links, and other components of graphs. c. Explain how a computer can solve a maze, find a route on a map, and use reasoning to solve problems.
	CSF.CSY.4 The student will describe and explain the methods in which computers learn through the use of machine learning.

	a. Compare and contrast the learning process of humans and computers. b. Identify mathematical models used by supervised learning to produce classifications and predictions.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Networks and the Internet	2024 Standards of Learning Knowledge and Skills (KS) Networks and the Internet (NI)
CSF.2 The student will model how information is broken down into smaller pieces, transmitted as packets through multiple devices over networks and the Internet, and reassembled at the destination.	**CSF.NI.1 The student will model the transmission of data across computing networks and the Internet.** a. Identify the roles of computing devices: routers, switches, servers, and clients. b. Explain the role of Internet protocols: HTTP(S) and TCP/IP to provide reliable and secure data. c. Analyze and create network topology diagrams. d. Model how computing devices communicate via networks using TCP/IP protocols. e. Identify common problems that impact network functionality. f. Identify solutions to resolve common network issues.
CSF.3 The student will explain the role of protocols in transmitting data across networks and the Internet.	**[Included in CSF.NI.1]**
CSF.4 The student will evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.	**[Included in CSF.NI.1]**

2017 Standards of Learning Essential Knowledge and Skills (EKS) Cybersecurity	2024 Standards of Learning Knowledge and Skills (KS) Cybersecurity (CYB)
CSF.5 The student will identify and explain ways that sensitive data (assets) can be threatened by malware and other computer attacks, using appropriate terminology.	**CSF.CYB.1 The student will evaluate the methods of protecting data and computing systems, considering the context of the user and other stakeholders, with the level of cybersecurity risk.** a. Describe ways data and computing systems can be threatened by malware, ransomware, social engineering, phishing, and other cyberattacks.

	b. Compare strategies to protect data and computing systems from malware, ransomware, social engineering, phishing, and other cyberattacks.
CSF.6 The student will give examples of ways to protect sensitive data (assets) from malware and other computer attacks and evaluate them according to multiple criteria.	**[Included in CSF.CYB.1]**
CSF.7 The student will explain typical tradeoffs between usability and security and recommend security measures in a given scenario based on these (or other) tradeoffs.	**CSF.CYB.3 The student will compare various security measures, considering tradeoffs between the usability and security of a computing system.** a. Evaluate tradeoffs between usability and security. b. Analyze scenarios to determine tradeoffs between usability and security. c. Propose recommendations for optimizing balance between usability and security in a given computing system.
CSF.8 The student will write or adapt a program to validate its input and to avoid certain kinds of vulnerabilities.	**CSF.CYB.2 The student will identify typical targets and perpetrators of cyberattacks.** a. Identify common targets and perpetrators of cyberattacks. b. Describe potential vulnerability when using publicly available networks. c. Assess the impact of cyber threats on systems and people with diverse backgrounds, technical knowledge, or threat profiles.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Data Analysis	**2024 Standards of Learning Knowledge and Skills (KS) Data Analysis (DA)**
CSF.9 The student will evaluate the tradeoffs in how data elements are organized and where data is stored.	**CSF.DA.2 The student will evaluate data collection and storage practices, including their impact on the stakeholders involved.** a. Identify methods for collecting and storing data of different data sizes. b. Evaluate technical and ethical implications of collecting and storing data from the perspectives of users, programmers, companies, and communities.

	c. Identify impacts of bias in data collection and storage practices. d. Analyze the impact of data quality, quantity, diversity, and other factors on the accuracy and reliability of data visualizations. e. Research emerging technologies that have the capabilities to construct reasoning from stakeholder data.
CSF.10 The student will create interactive data visualizations using software tools to help others better understand real-world phenomena.	**CSF.DA.1 The student will identify and explain specific examples of real-world problems that can be effectively addressed using data analysis.** a. Describe the types of data that business, industry, and government entities collect and maintain. b. Identify privacy and consumer protection issues that impact data representation. c. Identify real-world problems that can be addressed through data analysis. d. Compare two real world datasets to identify how the values of features are encoded and represented. e. Formulate questions to decompose a problem and develop a data project plan.
CSF.11 The student will use data analysis tools and techniques to identify patterns in data representing complex systems.	**[Included in CSF.DA.1]**
	CSF.DA.3 The student will explain the use of training data in machine learning. a. Describe training data and the role it has in the development of machine learning models. b. Identify a variety of sources of training data.

	c. Investigate data collection practices and the role of consent, transparency, and responsible data handling. d. Evaluate the quality of training data: completeness, accuracy, consistency, and relevance. e. Analyze and discuss the ethical implications and social and economic impact of training data choices.
	CSF.DA.4 The student will utilize data analysis to solve computational problems that make an impact and create solutions. a. Formulate questions that require data collection. b. Identify appropriate data to address predetermined questions. c. Define the stages of the data cycle and the interrelationship between each stage. d. Identify and explain constraints of a data-driven approach. e. Create a computational artifact of the data analysis results.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Algorithms and Programming	**2024 Standards of Learning Knowledge and Skills (KS) Algorithms and Programming (AP)**
CSF.12 The student will develop a program working individually and in teams using a text-based language.	**CSF.AP.2 The student will use the iterative design process to create, test, and refine programs using a text-based programming language.** a. Create programs using a text-based programming language. b. Trace the execution of an algorithm and predict its results. c. Analyze the outcomes of programs to identify logic and syntax errors. d. Use multiple test cases to verify and refine the program. e. Revise and improve an algorithm to resolve errors or produce desired outcomes. f. Use version control and incorporate user feedback to refine program.
CSF.13 The student will identify the expected output of a program given a problem and some input.	**[Included in CSF.AP.2]**

CSF.14 The student will design and iteratively develop programs for practical intent or personal expression, incorporating feedback from users.	**[Included in CSF.AP.2]**
CSF.15 The student will design and implement algorithms using **a. sequencing of instructions;** **b. conditional execution; and** **c. iteration.**	**[Included in CSF.AP.2]**
CSF.16 The student will implement a program that accepts input values, stores them in appropriately named variables, and produces output.	**CSF.AP.3 The student will plan and implement algorithms and programs that include loops, variables, and compound and nested control structures using a text-based programming language.** a. Read and interpret algorithms and programs expressed using plain language, pseudocode, and text-based programming languages b. Create design documents using plain language, pseudocode, or diagrams. c. Read and write algorithms and programs that accept multiple input values, use variables, and produce output. d. Read and write algorithms and programs that include predefined functions and procedures with parameters and returns. e. Compare several implementations of the same algorithm using different control structures.
CSF.17 The student will trace the execution of an algorithm, illustrating output and changes in values of named variables.	**[Included in CSF.AP.2]**
CSF.18 The student will apply the basic operations used with numeric and non-numeric data types in developing programs.	**CSF.AP.4 The student will design programs that use and manipulate data.** a. Determine appropriate data structures to address program specifications. b. Apply basic computations on numeric and non-numeric data types. c. Read and write programs that create, store, and manipulate primitive data d. Read and write programs that create, store, and manipulate linear collections of primitive data types: arrays or lists.

	e. Read and write programs that use relational, logical, and arithmetic expressions. f. Read and write programs that iterate over higher-order data structures.
CSF.19 The student will use predefined functions to simplify the solution of a complex problem.	**[Included in CSF.AP.3]**
CSF.20 The student will apply simple algorithms to a collection of data.	**[Included in CSF.AP.4]**
	CSF.AP.5 The student will define and describe neural network learning algorithms. a. Define and describe neural network learning algorithms. b. Identify and discuss examples of computing technologies that utilize neural networks. c. Compare and contrast a decision tree learning algorithm and a neural network learning algorithm.
CSF.21 The student will create programs **a. demonstrating an understanding that program development is an ongoing process that requires adjusting and debugging along the way; and** **b. using version control to create and refine programs.**	**[Included in CSF.AP.2]**
	CSF.AP.1 The student will apply computational thinking to address a computational problem. a. Decompose a problem or process into sub-components. b. Implement abstractions to improve program molarity, reusability, and readability. c. Identify computing-based solutions to address a computational problem.
	CSF.AP.6 The student will investigate different coding languages. a. Identify and describe characteristics of block-based and text-based coding languages. b. Analyze the advantages and disadvantages of block-based and text-based coding languages. c. Analyze the advantages and disadvantages of various text-based coding languages.
	CSF.AP.7 The student will use and search algorithms and sort algorithms. a. Define the concept and role of a search algorithm. b. Define the concept and role of a sort algorithm.

	c. Compare and contrast bubble sort, quick sort, and merge sort. d. Compare and contrast linear search and binary search. e. Evaluate and determine the best search or sort algorithm to use based on intended results.
	CSF.AP.8 The student will work collaboratively in an iterative design process to solve problems, including peer review and feedback. a. Identify project management frameworks and methodologies that emphasize iteration. b. Discuss the significance of communication and methods of communication when working collaboratively. c. Distribute roles and responsibilities and adhere to predetermined timeline and/or project scope. d. Collaboratively plan, design, and revise programs. e. Provide constructive feedback through peer review. f. Use project management tools to support collaboration. g. Justify and explain design choices, including constraints, and audiences. h. Reflect and discuss collaborative experience with team.

2017 Standards of Learning Essential Knowledge and Skills (EKS) Impacts of Computing	2024 Standards of Learning Knowledge and Skills (KS) Impacts of Computing (IC)
CSF.22 The student will use tools and methods for collaboration on a project to increase connectivity of people in different cultures and career fields.	**[Included in CSF.AP.8 - collaboration tools]** **[Included in 6.IC.4 and 8.IC.1-impact of connectivity of people]**
CSF.23 The student will evaluate the way computing impacts personal, ethical, social, economic, and cultural practices.	**CSF.IC.1 The student will research and hypothesize the societal, environmental, and ethical impacts of present and future computing technologies.** a. Identify the societal impacts of computing technologies and the various aspects of daily life and industry. b. Evaluate the effect of advances in information technology on the economy, environment, and ethics. c. Examine the environmental impact of computing technologies. d. Propose strategies to address the ethical impacts and potential challenges of computing technologies.

	CSF.IC.2 The student will identify historical advancements in computer science and their parallels with changes in society. a. Examine correlations between historical developments in computing technologies and changes in society. b. Appraise contributions of pioneers in the field of computer science. c. Explore the impact of Moore's Law on scientific and mathematical advancements.
	CSF.IC.3 The student will explore computer science careers in Virginia and globally. a. Research and explain the preparation and job outlook for computer science careers. b. Examine current and future computer science career pathways involving emerging technologies.
CSF.24 The student will explain the beneficial and harmful effects that intellectual property laws can have on innovation, including the impact of open source software.	**[Included in CSF.IC.1]**
CSF.25 The student will explain the privacy concerns related to the collection and generation of data through automated processes that are not always evident to users.	**[Included in CSF.A.2]**

Draft 2024 Computer Science Foundations Computer Science SOL – Summary of Changes

Computer Science Foundations 2017 SOL to 2024 SOL Numbering)
• CSF.1 → [Included in CSF.CSY.1] • CSF.2 → [Included in CSF.NI.1] • CSF.3 → [Included in CSF.NI.1] • CSF.4 → [Included in CSF.NI.1] • CSF.5 → [Included in CSF.CYB.1] • CSF.6 → [Included in CSF.CYB.1] • CSF.7 → CSF.CYB.3 • CSF.8 → CSF.CYB.2 • CSF.9 → CSF.DA.2 • CSF.10 → [Included in CSF.DA.1] • CSF.11 → [Included in CSF.DA.1] • CSF.12 → [Included in CSF.AP.2] • CSF.13 → [Included in CSF.AP.2] • CSF.14 → [Included in CSF.AP.2] • CSF.15 → [Included in CSF.AP.2] • CSF.16 → CSF.AP.3 • CSF.17 → [Included in CSF.AP.2] • CSF.18 → CSF.AP.4 • CSF.19 → [Included in CSF.AP.3] • CSF.20 → [Included in CSF.AP.4] • CSF.21 → [Included in CSF.AP.2] • CSF.22 → [Included in CSF.AP.8, 6.IC.4 and 8.IC.1] • CSF.23 → [Included in CSF.IC.1] • CSF.24 → [Included in CSF.IC.1] • CSF.25 → [Included in CSF.DA.2]

Deletions from Computer Science Foundations (2017 SOL)	Additions to Computer Science Foundations (2024 SOL)
None	• CSF.CSY.2 - Illustrate how computers create visual representations. • CSF.CSY.3 - Illustrate how computers can use visual representations of the world to solve problems. • CSF.CSY.4 - Describe and explain the methods in which computers learn through the use of machine learning. • CSF.DA.3 - Explain the use of training data in machine learning.

	• CSF.DA.4 - Utilize data analysis to solve computational problems that make an impact and create solutions. • CSF.AP.1 - Apply computational thinking to address a computational problem. • CSF.AP.5 - Define and describe neural network learning algorithms. • CSF.IC.2 - Identify historical advancements in computer science and their parallels with changes in society. • CSF.IC.3 - Explore computer science careers in Virginia and globally.

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Computer Science Principles Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to address a computational problem
- Design and create programs that use and manipulate data, include primitive data types and higher-order data structures
- Use the iterative design process to plan, implement, and create programs that satisfy user and design specifications
- Weigh the affordances and constraints of different coding representations

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Compare the structures, functions, and interactions between application software, system software, and hardware

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Evaluate security technologies, techniques, and practices in terms of confidentiality, integrity, and availability
- Explain the legal and ethical ramifications of cybersecurity breaches
- Explain the importance of protecting personally identifiable information (PII) and social identity

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Utilize, develop, evaluate, defend, and refine information about a dataset using computing technologies, techniques, and practices
- Collect and use training data
- Use supervised or unsupervised learning algorithm to train a model on real world data
- Create and refine predictive models based on patterns in data

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Analyze the impacts of computing technologies across global societies
- Analyze and design solutions to address local and global impacts of present and future computing technologies
- Expand on career explorations with work-based learning experiences
- Identify and describe the information processing capabilities of artificial intelligence in computing technologies

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- Explain, analyze, and model computing networks and communication over the Internet
- Explain design principles enabling large-scale operation of the Internet to connect devices and networks all over the world

Comparison of CS Principles Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Knowledge and Skills (KS) Computing Systems	2024 Standards of Learning Knowledge and Skills (KS) Computing Systems (CSY)
CSP.1 The student will develop and apply criteria for evaluating a computer system for a given purpose.	**[Moved to MSCSE. Refer to MSCSE-18.CSY.2]**
CSP.2 The student will illustrate ways computing systems implement logic, input, and output through hardware components.	**CSP.CSY.1 The student will compare the structures, functions, and interactions between application software, system software, and hardware.** a. Explain the role of abstraction and computing systems for user usability. b. Explore the interdependent relationship between hardware and software and the effect on functionality and system architecture. c. Analyze the components of hardware and software and propose solutions to increase functionality. d. Describe the functions of operating system, including resource management and process execution. e. Construct a model to show the hierarchy of hardware, system software, and application software.

2017 Standards of Learning Knowledge and Skills (KS) Networking and the Internet	2024 Standards of Learning Knowledge and Skills (KS) Networking and the Internet (NI)
CSP.3 The student will explain abstractions enabling a. one computer to communicate with another over an Internet connection; and b. different layers of Internet technology to build on one another.	**CSP.NI.1 The student will explain, analyze, and model computing networks and communication over the Internet.** a. Explain abstraction enabling computing devices to communicate to one another over an Internet connection. b. Model abstractions and protocols enabling computers to transmit, receive, and interpret data within networks and over the Internet. c. Explain how abstractions enables different layers of Internet technology to build on one another. d. Describe the seven layers of the OSI model. e. Analyze issues pertaining to networks through the sevens layers of the OSI model.

CSP.4 The student will explain design principles enabling large-scale operation of the Internet to connect devices and networks all over the world.	**CSP.NI.2 The student will explain design principles enabling large-scale operation of the Internet to connect devices and networks all over the world.** a. Explain design principles that permit scalability and reliability of connected devices on a network. b. Describe issues that impact network functionality, scalability, and reliability and recommend solutions c. Create a diagram to illustrate the communication connection between two distant devices.

2017 Standards of Learning Knowledge and Skills (KS) Cybersecurity	2024 Standards of Learning Knowledge and Skills (KS) Cybersecurity (CYB)
CSP.5 The student will explain symmetric and asymmetric encryption as they pertain to messages being sent on a network.	**[Moved to MSCSE. Refer to MSCSE-36.CYB.1]**
	CSP.CYB.1 The student will evaluate security technologies, techniques, and practices in terms of confidentiality, integrity, and availability. a. Explain the C-I-A Triad (Confidentiality, Integrity, and Availability) b. Solve a cybersecurity problem and propose security measures related to confidentiality, integrity, and availability. c. Compare information security and physical security measures to assess potential threats and vulnerabilities.
	CSP.CYB.2 The student will explain the legal and ethical ramifications of cybersecurity breaches. a. Describe state and federal laws that relate to cybersecurity and privacy. b. Compare and contrast ethical and unethical hacking. c. Evaluate the social and economic implications of privacy in the context of safety, law, or ethics.
	CSP.CYB.3 The student will explain the importance of protecting personally identifiable information (PII) and social identity.

	a. Examine measures to prevent the disclosure of personally identifiable information (PII). b. Compare and contrast ways to conduct threat analysis and to protect data and computing systems from data breaches. c. Analyze scenarios and propose computing practices to protect personal information and reduce the risk of a data breach.

2017 Standards of Learning Knowledge and Skills (KS) Data and Analysis	**2024 Standards of Learning Knowledge and Skills (KS) Data and Analysis (DA)**
CSP.6 The student will discuss the methods and tradeoffs of collecting and analyzing data elements on a large scale.	**CSP.DA.1 The student will utilize, develop, evaluate, defend, and refine information about a dataset using computing technologies, techniques, and practices.** a. Identify the role of relational databases in storing data and in data utilization. b. Analyze tradeoffs inherent in distilling raw data into data representations. c. Evaluate data reliability and scalability. d. Identify potential bias present in data representation practices. e. Discuss the potential effect of data bias and provide recommendations on how to mitigate data bias.
CSP.7 The student will select data collection tools and techniques to generate data sets that support a claim or communicate information. Implement a relational database to work with data.	**[Included in CSP.DA.1]**
CSP.8 The student will discuss how data representations can be interpreted in a variety of forms, convert between data representations, and analyze the representation tradeoffs among various forms of digital information.	**[Included in CSP.DA.1]** **[Moved to Programming. Refer to PRG.DA.1-Tradeoffs of data organization and storage options]**
	CSP.DA.2 The student will collect and use training data. a. Collect and clean diverse data sets to improve data quality and relevance. b. Apply preprocessing techniques: missing values, normalization, and encoding categorical variables.

	c. Create subsets of training data for training, validation, and testing. d. Investigate potential imbalances within training data that could result in a biased model.
	CSP.DA.3 The student will use supervised or unsupervised learning algorithm to train a model on real world data. a. Explain the difference between labeled and unlabeled data. b. Evaluate a dataset used to train an artificial intelligent system. c. Apply mathematical operations and algorithms to manipulate and extract insights from data sets. d. Describe how supervised or unsupervised learning algorithms find patterns and make predictions. e. Discuss how machines learn from data sets and derive new knowledge. f. Describe how natural language processors (NLP) analyze data and produce output.
	CSP.DA.4 The student will create and refine predictive models based on patterns in data. a. Create and refine models or computational artifacts that can be used to make predictions and communicate effectively. b. Justify tools and data visualizations selected to create and assess the model for accuracy.

2017 Standards of Learning Knowledge and Skills (KS) Algorithms and Programming	2024 Standards of Learning Knowledge and Skills (KS) Algorithms and Programming (AP)
CSP.9 The student will design and implement algorithms with **a. compound conditional execution; and** **b. a variety of loop control structures.**	**[Moved to MSCSE, CSF, and Programming. Refer to MSCSE 36.AP.3, CSF.AP.3, and PRG.AP.2]**
CSP.10 The student will solve a complex problem by decomposing it into subtasks consisting of predefined functions and user-defined functions.	**CSP.AP.1 The student will apply computational thinking to address a computational problem.** a. Identify and categorize real-world problems as classification, prediction, and sequential decision. b. Identify the process used by specialized algorithms used for perceptual tasks using sensory inputs.

	c. Decompose a computational problem or process into sub-components. d. Use abstraction to improve program molarity, reusability, and readability. e. Create a prototype that uses algorithms to address a complex computational problem. f. Justify selected control structure(s) used to design algorithm.
CSP.11 The student will store, process, and manipulate data contained in a data structure.	**CSP.AP.2 The student will design and create programs that use and manipulate data, include primitive data types and higher-order data structures.** a. Determine appropriate data structures to implement when given a programming problem or task. b. Create, modify, store data in, and manipulate primitive data types like numbers, strings/characters, or Boolean values. c. Create, modify, store data in, and manipulate linear and non-linear collections containing primitive and higher order data types: arrays, lists, objectives, or key-values structures. d. Read and write programs that include linear data structures and processes a collection of data.
CSP.12 The student will systematically debug a program using an appropriate set of data.	**CSP.AP.3 The student will use the iterative design process to plan, implement, and create programs that satisfy user and design specifications.** a. Use project management skills to work individually and in teams. b. Design an interactive program that accepts input from a variety of sources and produce output based on input. c. Create a design specification document. d. Design and create programs for various computing platforms. e. Trace the execution of an algorithm and predict its results. f. Use proper attribution to incorporate code written by others. g. Use multiple test cases to verify and refine program.

	h. Revise and improve an algorithm to resolve errors or produce desired outcomes. i. Solicit and synthesize user feedback to test and refine the program. j. Apply best practices in developing programs: program development cycle, code styling, documentation, and version control.
	CSP.AP.4 The student will weigh the affordances and constraints of different coding representations. a. Compare and contrast schematic representation, pictorial representation, and other coding representations. b. Generalize programming concepts, structures, and practices across coding representations. c. Communicate the ways a coding representation or approach shapes solutions to problems. d. Evaluate coding languages for specific real-world applications.

2017 Standards of Learning Knowledge and Skills (KS) Impacts of Computing	2024 Standards of Learning Knowledge and Skills (KS) Impacts of Computing (IC)
CSP.13 The student will explain how computing has impacted innovations in other fields positively and negatively, and enables collaboration between a variety of people.	**CSP.IC.1 The student will analyze the impacts of computing technologies across global societies.** a. Assess the impact of manufacturing and energy use on communities and the environment. b. Analyze ways in which global collaboration is supported by new technologies. c. Identify applications of quantum computing in research and commercial sectors.
CSP.14 The student will evaluate the impact of equity, access, and influence on the distribution of computing resources in a global society, including the impacts of cloud computing.	**CSP.IC.2 The student will analyze and design solutions to address local and global impacts of present and future computing technologies.** a. Analyze and evaluate equity, access, and influence on the distribution of computing resources in a global society. b. Analyze the implications of emerging computing technologies to design solutions.

	c. Create computing artifacts(s) that illustrates a solution to solve a problem locally or globally.
CSP.15 The student will explain how intellectual property concerns affect the tools for and products of computing, including combining existing content to create new artifacts and the impact of open source and free software.	**[Moved to Grade 5 and Grade 7. Refer to 5.IC.3 and 7.IC.3]**
CSP.16 The student will evaluate the social and economic implications of privacy in the context of safety, law, or ethics.	**[Included in CSP.CYB.2]**
	CSP.IC.3 The student will expand career explorations with work-based learning experiences. a. Engage in work-based learning experiences involving computer science and related pathways. b. Create a plan to navigate career pathways that include computer science skills and practices.
	CSP.IC.4 The student will identify and describe the information processing capabilities of artificial intelligence in computing technologies. a. Identify ways artificial intelligence applications can modify their behavior to respond to different people's emotional states. b. Describe the role of natural language processing in computing technologies.

2024 Computer Science Principles SOL – Summary of Changes

Computer Science Principles (2017 SOL to 2024 SOL Numbering)
• CSP.1 → [Moved to MSCSE. Refer to MSCSE-18.CSY.2] • CSP.2 → CSP.CSY.1 • CSP.3 → CSP.NI.1 • CSP.4 → CSP.NI.1 • CSP.5 → [Moved to MSCSE. Refer to MSCSE-36.CYB.1] • CSP.6 → CSP.DA.1 • CSP.7 → CSP.DA.1 • CSP.8 → CSP.DA.1 [Moved to Programming. Refer to PRG.DA.1-Tradeoffs of data organization and storage options] • CSP.9 → [Moved to MSCSE, CSF, and Programming. Refer to MSCSE-36.AP.3, CSF.AP.3, and PRG.AP.2] • CSP.10 → CSP.AP.1 • CSP.11 → CSP.AP.2 • CSP.12 → CSP.AP.3 • CSP.13 → CSP.IC.1 • CSP.14 → CSP.IC.2 • CSP.15 → [Moved to Grades 5 and 7. Refer to 5.IC.3 and 7.IC.3] • CSP.16 → CSP.CYB.2

Deletions from Computer Science Principles (2024 SOL)	Additions to Computer Science Principles (2024 SOL)
• CSP.1 - The student will develop and apply criteria for evaluating a computer system for a given purpose. [Moved to MSCSE-18.CSY.2] • CSP.5 - The student will explain symmetric and asymmetric encryption as they pertain to messages being sent on a network. [Moved to MSCSE-36.CYB.1] • CSP.9 - The student will design and implement algorithms with (a) compound conditional execution; and (b) a variety of loop control structures. [Moved to MSCSE-36.AP.3, CSF.AP.3, and PRG.AP.2] • CSP.15 - The student will explain how intellectual property concerns affect the tools for and products of computing, including combining existing content to create new artifacts and the impact of open source and free software. [Moved to 5.IC.3 and 7.IC.3]	• CSP.AP.4 - The student will weigh the affordances and constraints of different coding representations. • CSP.CYB.1 - The student will evaluate security technologies, techniques, and practices in terms of confidentiality, integrity, and availability. • CSP.CYB.3 - The student will explain the importance of protecting personally identifiable information (PII) and social identity. • CSP.DA.2 - The student will collect and use training data. • CSP.DA.3 - The student will use supervised or unsupervised learning algorithm to train a model on real world data. • CSP.DA.4 - The student will create and refine predictive models based on patterns in data. • CSP.IC.3 – The student will expand on career explorations with work-based learning experiences.

	• CSP.IC.4 – The student will analyze the role of artificial intelligence in computing technologies and understand the underlying concepts that enable its processing of information.

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)

Computer Science Programming Computer Science *Standards of Learning:* 2024 Overview of Revisions

This overview includes a summary of the content embedded in six content strands.

Algorithms and Programming: *Algorithms, a sequence of steps designed to accomplish a specific task, are translated into programs, or code, to provide instructions for computing devices. Creating programs involves choosing information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.*

- Apply computational thinking to manage complex programs
- Plan and implement programs that consist of compound conditionals, complex iterations, and complex computations using a text-based programming language
- Use the iterative design process to create, test, and refine programs using a text-based programming language
- Create programs that demonstrate an understanding of the data structures
- Create programs that demonstrate an understanding of the interactions between classes and object-oriented design
- Explain and justify program design and development decisions
- Interpret, adapt, test, debug, and refine algorithms for use in a particular context and evaluate for efficiency
- Evaluate the relationship between storage, processing, and efficiency, and analyze the role in program development

Computing Systems: *People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.*

- Evaluate the relationship between storage, processing, and efficiency, and analyze the role in program development

Cybersecurity: *Securing information technology involves the protection of computers, networks, programs, and data from unauthorized or unintentional access, manipulation, or destruction. Many organizations store significant amounts of data on computing devices that require continual monitoring and protection for the continued operation of vital systems and national security.*

- Evaluate current and emerging programming security practices
- Write or adapt a program to avoid common vulnerabilities

Data and Analysis: *Data is collected and stored so that it can be analyzed efficiently to better understand the world and make more accurate predictions.*

- Evaluate the tradeoffs between a variety of data organization and storage options
- Use a variety of data types and structures in representing programmatic solutions to real-world problems

- Identify data biases in the data collection process and understand the implications and privacy issues surrounding data collection and processing
- Use a programming language to develop a data visualization

Impacts of Computing: *Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices.*

- Examine the ramifications of technical and ethical design decisions when developing applications
- Expand computer science career explorations with work-based learning experiences

Networks and the Internet: *Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation.*

- No standards for this strand

Comparison of CS Programming Computer Science Standards of Learning—2017 to 2024

2017 Standards of Learning Knowledge and Skills (KS) Cybersecurity	2024 Standards of Learning Knowledge and Skills (KS) Cybersecurity (CYB)
PRG.1 The student will describe and use best practices of program development that make some common flaws less likely and explain how this improves computer security.	**PRG.CYB.1 The student will evaluate current and emerging programming security practices.** a. Create programs that safeguard against user error. b. Create programs that implement encryption algorithms. c. Describe how software programs can meet basic requirements for security based on best practices. d. Describe the impact of software vulnerabilities. e. Evaluate methods developers use to protect unauthorized access to programs.
	PRG.CYB.2 The student will write or adapt a program to avoid common vulnerabilities. a. Understand the role of input validation in programming. b. Develop code that validates input based on defined specifications. c. Explain common vulnerabilities in program function and their impact. d. Understand the impact of vulnerabilities on program function and security.

2017 Standards of Learning Knowledge and Skills (KS) Data and Analysis	2024 Standards of Learning Knowledge and Skills (KS) Data and Analysis (DA)
PRG.2 The student will create programs that model the relationships among different elements in collections of real-world data.	**PRG.DA.2 The student will use a variety of data types and structures in representing programmatic solutions to real-world problems.** a. Research and describe real-world reasoning problems that a search algorithm can be used to sort data.

	b. Read data summaries and visualizations and explain/translate into nontechnical terms for various audience groups. c. Collect, use, and manipulate data from a variety of types and structures. d. Utilize data analysis to create programmatic solutions and draw conclusions based on the results.
PRG.3 The student will translate numbers between machine representations and human-accessible representations.	**[Included in 2.CSY.1 and 4.DA.1]**
	PRG.DA.1 The student will evaluate the tradeoffs between a variety of data organization and storage options. a. Identify and compare data organization methods: variables, arrays, lists, trees, and schemas. b. Assess and compare data storage options such as databases, file systems, local storage, and cloud storage, for scalability, reliability, privacy, and cost. c. Evaluate the impact of data organization and storage choices on program performance, efficiency, and resource utilization.
	PRG.DA.3 The student will identify data biases in the data collection process and describe the privacy concerns surrounding data collection and processing. a. Use the data cycle in the collection and processing of data as part of the development of a program. b. Describe how the data collection process should be focused, relevant, and limited to the scope of the project. c. Analyze data to identify outliers or missing variables that could result in data biases. d. Describe privacy considerations in the collection of data
	PRG.DA.4 The student will use a programming language to develop a data visualization. a. Identify libraries and other resources that enable the visualization of data inputs. b. Compare and contrast the methods of creating data visualizations, including programming languages and application software.

	c. Develop a data visualization using a programming language's data processing function. d. Create visualizations for descriptive and inferential statistical analysis based on the context and intended audience. e. Apply mathematical operations and algorithms to manipulate and extract insights from data sets. f. Justify the design, use, and effectiveness of different forms of data visualizations.

2017 Standards of Learning Knowledge and Skills (KS) Algorithms and Programming	2024 Standards of Learning Knowledge and Skills (KS) Algorithms and Programming (AP)
PRG.4 The student will design and implement a program working individually and in teams using a text-based language.	**PRG.AP.3 The student will use the iterative design process to create, test, and refine programs using a text-based programming language.** a. Trace the execution of iterative and recursive algorithms, illustrating output and changes in values of named variables. b. Develop and systematically use a series of test cases to verify that a program performs according to its design specifications, including edge cases and all branches. c. Use code review to evaluate the correctness, readability, and usability of a program. d. Use debugging tools and user feedback to refine programs. e. Modify existing program to improve functionality.
PRG.5 The student will explain the software life cycle and how it applies to iterative development processes.	**PRG.AP.6 The student will explain and justify program design and development decisions.** a. Explain the software life cycle and how it applies to the iterative design process. b. Justify and communicate decisions and design elements.
PRG.6 The student will design and implement an algorithm • **with compound conditional execution, and analyze and evaluate complex Boolean conditions; and** • **using complex iteration, including nested loops.**	**PRG.AP.2 The student will plan and implement programs that consist of compound conditionals, complex iterations, and complex computations using a text-based programming language.** a. Read and interpret algorithms expressed using plain language, pseudocode, and Unified Modeling Language.

	b. Read and write programs that include compound conditional execution and evaluate complex Boolean conditions. c. Read and write programs that accept input from a a variety of sources and produce output based on that input. d. Read and write programs that include pre-defined and self-defined procedures. e. Read and write programs that include functions with/without parameters, and functions with/without return values. f. Read and write programs that consist of modular division, random number generation, substring manipulation and processing of individual characters. g. Integrate external code with Application Programming Interface (APIs) and library calls.
PRG.7 The student will implement programs that accept input from a variety of sources and produce output based on that input.	**[Included in PRG.AP.2]**
PRG.8 The student will trace the execution of iterative and recursive algorithms, illustrating output and changes in values of named variables.	**[Included in PRG.AP.3]**
PRG.9 The student will perform complex computations • **on numbers, including modular division and random number generation; and** • **on strings, including substring manipulation and processing individual characters.**	**[Included in PRG.AP.2]**
PRG.10 The student will demonstrate an understanding of different data types by using appropriate constructs to convert between them when appropriate.	**[Included in PRG.AP.4]**
PRG.11 The student will analyze a large-scale computational problem, identify generalizable patterns, and implement a solution.	**PRG.AP.1 The student will apply computational thinking to manage complex programs.** a. Identify and categorize real-world problems as classification, prediction, sequential decision, logical deduction, or statistical inference problem. b. Analyze a large-scale computational problem, identify generalizable patterns, and implement a computing-based solution.

	c. Decompose large-scale computational problems into subtasks and components processes and inter-relationships. d. Implement and evaluate abstractions based on their modularity, reusability, and readability.
PRG.12 The student will implement an algorithm that uses existing functions and accesses existing libraries or APIs to satisfy its requirements.	**[Included in PRG.AP.2]**
PRG.13 The student will write functions, both with and without parameters, and both with and without return values, that represent abstractions useful to the solution of a larger problem.	**[Included in PRG.AP.2]**
PRG.14 The student will create programs demonstrating an understanding of the interactions between classes in object-oriented design, and by implementing classes with instance data and methods to satisfy a design specification.	**PRG.AP.5 The student will create programs that demonstrate an understanding of the interactions between classes and object-oriented design.** a. Define and explain the role of inheritance, polymorphism, and encapsulation in object-oriented programming languages. b. Use classes with instance data and methods to satisfy a design specification. c. Organize programs methodically using comments and other organizational structures so that others can understand, interpret, and modify the program.
PRG.15 The student will use code written by others by reading the documentation and incorporating it into their programs using proper citation of the reused code.	**[Moved to Grade 8. Refer to 8.AP.4]**
PRG.16 The student will read and store data in 1D and 2D collections, and design and implement algorithms to process and manipulate those collections.	**PRG.AP.4 The student will create programs that demonstrate an understanding of the data structures.** a. Use linear data structures: arrays, lists, stacks, and queues, and non-linear data structures. b. Evaluate and convert data structures when appropriate. c. Read and write programs that store, process, and manipulate 1D and 2D collections. d. Read and write programs that include search and sort algorithms.
PRG.17 The student will adapt classic algorithms for use in a particular context and analyze them for effectiveness and efficiency.	**PRG.AP.7 The student will interpret, adapt, test, debug, and refine algorithms for use in a particular context and evaluate for efficiency.**

	a. Use Big O notation to compare the benefits and drawbacks of using different algorithms for a particular process.
PRG.18 The student will develop and use a series of test cases to verify that a program performs according to its design specifications, including edge cases and all branches.	**[Included in PRG.AP.2]**
PRG.19 The student will, through the process of code review, evaluate a program's correctness, readability, usability, and other factors.	**[Included in PRG.AP.2]**
PRG.20 The student will use a systematic approach and debugging tools to independently debug a program.	**[Included in PRG.AP.3]** .

2017 Standards of Learning Knowledge and Skills (KS) Computing Systems	2024 Standards of Learning Knowledge and Skills (KS) Computing Systems (CSY)
No 2017 SOL for Computing Systems.	**PRG.CSY.1 The student will evaluate the relationship between storage, processing, and efficiency, and analyze the role in program development.** a. Create programs that utilize persistent storage for program input and output. b. Define the role of cache memory. c. Analyze the impact of different types of memory on program processing speed. d. Conduct a cost-benefit analysis for different types of memory. e. Redesign a program to improve efficiency and performance.

2017 Standards of Learning Knowledge and Skills (KS) Impacts of Computing	2024 Standards of Learning Knowledge and Skills (KS) Impacts of Computing (IC)
PRG.21 The student will identify some of the practical, business, and ethical impacts of open source and free software and the widespread access they provide.	**PRG.IC.1 The student will examine the ramifications of technical and ethical design decisions when developing applications.** a. Use design documents to explain the reasoning for the design decisions made when developing an application.

	b. Research effects of technical design decisions on overall program function. c. Examine and explain the impacts of unintended consequences related to program design.
	PRG.IC.2 The student will expand computer science career explorations with work-based learning experiences. a. Engage in work-based learning experiences involving computer science.

2017 Standards of Learning Knowledge and Skills (KS) Networking and the Internet	**2024 Standards of Learning Knowledge and Skills (KS) Networking and the Internet (NI)**
No standard for Networks and the Internet.	**No standard for Networks and the Internet.**

2024 Computer Science Programming SOL – Summary of Changes

Computer Science Programming (2017 SOL to 2024 SOL Numbering)
• PRG.1 → PRG.CYB.1 and PRG.CYB.2 • PRG.2 → PRG.DA.1 • PRG.3 → [Included in 2.CSY.1 and 4.DA.1] • PRG.4 → PRG.AP.3 • PRG.5 → PRG.AP.6 • PRG.6 → PRG.AP.2 • PRG.7 → PRG.AP.2 • PRG.8 → PRG.AP.3 • PRG.9 → PRG.AP.2 • PRG.10 → PRG.DA.1 • PRG.11 → PRG.AP.1 • PRG.12 → PRG.AP.2 • PRG.13 → PRG.AP.2 • PRG.14 → PRG.AP.5 • PRG.15 → [Moved to Grade 8. Refer to 8.AP.4] • PRG.16 → PRG.AP.4 • PRG.17 → PRG.AP.7 • PRG.18 → PRG.AP.2 and PRG.AP.7 • PRG.19 → PRG.AP.2 • PRG.20 → PRG.AP.3 • PRG.21 → PRG.IC.1

Deletions from Computer Science Programming (2024 SOL)	Additions to Computer Science Programming (2024 SOL)
• PRG.15 – [Moved to Grade 8. Refer to 8.AP.4] • PRG.3 – [Included in 2.CSY.1 and 4.DA.1]	• PRG.CSY.1 - Evaluate the relationship between storage, processing, and efficiency, and analyze the role in program development. • PRG.DA.2 - Use a programming language to develop a data visualization. • PRG.DA.3 - Identify data biases in the data collection process and understand the implications and privacy issues surrounding data collection and processing.

	• PRG.DA.4 - Use a programming language to develop a data visualization. • PRG.IC.2 - Expand computer science career explorations with work-based learning experiences.

KEY: AP = Algorithms & Programming; CYB = Cybersecurity; DA = Data & Analysis; IC = Impacts of Computing; NI = Networking & the Internet; EKS = Essential Knowledge & Skills (2017); KS = Knowledge & Skills (2024)