2020 Wyoming Computer Science Content & Performance Standards

BOOT UP WYOMING

THIS DOCUMENT IS USED TO COLLECT PUBLIC INPUT AND EDUCATOR INPUT FOR THE STATE BOARD OF EDUCATION
THE FIRST THREE PAGES ARE INFORMATIONAL FOR THE INPUT PERIOD

The Wyoming Department of Education (WDE) seeks educator input on the proposed 2020 Computer Science Performance Standards. Previously all Performance Level Descriptors (PLDs) were deemed the Performance Standards to measure student proficiency. The State Board of Education (SBE) has asked the Computer Science Standards Review Committee to identify a subset of PLDs to be the Performance Standards, on which students will be assessed through the District Assessment System.

For Educator and Public Input:

1. Review the Proposed 2020 Wyoming Computer Science Content & Performance Standards here https://edu.wyoming.gov. The NEW Performance Standards can easily be found with the blue highlight.
2. Then complete the Educator Input survey or the Public Input survey (for non-educators).
3. Both surveys close at 11:59 p.m. on **August 27, 2020**.
4. The input collected on the Performance Standards will be shared with the SBE for its consideration for adoption.

Important Information for Understanding this New Addition to the Process:

1. The **Content Standards** were adopted on **Feb. 4, 2020**. The Computer Science "Content Standards" are the content and skills students are expected to know and be able to do by the end-of-the grade band.
2. **Performance Standards** are the standards all students are expected to learn and be assessed on through the district assessment system. They specify the specific degree of understanding or demonstration of the knowledge and/or skill for a particular content standard. As such, it employs clear action verbs and describes “how good is good enough.” Districts are expected to give students multiple opportunities to demonstrate proficiency on the Performance Standards and provide appropriate supports for student success.
3. Once adopted, the **Performance Standards** will accompany the previously adopted 2019 Wyoming Computer Science Content Standards. Performance Standards will be tied to the Content Standards on which districts are expected to assess all students through the district assessment system.
4. All Performance Level Descriptors (PLDs) will remain in an educator resource document, Appendix B.

For more information on the content of the standards, contact Alicia Wilson, Math/CS Consultant, at 307-777-5036 or alicia.wilson@wyo.gov. For all other questions, contact Barb Marquer, Standards Supervisor at 307-777-5506 or barb.marquer@wyo.gov or Laurie Hernandez, Director of Standards & Assessment at 307-777-3469 or laurie.hernandez@wyo.gov.

This page and the next are a quick snapshot of the whole set of Performance Standards. They are embedded within the Content Standards in the attached document, in blue highlight.

GRADE K-2 PERFORMANCE STANDARDS

***2.CS.HS.01** - The Proficient student demonstrates and describes: 1) a variety of hardware components (e.g., input devices, printers) and 2) software applications (e.g., search engine, browsers, apps).
***2.NI.C.01** - The Proficient student: 1) Explains what authentication factors (e.g., login) are and why we use them and 2) Models use of authentication factors to appropriate apps and devices.
***2.AP.A.01** - The Proficient student, with guidance: 1) Follows algorithms to complete tasks and 2) Creates algorithms to complete tasks.
***2.AP.C.01** - The Proficient student, with guidance: 1) Individually creates programs that include sequencing, conditionals, and repetition and 2) Collaboratively creates programs that include sequencing, conditionals, and repetition.
***2.AP.M.01** - The Proficient student, independently: 1) Decomposes a problem and 2) Creates a sequence of instructions to solve that problem.
***2.AP.PD.03** - The Proficient student debugs using a programming language: 1) Independently and 2) Collaboratively.
***2.IC.SI.01** - The Proficient student, independently: 1) Makes appropriate choices when participating in an online community; 2) Interacts respectfully with others; and 3) Reports inappropriate behavior to an adult.

GRADE 3-5 PERFORMANCE STANDARDS

***5.CS.HS.01** - The Proficient student creates a simple example of how a computing device takes input, stores information, processes input and information, and provides output (e.g., click volume button and the sound level increases).
***5.NI.C.01** - The Proficient student: 1) Describes, with specificity, real-world cybersecurity problems; 2) Discusses with peers using a variety of methods (e.g., blog, discussion post, oral) the personal consequences of inappropriate use; and 3) Identifies and implements appropriate strategies for how personal information can be protected.
***5.DA.S.01** - The Proficient student explains/justifies why a particular location or format is appropriate for the data they are creating or using.
***5.DA.IM.01** - The Proficient student independently: 1) Makes a statement based on a data set to describe a relationship, and then 2) Predicts an outcome or communicates an idea.
***5.AP.A.01** - The Proficient student: 1) Compares and refines multiple algorithms for the same task and 2) Determines which algorithm is the most appropriate for the same task.
***5.AP.V.01** - The Proficient student creates programs that use variables to: 1) store data and 2) modify data.
***5.AP.C.01** - The Proficient student: 1) Independently, creates programs that include combinations of sequences, events, loops, and conditionals. and 2) Collaboratively, creates programs that include combinations of sequences, events, loops, and conditionals.
***5.AP.PD.03** - The Proficient student independently tests and debugs a program or algorithm to ensure it runs as intended.
***5.IC.SI.02** - The Proficient student practices grade-level appropriate behavior and responsibilities while participating in an online community.
***5.IC.SLE.01** - The Proficient student: 1) Appropriately uses public domain and creative commons media and 2) Discusses the social impact of violating intellectual property rights.

GRADE 6-8 PERFORMANCE STANDARDS

***8.CS.HS.01** - The Proficient student: 1) Designs a project that combines hardware and software components to collect and exchange data and 2) Refines a project that combines hardware and software components to collect and exchange data.
***8.NI.C.01** - The Proficient student critiques physical and digital procedures that could be implemented to protect electronic data/information.

***8.DA.CVT.01** - The Proficient student uses computational tools to: 1) Transform data to improve reliability by removing errors and 2) Highlight or expose relationships in the data.
***8.AP.V.01** - The Proficient student: 1) Creates clearly named variables; 2) Creates variables that represent different data types; and 3) Performs operations on the values of variables.
***8.AP.C.01** - The Proficient student designs and iteratively develops programs that include: 1) nested loops and 2) compound conditionals.
***8.AP.M.01** - The Proficient student decomposes problems and sub-problems into parts for the design, implementation, and review of programs.
***8.AP.PD.04** - The Proficient student documents programs in order to make them easier to follow, test, and debug.
***8.IC.SLE.01** - The Proficient student: 1) describes tradeoffs between allowing information to be public and keeping information private and secure.

GRADE 9-12 LEVEL 1 PERFORMANCE STANDARDS

***L1.NI.C.03** - The Proficient student compares two or more security measures, considering trade-offs between the usability and security of a computing system.
***L1.DA.CVT.01** - The Proficient student creates appropriate interactive data representations using software tools to help others better understand real-world phenomena.
***L1.AP.A.01** - The Proficient student creates a prototype that uses appropriate algorithms (e.g., searching, sorting, finding shortest distance) to provide a possible solution for a real-world problem relevant to the student.
***L1.AP.C.03** - The Proficient student designs and iteratively develops a computational artifact that uses events to initiate instructions for: 1) practical intent, 2) personal expression, or 3) societal issues.
***L1.AP.M.01** - The Proficient student decomposes problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
***L1.AP.PD.01** - The Proficient student plans and develops programs by: 1) analyzing a problem and/or process; 2) developing and documenting a solution; 3) testing outcomes; and 4) adapting the program for a variety of users.
***L1.AP.PD.04** - The Proficient student designs and develops computational artifacts while working in teams and using collaborative tools.
***L1.IC.SLE.03** - The Proficient student evaluates the following implications of privacy in the context of safety, law, or ethics: 1) social implications and 2) economic implications.
***L1.IC.SLE.04** - The Proficient student, when considering both positive and malicious intent regarding software development and use, discusses the: 1) legal impacts, 2) social impacts, and 3) ethical impacts.

GRADE 9-12 LEVEL 2 PERFORMANCE STANDARDS

***L2.NI.NCO.01** - The Proficient student describes common issues that impact network functionality (e.g., bandwidth, load, latency, topology).
***L2.DA.CVT.02** - The Proficient student: 1) Selects data collection tools and techniques and 2) Uses data collection tools to generate data sets that support a claim or communicate information.
***L2.AP.A.03** - The Proficient student evaluates algorithms in terms of their: 1) efficiency, 2) correctness, and 3) clarity.
***L2.AP.M.01** - The Proficient student constructs solutions to problems using student-created components, such as procedures, modules, and/or objects.
***L2.AP.PD.04** - The Proficient student evaluates key qualities of a program (e.g., correctness, usability, readability, efficiency, portability, and scalability) through a process such as a code review.
***L2.AP.PD.05** - The Proficient student develops and uses a series of test cases to verify that a program performs according to its design specifications.
***L2.IC.C.02** - The Proficient student evaluates the impact of the following on the distribution of computing resources in a global society: 1) equity, 2) access, and 3) influence.

ACKNOWLEDGMENT: The State Board of Education thanks the Computer Science Standards Review Committee and the Wyoming Department of Education for their work on this new set of standards.

INTRODUCTION: The Wyoming Computer Science Content and Performance Standards (WYCPS) were developed in accordance with Wyoming State Statute W.S. 21-2- 304(c). In the years 2018-2019 Wyoming Computer Science Content Standards were developed collaboratively through the contributions of the Computer Science Standards Review Committee (CSSRC) which included Wyoming parents, educators, and community members, as well as business members from across the state and nation. The committee's work was informed and guided by initial public input through community forums, as well as input solicited from specific stakeholder groups. Additional appendices and teacher resources, created by the CSSRC, are also available on the WDE Computer Science website at edu.wyoming.gov/standards.

In 2020, twelve educators from the original committee convened to review the Content Standards and identify those of which should be the most critical for **all students** to demonstrate mastery. They then reviewed and refined, as necessary, the Proficient PLD statement to become the Computer Science Performance Standards. **All of the Content Standards are critically important to build upon the skills students need to master this content; however, the Performance Standards are the essential standards by which a student's performance is measured to ensure they are proficient on (have mastered) the content. Teachers should provide extra focus, targeted supports, and offer multiple opportunities to demonstrate** student understanding (mastery) of the content through the District Assessment System (DAS). In the secondary levels, only students electing to take a course aligned to the Computer Science Standards would need to be assessed.

RATIONALE: The committee's (CSSRC) vision is that every student in every school has the opportunity to learn computer science. We believe that computing is fundamental to understanding and participating in an increasingly technological society, and it is essential for every Wyoming student to learn as part of a modern education. We see computer science as a subject that provides students with a critical lens for interpreting the world around them and challenges them to explore how computing and technology can expand Wyoming's impact on the world.

The standards we (CSSRC) present here provide the necessary foundation for local school district decisions about curriculum, instruction, and assessment. Implementation of these standards will better prepare Wyoming high school graduates for the rigors of college and/or career. In turn, Wyoming employers will be able to hire workers with a strong foundation in Computer Science—both in specific content areas and in critical thinking and inquiry-based problem solving.

The Computer Science Standards are written in grade bands (K-2, 3-5, 6-8, and 9-12). The committee (CSSRC) determined the standard to be met by the end of the grade band and also provides suggested progressions, which can be found on *Appendix D: Teacher Resource Progression Document*. (See all Appendices on pg. 4) **Districts have local flexibility on mapping the Computer Science Content Standards to their curriculum and instruction; however, all students must have multiple opportunities to demonstrate proficiency on the Performance Standards by the end of the grade band.**

In grades 9-12, the committee provides level 1 and level 2 standards. Level 1 standards include introductory skills. The level 2 standards are intended for students who wish to advance their study of Computer Science.

COMPUTER SCIENCE: Computer Science is the study of computing principles, design, and applications (hardware & software); the creation, access, and use of information through algorithms and problem solving, and the impact of computing on society.

COMPUTATIONAL THINKING: Computational thinking is a necessary and meaningful 21st century skill. Computational thinking is defined as the thought processes involved in formulating a problem and expressing its solutions in such a way that a computer (human or machine) can effectively carry them out. Computational thinking develops into competencies in problem solving, critical thinking, productivity, and creativity. Over time, engaging in computational thought builds a student's capacity to persevere, work efficiently, gain confidence, recognize and resolve ambiguity, generalize concepts, and communicate effectively. In order to adapt to global advancements in technology, students will need to use their computational thinking skills to formulate, articulate, and discuss solutions in a meaningful manner.

ORGANIZATION OF THE STANDARDS: (with terminology**)**
Standard Code: Grade.Domain.Subconcept.Standard#
Key: 2.CS.D.01 = 2nd Grade.Computing Systems.Devices.Standard #1

DOMAIN: The core concepts to be studied in computer science are as follows: 1) Computing Systems; 2) Networks and the Internet; 3) Data and Analysis; 4) Algorithms and Programming; and 5) Impacts of Computing.

CONTENT STANDARDS define the content and skills students are expected to know and be able to do by the end-of-the grade band. They are built foundationally and then in learning progressions. They do not dictate what methodology or instructional materials should be used, nor how the material is delivered. In grades 9- 12, the computer science standards are organized into 2 levels. Mostly, Level 1 is intended to represent the introductory level while Level 2 reaches a deeper level.

🔌 = Plugged in
This symbol designates when a standard may require hardware, software, or both in order to fully address the intent of the standard.

PERFORMANCE STANDARDS (PS), **identified with the code in blue highlight and an asterisk (*),** are the standards all students are expected to learn and be assessed on through the district assessment system by the end-of-the grade band. They specify the specific degree of understanding or demonstration of the knowledge and/or skill for a particular content standard. As such, it employs clear action verbs and describes "how good is good enough." Districts are expected to give students multiple opportunities to demonstrate proficiency on the Performance Standards through the District Assessment System (DAS) and provide appropriate supports for student success. **Teachers should provide extra focus, targeted supports, and offer multiple opportunities to demonstrate** student understanding (mastery). In the secondary level, only students electing to take a course aligned to these standards need to be assessed in the DAS.

PS Snapshot (# of Content Standards tied to PS)

Grade K-2 (7 out of 18)	Grade 3-5 (10 out of 23)	6-8 MS (8 out of 25)	HS Level 1 (9 out of 35)	HS Level 2 (7 out of 28)
2.CS.HS.01	5.CS.HS.01	8.CS.HS.01	L1.NI.C.03	L2.NI.NCO.01
2.NI.C.01	5.NI.C.01	8.NI.C.01	L1.DA.CVT.01	L2.DA.CVT.02
2.AP.A.01	5.DA.S.01	8.DA.CVT.01	L1.AP.A.01	L2.AP.A.03
2.AP.C.01	5.DA.IM.01	8.AP.V.01	L1.AP.C.03	L2.AP.M.01
2.AP.M.01	5.AP.A.01	8.AP.C.01	L1.AP.M.01	L2.AP.PD.04
2.AP.PD.03	5.AP.V.01	8.AP.M.01	L1.AP.PD.01	L2.AP.PD.05
2.IC.SI.01	5.AP.C.01	8.AP.PD.04	L1.AP.PD.04	L2.IC.C.02
	5.AP.PD.03	8.IC.SLE.01	L1.IC.SLE.03	
	5.IC.SI.02		L1.IC.SLE.04	
	5.IC.SLE.01			

PERFORMANCE LEVEL DESCRIPTORS (PLDs) describe the performance expectations of students for each of the four (4) performance level categories: advanced, proficient, basic, and below basic. These are a description of what students within each performance level are expected to know and be able to do. The PLDs can be found in Appendix B.

COMPUTER SCIENCE (CS) PRACTICES: There are seven (7) CS Practices that can be used as the standards are taught and measured. The seven (7) CS Practices are listed below and are more deeply explored in Appendix A: Descriptions of the CS Practices. (See Appendices below)

Practice 1. Fostering an Inclusive Computing Culture
Practice 2. Collaborating Around Computing
Practice 3. Recognizing and Defining Computational Problems
Practice 4. Developing and Using Abstractions
Practice 5. Creating Computational Artifacts
Practice 6. Testing and Refining Computational Artifacts
Practice 7. Communicating About Computing

APPENDICES: found at edu.wyoming.gov/standards

- APPENDIX A: DESCRIPTIONS OF COMPUTER SCIENCE (CS) PRACTICES
- APPENDIX B: PERFORMANCE LEVEL DESCRIPTORS (PLDs)
- APPENDIX C: GLOSSARY
- APPENDIX D: TEACHER RESOURCE PROGRESSION DOCUMENT
- APPENDIX E: ADMINISTRATOR K-12 CS STANDARDS OVERVIEW
- APPENDIX F: WYOMING DIGITAL LEARNING GUIDELINES (based on the 2016 ISTE Standards for Students)

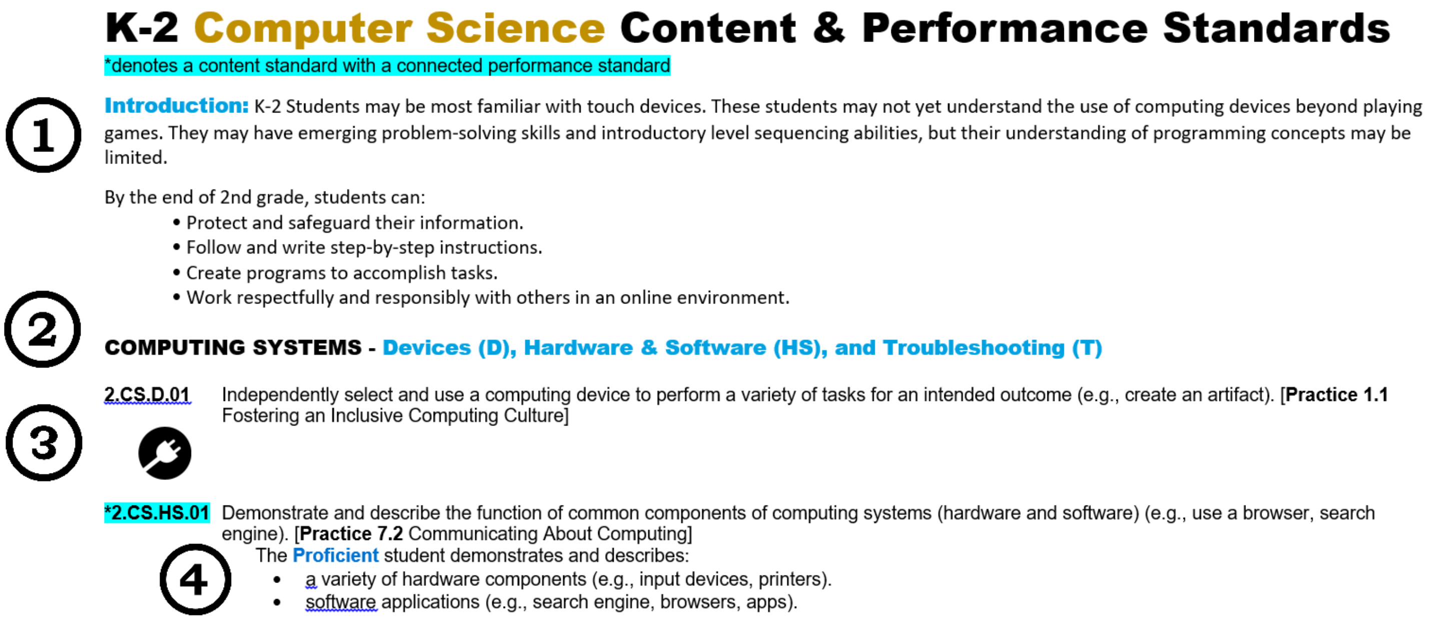
RESOURCES/REFERENCES:

- K-12 Computer Science Framework, (2016). Retrieved from http://k12cs.org/. [Ch. 5 Practices].
- Computer Science Teachers Association (CSTA), (2017). Retrieved from http://www.csteachers.org/page/standards.

HOW TO READ THIS DOCUMENT

Each grade band has 4 main sections:

1) Introduction describing the expectation by the end of the grade-band
2) Domain (Core Concepts) and Subconcepts
3) Content Standard with correlating CS Practice
4) Performance Standard – The Proficient statement that accompanies certain Content Standards that are denoted with an asterisk (*) and highlighted in blue



K-2 Computer Science Content & Performance Standards

*denotes a content standard with a connected performance standard

Introduction: K-2 Students may be most familiar with touch devices. These students may not yet understand the use of computing devices beyond playing games. They may have emerging problem-solving skills and introductory level sequencing abilities, but their understanding of programming concepts may be limited.

By the end of 2nd grade, students can:

- Protect and safeguard their information.
- Follow and write step-by-step instructions.
- Create programs to accomplish tasks.
- Work respectfully and responsibly with others in an online environment.

COMPUTING SYSTEMS - Devices (D), Hardware & Software (HS), and Troubleshooting (T)

2.CS.D.01 Independently select and use a computing device to perform a variety of tasks for an intended outcome (e.g., create an artifact). [**Practice 1.1** Fostering an Inclusive Computing Culture]

***2.CS.HS.01** Demonstrate and describe the function of common components of computing systems (hardware and software) (e.g., use a browser, search engine). [**Practice 7.2** Communicating About Computing]

The Proficient student demonstrates and describes:

- a variety of hardware components (e.g., input devices, printers).
- software applications (e.g., search engine, browsers, apps).

K-2 Computer Science Content & Performance Standards

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***2.CS.HS.01** Demonstrate and describe the function of common components of computing systems (hardware and software) (e.g., use a browser, search engine). [**Practice 7.2** Communicating About Computing]

The **Proficient** student demonstrates and describes:

- a variety of hardware components (e.g., input devices, printers).
- software applications (e.g., search engine, browsers, apps).

2.CS.T.01 Recognize computing systems might not work as expected and identify and effectively communicate simple hardware or software problems and implement solutions (e.g., app or program is not working as expected, no sound is coming from the device, caps lock turned on) and discuss problems with peers and adults. [**Practice 6.2** Testing and Refining Computational Artifacts**;** **Practice 7.2** Communicating About Culture]

NETWORK & THE INTERNET - Network, Communication, & Organization (NCO) and Cybersecurity (C)

2.NI.NCO.01 Identify and describe that computing devices can be connected in a variety of ways (e.g., Bluetooth, Wi-Fi, home and school networks, the internet). [**Practice 6.2** Testing and Refining Computational Artifacts]

*2.NI.C.01 Explain what authentication factors (e.g., login) are, why we use them, and apply authentication to protect devices and information (personal and private) from unauthorized access. [**Practice 7.3** Communication About Computing]

The **Proficient** student:

- Explains what authentication factors (e.g., login) are and why we use them.
- Models use of authentication factors to appropriate apps and devices.

DATA ANALYSIS – Storage (S), Collection, Visualization, & Transformation (CVT), and Inference & Models (IM)

2.DA.S.01 With guidance, develop and modify an organizational structure by creating, copying, moving, and deleting files and folders. [**Practice 4.2** Developing and Using Abstractions]

2.DA.CVT.01 With guidance, collect data and independently present the same data in various visual formats. [**Practice 4.4** Developing and Using Abstractions; **Practice 7.1** Communicating About Computing]

2.DA.IM.01 With guidance, interpret data and present it in a chart or graph (visualization) in order to make a prediction, with or without a computing device. [**Practice 4.1** Developing and Using Abstractions]

ALGORITHMS & PROGRAMMING – Algorithms (A), Variables (V), Control (C), Modularity (M), and Program Development (PD)

***2.AP.A.01** With guidance, identify and model daily processes by creating and following algorithms (sets of step-by- step instructions) to complete tasks (e.g., verbally, kinesthetically, with robot devices, or a programming language). [**Practice 4.4** Developing and Using Abstractions]

The **Proficient** student, with guidance:

- Follows algorithms to complete tasks.
- Creates algorithms to complete tasks.

2.AP.V.01 Model the way programs store and manipulate data by using numbers or other symbols to represent information (e.g., thumbs up/down as representations of yes/no, arrows when writing algorithms to represent direction, or encode and decode words using numbers, pictographs, or other symbols to represent letters or words). [**Practice 4.1** Developing and Using Abstractions]

***2.AP.C.01** With guidance, independently and collaboratively create programs to accomplish tasks using a programming language, robot device, or unplugged activity that includes sequencing, conditionals, and repetition. [**Practice 5.2** Creating Computational Artifacts]

The **Proficient** student, with guidance:

- Individually creates programs that include sequencing, conditionals, and repetition.
- Collaboratively creates programs that include sequencing, conditionals, and repetition.

*2.AP.M.01 Using grade appropriate content and complexity, decompose (breakdown) the steps needed to solve a problem into a precise sequence of instructions (e.g., develop a set of instructions on how to play your favorite game). [**Practice 3.2** Recognizing and Defining Computational Problems]

The **Proficient** student, independently:

- Decomposes a problem.
- Creates a sequence of instructions to solve that problem.

2.AP.PD.01 Develop plans that describe a program's sequence of events, goals, and expected outcomes. [**Practice 5.1** Creating Computational Artifacts; **Practice 7.2** Communicating About Culture]

2.AP.PD.02 Give credit to ideas, creations, and solutions of others while writing and developing programs. [**Practice 7.3** Communicating About Computing]

*2.AP.PD.03 Independently and collaboratively debug (identify and fix errors) programs using a programming language. [**Practice 6.2** Testing and Refining Computational Artifacts]

The **Proficient** student debugs using a programming language:

- Independently.
- Collaboratively.

2.AP.PD.04 Use correct terminology (debug, program input/output, code) to explain the development of a program or an algorithm (e.g., in an unplugged activity, hands on manipulatives, or a programming language). [**Practice 7.2** Communicating About Computing]

IMPACTS OF COMPUTING – Culture (C) and Social Interactions (SI)

2.IC.C.01 Describe how people use different types of technologies in their daily work and personal lives. [**Practice 3.1** Recognizing and Defining Computational Problems]

*2.IC.SI.01 Practice grade-level appropriate behavior and responsibilities while participating in an online community. Identify and report inappropriate behavior. [**Practice 2.1** Collaborating Around Computing]

The **Proficient** student, independently:

- Makes appropriate choices when participating in an online community.
- Interacts respectfully with others.
- Reports inappropriate behavior to an adult.

3-5 Computer Science Content & Performance Standards

*denotes a content standard with a connected performance standard

Introduction: Throughout grades 3-5, students engage in creative applications of Computer Science concepts and practices introduced in K-2. By the end of fifth grade, students will build upon their previous understanding of algorithms, programming (coding), networks, and the Internet. In addition, students will create, modify, and troubleshoot increasingly complex programs for a variety of purposes. Students will be able to explain cultural, social, and ethical impacts of computing.

By the end of 5th grade, students can:

- Model how information is translated, transmitted, and processed.
- Identify and implement strategies for protecting personal information.
- Justify the format and location for storage.
- Create and modify (remix) programs through an iterative process.
- Develop, test, and refine digital artifacts.
- Work respectfully and responsibly with others in an online environment and discuss the social impact of violating intellectual property rights.

COMPUTING SYSTEMS - Devices (D), Hardware & Software (HS), and Troubleshooting (T)

5.CS.D.01 Independently, describe how internal and external parts of computing devices function to form a system. [**Practice 7.2** Communicating About Computing]

***5.CS.HS.01** Model how information is translated, transmitted, and processed in order to flow through hardware and software to accomplish tasks. [**Practice 4.4** Developing and Using Abstractions]

The **Proficient** student creates a simple example of how a computing device takes input, stores information, processes input and information, and provides output (e.g., click volume button and the sound level increases).

5.CS.T.01 Identify hardware and software problems that may occur during everyday use, then develop, apply, and explain strategies for solving these problems. [**Practice 6.2** Testing and Refining Computational Artifacts]

NETWORK & THE INTERNET - Network, Communication, & Organization (NCO) and Cybersecurity (C)

5.NI.NCO.01 Model and explain 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 4.4** Developing and Using Abstractions]

***5.NI.C.01** Discuss real-world cybersecurity problems and identify and implement appropriate strategies for how personal information can be protected. [**Practice 3.1** Recognizing and Defining Computational Problems]

The **Proficient** student:

- Describes, with specificity, real-world cybersecurity problems.
- Discusses with peers using a variety of methods (e.g., blog, discussion post, oral) the personal consequences of inappropriate use.
- Identifies and implements appropriate strategies for how personal information can be protected.

DATA ANALYSIS – Storage (S), Collection, Visualization, & Transformation (CVT), and Inference & Models (IM)

***5.DA.S.01** Justify the format and location for storing data based on sharing requirements and the type of information (e.g., images, videos, text). [**Practice 4.2** Developing and Using Abstractions]

The **Proficient** student explains/justifies why a particular location or format is appropriate for the data they are creating or using.

5.DA.CVT.01 Organize and present collected data to highlight relationships and support a claim. [**Practice 7.1** Communicating About Computing]

***5.DA.IM.01** Use data to highlight or propose relationships, predict outcomes, or communicate an idea. [**Practice 7.1** Communicating About Computing]

The **Proficient** student independently:

- Makes a statement based on a data set to describe a relationship, **and then**
- Predicts an outcome **or** communicates an idea.

ALGORITHMS & PROGRAMMING – Algorithms (A), Variables (V), Control (C), Modularity (M), and Program Development (PD)

***5.AP.A.01** Using grade appropriate content and complexity, compare and refine multiple algorithms for the same task and determine which is the most appropriate. [**Practice 3.3** Recognizing and Defining Computational Problems] [**Practice 6.3** Testing and Refining Computational Artifacts]

The **Proficient** student:

- Compares and refines multiple algorithms for the same task.
- Determines which algorithm is the most appropriate for the same task.

***5.AP.V.01** Using grade appropriate content and complexity, create programs that use variables to store and modify data. [**Practice 5.2** Creating Computational Artifacts]

The **Proficient** student creates programs that use variables to:

- Store data.
- Modify data.

***5.AP.C.01** Using grade appropriate content and complexity, create programs that include sequences, events, loops, and conditionals, both individually and collaboratively. [**Practice 5.2** Creating Computational Artifacts]

🔌

The **Proficient** student:

- Independently, creates programs that include combinations of sequences, events, loops, and conditionals.
- Collaboratively, creates programs that include combinations of sequences, events, loops, and conditionals.

5.AP.M.01 Using grade appropriate content and complexity, decompose (break down) problems into smaller, manageable sub-problems to facilitate the program development process. [**Practice 3.2** Recognizing and Defining Computational Problems]

5.AP.M.02 Using grade appropriate content and complexity, modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features. [**Practice 5.3** Creating Computational Artifacts]

5.AP.PD.01 Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences. [**Practice 6.2** Testing and Refining Computational Artifacts]

5.AP.PD.02 Using grade appropriate content and complexity, observe intellectual property rights and give appropriate credit when creating or remixing programs. [**Practice 5.2** Creating Computational Artifacts] [**Practice 7.3** Communicating About Computing]

***5.AP.PD.03** Using grade appropriate content and complexity, test and debug (i.e., identify and fix errors) a program or algorithm to ensure it runs as intended. [**Practice 6.1 & 6.2** Testing and Refining Computational Artifacts]

The **Proficient** student independently tests and debugs a program or algorithm to ensure it runs as intended.

5.AP.PD.04 Using grade appropriate content and complexity, describe choices made during program development using code comments, presentations, and demonstrations. [**Practice 7.2** Communicating About Computing]

5.AP.PD.05 Using grade appropriate content and complexity, with teacher guidance, perform varying roles when collaborating with peers during the design, implementation, and review stages of program development. [**Practice 2.2** Collaborating Around Computing]

IMPACTS OF COMPUTING – Culture (C) and Social Interactions (SI)

5.IC.C.01 Give examples and explain how computing technologies have changed the world and express how those technologies influence and are influenced by cultural practices. [**Practice 3.1** Recognizing and Defining Computational Problems]

5.IC.C.02 Develop, test, and refine digital artifacts or devices to improve accessibility and usability for diverse end users. [**Practice 1.2** Fostering an Inclusive Computing Culture]

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5.IC.SI.01 Seek diverse perspectives for the purpose of improving computational artifacts. [**Practice 1.1** Fostering an Inclusive Computing Culture]

***5.IC.SI.02** Practice grade-level appropriate behavior and responsibilities while participating in an online community. Identify and report inappropriate behavior. [**Practice 2.1** Collaborating Around Computing]

The **Proficient** student practices grade-level appropriate behavior and responsibilities while participating in an online community.

***5.IC.SLE.01** Recognize and appropriately use public domain and creative commons media and discuss the social impact of violating intellectual property rights. [**Practice 7.3** Communicating About Computing]

The **Proficient** student:

- Appropriately uses public domain and creative commons media.
- Discusses the social impact of violating intellectual property rights.

6-8 Computer Science Content & Performance Standards

*denotes a content standard with a connected performance standard

Introduction: Throughout grades 6-8, students continue to develop their understanding of algorithms and programming (coding). Students work collaboratively and independently to create and modify increasingly complex programs for a variety of purposes introduced in grades 3-5.

By the end of 8th grade, students can:

- Systematically identify, recommend, resolve, and document increasingly complex software and hardware problems with computing devices and their components.
- Model the role of protocols in transmitting data across networks and the internet.
- Critique physical and digital procedures that could be implemented to protect electronic data/information.
- Use and refine computational tools to transform collected data in order to make it more useful and reliable.
- Create flowcharts and pseudocode to design algorithms to solve complex problems.
- Create clearly named variables that represent different data types and perform operations on their values.
- Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.
- Decompose problems into parts to facilitate the design, implementation, and review of programs.
- Create procedures with parameters to organize code and make it easier to reuse.
- Seek and incorporate feedback from team members and users to refine a solution to a problem.
- Describe impacts associated with computing technologies that affect people's everyday activities and career options along with issues of bias and accessibility in the design of technologies.
- Practice grade-level appropriate behavior and responsibilities while participating in an online community, including identifying and reporting inappropriate behavior.
- Describe tradeoffs between allowing information to be public and keeping information private and secure.
- Discuss the legal, social, and ethical impacts associated with software development and use, including both positive and malicious intent.

COMPUTING SYSTEMS - Devices (D), Hardware & Software (HS), and Troubleshooting (T)

8.CS.D.01 Recommend improvements to the design of computing devices based on an analysis of how a variety of users interact with the device. [**Practice 3.3** Recognizing and Defining Computational Problems]

***8.CS.HS.01** Design and refine a project that combines hardware and software components to collect and exchange data. [**Practice 5.1** Creating Computational Artifacts]

The **Proficient** student:

- Designs a project that combines hardware and software components to collect and exchange data.

- Refines a project that combines hardware and software components to collect and exchange data.

8.CS.T.01 Systematically identify, resolve, and document increasingly complex software and hardware problems with computing devices and their components. [**Practice 6.2** Testing and Refining Computational Artifacts]

NETWORK & THE INTERNET - Network, Communication, & Organization (NCO) and Cybersecurity (C)

8.NI.NCO.01 Model the role of protocols in transmitting data across networks and the internet (e.g., explain protocols and their importance to data transmission; model how packets are broken down into smaller pieces and how they are delivered). [**Practice 4.4** Developing and Using Abstractions]

***8.NI.C.01** Critique physical and digital procedures that could be implemented to protect electronic data/information. [**Practice 7.3** Communicating About Computing]

The **Proficient** student critiques physical and digital procedures that could be implemented to protect electronic data/information.

8.NI.C.02 Apply multiple methods of encryption to model the secure transmission of data. [**Practice 4.4** Developing and Using Abstractions]

DATA ANALYSIS – Storage (S), Collection, Visualization, & Transformation (CVT), and Inference & Models (IM)

8.DA.S.01 Represent data using multiple encoding schemes (e.g., ASCII, binary). [**Practice 4.4** Developing and Using Abstractions]

***8.DA.CVT.01** Using computational tools, transform collected data to make it more useful and reliable. [**Practice 6.3** Testing and Refining Computational Artifacts]

The **Proficient** student uses computational tools to:

- Transform data to improve reliability by removing errors.
- Highlight or expose relationships in the data.

8.DA.IM.01 Refine computational models based on generated data. [**Practice 4.4** Developing and Using Abstractions] [**Practice 5.3** Creating Computational Artifacts]

ALGORITHMS & PROGRAMMING – Algorithms (A), Variables (V), Control (C), Modularity (M), and Program Development (PD)

8.AP.A.01 Create flowcharts and pseudocode to design algorithms to solve complex problems. [**Practice 4.1 & 4.4** Developing and Using Abstractions]

***8.AP.V.01** Using grade appropriate content and complexity, create clearly named variables that represent different data types and perform operations on their values. [**Practice 5.1 & 5.2** Creating Computational Artifacts]

The **Proficient** student:

- Creates clearly named variables.
- Creates variables that represent different data types.
- Performs operations on the values of variables.

***8.AP.C.01** Using grade appropriate content and complexity, design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. [**Practice 5.1 & 5.2** Creating Computational Artifacts]

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The **Proficient** student designs and iteratively develops programs that include:

- nested loops.
- compound conditionals.

***8.AP.M.01** Using grade appropriate content and complexity, decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs. [**Practice 3.2** Recognizing and Defining Computational Problems]

The **Proficient** student decomposes problems and sub-problems into parts for the design, implantation, and review of programs.

8.AP.M.02 Using grade appropriate content and complexity, create procedures with parameters to organize code and make it easier to reuse. [**Practice 4.1 & 4.3** Developing and Using Abstractions]

8.AP.PD.01 Using grade appropriate content and complexity, seek and incorporate feedback from team members and users to refine a solution to a problem. [**Practice 1.1** Fostering an Inclusive Computing Culture] [**Practice 2.3** Collaborating Around Computing]

8.AP.PD.02 Incorporate existing code, media, and libraries into original programs of increasing complexity and give attribution. [**Practice 4.2** Developing and Using Abstractions] [**Practice 5.2** Creating Computational Artifacts] [**Practice 7.3** Communicating About Computing]

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8.AP.PD.03 Systematically test and refine programs using a range of test cases. [**Practice 6.1** Testing and Refining Computational Artifacts]

***8.AP.PD.04** Using grade appropriate content and complexity, document programs in order to make them easier to follow, test, and debug. [**Practice 7.2** Communicating About Computing]

The **Proficient** student documents programs in order to make them easier to follow, test, and debug.

8.AP.PD.05 Distribute tasks and maintain a project timeline when collaboratively developing computational artifacts. [**Practice 2.2** Collaborating Around Computing]

IMPACTS OF COMPUTING – Culture (C) and Social Interactions (SI)

8.IC.C.01 Describe impacts associated with computing technologies that affect people's everyday activities and career options. [**Practice 7.2** Communicating About Computing]

8.IC.C.02 Describe issues of bias and accessibility in the design of technologies. [**Practice 1.2** Fostering an Inclusive Computing Culture]

8.IC.SI.01 Using grade appropriate content and complexity, collaborate using tools to connect with peers when creating a computational artifact. [**Practice 2.4** Collaborating Around Computing] [**Practice 5.2** Creating Computational Artifacts]

8.IC.SI.02 Practice grade-level appropriate behavior and responsibilities while participating in an online community. Identify and report inappropriate behavior. [**Practice 2.1** Collaborating Around Computing] [**Practice 7.3** Communicating About Computing]

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*8.IC.SLE.01 Using grade appropriate content and complexity, describe tradeoffs between allowing information to be public and keeping information private and secure. [**Practice 7.2** Communicating About Computing]

The **Proficient** student describes tradeoffs between allowing information to be public and keeping information private and secure.

8.IC.SLE.02 Using grade-level appropriate content and complexity, discuss the legal, social, and ethical impacts associated with software development and use, including both positive and malicious intent. [**Practice 1.1** Fostering an Inclusive Computing Culture] [**Practice 7.2** Communicating About Computing]

9-12 Computer Science Content & Performance Standards

*denotes a content standard with a connected performance standard

Introduction: In high school, students will continue to develop their knowledge of computing systems, their components, and how systems interact. Students will use their understanding about the basic principles of computation, that algorithms describe a step-by-step solution to a problem, that programs are algorithms written in a language that a computer can understand, and that the solution to many problems can be described as a program. A solid foundation of algebraic concepts is important for success in high school computer science courses. Students will expand their ability to identify patterns and create algorithms that can model the observed patterns.

By the end of 12th grade, students can:

- Create a computer program using sequencing, selection, and iteration.
- Decompose complex problems into smaller, more manageable sections.
- Use tools of coding to create, debug, and document the evolution of an artifact.
- Compare and contrast trade-offs in programming techniques.
- Develop complex computer programs individually and as part of a group.
- Recognize how various components of a complex computing system work together.
- Use tools to analyze data and know how data is stored.
- Explain how cybersecurity issues affect networks and the internet.
- Justify how proliferation of computing affects privacy, rights, opportunities, and responsibility.

The high school standards are organized into 2 levels. Mostly, Level 1 is intended to be at the introductory level, and Level 2 reaches at a deeper level.

COMPUTING SYSTEMS - Devices (D), Hardware & Software (HS), and Troubleshooting (T)

L1.CS.D.01 Explain how abstractions hide the underlying implementation details of computing systems embedded in everyday objects. [**Practice 4.1** Developing and Using Abstractions]

L1.CS.HS.01 Explain the interactions between application software, system software, and hardware layers. [**Practice 4.1** Developing and Using Abstractions]

L2.CS.HS.01 Categorize the roles of operating system software. [**Practice 4.1** Developing and Using Abstractions] [**Practice 7.2** Communicating About Computing]

L1.CS.T.01 Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and resolve errors. [**Practice 6.1 & 6.2** Testing and Refining Computational Artifacts]

L2.CS.T.01 Identify how hardware components facilitate logic, input, output, and storage in computing systems, and their common malfunctions. [**Practice 7.2** Communicating About Computing]

NETWORK & THE INTERNET - Network, Communication, & Organization (NCO) and Cybersecurity (C)

L1.NI.NCO.01 Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing. [**Practice 4.1** Developing and Using Abstractions] [**Practice 7.2** Communicating About Computing]

*L2.NI.NCO.01 Describe the issues that impact network functionality (e.g., bandwidth, load, latency, topology). [**Practice 7.2** Communicating About Computing]

The **Proficient** student describes common issues that impact network functionality (e.g., bandwidth, load, latency, topology).

L1.NI.C.01 Give examples to illustrate how sensitive data can be affected by malware and other attacks. [**Practice 7.2** Communicating About Computing]

L2.NI.C.01 Compare ways software developers protect devices and information from unauthorized access. [**Practice 7.2** Communicating About Computing]

L1.NI.C.02 Recommend cybersecurity measures to address various scenarios based on factors such as efficiency, feasibility, and ethical impacts. [**Practice 3.3** Recognizing and Defining Computational Problems]

*L1.NI.C.03 Compare various security measures, considering trade-offs between the usability and security of a computing system. [**Practice 6.3** Testing and Refining Computational Artifacts]

The **Proficient** student compares two or more security measures, considering trade-offs between the usability and security of a computing system.

L1.NI.C.04 Explain trade-offs when selecting and implementing cybersecurity recommendations. [**Practice 7.2** Communicating About Computing]

DATA ANALYSIS – Storage (S), Collection, Visualization, & Transformation (CVT), and Inference & Models (IM)

L1.DA.S.01 Translate between different bit representations of real-world phenomena, such as characters, numbers, and images. [**Practice 4.1** Developing and Using Abstractions]

L1.DA.S.02 Evaluate the trade-offs in how data elements are organized and where data is stored. [**Practice 3.3** Recognizing and Defining Computational Problems]

*L1.DA.CVT.01 Create interactive data representations using software tools to help others better understand real-world phenomena (e.g., paper surveys and online data sets). [**Practice 4.4** Developing and Using Abstractions]

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The **Proficient** student creates appropriate interactive data representations using software tools to help others better understand real-world phenomena.

L2.DA.CVT.01 Use data analysis tools and techniques to identify patterns in data representing complex systems. [**Practice 4.1** Developing and Using Abstractions] [**Practice 7.1** Communicating About Computing]

***L2.DA.CVT.02** Select data collection tools and techniques, and use them to generate data sets that support a claim or communicate information. [**Practice 7.1 & 7.2** Communicating About Computing]

The **Proficient** student:

- Selects data collection tools and techniques.
- Uses data collection tools to generate data sets that support a claim or communicate information.

L1.DA.IM.01 Create computational models that represent the relationships among different elements of data collected from a phenomenon or process. [**Practice 4.4** Developing and Using Abstractions]

L2.DA.IM.01 Formulate, refine, and test scientific hypotheses using models and simulations. [**Practice 4.4** Developing and Using Abstractions]

ALGORITHMS & PROGRAMMING – Algorithms (A), Variables (V), Control (C), Modularity (M), and Program Development (PD)

***L1.AP.A.01** Create a prototype that uses algorithms (e.g., searching, sorting, finding shortest distance) to provide a possible solution for a real-world problem relevant to the student. [**Practice 5.2** Creating Computational Artifacts]

The **Proficient** student creates a prototype that uses appropriate algorithms (e.g., searching, sorting, finding shortest distance) to provide a possible solution for a real-world problem relevant to the student.

L2.AP.A.01 Critically examine and trace classic algorithms. Use and adapt classic algorithms to solve computational problems (e.g., selection sort, insertion sort, binary search, linear search). [**Practice 4.2** Developing and Using Abstractions]

L1.AP.A.02 Describe how artificial intelligence algorithms drive many software and physical systems. [**Practice 7.2** Communicating About Computing]

L2.AP.A.02 Develop an artificial intelligence algorithm to play a game against a human opponent or solve a real-world problem. [**Practice 5.2 & 5.3** Creating Computational Artifacts]

***L2.AP.A.03** Evaluate algorithms (e.g., sorting, searching) in terms of their efficiency, correctness, and clarity. [**Practice 4.2** Developing and Using Abstractions]

The **Proficient** student evaluates algorithms in terms of their:

- efficiency
- correctness
- clarity

L1.AP.V.01 🔌 Use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables. [**Practice 4.1** Developing and Using Abstractions]

L2.AP.V.01 Compare and contrast simple data structures and their uses (e.g., lists, stacks, queues). [**Practice 4.2** Developing and Using Abstractions]

L1.AP.C.01 Justify the selection of specific control structures when tradeoffs involve implementation, readability, and program performance, and explain the benefits and drawbacks of choices made. [**Practice 5.2** Creating Computational Artifacts]

L2.AP.C.01 Trace the execution of recursion, illustrating output and changes in values of named variables. [**Practice 3.2** Recognizing and Defining Computational Problems]

L1.AP.C.02 Trace the execution of loops and conditional statements, illustrating output and changes in values of named variables. [**Practice 3.2** Recognizing and Defining Computational Problems]

***L1.AP.C.03** 🔌 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. [**Practice 5.2** Creating Computational Artifacts]

The **Proficient** student designs and iteratively develops a computational artifact that uses events to initiate instructions for:

- practical intent,
- personal expression, **or**
- societal issues.

***L1.AP.M.01** Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. [**Practice 3.2** Recognizing and Defining Computational]

The **Proficient** student decomposes problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

***L2.AP.M.01** Construct solutions to problems using student-created components, such as procedures, modules, and/or objects. [**Practice 4.3** Developing and Using Abstractions] [**Practice 5.2** Creating Computational Artifacts]

The **Proficient** student constructs solutions to problems using student-created components, such as procedures, modules, and/or objects.

L1.AP.M.02 Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. [**Practice 5.2** Creating Computational Artifacts]

L2.AP.M.02 Analyze a large-scale computational problem and identify generalizable patterns that can be applied to a solution. [**Practice 4.1** Developing and Using Abstractions]

L2.AP.M.03 Demonstrate code reuse by creating programming solutions using libraries and APIs. [**Practice 4.2** Developing and Using Abstractions] [**Practice 5.3** Creating Computational Artifacts]

***L1.AP.PD.01** Plan and develop programs by analyzing a problem and/or process, developing and documenting a solution, testing outcomes, and adapting the program for a variety of users. [**Practice 5.1** Creating Computational Artifacts]

The **Proficient** student plans and develops programs by:

- analyzing a problem and/or process.
- developing and documenting a solution.
- testing outcomes.
- adapting the program for a variety of users.

L2.AP.PD.01 Plan and develop programs that will provide solutions to a variety of users using a software life cycle process. [**Practice 5.1** Creating Computational Artifacts]

L1.AP.PD.02 Evaluate licenses that limit or restrict use of computational artifacts when using resources such as libraries. [**Practice 7.3** Communicating About Computing]

L2.AP.PD.02 Use version control systems, integrated development environments (IDEs), and collaborative tools and practices (e.g., code documentation) in a group software project. [**Practice 2.4** Collaborating Around Computing]

L1.AP.PD.03 Use debugging tools to identify and fix errors in a program. [**Practice 6.2** Testing and Refining Computational Artifacts]

L2.AP.PD.03 Develop programs for multiple computing platforms. [**Practice 5.2** Creating Computational Artifacts]

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***L1.AP.PD.04** Design and develop computational artifacts, working in team roles, using collaborative tools. [**Practice 2.4** Collaborating Around Computing]

The **Proficient** student designs and develops computational artifacts while working in teams and using collaborative tools.

***L2.AP.PD.04** Evaluate key qualities of a program through a process such as a code review (e.g., qualities could include correctness, usability, readability, efficiency, portability, and scalability). [**Practice 6.3** Testing and Refining Computational Artifacts]

The **Proficient** student evaluates key qualities of a program (e.g., correctness, usability, readability, efficiency, portability, and scalability) through a process such as a code review.

L1.AP.PD.05 Document design decisions using text, graphics, presentations, and/or demonstrations in the development of complex programs. [**Practice 7.2** Communicating About Computing]

***L2.AP.PD.05** Develop and use a series of test cases to verify that a program performs according to its design specifications. [**Practice 6.1** Testing and Refining Computational Artifacts]

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The **Proficient** student develops and uses a series of test cases to verify that a program performs according to its design specifications.

L1.AP.PD.06 Evaluate and refine computational artifacts to make them more usable and accessible. [**Practice 6.3** Testing and Refining Computational Artifacts]

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L2.AP.PD.06 Explain security issues that might lead to compromised computer programs. [**Practice 7.2** Communicating About Computing]

L2.AP.PD.07 Modify an existing program to add additional functionality and discuss intended and unintended implications (e.g., breaking other functionality). [**Practice 5.3** Creating Computational Artifacts]

L2.AP.PD.08 Compare multiple programming languages and discuss how their features make them suitable for solving different types of problems. [**Practice 7.2** Communicating About Computing]

IMPACTS OF COMPUTING – Culture (C) and Social Interactions (SI)

L1.IC.C.01 Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. [**Practice 1.2** Fostering an Inclusive Computing Culture]

L2.IC.C.01 Evaluate the beneficial and harmful effects that computational artifacts and innovations have on society. [**Practice 1.2** Fostering an Inclusive Computing Culture]

L1.IC.C.02 🔌 Test and refine computational artifacts to reduce bias and equity deficits. [**Practice 1.2** Fostering an Inclusive Computing Culture]

***L2.IC.C.02** Evaluate the impact of equity, access, and influence on the distribution of computing resources in a global society. [**Practice 1.2** Fostering an Inclusive Computing Culture]

The **Proficient** student evaluates the impact of the following on the distribution of computing resources in a global society:

- equity
- access
- influence

L1.IC.C.03 Demonstrate how a given algorithm applies to problems across disciplines. [**Practice 3.1** Recognizing and Defining Computational Problems]

L2.IC.C.03 Predict how computational innovations that have revolutionized aspects of our culture might evolve. [**Practice 5.2** Creating Computational Artifacts]

L1.IC.SI.01 Use tools and methods for collaboration. [**Practice 2.4** Collaborating Around Computing]

L2.IC.SI.01 🔌 Practice grade-level appropriate behavior and responsibilities while participating in an online community. Identify and report inappropriate behavior. [**Practice 2.1** Collaborating Around Computing] [**Practice 7.3** Communicating About Computing]

L1.IC.SI.02 🔌 Practice grade-level appropriate behavior and responsibilities while participating in an online community. Identify and report inappropriate behavior. [**Practice 2.1** Collaborating Around Computing] [**Practice 7.3** Communicating About Computing]

L1.IC.SLE.01 Explain the beneficial and harmful effects that intellectual property laws can have on innovation. [**Practice 7.3** Communicating About Computing]

L2.IC.SLE.01 Debate laws and regulations that impact the development and use of software and technology. [**Practice 1.1** Recognizing and Defining Computational Problems] [**Practice 7.3** Communicating About Computing]

L1.IC.SLE.02 Explain the privacy concerns related to the collection and generation of data through automated processes that may not be evident to users. [**Practice 7.2** Communicating About Computing]

L2.IC.SLE.02 Using grade-level appropriate content and complexity, discuss the legal, social, and ethical impacts associated with software development and use, including both positive and malicious intent. [**Practice 1.1** Fostering an Inclusive Computing Culture] [**Practice 7.2** Communicating About Computing]

***L1.IC.SLE.03** Evaluate the social and economic implications of privacy in the context of safety, law, or ethics. [**Practice 7.3** Communicating About Computing]

The **Proficient** student evaluates the following implications of privacy in the context of safety, law, or ethics:

- social implications
- economic implications

***L1.IC.SLE.04** Using grade-level appropriate content and complexity, discuss the legal, social, and ethical impacts associated with software development and use, including both positive and malicious intent. [**Practice 1.1** Fostering an Inclusive Computing Culture] [**Practice 7.2** Communicating About Computing]

The **Proficient** student, when considering both positive and malicious intent regarding software development and use, discusses the:

- legal impacts
- social impacts
- ethical impacts