Kindergarten Computer Science Standards

Algorithms and Programming

Students who demonstrate understanding can:

Indicator	Standard
K.AP.A.1	Model daily processes by creating and following sets of step-by-step instructions (algorithms) to complete tasks.
K.AP.PD.1	Identify and fix (debug) errors in a sequence of instructions (algorithms) that includes loops.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *4. Model phenomena and processes and simulate systems to understand and evaluate potential outcome* (K.AP.A.1). **Practice 6. Testing and Refining Computational Artifacts** *2. Identify and fix errors using a systematic process* (K.AP.PD.1).	**Algorithms and Programming** ● AP.A: Algorithms - *People follow and create processes as part of daily life. Many of these processes can be expressed as algorithms that computers can follow* (K.AP.A.1). ● AP.PD: Program Development - *People develop programs collaboratively and for a purpose, such as expressing ideas or addressing problems* (K.AP.PD.1).

	Connections to other NVACS at this grade level
NVACS for Science	(K.AP.PD.1) – CCC: Cause and Effect, CCC: Patterns (K.AP.A.1) – SEP: Obtaining, evaluating and communicating information, CCC: Systems and System Models
NVACS for Mathematics	SMP 6, 7 & 8
NVACS for ELA	(K.AP.A.1) – RF.K.A, RI.K.7 (K.AP.PD.1) – RL.K.2, W.K.6
NVACS for Social Studies	None

Kindergarten Computer Science Standards

Computing Systems

Students who demonstrate understanding can:

Indicator	Standard
K.CS.HS.1	Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware). *For example: monitor, keyboard, mouse, earbuds, headphones, printer.*
K.CS.HS.2	Recognize some computing devices (e.g., computer, smartphone) can perform a variety of tasks and some computing devices are specialized (e.g., navigation system, game controller).

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *2. Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose* (K.CS.HS.1 and K.CS.HS.2).	**Computing Systems** ● CS.HS: Hardware and Software - *A computing system is composed of hardware and software. Hardware consists of physical components, while software provides instructions for the system. These instructions are represented in a form that a computer can understand* (K.CS.HS.1 and K.CS.HS.2).

	Connections to other NVACS at this grade level
NVACS for Science	(K.CS.HS.1) – Structure and Function
NVACS for Mathematics	SMP 2, 3, & 5
NVACS for ELA	(K.CS.HS.1) – L.K.5c, L.K.6, RI.K.2 (K.CS.HS.2) – W.K.6
NVACS for Social Studies	None

Kindergarten Computer Science Standards

Data and Analysis

Students who demonstrate understanding can:

Indicator	Standard
K.DA.S.1	Recognize that data can be collected and stored on different computing devices over time.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *2. Evaluate existing technological functionalities and incorporate them into new designs* (K.DA.S.1).	**Data and Analysis** ● DA.S: Storage - *Computers store data that can be retrieved later. Identical copies of data can be made and stored in multiple locations for a variety of reasons, such as to protect against loss* (K.DA.S.1).

	Connections to other NVACS at this grade level
NVACS for Science	None
NVACS for Mathematics	SMP 5, K.MD.B.3
NVACS for ELA	W.K.6
NVACS for Social Studies	None

Impacts of Computing

Students who demonstrate understanding can:

Indicator	Standard
K.IC.C.1	Understand how computing devices have changed people's lives.
K.IC.SI.1	Exhibit good digital citizenship using technology safely, responsibly, and ethically.

Practice Connection	Concept Connection
Practice 1. Foster an Inclusive Computing Culture 　*1. Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products* (K.IC.C.1). **Practice 2. Collaborating Around Computing** 　*1. Cultivate working relationships with individuals possessing diverse perspectives, skills, and personalities* (K.IC.SI.1).	**Impacts of Computing** ● IC.C: Culture - *Computing technology has positively and negatively changed the way people live and work. Computing devices can be used for entertainment and as productivity tools, and they can affect relationships and lifestyles* (K.IC.C.1). ● IC.SI: Social Interactions - *Computing has positively and negatively changed the way people communicate. People can have access to information and each other instantly, anywhere, and at any time, but they are at the risk of cyberbullying and reduced privacy* (K.IC.SI.1).

	Connections to other NVACS at this grade-level
NVACS for Science	(K.IC.C.1) – CCC: Cause and Effect (K.IC.C.A) – K-ESS3-2 (Influence of Engineering, Technology and Science on society and the natural world. People depend on various technologies in their lives: human life would be very different without technology.)
NVACS for Mathematics	None
NVACS for ELA	(K.IC.C.1) – RI.K.3 (K.IC.SI.1) – SL.K.1
NVACS for Social Studies	(K.IC.C.1) – SS.K.17 (K.IC.SI.1) – SS.K.17

Kindergarten Computer Science Standards

Networks and the Internet

Students who demonstrate understanding can:

Indicator	Standard
K.NI.C.1	Explain that a password helps protect the privacy of information.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (K.NI.C.1).*	**Networks and the Internet** ● NI.C: Cybersecurity - *Connecting devices to a network or the Internet provides great benefit. Care must be taken to use authentication measures, such as strong passwords, to protect devices and information from unauthorized access* (K.NI.C.1).

	Connections to other NVACS at this grade level
NVACS for Science	(K.NI.C.1) – CCC: Cause and Effect
NVACS for Mathematics	SMP 3 & 4
NVACS for ELA	(K.NI.C.1) – W.K.2
NVACS for Social Studies	None

Grade 1 Computer Science Standards

Algorithms and Programming

Students who demonstrate understanding can:

Indicator	Standard
1.AP.PD.1	Describe the iterative process of program development (including terminology, steps taken, and the logic of choices).
1.AP.V.1	Model the way programs store and manipulate data by using numbers or other symbols to represent information.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *2. Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose (1.AP.PD.1).* **Practice 4. Developing and Using Abstractions** *4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes (1.AP.V.1).*	**Algorithms and Programming** ● AP.PD: Program Development - *People develop programs collaboratively and for a purpose, such as expressing ideas or addressing problems (1.AP.PD.1).* ● AP.V: Variables - *Information in the real world can be represented in computer programs. Programs store and manipulate data, such as numbers, words, colors, and images. The type of data determines the actions and attributes associated with it (1.AP.V.1).*

	Connections to other NVACS at this grade level
NVACS for Science	(1.AP.PD.1) – CCC: Patterns, SEP: Obtaining, Evaluating and Communicating Information (1.AP.V.1) – CCC: Systems and System Models, SEP: Analyzing and Interpreting Data
NVACS for Mathematics	SMP 2, 3, 4; 1.MD.C.4
NVACS for ELA	(1.AP.PD.1) – W.1.2, W.1.3 (1.AP.V.1) – SL.1.5
NVACS for Social Studies	None

Grade 1 Computer Science Standards

Computing Systems

Students who demonstrate understanding can:

Indicator	Standard
1.CS.D.1	Select and operate appropriate device and software to perform a variety of tasks, and recognize that users have different needs and preferences for the technology they use.

Practice Connection	Concept Connection
Practice 1. Fostering an Inclusive Computing Culture *1. Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products* (1.CS.D.1).	**Computing Systems** ● CS.D: Devices - *People use computing devices to perform a variety of tasks accurately and quickly. Computing devices interpret and follow the instructions they are given literally* (1.CS.D.1).

	Connections to other NVACS at this grade level
NVACS for Science	(1.CS.D.1) – SEP: Asking Questions and Defining Problems
NVACS for Mathematics	SMP 5
NVACS for ELA	None
NVACS for Social Studies	None

Grade 1 Computer Science Standards

Data and Analysis

Students who demonstrate understanding can:

Indicator	Standard
1.DA.S.1	Recognize that a variety of data (e.g., music, video, images, text) can be stored in and retrieved from a computing device.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *2. Evaluate existing technological functionalities and incorporate them into new designs* (K.DA.S.1).	**Data and Analysis** ● DA.S: Storage - *Computers store data that can be retrieved later. Identical copies of data can be made and stored in multiple locations for a variety of reasons, such as to protect against loss* (1.DA.S.1).

	Connections to other NVACS at this grade level
NVACS for Science	None
NVACS for Mathematics	SMP 5
NVACS for ELA	(1.DA.S.1) – W.1.6
NVACS for Social Studies	None

Grade 1 Computer Science Standards

Impacts of Computing

Students who demonstrate understanding can:

Indicator	Standard
1.IC.SI.1	Work respectfully and responsibly with others online.

Practice Connection	Concept Connection
Practice 2. Collaborating Around Computing *1. Cultivate working relationships with individuals possessing diverse perspectives, skills, and personalities* (1.IC.SI.1).	**Impacts of Computing** ● IC.SI: Social Interactions - *Computing has positively and negatively changed the way people communicate. People can have access to information and each other instantly, anywhere, and at any time, but they are at the risk of cyberbullying and reduced privacy* (1.IC.SI.1).

	Connections to other NVACS at this grade level
NVACS for Science	None
NVACS for Mathematics	None
NVACS for ELA	(1.IC.SI.1) – SL.1.1
NVACS for Social Studies	(1.IC.SI.1) – SS.1.18, SS.1.20, SS.1.22

Grade 1 Computer Science Standards

Networks and the Internet

Students who demonstrate understanding can:

Indicator	Standard
1.NI.C.1	Explain why we keep personal information (e.g., name, location, phone number, home address) private.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (1.NI.C.1).*	**Networks and the Internet** ● NI.C: Cybersecurity - *Connecting devices to a network or the Internet provides great benefit. Care must be taken to use authentication measures, such as strong passwords, to protect devices and information from unauthorized access (1.NI.C.1).*

	Connections to other NVACS at this grade level
NVACS for Science	(1.NI.C.1) – CCC: Cause and Effect
NVACS for Mathematics	SMP 3
NVACS for ELA	(1.NI.C.1) – W.1.2
NVACS for Social Studies	Connect with financial literacy for password safety and ID theft (indicator coming soon as those standards are being approved)

Grade 2 Computer Science Standards

Algorithms and Programming

Students who demonstrate understanding can:

Indicator	Standard
2.AP.C.1	Develop programs with sequences and loops, to express ideas or address a problem.
2.AP.M.1	Break down (decompose) the steps needed to solve a problem into a precise sequence of instructions.
2.AP.PD.1	Develop plans that describe a program's sequence of events, goals, and expected outcomes.
2.AP.PD.2	Give attribution (credit) when using the ideas and creations of others while developing programs.

Practice Connection	Concept Connection

Practice 3. Recognizing and Defining Computational Problems
    2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures (2.AP.M.1).
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.AP.PD.1).
    2. Create a computational artifact for practical intent, personal expression, or to address a societal issue (2.AP.C.1).
Practice 7. Communicating About Computing
    2. Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose (2.AP.PD.1).
    3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (2.AP.PD.2).
	Algorithms and Programming
	● AP.C: Control - *Computers follow precise sequences of instructions that automate tasks. Program execution can also be nonsequential by repeating patterns of instructions and using events to initiate instructions (2.AP.C.1).*
	● AP.M: Modularity - *Complex tasks can be broken down into simpler instructions, some of which can be broken down even further. Likewise, instructions can be combined to accomplish complex tasks (2.AP.M.1).*
	● AP.PD: Program Development - *People develop programs collaboratively and for a purpose, such as expressing ideas or addressing problems (2.AP.PD.1 and 2.AP.PD.2).*

	Connections to other NVACS at this grade level
NVACS for Science	(2.AP.C.1) – SEP: Developing and Using Models, SEP: Asking Questions and Defining Problems (2.AP.M.1) – SEP: Analyzing and Interpreting Data (2.AP.PD.1) – ETS 1B: Developing Possible Solutions, SEP: Obtaining, Communicating, and Evaluating Data, SEP: Planning and Carrying Out Investigations
NVACS for Mathematics	None
NVACS for ELA	(2.AP.C.1) – W.2.2, RI.2.3 (2.AP.M.1) – W.2.2 (2.AP.PD.1) – L.2.4 (2.AP.PD.2) – SL.2.2, SL.2.4
NVACS for Social Studies	None

Grade 2 Computer Science Standards

Computing Systems

Students who demonstrate understanding can:

Indicator	Standard
2.CS.T.1	Describe basic hardware and software problems using accurate terminology.

Practice Connection	Concept Connection
Practice 6. Testing and Refining Computational Artifacts *2. Identify and fix errors using a systematic process (2.CS.T.1).* **Practice 7. Communicating About Computing** *2. Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose (2.CS.T.1).*	**Computing Systems** ● CS.T: Troubleshooting - *Computing systems might not work as expected because of hardware or software problems. Clearly describing a problem is the first step toward finding a solution* (2.CS.T.1).

	Connections to other NVACS at this grade level
NVACS for Science	None
NVACS for Mathematics	SMP 2 & 6
NVACS for ELA	(2.CS.T.1) – L.2.4e
NVACS for Social Studies	None

Grade 2 Computer Science Standards

Data and Analysis

Students who demonstrate understanding can:

Indicator	Standard
2.DA.S.1	Store, copy, search, retrieve, modify, and delete information using a computing device and define the information stored as data.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *2. Evaluate existing technological functionalities and incorporate them into new designs* (2.DA.S.1).	**Data and Analysis** DA.S: Storage - *Computers store data that can be retrieved later. Identical copies of data can be made and stored in multiple locations for a variety of reasons, such as to protect against loss* (2.DA.S.1).

	Connections to other NVACS at this grade level
NVACS for Science	None
NVACS for Mathematics	None
NVACS for ELA	(2.DA.S.1) – W.2.7
NVACS for Social Studies	None

Impacts of Computing

Students who demonstrate understanding can:

Indicator	Standard
2.IC.C.1	Compare how people live and work before and after the implementation or adoption of new computing technology.
2.IC.SLE.1	Identify safe and unsafe examples of online communications.

Practice Connection	Concept Connection

Practice 1. Foster an Inclusive Computing Culture
    1. Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products (2.IC.C.1).
    3. Employ self- and peer- advocacy to address bias in interactions, product design, and development methods (2.IC.C.1).
Practice 2. Collaborating Around Computing
    1. Cultivate working relationships with individuals possessing diverse perspectives, skills, and personalities (2.IC.SLE.1).
Practice 7. Communicating About Computing
    3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (2.IC.SLE.1).
	Impacts of Computing
	● IC.C: Culture - *Computing technology has positively and negatively changed the way people live and work. Computing devices can be used for entertainment and as productivity tools, and they can affect relationships and lifestyles (2.IC.C.1).*
	● IC.SLE: Safety, Law, and Ethics - *People use computing technology in ways that can help or hurt themselves or others. Harmful behaviors, such as sharing private information and interacting with strangers, should be recognized and avoided (2.IC.SLE.1).*

	Connections to other NVACS at this grade level
NVACS for Science	(2.IC.C.1) – CCC: Cause and Effect (2.IC.SLE.1) – SEP: Obtaining, Evaluating, and Communicating Information
NVACS for Mathematics	None
NVACS for ELA	(2.IC.C.1) – RI.2.9, RL.2.9
NVACS for Social Studies	(2.IC.C.1) – SS.2.22, SS.2.23 (2.IC.SLE.1) – Connection to financial literacy (risk)

Grade 2 Computer Science Standards

Networks and the Internet

Students who demonstrate understanding can:

Indicator	Standard
2.NI.C.1	Explain what passwords are and why we use them; use strong passwords to protect devices and information from unauthorized access.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (2.NI.C.1).*	**Networks and the Internet** ● NI.C: Cybersecurity - *Connecting devices to a network or the Internet provides great benefit, care must be taken to use authentication measures, such as strong passwords, to protect devices and information from unauthorized access (2.NI.C.1).*

	Connections to other NVACS at this grade level
NVACS for Science	(2.NI.C.1) – CCC: Cause and Effect
NVACS for Mathematics	SMP 2
NVACS for ELA	(2.NI.C.1) – W.2.2
NVACS for Social Studies	Connect to financial literacy (risk)

Grade 3 Computer Science Standards

Algorithms and Programming

Students who demonstrate understanding can:

Indicator	Standard
3.AP.PD.1	Debug (identify and fix) errors in an algorithm or program that includes sequences and loops.
3.AP.PD.2	Take on varying roles (e.g., researcher, programmer, test developer, designer, recorder) with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development.
3.AP.V.1	Create programs that use variables to store and modify data.

Practice Connection	Concept Connection

Practice 2. Collaborating Around Computing
   2. Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness (3.AP.PD.2).
Practice 5. Creating Computational Artifacts
   2. Create a computational artifact for practical intent, personal expression, or to address a societal issue (3.AP.V.1).
Practice 6. Testing and Refining Computational Artifacts
   1. Systematically test computational artifacts by considering all scenarios and using test cases (3.AP.PD.1).
   2. Identify and fix errors using a systematic process (3.AP.PD.1).
	Algorithms and Programming
	● AP.PD: Program Development - *People develop programs using an iterative process involving design, implementation, and review. Design often involves reusing existing code or remixing other programs within a community. People continuously review whether programs work as expected, and they fix, or debug, parts that do not. Repeating these steps enables people to refine and improve programs* (3.AP.PD.1 and 3.AP.PD.2).
	● AP.V: Variables - *Programming languages provide variables, which are used to store and modify data. The data type determines the values and operations that can be performed on that data* (3.AP.V.1).

	Connections to other NVACS at this grade level
NVACS for Science	(3.AP.PD.1) – CCC: Cause and Effect, SEP: Asking Questions and Defining Problems, 3-5 ETS1-2: Generate and Compare Multiple Solutions (3.AP.PD.2) – SEP: Planning and Carrying Out Investigations (3.AP.V.1) – CCC: Cause and Effect
NVACS for Mathematics	SMP 3
NVACS for ELA	(3.AP.PD.1) – RI.3.8 (3.AP.PD.2) – W.3.5 (3.AP.V.1) – W.3.5
NVACS for Social Studies	None

Grade 3 Computer Science Standards

Computing Systems

Students who demonstrate understanding can:

Indicator	Standard
3.CS.D.1	Describe how internal and external parts of computing devices function to form a system.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *2. Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose (3.CS.D.1).*	**Computing Systems** ● CS.D: Devices - *Computing devices may be connected to other devices or components to extend their capabilities, such as sensing and sending information. Connections can take many forms, such as physical or wireless. Together, devices and components form a system of interdependent parts that interact for a common purpose (3.CS.D.1).*

	Connections to other NVACS at this grade level
NVACS for Science	(3.CS.D.1) – CCC: Systems and System Models, CCC: Structure and Function
NVACS for Mathematics	SMP 2
NVACS for ELA	(3.CS.D.1) – RL.3.5, RI.3.2
NVACS for Social Studies	None

Grade 3 Computer Science Standards

Data and Analysis

Students who demonstrate understanding can:

Indicator	Standard
3.DA.CVT.1	Organize and present collected data visually to highlight relationships and support a claim.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *1. Select, organize, and interpret large data sets from multiple sources to support a claim* (3.DA.CVT.1).	**Data and Analysis** ● DA.CVT: Collection, Visualization, and Transformation - People select digital tools for the collection of data based on what is being observed and how the data will be used. For example, a digital thermometer is used to measure temperature and a GPS sensor is used to track locations. *People select aspects and subsets of data to be transformed, organized, clustered, and categorized to provide different views and communicate insights gained from the data* (3.DA.CVT.1).

	Connections to other NVACS at this grade level
NVACS for Science	SEP: Obtaining, Evaluating, and Communicating data, Engaging in Argumentation from Evidence
NVACS for Mathematics	SMP 2 & 4, 3.MD.B.3
NVACS for ELA	W.3.8, W.3.2a, SL.3.2, SL.3.4, SL.3.5
NVACS for Social Studies	None

Grade 3 Computer Science Standards

Impacts of Computing

Students who demonstrate understanding can:

Indicator	Standard
3.IC.C.1	Discuss computing technologies that have changed the world, and express how those technologies influence and are influenced by cultural practices.
3.IC.SLE.1	Use public domain or creative commons media, and refrain from copying or using material created by others without permission.

Practice Connection	Concept Connection

Practice 3. Recognizing and Defining Computational Problems
    1. Identify complex, interdisciplinary, real-world problems that can be solved computationally (3.IC.C.1).
Practice 7. Communicating About Computing
    3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (3.IC.SLE.1).
	Impacts of Computing
	● IC.C: Culture - *The development and modification of computing technology is driven by people's needs and wants and can affect groups differently. Computing technologies influence, and are influenced by, cultural practices* (3.IC.C.1).
	● IC.SLE: Safety, Law, and Ethics - *Ethical complications arise from the opportunities provided by computing. The ease of sending and receiving copies of media on the Internet, such as video, photos, and music, creates the opportunity for unauthorized use, such as online piracy, and disregard of copyrights, such as lack of attribution* (3.IC.SLE.1).

	Connections to other NVACS at this grade level
NVACS for Science	(3.IC.C.1) – SEP: Obtaining, Communicating, and Evaluating Information, 3-ESS3-1: Influence of engineering, technology and science on society and the natural world) Engineers improve existing technologies or develop new ones to increase their benefits.
NVACS for Mathematics	None
NVACS for ELA	(3.IC.SLE.1) – W.3.8
NVACS for Social Studies	(3.IC.C.1) – SS.3.23 (3.IC.SLE.1) – Connect to financial literacy (risk)

Grade 3 Computer Science Standards

Networks and the Internet

Students who demonstrate understanding can:

Indicator	Standard
3.NI.C.1	Discuss real-world cybersecurity problems and how personal information can be protected.

Practice Connection	Concept Connection
Practice 3. Recognizing and Defining Computational Problems *1. Identify complex, interdisciplinary, real-world problems that can be solved computationally* (3.NI.C.1).	**Networks and the Internet** ● NI.C: Cybersecurity - *Information can be protected using various security measures. These measures can be physical and/or digital* (3.NI.C.1).

	Connections to other NVACS at this grade level
NVACS for Science	(3.NI.CI.1) – SEP: Obtaining, Communicating, and Evaluating Information, CCC: Cause and Effect
NVACS for Mathematics	None
NVACS for ELA	None
NVACS for Social Studies	Connect to financial literacy (risk)

Grade 4 Computer Science Standards

Algorithms and Programming

Students who demonstrate understanding can:

Indicator	Standard
4.AP.A.1	Test, compare, and refine multiple algorithms for the same task and determine which is the most appropriate.
4.AP.C.1	Develop programs that include sequences, events, loops, and conditionals.
4.AP.M.1	Explore how complex tasks can be decomposed into simple tasks and how simple tasks can be composed into complex tasks.
4.AP.PD.1	Test and debug (identify and fix) errors in a program or algorithm to ensure it runs as intended.

Practice Connection	Concept Connection
Practice 3. Recognizing and Defining Computational Problems *2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures (4.AP.M.1).* *3. Evaluate whether it is appropriate and feasible to solve a problem computationally (4.AP.A.1).* **Practice 5. Creating Computational Artifacts** *2. Create a computational artifact for practical intent, personal expression, or to address a societal issue (4.AP.C.1).* **Practice 6. Testing and Refining Computational Artifacts** *1. Systematically test computational artifacts by considering all scenarios and using test cases (4.AP.A.1 and 4.AP.PD.1).* *2. Identify and fix errors using a systematic process (4.AP.A.1 and 4.AP.PD.1).* *3. Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility (4.AP.A.1).*	**Algorithms and Programming** ● AP.A: Algorithms - *Different algorithms can achieve the same result. Some algorithms are more appropriate for a specific context than others (4.AP.A.1).* ● AP.C: Control - *Control structures, including loops, event handlers, and conditionals, are used to specify the flow of execution. Conditionals selectively execute or skip instructions under different conditions (4.AP.C.1).* ● AP.M: Modularity - *Programs can be broken down into smaller parts to facilitate their design, implementation, and review. Programs can also be created by incorporating smaller portions of programs that have already been created (4.AP.M.1).* ● AP.PD: Program Development - *People develop programs using an iterative process involving design, implementation, and review. Design often involves reusing existing code or remixing other programs within a community. People continuously review whether programs work as expected, and they fix, or debug, parts that do not. Repeating these steps enables people to refine and improve programs (4.AP.PD.1).*

	Connections to other NVACS at this grade level
NVACS for Science	(4.AP.A.1) – 3-5 ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem, 3-5 ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved, SEP: Analyzing and Interpreting Data (4.AP.C.1) – SEP: Developing and Using Models, CCC: Patterns (4.AP.M.1) – SEP: Developing and Using Models, CCC: Systems and System Models (4.AP.PD.1) – 3-5 ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved, SEP: Constructing Explanations and Designing Solutions
NVACS for Mathematics	SMP 2 & 6
NVACS for ELA	(4.AP.A.1) – RI.4.6, W.4.5 (4.AP.C.1) – RI.4.3, W.4.2 (4.AP.M.1) – RL.4.5, RI.4.9, W.4.7 (4.AP.PD.1) – W.4.5
NVACS for Social Studies	None

Grade 4 Computer Science Standards

Computing Systems

Students who demonstrate understanding can:

Indicator	Standard
4.CS.HS.1	Model how computer hardware and software work together as a system to accomplish tasks.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* (4.CS.HS.1).	**Computing Systems** ● CS.HS: Hardware and Software *- Hardware and software work together as a system to accomplish tasks, such as sending, receiving, processing, and storing units of information as bits. Bits serve as the basic unit of data in computing systems and can represent a variety of information* (4.CS.HS.1).

	Connections to other NVACS at this grade level
NVACS for Science	CCC: Systems and System Models, SEP: Developing and Using Models
NVACS for Mathematics	SMP 4
NVACS for ELA	W.4.6, RL.5.3
NVACS for Social Studies	None

Grade 4 Computer Science Standards

Data and Analysis

Students who demonstrate understanding can:

Indicator	Standard
4.DA.IM.1	Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate ideas.

Practice Connection	Concept Connection
Practice 7. Communicating About Computing *1. Select, organize, and interpret large data sets from multiple sources to support a claim* (4.DA.IM.1).	**Data and Analysis** ● DA.IM: Inference and Models - *The accuracy of inferences and predictions is related to how realistically data is represented. Many factors influence the accuracy of inferences and predictions, such as the amount and relevance of data collected* (4.DA.IM.1).

	Connections to other NVACS at this grade level
NVACS for Science	SEP: Obtaining, Evaluating, and Communicating Data, CCC: Cause and Effect, SEP: Using Mathematics and Computational Thinking
NVACS for Mathematics	SMP 2, 4.MD.B.4
NVACS for ELA	RI.4.5, RI.4.9
NVACS for Social Studies	None

Grade 4 Computer Science Standards

Impacts of Computing

Students who demonstrate understanding can:

Indicator	Standard
4.IC.C.1	Compare and contrast how computing has changed society from the past to the present.

Practice Connection	Concept Connection
Practice 3. Recognizing and Defining Computational Problems *1. Identify complex, interdisciplinary, real-world problems that can be solved computationally* (4.IC.C.1).	**Impacts of Computing** ● IC.C: Culture - *The development and modification of computing technology is driven by people's needs and wants and can affect groups differently. Computing technologies influence, and are influenced by, cultural practices* (4.IC.C.1).

	Connections to other NVACS at this grade level
NVACS for Science	CCC: Cause and Effect, SEP: Analyzing and Interpreting Data
NVACS for Mathematics	None
NVACS for ELA	RL.4.5
NVACS for Social Studies	Connect to financial literacy (decision making)

Grade 4 Computer Science Standards

Networks and the Internet

Students who demonstrate understanding can:

Indicator	Standard
4.NI.NCO.1	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.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* (4.NI.NCO.1).	**Networks and the Internet** ● NI.NCO: Network, Communication, and Organization - *Information needs a physical or wireless path to travel to be sent and received, and some paths are better than others. Information is broken into smaller pieces, called packets, that are sent independently and reassembled at the destination. Routers and switches are used to properly send packets across paths to their destinations* (4.NI.NCO.1).

	Connections to other NVACS at this grade level
NVACS for Science	CCC: Systems and System Models, SEP: Developing and Using Models
NVACS for Mathematics	SMP 4
NVACS for ELA	None
NVACS for Social Studies	None

Grade 5 Computer Science Standards

Algorithms and Programming

Students who demonstrate understanding can:

Indicator	Standard
5.AP.M.1	Demonstrate how to decompose a task of complexity into simple tasks and compose a simple task into tasks of complexity.
5.AP.M.2	Modify, incorporate, and test portions of an existing program into their own work, to develop something new or add more advanced features.
5.AP.PD.1	Use the iterative process to develop a program to express an idea or address a problem while considering others' perspectives and preferences.
5.AP.PD.2	Describe choices made during program development using code comments, presentations, and demonstrations.
5.AP.PD.3	Observe intellectual property rights and give appropriate attribution (credit) when creating or remixing programs.

Practice Connection	Concept Connection

Practice 1. Fostering an Inclusive Computing Culture
    1. Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products (5.AP.PD.1).
Practice 3. Recognizing and Defining Computational Problems
    2. Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures (5.AP.M.1).
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 (5.AP.PD.1).
    2. Create a computational artifact for practical intent, personal expression, or to address a societal issue (5.AP.PD.3).
    3. Modify an existing artifact to improve or customize it (5.AP.M.2).
Practice 7. Communicating About Computing
    2. Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose (5.AP.PD.2).
    3. Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution (5.AP.PD.3).
	Algorithms and Programming
	  ● AP.M: Modularity - *Programs can be broken down into smaller parts to facilitate their design, implementation, and review. Programs can also be created by incorporating smaller portions of programs that have already been created (5.AP.M.1 and 5.AP.M.2).*
	  ● AP.PD: Program Development - *People develop programs using an iterative process involving design, implementation, and review. Design often involves reusing existing code or remixing other programs within a community. People continuously review whether programs work as expected, and they fix, or debug, parts that do not. Repeating these steps enables people to refine and improve programs (5.AP.PD.1-3).*

	Connections to other NVACS at this grade level
NVACS for Science	(5.AP.M.1) – CCC: Patterns, Systems and System Models (5.AP.M.2) – 3-5 ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem, 3-5 ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved (5.AP.PD.1) – CCC: Cause and Effect, SEP: Obtaining, Communicating, and Evaluating Information (5.AP.PD.2) – SEP: Obtaining, Communicating, and Evaluating Information
NVACS for Mathematics	SMP 2 & 3
NVACS for ELA	(5.AP.M.1) – RL.5.5, RI.5.9, W.7 (5.AP.M.2) – SL.5.5, RI.5.9, SL.1.c,d, SL.5.5, RL.5.7 (5.AP.PD.1) – RL.5.6, W.5.5 (5.AP.PD.2) – SL.5.1a, W.5.6 (5.AP.PD.3) – W.5.8, W.5.9
NVACS for Social Studies	None

Grade 5 Computer Science Standards

Computing Systems

Students who demonstrate understanding can:

Indicator	Standard
5.CS.T.1	Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.

Practice Connection	Concept Connection
Practice 6. Testing and Refining Computational Artifacts *2. Identify and fix errors using a systematic process (5.CS.T.1).*	**Computing Systems** ● CS.T: Troubleshooting - *Computing systems share similarities, such as the use of power, data, and memory. Common troubleshooting strategies, such as checking that power is available, checking that physical and wireless connections are working, and clearing out the working memory by restarting programs or devices, are effective for many systems (5.CS.T.1).*

	Connections to other NVACS at this grade level
NVACS for Science	3-5 ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5 ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
NVACS for Mathematics	SMP 1, 2, & 3
NVACS for ELA	W.5.5
NVACS for Social Studies	None

Grade 5 Computer Science Standards

Data and Analysis

Students who demonstrate understanding can:

Indicator	Standard
5.DA.IM.1	Recognize how text, images, and sounds are represented as binary numbers in computing devices.

Practice Connection	Concept Connection
Practice 4. Developing and Using Abstractions *1. Extract common features from a set of interrelated processes or complex phenomena (5.DA.IM.1).*	**Data and Analysis** ● DA.IM: Inference and Models - *The accuracy of inferences and predictions is related to how realistically data is represented. Many factors influence the accuracy of inferences and predictions, such as the amount and relevance of data collected (5.DA.IM.1).*

	Connections to other NVACS at this grade level
NVACS for Science	SEP: Using Mathematics and Computational Thinking, SEP: Developing and Using Models
NVACS for Mathematics	SMP 7 & 8, 5.OA.B.3
NVACS for ELA	None
NVACS for Social Studies	None

Grade 5 Computer Science Standards

Impacts of Computing

Students who demonstrate understanding can:

Indicator	Standard
5.IC.C.1	Brainstorm ways to improve the accessibility and usability of technology products for the diverse needs and wants of users.
5.IC.SI.1	Seek diverse perspectives for the purpose of improving computational artifacts.

Practice Connection	Concept Connection
Practice 1. Fostering an Inclusive Computing Culture 1. *Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products* (5.IC.SI.1). 2. *Address the needs of diverse end users during the design process to produce artifacts with broad accessibility and usability* (5.IC.C.1).	**Impacts of Computing** ● IC.C: Culture - *The development and modification of computing technology is driven by people's needs and wants and can affect groups differently. Computing technologies influence, and are influenced by, cultural practices* (5.IC.C.1). ● IC.SI: Social Interactions - *Computing technology allows for local and global collaboration. By facilitating communication and innovation, computing influences many social institutions such as family, education, religion, and the economy* (5.IC.SI.1).

	Connections to other NVACS at this grade level
NVACS for Science	(5.IC.C.1) – SEP: Asking Questions and Defining Problems
NVACS for Mathematics	SMP 5
NVACS for ELA	(5.IC.C.1) – W.5.5, W.5.6 (5.IC.SI.1) – SL.5.1, SL.5.3
NVACS for Social Studies	(5.IC.C.1) – SS.5.19

Grade 5 Computer Science Standards

Networks and the Internet

Students who demonstrate understanding can:

Indicator	Standard
5.NI.NCO.1	Explain the concept of network protocols.
5.NI.NCO.2	Identify the advantages and disadvantages of various network types (e.g., wire, WiFi, cellular data).

Practice Connection	Standard Concept Connection
Practice 4. Developing and Using Abstractions *1. Extract common features from a set of interrelated processes or complex phenomena* (5.NI.NCO.2). *4. Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* (5.NI.NCO.1).	**Networks and the Internet** ● NI.NCO: Network, Communication, and Organization - *Information needs a physical or wireless path to travel to be sent and received, and some paths are better than others. Information is broken into smaller pieces, called packets, that are sent independently and reassembled at the destination. Routers and switches are used to properly send packets across paths to their destinations* (5.NI.NCO.1 and 5.NI.NCO.2).

	Connections to other NVACS at this grade level
NVACS for Science	(5.NI.NCO.2) – CCC: Cause and Effect
NVACS for Mathematics	None
NVACS for ELA	(5.NI.NCO.1) – RI.5.4 (5.NI.NCO.2) – W.5.1, RL.5.3
NVACS for Social Studies	None