Ohio's Model Curriculum for Computer Science

Grade 4

ADOPTED SEPT. 2022

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Strand	Computing Systems
Topic	**Devices**

CS.D.4.a Explore external components (i.e., parts) of a computing system and their function to understand and describe the role they play in a computer system.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students developed an understanding that the device they selected for a specific task has components that all play a role in the computer system. In grade 4, students develop their understanding of what external components are used to share information. In grade 5, students will develop their understanding of the internal parts of the computer and how they play a role in the computer system. **IMPORTANT CONCEPTS** - External devices are used to input, store and transfer data into the computer. - Different devices have different purposes. - Each external component (i.e., part) has a different function in a computer system. **KEY SKILL/PROCEDURES** - Identify key external components (i.e., parts) such as USB port, HDMI, network cable, power supply, etc. - Select the appropriate device to accomplish a task. - Describe the components of the selected device. ## Content Elaborations **CLARIFICATIONS** External components (i.e., parts) in this grade level may focus on things plugged-in or attached to the computer. External components can include a USB port and drive, power supply, network cable or HDMI port. Depending on the device, some of these components may or may not exist. For example, on some tablets, a USB port is not available. Mobile devices do not always require the device to be plugged into the power source. **CONTENT FOCUS** The focus should be on students understanding the components (i.e., parts) of the device that they select for their task. For example, if they select a networked computer, this can allow them to communicate with others globally. If their computer is not connected to a network, their communication is limited.

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Strand	Computing Systems
Topic	Devices
	COMPUTER SCIENCE PRACTICES *Practice 2.* Collaborating Around Computing 4. Evaluate and select technological tools that can be used to collaborate on a project.

Strand	Computing Systems
Topic	Hardware and Software

CS.HS.4.a Select and use digital learning tools/devices to support planning, implementing and reflecting upon a defined task.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students selected learning tools or devices to plan, implement, and reflect upon tasks. In grade 4, students continue to select learning tools/devices and use them to aid in planning, implementing and reflecting on given tasks. In grade 5, students will use and evaluate the digital learning tools and devices they've chosen and consider the planning, implementation and reflection across curricular areas.

IMPORTANT CONCEPTS
- Different types of software and hardware can be used to accomplish a task.
- Learning tools should support the planning, implementation and reflection of a task.

KEY SKILL/PROCEDURES
- Select and use a tool such as a presentation software program, document, graphic design program or video creating software to accomplish a given task.
- Select and use an appropriate device, such as a tablet, laptop or desktop to accomplish a given task.

Content Elaborations

CLARIFICATIONS
Tools should begin to extend to apps and programs beyond basic programs provided on the selected devices. Selection and use of a variety of devices such as tablets, desktops and laptops should be included.

CONTENT FOCUS
The focus is on students selecting and using their tools or devices. Tasks should increase in complexity from third grade and focus on specific curricular goals in the subject content.

COMPUTER SCIENCE PRACTICES
Practice 2. Collaborating Around Computing
    4. Evaluate and select technological tools that can be used to collaborate on a project.

Career Connections

CAREER AWARENESS
Students select a career and identify the digital tools used in the career. Students then choose a task that a person in that career would perform. Students create a presentation reflecting their research.

Strand	Computing Systems
Topic	**Troubleshooting**

CS.T.4.a Diagnose problems and select an appropriate solution from a list of problems and solutions to resolve hardware and software issues.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students began to move beyond trial and error to apply more strategic troubleshooting techniques to fix their problems. In grade 4, students focus on diagnosing and describing potential hardware and software problems. In grade 5, students will work to diagnose problems, describe the problem and develop strategies to resolve technology issues. **IMPORTANT CONCEPTS** • Troubleshooting strategies can be used to solve hardware and software issues. **KEY SKILL/PROCEDURES** • Diagnose problems in hardware and software. • Select a solution for the problem from a given list. ## Content Elaborations **CLARIFICATIONS** Students should describe the reason for the problem. For example, if the computer does not turn on, maybe the battery is dead. If the program does not work, maybe the username or password is wrong. If needed, students should be able to select solutions from a list of potential solutions. Students should be exposed to specific problems so they can develop the skills to troubleshoot in the future (i.e., disconnecting a computer from the network so that students can see what this looks like). **CONTENT FOCUS** The focus is on students diagnosing and describing problems. Students should be able to select solutions. **COMPUTER SCIENCE PRACTICES** *Practice 6.* Testing and Refining Computational Artifacts 2. Identify and fix errors using a systematic process.

Strand	Networks and the Internet
Topic	Networking

NI.N.4.a Describe how information is broken down to be transmitted over a network to help students gain a better understanding of the internet and networks.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students explored how information is sent and received over the internet. In grade 4, students explain how information is broken apart, sent and received over the internet. In grade 5, students will demonstrate how information is broken apart, sent and received over the internet.

IMPORTANT CONCEPTS
- Manipulating a URL (i.e., web address) even slightly can change what information is accessed.
- Information is broken into parts at the sending point and reassembled at the receiving point.

KEY SKILL/PROCEDURES
- Modify a URL (i.e., web address) to access the content.
- Describe what occurs when a URL is modified.
- Use a metaphorical example to describe how information is broken down into parts and reassembled.

Content Elaborations

CLARIFICATIONS
Students should understand that altering a URL will change the information that is displayed. An example of metaphorical connection students could make to describe how information is transmitted would be a roller coaster ride. The track could be seen as the internet connection and the cars and the people are the information traveling through the connection.

CONTENT FOCUS
The focus is on students modifying a URL to reach a specific site and describing how the modification impacts the information accessed. Students communicate how information is transmitted.

COMPUTER SCIENCE PRACTICES
Practice 4. Developing and Using Abstractions
   4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.

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Strand	Networks and the Internet
Topic	**Networking**

NI.N.4.b Describe network addresses, names and rules (i.e., protocols) to share or receive information from the global community.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students have developed an understanding of how information is shared, received and stored. In grade 4, students identify that different naming techniques are related to the type of information accessed. In grade 5, students will continue applying this knowledge. **IMPORTANT CONCEPTS** • Different types of rules for naming a web address identify different types of sites. • The search terms or the web address is converted to a format that the computer can read to reach the desired site. **KEY SKILL/PROCEDURES** • Identify the reliability of a site based on the naming rule (e.g., top-level domain). • Use search techniques (Boolean) to allow the computer to understand what is being searched. ## Content Elaborations **CLARIFICATIONS** Students identify reliability based on the top-level domain naming such as ".edu" for education purposes, ".com" for commercial purposes, ".gov" for government purposes, and ".org" for organizations. Boolean searches use " ", *and, or*, etc. **CONTENT FOCUS** The focus is on identifying informational reliability and making a connection between search terms and website addresses. **COMPUTER SCIENCE PRACTICES** *Practice 4.* Developing and Using Abstractions 4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.

Strand	Networks and the Internet
Topic	Cybersecurity

NI.C.4.a Describe what information should be protected and the importance of a secure password to protect information.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students explored and understood personal information and how passwords are used to protect information. In grade 4, students describe types of private information and the importance of protecting that information. In grade 5, students will create secure passwords to protect personal information and store them securely. **IMPORTANT CONCEPTS** • Personal information should be protected by secure passwords. • Potential consequences of personal information being unsecured. **KEY SKILL/PROCEDURES** • Describe why personal information needs to be protected. • Describe what could happen if personal information is unsecured. ## Content Elaborations **CLARIFICATIONS** Students often only associate the worst-case scenario with sharing information. They need to understand the real-world dangers of personal information being shared in an unsecured environment. Students need to know what a secure password looks like and why they should use a secure password. **CONTENT FOCUS** The focus is on students identifying why information needs to be protected and being aware of consequences related to data security. **COMPUTER SCIENCE PRACTICES** *Practice 3.* Recognizing and Defining Computational Problems 1. Identify complex, interdisciplinary, real-world problems that can be solved computationally.

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Strand	Networks and the Internet
Topic	Cybersecurity

NI.C.4.b Describe and explain safe usage of various online services such as web, email, video, gaming, cloud services and networked drives.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students learned to explore and explain grade-appropriate examples of unsafe content. In grade 4, students describe the effects of malicious content. In grade 5, students will analyze the appropriate and inappropriate use of online services. **IMPORTANT CONCEPTS** • Online services have different purposes and methods of use. • Devices can be used for proper or improper purposes. • Not all online services are safe. **KEY SKILLS/PROCEDURES** • Define and describe malware and pop-ups. • Explain how to protect yourself from malware, pop-ups and other threat vectors. • Describe the effects of malware and the use of malware to access private information. ## Content Elaborations **CLARIFICATIONS** Many devices can connect to the internet (cloud services) to share information and access applications (Apps). Students should understand that using websites, email, video gaming, cloud services and networked drives that share information adds to the need for security practices. **CONTENT FOCUS** The focus is on students identifying and securing personal information and being aware of the consequences of data security, malware and other online threat vectors. **COMPUTER SCIENCE PRACTICES** *Practice 2.* Collaborating Around Computing Practice 　4. Evaluate and select technological tools that can be used to collaborate on a project. *Practice 5.* Creating Computational Artifacts 　2. Create a computational artifact for practical intent, personal expression, or to address a societal issue. 　3. Modify an existing artifact to improve or customize it.

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Strand	Networks and the Internet
Topic	**Internet of Things**

NI.IOT.4.a Explore how information is transferred to the internet from smart and intelligent devices to recognize how the internet and networks operate.

NI.IOT.4.b Describe how transferred information is tagged using identifiers to transmit information about the user so students begin to learn no information on the internet is anonymous.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students described information transmission, explored and explained the difference between smart and intelligent devices. In grade 4, students recognize how smart and intelligent devices communicate over the internet and see how network communication can be traced. In grade 5, students will explore how information is transmitted over the internet and identify the risks and benefits of using the internet.

IMPORTANT CONCEPTS
- The information collected by smart and intelligent devices to be transferred over the internet can be identified by the user.
- No information that is transmitted over the internet is anonymous.

KEY SKILLS/PROCEDURES
- Describe how information can be identified when transmitted over a network.
- Explain how information is sent over a network from a smart or intelligent device.

Content Elaborations

CLARIFICATIONS
Smart devices know how to create packets of information that have a "sender" and "recipient." Devices on the internet know how to route those packets to the correct recipient.

Explain how data is transmitted across the internet and that anyone is allowed to look at it. Discuss that the act of sending information implies that the sender is permitting anyone who can see the data stream to examine its contents.

An example is the letter metaphor: Anyone can see the address on an envelope. If you open it and read it, you will know the contents. You can use coded (encrypted) messages to prevent people from knowing what the letter says.

CONTENT FOCUS
Describe how information is split into packets for communication and how those packets can be traced back to the sender.

Strand	Networks and the Internet
Topic	Internet of Things
	COMPUTER SCIENCE PRACTICES *Practice 4.* Developing and Using Abstractions 4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes. *Practice 7.* Communicate About Computing 3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution.

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Strand	Data and Analysis
Topic	**Data Collection and Storage**

DA.DCS.4.a Gather and organize multiple quantitative data elements using a tool to perform various tasks.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students collected, recorded and maintained data over time using various tools, such as a thermometer, ruler, scale and survey. In grade 4, students build upon the use of tools from grade 3, to collect data from multiple sources within a singular topic over time. In grade 5, students will select appropriate tools to collect data from multiple sources within a singular topic over time.

IMPORTANT CONCEPTS
- Keeping an organized record of data over time is critical to analyzing data.
- Various tools can be used to generate data.
- Different tools are used to collect different types of data.

KEY SKILL/PROCEDURES
- Use appropriate tools to collect data.
- Use appropriate tools to organize data.
- Maintain accurate data from multiple sources within a singular topic over some time.
- Collect data from multiple sources within a singular topic, by making repeated observations over time.

Content Elaborations

CLARIFICATIONS
Tools that may be explored are digital thermometers, GPS sensors, calculators, scales, digital forms (i.e., survey tools), length measurement tools, a stopwatch, etc.

Data can be organized by using various digital and non-digital tables and charts. Digital organizational resources could include spreadsheets, online graphing programs, etc.

An example of collecting data from multiple sources within a singular topic could be collecting the height of students in three different classes throughout the school year.

CONTENT FOCUS
The focus is on students collecting, recording, maintaining and organizing data from multiple sources within a singular topic over time.

COMPUTER SCIENCE PRACTICES
Practice 7. Communicating About Computing
    1. Select, organize and interpret large data sets from multiple sources to support a claim.

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Strand	Data and Analysis
Topic	**Data Collection and Storage**

DA.DCS.4.b Identify techniques and formats to store, process and retrieve different types of information.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students used different software tools to access data and store it in different locations. In grade 4, students begin to gain an understanding that different file types may require different storage. In grade 5, students will use their knowledge of file types to explore how file size impacts storage. **IMPORTANT CONCEPTS** • Different data is stored in different ways on a computing device. • Data can be stored locally, on a computing device or online. • How data is stored impacts accessibility. **KEY SKILL/PROCEDURES** • Store data as a specific file type. • Locate and retrieve data on a computing device. ## Content Elaborations **CLARIFICATIONS** Examples of data storage could include saving to a device, local network or the cloud. Accessibility refers to the ability to retrieve data. Students should understand that data saved to a device will not be accessible without that same device. Accessibility also refers to the ability to open file formats on different devices. Information refers to data, which could include pictures, audio, video, or documents. Examples of file types would be image (i.e., .jpg, .png, .gif .bmp), document (e.g., .doc, .docx, .pages, .txt), multi-media (e.g., .mov, mp4, .wmb) and presentation (e.g., .ppt, .pptx, .key). **CONTENT FOCUS** The focus is that data storage impacts the accessibility of information and that different data types are stored in different formats. **COMPUTER SCIENCE PRACTICES** *Practice 7.* Communicating About Computing 1. Select, organize and interpret large data sets from multiple sources to support a claim.

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Strand	Data and Analysis
Topic	**Visualization and Communication**

DA.VC.4.a Organize data into subsets to provide different views or commonalities and present insights gained using visual or other types of representations.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students extended their knowledge by creating scaled pictures and bar graphs. They also created line plots using scales that include whole numbers and fractions (e.g., halves and fourths). In grade 4, students interpret data in self-created graphs to present insights. In grade 5, students will use graphs created to highlight and support a claim they have made. **IMPORTANT CONCEPTS** • A symbol on a graph (picture, bar, etc.) can represent more than one item. • A key on a graph indicates how many items a symbol represents. • A scale on a bar graph varies depending on the data available. • Symbols used in picture graphs should be evenly spaced to present visually accurate data. • Data from a graph can be used to gain insights or solve a problem. **KEY SKILL/PROCEDURES** • Record data with several categories on a scaled bar graph or picture graph. • Determine the appropriate scale for the data given. • Interpret and answer questions regarding data presented in a bar or picture graph. ## Content Elaborations **CLARIFICATIONS** An important concept for students to begin to understand is that a scale is chosen based on the data available. Students should begin understanding that data is used to solve problems. For example, if many people report they do not recycle due to a lack of recycling bins, we can conclude that providing recycling bins to people will increase recycling and improve the environment. **CONTENT FOCUS** The focus is on students using a visual representation to communicate the data they have collected and interpreting the data to answer questions. **COMPUTER SCIENCE PRACTICES** *Practice 7.* Communicating About Computing 　　1. Select, organize and interpret large data sets from multiple sources to support a claim.

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Strand	Data and Analysis
Topic	Inference and Modeling

DA.IM.4.a Utilize data to make predictions and discuss whether there is adequate data to make reliable predictions.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students analyzed and explained relationships or patterns and predicted an unknown. In grade 4, students determine if adequate data has been collected and run simulations to explore outcomes. In grade 5, students will run simulations to test theories and make predictions about how larger data sets affect outcomes. **IMPORTANT CONCEPTS** • Data from a graph can be used to determine patterns. • Patterns can be analyzed to determine a missing value and predict outcomes. • A data set can be modified to manipulate outcomes. • Analyze trends based on the number of data sets. **KEY SKILL/PROCEDURES** • Answer questions about missing variables in a data set. • Use data to make predictions about outcomes. • Manipulate data and explain how quantity affects outcomes. ## Content Elaborations **CLARIFICATIONS** Students explain patterns in data and identify missing values. They begin to manipulate data and reflect on how the quantity of data affects outcomes. Students will use software tools such as spreadsheets to manipulate the quantity of data and reflect on changes that occur. **CONTENT FOCUS** The focus is on students identifying patterns in data to find missing values. They predict outcomes to continue patterns. **COMPUTER SCIENCE PRACTICES** *Practice 4.* Developing and Using Abstractions 1. Extract common features from a set of interrelated processes or complex phenomena.

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Strand	Algorithmic Think and Programming
Topic	**Algorithms**

ATP.A.4.a Construct and refine an algorithm to accomplish a given task.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students experienced designing algorithms. In grade 4, students refine an algorithm to accomplish a given task. In grade 5, students will compare and refine algorithms with a focus on efficiency. **IMPORTANT CONCEPTS** • An algorithm is a series of steps to complete a process or task. • Once algorithms are created and written, they need to be tested and possibly revised based on the results. • Pseudocode and flowcharts can be used to create and modify an algorithm. **KEY SKILL/PROCEDURES** • Utilize logical patterns of progression within an algorithm to modify it to accomplish a given task. • Recognize and identify errors within an algorithm to modify it to accomplish a given task. • Utilize pseudocode and flow charts to assist with creating and modifying an algorithm to accomplish a given task. ## Content Elaborations **CLARIFICATIONS** Processes of computational thinking (i.e., logical thought) or beginning, middle and end to create organized steps should be emphasized to decompose, abstract, and reassemble an algorithm. Use proper editing for modifying algorithms (i.e., conditional, loops). Computational thinking also needs to be emphasized to identify where an error has occurred and the process needed to fix it. This can be written in code, pseudocode, real language or flowcharts. **CONTENT FOCUS** The focus is on students modifying the algorithm to fix it and reconstructing it to accomplish a given task. **COMPUTER SCIENCE PRACTICES** *Practice 3*. Recognizing and Defining Computational Problems 2. Decompose real-world problems.

Strand	Algorithmic Think and Programming
Topic	Variables and Data Representation

| ATP.VDR.4.a Identify and use a variable, a placeholder for storing a value, to understand how it works in a multi-step process (i.e., algorithm). | **Expectations for Learning**

LEARNING PROGRESSION
In grade 3, students defined and identified variables to understand how they are used in algorithms.
In grade 4, students further expand on defining and identifying variables and begin to use them.
In grade 5, students will create a variable to store and modify data.

IMPORTANT CONCEPTS
• Letters or symbols are used to represent a variable within an algorithm.
• Data can be stored in the variable.
• Variables represent a changing value.

KEY SKILL/PROCEDURES
• Explain and identify variables within algorithms.
• Write an algorithm that substitutes a variable for a value.
• Edit the algorithm to show how it changes the algorithm's result.

Content Elaborations

CLARIFICATIONS
Symbols such as letters are used in programming to hold values. Students need to learn that the syntax (i.e., the order of symbols in the equation) may impact the success of a program. Students can explore what happens when the data stored in a variable is changed.

For example, a cloze activity allows students to choose varying words for a single blank within a passage. Students would examine how this changes the meaning of the passage. This is a variable (i.e., a placeholder that can change).

Students are not required to know and recognize the formal terms "variable" and "algorithm."

CONTENT FOCUS
The focus is on students being able to define and identify unknown variables as symbols, such as letters, and understanding how they are used in algorithms to store data. Students should begin using variables within equations.

COMPUTER SCIENCE PRACTICES
Practice 4. Developing and Using Abstractions
  1. Extract common features from a set of interrelated processes or complex phenomena. |

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Strand	Algorithmic Think and Programming
Topic	Control Structures

| ATP.CS.4.a Create a program using sequences, events, loops and conditionals to solve a problem. | ## Expectations for Learning

LEARNING PROGRESSION
In grade 3, students built upon their skills and knowledge to create programs with more refined strategies, such as loops and conditionals, and considered the components of an event. In grade 4, students continue to refine their programming skills using established structures such as loops and conditionals. In grade 5, students will apply these new skills in increasingly complex ways and will continue to refine these to work towards programming efficiency.

IMPORTANT CONCEPTS
• Loops are statements that repeat and make programming more efficient for the computer and the programmer.
• Conditionals are typically in the form of "if/then" statements and enable the program to follow different paths.
• Events are structures that programmers can use to explain how the program will react when the user interacts with it.
• Proper sequencing of steps within the program ensures efficiency.

KEY SKILL/PROCEDURES
• Insert a loop in a program to avoid typing a command several times.
• Insert a conditional in a program to create several paths (if/then).
• Create an event in the format "When (action), then (result) occurs."
• Diagram the flow of a program to demonstrate the sequence of its events and products.
• Combine statements to make a length of code shorter (i.e. if/else/then).

Content Elaborations

CLARIFICATIONS
Loops can occur in programming by having the robot or pen repeat a motion several times, such as going forward ten paces and then turning thirty degrees. In an algorithm, students can program to have a number added several times.

Conditionals occur in a program by inserting a command to complete when a condition is met. For instance, if a condition states "If n=5," when the value n=5 is achieved, then the program will execute the command given.

Events can be thought of as an action because of an action. Such as, "When I click the mouse, the the image rotates." |

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Strand	Algorithmic Think and Programming
Topic	**Control Structures**
	Sequencing of events and commands is an important part of programming when creating a program from scratch or remixing an existing one. Students can diagram or describe the steps of a program using a flowchart or other graphic organizer. **CONTENT FOCUS** The focus is on students using a loop, conditional, and/or event. Students should also diagram or describe the flow of a program. The complexity of the loops, conditionals, events, and sequences continues to increase from the prior grade level. **COMPUTER SCIENCE PRACTICES** *Practice 4.* Developing and Using Abstractions 1. Extract common features from a set of interrelated processes or complex phenomena.

Strand	Algorithmic Think and Programming
Topic	Modularity

ATP.M.4.a Decompose (i.e., break down) the steps needed or not needed (i.e., abstraction) into precise sequences of instructions to design an algorithm.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students experienced decomposing abstractions into sequences to design algorithms.
In grade 4, students continue to refine the decomposition, abstraction and algorithm creation process.
In grade 5, students will begin to compare and refine multiple algorithms for efficiency.

IMPORTANT CONCEPTS
- Modularity refers to components of programs that complete a procedure or task. Modules within a program may need to be evaluated, refined and/or copied.

KEY SKILL/PROCEDURES
- Utilize logical patterns of progression within an algorithm to make the best use of a series of steps to decompose the algorithm into functional sections.
- Regroup or redesign sets of a decomposed algorithm to modify the result of the algorithm.
- Determine if the logic of an algorithm requires decomposition or abstraction.
- Utilize pseudocode and flow charts as related to the algorithm.

Content Elaborations

CLARIFICATIONS
Processes of logical thought should include the dissection of a whole into its parts. Solve smaller sections of a larger equation to determine its functionality toward the end goal. Ensure that sets of instructions include all needed parts to modify the result to reach the end goal. This can be written in code, pseudocode, real language or flowcharts related to the language of the algorithm.

CONTENT FOCUS
The focus is on students using computational thinking as they work through an algorithm and then breaking an algorithm into its smaller components (i.e., parts) and logically determining if an error has occurred somewhere within an algorithm.

COMPUTER SCIENCE PRACTICES
Practice 3. Recognizing and Defining Computational Problems
    2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.

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Strand	Algorithmic Think and Programming
Topic	**Modularity**
	Practice 4. Developing and Using Abstractions 3. Create modules and develop points of interaction that can apply to multiple situations and reduce complexity. *Practice 7.* Communicating about Computing 1. Select, organize and interpret large data sets from multiple sources to support a claim.

Strand	Algorithmic Think and Programming
Topic	**Program Development**

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ATP.PD.4.a Use a design process to plan and develop a program that addresses a multi-step problem.

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Expectations for Learning

LEARNING PROGRESSION
In grade 3, students began to design and create a program to solve a problem. In grade 4, students design and create a program for a multi-step problem. In grade 5, students will design and create a program that addresses a multi-step problem and the preferences of the end user.

IMPORTANT CONCEPTS
- A flow chart is one type of organizational tool that can be used to plan a program considering the sequence of its features.
- An algorithm can be used to plan a program.
- Programs can execute multiple steps.

KEY SKILL/PROCEDURES
- Design a program that can solve a problem.
- Use the design process when planning a program.
- Create a program for a multi-step problem.

Content Elaborations

CLARIFICATIONS
Programs can be designed in a plugged (i.e., using a computer) or unplugged environment (i.e., not using a computer).

Programs can be designed using a block-based environment.

Multi-step problems will ask the user to complete two or more tasks.

A flow chart is a type of organizational tool that can be used to plan a program.

CONTENT FOCUS
The focus is on designing a program that can solve a problem with two or three steps.

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Strand	Algorithmic Think and Programming
Topic	Program Development
	COMPUTER SCIENCE PRACTICES *Practice 5.* Creating Computational Artifacts 1. Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, considering key features, time and resource constraints and user expectations. 2. Create a computational artifact for practical intent, personal expression or to address a societal issue.

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Strand	Algorithmic Think and Programming
Topic	Program Development

ATP.PD.4.b Using guided questions, work through a program to identify errors and discuss possible solutions to repair the program.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, guided questions were asked to help students think more strategically about how to solve a problem in their program. In grade 4, students continue with guided questions that assist them in debugging their program. In grade 5, students will become less dependent upon guided questions and will begin to debug more complex programs.

IMPORTANT CONCEPTS
- A computer bug is a series of commands that do not properly interact with each other and causes interruptions in the program execution (i.e., an error in the program).
- To "debug" is to find the error within a program and then apply an appropriate fix.

KEY SKILL/PROCEDURES
- Identify errors in a program.
- Apply a fix to errors in a program.

Content Elaborations

CLARIFICATIONS
If a program that is written will not execute properly, programmers often refer to the issue as the program "breaks" or the program has a "bug" error. "Debugging" a program refers to scanning through the program code to find the error in the commands and then correcting or repairing that programming code.

Guided questions are questions that prompt the programmer to think more about their error and problem solve potential solutions without being given the answer.

Program complexity increases from grade level to grade level.

CONTENT FOCUS
The focus is on locating errors in a block-based environment program and through guided questioning determining solutions and applying the fix.

COMPUTER SCIENCE PRACTICES
Practice 6. Testing and Refining Computational Artifacts
2. Identify and fix errors using a systematic process.

Strand	Artificial Intelligence
Topic	Machine Learning

AI.ML.4.a Explain three different machine learning approaches to choose which may be best for a given situation.	## Expectations for Learning
	
	LEARNING PROGRESSION
	In grade 3, students were introduced to three different types of machine learning and labeled them.
	In grade 4, students explain three different machine learning approaches. In grade 5, students will compare the three types of machine learning.
	
	IMPORTANT CONCEPTS
	    • Explain three different machine learning approaches (supervised learning, unsupervised learning and reinforcement learning).
	
	KEY SKILLS/PROCEDURES
	    • List problems Artificial Intelligence (AI) could encounter.
	    • Decipher which machine learning would work best to discover AI limitations.
	
	## Content Elaborations
	
	CLARIFICATIONS
	Machine Learning is the study of computer algorithms that improve automatically through experience. Applications range from data-mining programs that discover general rules in large data sets to information filtering systems that automatically learn users' interests.
	
	CONTENT FOCUS
	There are different types of machine learning.
	
	COMPUTER SCIENCE PRACTICES
	Practice 3. Recognizing and Defining Computational Problems
	    1. Identify complex, interdisciplinary, real-world problems that can be solved computationally.
	    2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.
	    3. Evaluate whether it is appropriate and feasible to solve a problem computationally.

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Strand	Artificial Intelligence
Topic	Machine Learning

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AI.ML.4.b Explain how machine learning can create a bias to understand how computers can be biased.

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Expectations for Learning

LEARNING PROGRESSION
In grade 3, students learned about the concept of bias in machine learning. In grade 4, students explain how machine learning can create a bias. In grade 5, students will describe how an algorithm can affect machine learning and how humans can introduce bias into algorithms for machine learning.

IMPORTANT CONCEPTS
- Explain how machine learning can create a bias.

KEY SKILLS/PROCEDURES
- Give examples of how computers using machine learning can create bias.

Content Elaborations

CLARIFICATIONS
Data sets are formed from input from sensors.

CONTENT FOCUS
Input in machine learning can be biased based on the identified data set.

COMPUTER SCIENCE PRACTICES
Practice 3. Recognizing and Defining Computational Problems
1. Identify complex, interdisciplinary, real-world problems that can be solved computationally.
2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.
3. Evaluate whether it is appropriate and feasible to solve a problem computationally.

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Strand	Artificial Intelligence
Topic	Machine Learning

AI.ML.4.c Describe tasks where AI outperforms human tasks and when it does not to describe how humans rely on AI.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students identified tasks that use Artificial Intelligence (AI) to perform human tasks. In grade 4, students describe tasks where AI outperforms human tasks. In grade 5, students will describe tasks where AI outperforms humans and where it does not. Then propose ways AI could perform human tasks. **IMPORTANT CONCEPTS** - Students discover AI and its growth and change as it improves and outperforms humans. **KEY SKILLS/PROCEDURES** - List ways humans depend on AI for everyday tasks. - Compare and contrast tasks humans and AI each do better. ## Content Elaborations **CLARIFICATIONS** AI can perform tasks that humans once did. As AI grows, it can take over more human tasks like self-driving cars. **CONTENT FOCUS** AI is a growing field that can replicate some human tasks. AI takes a long time to develop and is not perfect. **COMPUTER SCIENCE PRACTICES** *Practice 3.* Recognizing and Defining Computational Problems 1. Identify complex, interdisciplinary, real-world problems that can be solved computationally. 2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures. 3. Evaluate whether it is appropriate and feasible to solve a problem computationally.

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Strand	Artificial Intelligence
Topic	**Natural Interactions**

AI.NI.4.a Use AI systems that are designed to be inclusive and describe how they affect the humans who use them.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3 students located Artificial Intelligence (AI) systems to help everyone have equal access. In grade 4, students use AI systems that are designed to be inclusive and describe how they affect humans. In grade 5, students will describe ways that AI can be used for inclusivity. **IMPORTANT CONCEPTS** • List ways AI can be used for inclusivity and how it can affect humans. **KEY SKILLS/PROCEDURES** • List ways humans are barred from accessing technology, such as physical needs, community needs, etc. • List ways technology can help humans to explain how AI can be used for inclusivity. ## Content Elaborations **CLARIFICATIONS** Accessible design is a design process in which the needs of people with disabilities are specifically considered. Accessibility sometimes refers to the characteristic that products, services and facilities can be independently used by people with a variety of disabilities. **CONTENT FOCUS** Humans can be barred from technology for a variety of reasons. AI can assist in making technology accessible to all. **COMPUTER SCIENCE PRACTICES** *Practice 4.* Developing and Using Abstractions 1. Extract common features from a set of interrelated processes or complex phenomena. 2. Evaluate existing technological functionalities and incorporate them into new designs. 3. Create modules and develop points of interaction that can apply to multiple situations and reduce complexity. 4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.

Strand	Artificial Intelligence
Topic	**Natural Interactions**

AI.NI.4.b Give examples of bias to demonstrate how it can affect decision-making.	## Expectations for Learning **LEARNING PROGRESSION** In grade 4, students gave examples of bias and how it affects decision-making. In grade 6, students will identify and explain how humans have agency in curating training data sets to identify bias in machine learning **IMPORTANT CONCEPTS** • Data input for Artificial Intelligence (AI) and how it creates bias. **KEY SKILLS/PROCEDURES** • Explore the various types of bias based on data sets. • Give examples of bias found in machine learning including sample bias, exclusion bias, recall bias, observer bias, racial bias and association bias. • Explore bias in advertising based on Big Data, Netflix, TikTok and YouTube, and make recommendations to defend how data is used to create biased recommendations. ## Content Elaborations **CLARIFICATIONS** The type of bias can affect the outcome of AI. **CONTENT FOCUS** Bias in data input can have negative consequences. **COMPUTER SCIENCE PRACTICES** *Practice 4.* Developing and Using Abstractions

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Strand	Artificial Intelligence
Topic	**Perception**

AI.P.4.a Describe the difference between analog and digital signals to understand their uses.
 	
AI.P.4.b Give examples of computer perception to understand how it is affected by the environment.
	## Expectations for Learning
	
	LEARNING PROGRESSION
	In grade 3, students moved from intelligent agents as a form of perception to how computers perceive the world compared to humans. In grade 4, students give examples of computer perception. In grade 5, students will demonstrate the limitations of how computers interact with humans.
	
	IMPORTANT CONCEPTS
	• Give examples of computer perception to demonstrate how computer input can create biased output.
	
	KEY SKILLS/PROCEDURES
	• Gather data on a topic from the class.
	• Compare gathered data to a larger group to demonstrate how it can be affected by the environment.
	
	## Content Elaborations
	
	CLARIFICATIONS
	Computers only know what we tell them through data input.
	
	CONTENT FOCUS
	Data can show a bias.
	
	COMPUTER SCIENCE PRACTICES
	Practice 3. Recognizing and Defining Computational Problems
	  1. Identify complex, interdisciplinary, real-world problems that can be solved computationally.
	  2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.
	  3. Evaluate whether it is appropriate and feasible to solve a problem computationally.

Strand	Artificial Intelligence
Topic	Representation & Reasoning

AI.RR.4.a Create a classification system using a tree structure to understand binary solutions.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students created a classification system to see how computers think. In grade 4, students create a classification system using a tree structure. In grade 5, they will create a tree structure to demonstrate binary solutions. **IMPORTANT CONCEPTS** • Create a flowchart using binary solutions to make a decision. **KEY SKILLS/PROCEDURES** • Use a flowchart to show the decision-making process. ## Content Elaborations **CLARIFICATIONS** Decision trees help Artificial Intelligence (AI) make decisions through machine learning. **CONTENT FOCUS** Decision trees in artificial intelligence are used to arrive at conclusions based on the data available from decisions made in the past. **COMPUTER SCIENCE PRACTICES** *Practice 5.* Creating Computational Artifacts 1. Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints and user expectations. 2. Create a computational artifact for practical intent, personal expression, or to address a societal issue. 3. Modify an existing artifact to improve or customize it.

Strand	Artificial Intelligence
Topic	**Representation & Reasoning**

AI.RR.4.b Describe how AI represents knowledge to make a reasonable answer.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students were introduced to the idea of reasonable answers with Artificial Intelligence (AI). In grade 4, students describe how AI represents knowledge to make a reasonable answer. In grade 5, students will describe how AI knowledge supports reasonable answers. **IMPORTANT CONCEPTS** • AI tries to give a reasonable answer based on the input. **KEY SKILLS/PROCEDURES** • Create scenarios that challenge the AI to provide an unreasonable answer. ## Content Elaborations **CLARIFICATIONS** Students determine what qualities make an answer reasonable. Students differentiate between different data sets to find a reasonable answer. **CONTENT FOCUS** AI is complex and must make many decisions to differentiate between multiple meanings. **COMPUTER SCIENCE PRACTICES** *Practice 3.* Recognizing and Defining Computational Problems 1. Identify complex, interdisciplinary, real-world problems that can be solved computationally. 2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures. 3. Evaluate whether it is appropriate and feasible to solve a problem computationally.

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Strand	Artificial Intelligence
Topic	**Societal Impacts**

AI.SI.4.a Give examples of bias to demonstrate how it can affect specific groups of people.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students identified bias and how it can influence humans. In grade 5, students will explore how data can be influenced by bias and how it affects Artificial Intelligence (AI). **IMPORTANT CONCEPTS** • Bias can affect decision-making. **KEY SKILLS/PROCEDURES** • Give examples of bias to demonstrate how affects humans and machines based on algorithms used. ## Content Elaborations **CLARIFICATIONS** Bias is a human trait and it has consequences. **CONTENT FOCUS** Bias is a way humans make quick decisions; these decisions have consequences. **COMPUTER SCIENCE PRACTICES** *Practice 3.* Recognizing and Defining Computational Problems 　1. Identify complex, interdisciplinary, real-world problems that can be solved computationally. 　2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures. 　3. Evaluate whether it is appropriate and feasible to solve a problem computationally.

Strand	Impacts of Computing
Topic	**Culture**

IC.Cu.4.a List examples of computing technologies that have changed the global community to express how those technologies influence and are influenced by cultural practice.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students identified the impact technology has on everyday life in the local community.
In grade 4, students recognize the impact of technology on the global community. In grade 5, students will explain how technology has changed everyday life globally.

IMPORTANT CONCEPTS
- People within a local region use technology in various ways.
- Daily life is influenced by the technology within the community.

KEY SKILL/PROCEDURES
- Identify specific types of technology used in the global community.
- Describe ways that various technology resources impact daily life in a region.

Content Elaborations

CLARIFICATIONS
New computing technology is created, and existing technologies are modified for many reasons, including to increase their benefits, decrease their risks, and meet societal needs. Students explore topics that relate to the history of technology and the changes in the world due to technology. Topics could be based on current news content, such as robotics, wireless internet, mobile computing devices, GPS systems, wearable computing, or ways social media has influenced social and political changes. (CSTA K-12 Computer Science Standards, 2017)

CONTENT FOCUS
The focus is on the impacts of technology in daily life and the influence of cultural practices within the community.

COMPUTER SCIENCE PRACTICES
Practice 1. Fostering an Inclusive Computing Culture
   1. Include the unique perspective of others and reflect on one's own perspectives when designing and developing computational products.

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Strand	Impacts of Computing
Topic	**Culture**

IC.Cu.4.b Identify and anticipate diverse user needs to increase accessibility to all users.

Expectations for Learning

LEARNING PROGRESSION
In grade 3, students identified diverse user needs and how computing devices have features built in to increase accessibility. In grade 4, students identify and anticipate diverse needs and ways to improve devices to make them more accessible to users. In grade 5, students will modify artifacts to meet diverse user needs to increase accessibility.

IMPORTANT CONCEPTS
- Users have diverse needs that impact accessibility.
- Computing devices have built-in features to increase accessibility.

KEY SKILL/PROCEDURES
- Locate and use built-in features to increase accessibility.
- Identify the diverse needs of users.

Content Elaborations

CLARIFICATIONS
Anticipating the needs and wants of diverse end-users requires students to purposefully consider potential perspectives of users with different backgrounds, ability levels, points of view and disabilities. Examples of built-in features to increase accessibility include voice command, text-to-speech and magnify text.
(CSTA K-12 Computer Science Standards, 2017)

CONTENT FOCUS
The focus is on identifying the diverse needs of users to increase accessibility.

COMPUTER SCIENCE PRACTICES
Practice 1 Fostering an Inclusive Computing Culture
2. Address the needs of diverse end-users during the design process to produce artifacts with broad accessibility and usability.

Strand	Impacts of Computing
Topic	Social Interactions

IC.SI.4.a Collaborate and consider diverse perspectives to improve digital artifacts.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students collaborated through feedback and reflection to improve a digital artifact and begin to explore how diverse perspectives improve digital artifacts. In grade 4, students collaborate with others to share the workload, increase diverse perspectives and improve a digital artifact. In grade 5, students will collaborate with others outside of the classroom to share the workload, increase diverse perspectives and improve the artifact. **IMPORTANT CONCEPTS** • Collaborating with peers to include diverse perspectives can improve digital artifacts. • Reflecting on feedback from others can improve digital artifacts. • Providing feedback to others can help them improve the quality of their work. • Sharing the workload with peers can increase productivity and improve the quality of artifacts. **KEY SKILL/PROCEDURES** • Leave thoughtful feedback for peers that will help improve their digital artifacts. • Reflect on feedback from peers to improve digital artifacts. • Work with a partner or group to produce a digital artifact. ## Content Elaborations **CLARIFICATIONS** Teachers can support students to leave thoughtful feedback through modeling this process. Teachers should conduct whole group discussions after students have left feedback to determine if the feedback was productive. As students collaborate, they should begin to understand that group members take on agreed-upon roles to share the workload. **CONTENT FOCUS** The focus is on collaborating as a group to produce digital artifacts. Students begin to understand that feedback can be provided to improve artifacts during the creation process.

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Strand	Impacts of Computing
Topic	Social Interactions
	COMPUTER SCIENCE PRACTICES *Practice 2.* Collaborating Around Computing 1. Cultivate working relationships with individuals possessing diverse perspectives, skills and personalities. 2. Create team norms, expectations and equitable workloads to increase efficiency and effectiveness. 3. Solicit and incorporate feedback from and provide constructive feedback to team members and other stakeholders. 4. Evaluate and select technological tools that can be used to collaborate on a project.

Strand	**Impacts of Computing**
Topic	**Safety, Law and Ethics**

IC.SLE.4.a Use public domain or Creative Commons media, and refrain from copying or using material created by others without permission.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students were introduced to the concept that some resources can be shared (e.g., public domain, Creative Commons), while others must be used only with proper citations or permission. In grade 4, students are introduced to formal procedures used when sharing materials. Students will be expected to identify the type of source and give credit to the source. In grade 5, students will apply proper procedures when giving credit to a source. **IMPORTANT CONCEPTS** • Certain resources can be shared freely; some resources can be shared with proper citation and others can only be shared with permission from the creator. • Sources can be cited formally or informally to give credit for the use of these materials. **KEY SKILL/PROCEDURES** • Determine whether a source can or cannot be used freely. • Informally site sources. ## Content Elaborations **CLARIFICATIONS** Ethical complications arise from the opportunities provided by computing. The ease of sending and receiving copies of media on the internet (e.g., video, photos, music) creates the opportunity for unauthorized use, such as online piracy, and disregard of copyrights. Students should consider the licenses on computational artifacts that they wish to use. For example, the license on a downloaded image or audio file may have restrictions that prohibit modification, require attribution, or prohibit use entirely. (CSTA K-12 Computer Science Standards, 2017) **CONTENT FOCUS** The focus is on recognizing that some resources are public domain and can be used freely and other materials need to be cited properly. **COMPUTER SCIENCE PRACTICES** *Practice 7.* Communicating about Computing 3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution.

Strand	Impacts of Computing
Topic	**Safety, Law and Ethics**

IC.SLE.4.b Explain why information should be shared or kept private to protect student identity.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students learned the importance of keeping personal information secure. In grade 4, students start to make distinctions between what information should be shared and what information should be kept private. In grade 5, students will begin to consider the effects of sharing private information. **IMPORTANT CONCEPTS** • For safety and security, personal information should be kept private. **KEY SKILL/PROCEDURES** • Determine whether information should or should not be shared. • Recognize that keeping information private protects your identity. ## Content Elaborations **CLARIFICATIONS** Examples of information to be kept private are first and last name, birthday, addresses, phone numbers or other personal identifiers. Students should also understand that they should not share the personal information of others. **CONTENT FOCUS** The focus is on knowing why some information can be shared and some should be kept private. **COMPUTER SCIENCE PRACTICES** *Practice 7.* Communicating about Computing 2. Describe, justify and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose.

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Strand	**Impacts of Computing**
Topic	**Safety, Law and Ethics**

IC.SLE.4.c Communicate the importance of protecting one's own digital footprint.	**Expectations for Learning** **LEARNING PROGRESSION** In grade 3, students were exposed to the vocabulary relating to information security and formed a basic understanding of a digital footprint. In grade 4, students consider how their current online behavior affects their digital footprint. In grade 5, students will expand on the subject by further examining their online behaviors and how they affect others. **IMPORTANT CONCEPTS** • Students already have a digital footprint and continue to add to it with online behavior. • Sites that students are currently using are storing personal information. • Sites that collect digital information store personal information for an infinite amount of time. **KEY SKILL/PROCEDURES** • List examples of what would be included in a personal digital footprint. • Give examples of personal information that is appropriate to share. • Determine the impact of contributions to your digital footprint. **Content Elaborations** **CLARIFICATIONS** Students should begin to consider their own digital footprint and have discussions about the specific impacts of sharing different types of content on one's digital footprint. **CONTENT FOCUS** The focus is on considering specific examples of safe practices regarding online sharing and having students consider their own online actions. **COMPUTER SCIENCE PRACTICES** *Practice 7.* Communicating about Computing. 2. Describe, justify and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose.

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Strand	Impacts of Computing
Topic	Safety, Law and Ethics

IC.SLE.4.d Describe tradeoffs between allowing information to be public and keeping information private and secure.	## Expectations for Learning **LEARNING PROGRESSION** In grade 3, students will learn about what information should be shared and how to keep their information secure. In grade 4, students are introduced to the idea that there are tradeoffs between allowing information to be public versus keeping information private. In grade 5, students will learn about their digital footprint. **IMPORTANT CONCEPTS** • Students understand personally identifiable information (PII). • Students should know steps to keeping personally identifiable information (PII) secure. **KEY SKILLS/PROCEDURES** • List examples of personally identifiable information (PII). • Explain the dangers of sharing personally identifiable information. ## Content Elaborations **CLARIFICATIONS** Student discussions should focus on examples of personally identifiable information and how to keep personal information, both private and public, safe online. **CONTENT FOCUS** Students to be able to effectively manage their digital identities. Students should understand that online information does not go away and that information online can affect the students' real lives, even in future years. **COMPUTER SCIENCE PRACTICES** *Practice 3.* Recognizing and Defining Computational Problems. 1. Identify complex, interdisciplinary, real-world problems that can be solved computationally.

Strand	**Impacts of Computing**
Topic	**Safety, Law and Ethics**

IC.SLE.4.e Explain the effect of cyber bullying and who to tell if this is happening.	## Expectations for Learning In grade 4, students learn what cyberbullying is and what to do if they feel threatened online. In grade 5, students will learn about the forms of cyberbullying and strategies to use to stop this type of behavior. **IMPORTANT CONCEPTS** • Define cyberbullying. • List the effects of cyberbullying. • Know what to do if anyone is being cyberbullied. **KEY SKILLS/PROCEDURES** • Define the term cyberbully. • Categorize the effects of cyberbullies on individuals and the online community. • Create a plan for who to contact is you or someone else if being bullied in person or online. ## Content Elaborations A bully is a person that habitually seeks to intimidate or otherwise harm others. Similarly, a cyberbully seeks to harm others using communications through the Internet. Understanding the effects of cyberbullying and knowing what is appropriate versus inappropriate online behavior can help students how to handle situations of cyberbullying when it happens to them or someone else. **CLARIFICATIONS** Cyberbullying can occur during gaming; social media activities or any other time people interact on the computer. Knowing when to alert adults to online activities are skills all students should know and have when working online. There are many federal and state resources available online and are great resources for teachers.

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Strand	Impacts of Computing
Topic	Safety, Law and Ethics

	COMPUTER SCIENCE PRACTICES
	Practice 1. Fostering an Inclusive Computing Culture
	    2. Address the needs of diverse end-users during the design process to produce artifacts with broad accessibility and usability.
	    3. Employ self and peer advocacy to address bias in interactions, product design and development methods.