
COMPUTER SCIENCE DRAFT FOR ECONOMIC IMPACT SURVEY
12.16.19

This revised draft reflects the consensus decisions of the Computer Science Negotiated Rulemaking Committee, held on December 5, 2019.

Please visit the [OPI K-12 Content Standards and Revision webpage](#) for meeting agenda, minutes, video recording, and other meeting materials.

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1 MONTANA CONTENT STANDARDS FOR COMPUTER SCIENCE

2 STANDARDS FOR COMPUTER SCIENCE FOR GRADES K-12

- 3 1. The content areas covered by the computer science standards include:
- 4 a. algorithms and programming;
 - 5 b. computing systems;
 - 6 c. data and analysis;
 - 7 d. impacts of computing; and,
 - 8 e. computer science networks and the internet
- 9 2. When a district incorporates or integrates computer science content into district
10 curriculum or offers a course in computer science, the following skills at each grade level
11 apply:
- 12 a. fostering an inclusive computing culture
 - 13 b. collaborating around computing
 - 14 c. recognizing and defining computational problems
 - 15 d. developing and using abstractions
 - 16 e. creating computational artifacts
 - 17 f. testing and refining computational artifacts; and
 - 18 g. communicating about computing

- 1 **COMPUTER SCIENCE CONTENT STANDARDS FOR KINDERGARTEN**
- 2 1. Computer science algorithms and programming standards for kindergarten are:
- 3 a. follow step-by-step instructions
- 4 b. recognize that numbers and symbols represent information
- 5 2. Computer science computing systems standards for kindergarten are:
- 6 a. identify computing devices
- 7 b. identify examples of common hardware and software
- 8 3. Computer science data and analysis standards for kindergarten are:
- 9 a. collect and categorize data
- 10 b. retrieve information
- 11 c. identify patterns in data
- 12 4. Computer science impacts of computing standards for kindergarten are:
- 13 a. work respectfully and responsibly in groups
- 14 b. keep login information private and log off devices appropriately

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1 **COMPUTER SCIENCE CONTENT STANDARDS FOR FIRST GRADE**

- 2 1. Computer science algorithms and programming standards for first grade are:
- 3 a. retell step-by-step instructions to complete a task
- 4 b. use numbers and symbols to represent information
- 5 c. arrange sequences and simple loops in correct order
- 6 2. Computer science computing systems standards for first grade are:
- 7 a. identify tasks that can be performed by computing devices
- 8 b. use appropriate terminology in identifying common hardware and software
- 9 c. identify simple hardware and software problems
- 10 3. Computer science data and analysis standards for first grade are:
- 11 a. collect and categorize data in up to three categories
- 12 b. retrieve, arrange, and modify information
- 13 c. identify patterns in data
- 14 4. Computer science impacts of computing standards for first grade are:
- 15 a. work respectfully and responsibly in groups
- 16 b. keep login information private and log off devices appropriately

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1 **COMPUTER SCIENCE CONTENT STANDARDS FOR SECOND GRADE**

- 2 1. Computer science algorithms and programming standards for second grade are:
- 3 a. model daily processes by creating and following sets of step-by-step instructions
- 4 to complete tasks
- 5 b. model the way programs store and manipulate data by using numbers or other
- 6 symbols to represent information
- 7 c. develop programs with sequences and simple loops to express ideas or address
- 8 a problem
- 9 d. break down the steps needed to solve a problem into a precise sequence of
- 10 instructions
- 11 2. Computer science computing systems standards for second grade are:
- 12 a. select and operate appropriate tools to perform a variety of tasks
- 13 b. use appropriate terminology in identifying and describing the function of common
- 14 hardware and software
- 15 c. describe basic hardware and software problems using accurate terminology
- 16 3. Computer science data and analysis standards for second grade are:
- 17 a. collect and present the data in various visual formats
- 18 b. define data as gathered and stored information
- 19 c. identify and describe patterns in data visualizations, such as charts or graphs, to
- 20 make predictions
- 21 4. Computer science impacts of computing standards for second grade are:
- 22 a. identify how computing technology has changed how the people, including
- 23 American Indians, live and work
- 24 b. work respectfully and responsibly online
- 25 c. keep login information private and log off devices appropriately
- 26 5. Computer science networks and the internet standards for second grade are:
- 27 a. explain what passwords are and why they are used
- 28 b. recognize that computing devices and the internet enable people to connect with
- 29 other people, places, information, and ideas
- 30

31 Note: 4a will be relooked at by the committee in January.

Commented [MK1]: NOTE:
Committee members are reviewing #4.a more closely during
the interim will have additional discussion in January.

1 **COMPUTER SCIENCE CONTENT STANDARDS FOR THIRD GRADE**

- 2 1. Computer science algorithms and programming standards for third grade are:
- 3 a. compare and contrast multiple algorithms to complete the same task
- 4 b. break down problems into smaller, manageable subproblems to facilitate the
- 5 program development process
- 6 c. describe steps taken and choices made during the process of program
- 7 development
- 8 d. identify intellectual property rights and give appropriate credit when creating or
- 9 remixing programs
- 10 2. Computer science computing systems standards for third grade are:
- 11 a. identify the internal and external parts of computing devices
- 12 b. determine potential solutions to solve simple hardware and software problems
- 13 using common troubleshooting strategies
- 14 3. Computer science data and analysis standards for third grade are:
- 15 a. collect data from multiple sources and display the data in graphs
- 16 b. describe multiple types of data
- 17 c. understand the accuracy of predictions and how they are influenced by the
- 18 amount of data collected
- 19 4. Computer science impacts of computing standards for third grade are:
- 20 a. collect diverse perspectives for the purpose of improving computational artifacts
- 21 b. identify rules associated with the appropriate use of digital information when
- 22 creating computational artifacts
- 23 c. describe ethical issues that relate to computing devices and networks
- 24 5. Computer science networks and the internet standards for third grade are:
- 25 a. identify how personal information can be protected

1 **COMPUTER SCIENCE CONTENT STANDARDS FOR FOURTH GRADE**

- 2 1. Computer science algorithms and programming standards for fourth grade are:
- 3 a. compare and refine multiple algorithms for the same task and determine which is
- 4 the most appropriate
- 5 b. break down problems into smaller, manageable subproblems to facilitate the
- 6 program development process
- 7 c. test and debug a program or algorithm to ensure it runs as intended
- 8 2. Computer science computing systems standards for fourth grade are:
- 9 a. explain the function of individual internal and external parts
- 10 b. determine potential solutions to solve simple hardware and software problems
- 11 using common troubleshooting strategies
- 12 3. Computer science data and analysis standards for fourth grade are:
- 13 a. select and use appropriate non-digital and digital tools to collect and represent
- 14 data
- 15 b. identify and use multiple types of data to complete a task
- 16 c. evaluate the validity of data based on accuracy and relevance
- 17 4. Computer science impacts of computing standards for fourth grade are:
- 18 a. collect diverse perspectives for the purpose of improving computational artifacts
- 19 b. identify rules associated with the appropriate use of digital information when
- 20 creating computational artifacts
- 21 c. describe ethical issues that relate to computing devices and networks
- 22 5. Computer science networks and the internet standards for fourth grade are:
- 23 a. identify cybersecurity problems

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1 **COMPUTER SCIENCE CONTENT STANDARDS FOR FIFTH GRADE**

- 2 1. Computer science algorithms and programming standards for fifth grade are:
- 3 a. compare and refine multiple algorithms for the same task and determine which is
- 4 the most appropriate
- 5 b. create programs that use variables to store and modify data
- 6 c. create programs that include sequences, events, loops, and conditionals
- 7 d. modify, remix, or incorporate portions of an existing program to develop
- 8 something new or add more advanced features
- 9 e. describe choices made during program development
- 10 2. Computer science computing systems standards for fifth grade are:
- 11 a. describe how internal and external parts of computing devices function to form a
- 12 system
- 13 b. model how computer hardware and software work together as a system to
- 14 accomplish tasks
- 15 c. determine potential solutions to solve simple hardware and software problems
- 16 using common troubleshooting strategies
- 17 3. Computer science data and analysis standards for fifth grade are:
- 18 a. organize and present collected data visually to highlight relationships and support
- 19 a claim
- 20 b. demonstrate how to store, copy, search, retrieve, modify, and delete information
- 21 using a computing device
- 22 c. use accurate and relevant data to highlight or propose cause-and-effect
- 23 relationships, predict outcomes, or communicate an idea
- 24 4. Computer science impacts of computing standards for fifth grade are:
- 25 a. explain how computing technologies have changed Montana and the world, and
- 26 express how those technologies influence, and are influenced by, cultural
- 27 practices, including American Indians
- 28 b. identify ways to improve the accessibility and usability of technology products for
- 29 the diverse needs and wants of users
- 30 c. utilize diverse perspectives for the purpose of improving computational artifacts
- 31 d. apply laws associated with digital information and intellectual property
- 32 e. describe ethical issues that relate to computing devices and networks
- 33 5. Computer science networks and the internet standards for fifth grade are:
- 34 a. explain cybersecurity problems
- 35 b. explain how personal information can be protected

1 COMPUTER SCIENCE CONTENT STANDARDS FOR SIXTH THROUGH EIGHTH
2 GRADE

- 3 1. Computer science algorithms and programming standards for sixth through eighth
4 grades are:
- 5 a. use algorithms to address complex problems
 - 6 b. create clearly named variables that represent different data types and perform
7 operations on their values
 - 8 c. develop programs that combine control structures, including nested loops and
9 compound conditionals
 - 10 d. decompose problems and subproblems into parts to facilitate the design,
11 implementation, and review of programs
 - 12 e. create procedures with parameters to organize code and make it easier to reuse
 - 13 f. seek and incorporate feedback from team members and users to refine a
14 solution that meets user needs
 - 15 g. incorporate existing code, media, and libraries into original programs, and give
16 attribution
 - 17 h. systematically test and refine programs using a range of test cases
 - 18 i. distribute tasks and maintain a project timeline when collaboratively developing
19 computational artifacts
 - 20 j. document programs in order to make them easier to follow, test, and debug
- 21 2. Computer science computing systems standards for sixth through eighth grades are:
- 22 a. recommend improvements to the design of computing devices, based on an
23 analysis of how users interact with the devices
 - 24 b. design projects that combine hardware and software components to collect and
25 exchange data
 - 26 c. systematically identify and fix problems with computing devices and their
27 components
- 28 3. Computer science data and analysis standards for sixth through eighth grades are:
- 29 a. collect data using computational tools and transform the data to make it more
30 useful and reliable
 - 31 b. represent data using multiple formats
 - 32 c. refine computational models based on the data they have generated
- 33 4. Computer science impacts of computing standards for sixth through eighth grades are:
- 34 a. compare tradeoffs associated with computing technologies that affect people's
35 everyday activities and career options in Montana and the world, including
36 American Indians
 - 37 b. discuss issues of bias and accessibility in the design of existing technologies
 - 38 c. collaborate with other contributors when creating a computational artifact
 - 39 d. describe tradeoffs between allowing information, personal or intellectual, to be
40 public and keeping information private and secure

- 1 5. Computer science networks and the internet standards for sixth through eighth grades
2 are:
3 a. explain how physical and digital security measures protect electronic information
4 b. apply multiple methods of encryption to demonstrate how to securely transmit
5 information
6 c. demonstrate how information is broken down and transmitted through multiple
7 devices over networks and the internet and reassembled at the destination

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1 COMPUTER SCIENCE CONTENT STANDARDS FOR NINTH THROUGH TWELFTH
2 GRADES

- 3 1. Computer science algorithms and programming standards for ninth through twelfth
4 grades are:
- 5 a. create prototypes that use algorithms to solve computational problems by
 - 6 leveraging prior student knowledge and personal interests
 - 7 b. describe how artificial intelligence drives many software and physical systems
 - 8 c. implement an artificial intelligence algorithm to play a game against a human
 - 9 opponent or solve a problem
 - 10 d. use and adapt classic algorithms to solve computational problems
 - 11 e. evaluate algorithms in terms of their efficiency, correctness, and clarity
 - 12 f. use lists to simplify solutions, generalizing computational problems instead of
 - 13 repeatedly using simple variables
 - 14 g. compare and contrast fundamental data structures and their uses
 - 15 h. justify the selection of specific control structures when tradeoffs involve
 - 16 implementation, readability, and program performance, and explain the benefits
 - 17 and drawbacks of choices made
 - 18 i. design and iteratively develop computational artifacts for practical intent,
 - 19 personal expression, or to address a societal issue by using events to initiate
 - 20 instructions
 - 21 j. decompose problems into smaller components through systematic analysis,
 - 22 using constructs such as procedures, modules, or objects
 - 23 k. create artifacts by using procedures within a program, combinations of data and
 - 24 procedures, or independent but interrelated programs
 - 25 l. construct solutions to problems using student-created procedures, modules or
 - 26 objects
 - 27 m. analyze a large-scale computational problem and identify generalizable patterns
 - 28 that can be applied to a solution
 - 29 n. demonstrate code reuse by creating programming solutions using libraries and
 - 30 application programming interfaces
 - 31 o. systematically design and develop programs for broad audiences by
 - 32 incorporating feedback from users
 - 33 p. evaluate and refine computational artifacts to make them more usable and
 - 34 accessible
 - 35 q. design and develop computational artifacts working in team roles using
 - 36 collaborative tools
 - 37 r. document design decisions using text, graphics, presentations, or
 - 38 demonstrations in the development of complex programs
 - 39 s. plan and develop programs for broad audiences using a software life cycle
 - 40 process
 - 41 t. explain security issues that might lead to compromised computer programs

Commented [MK2]: NOTE:

Committee members are reviewing #1 more closely during the interim will have additional discussion in January.

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- 1 u. develop programs for multiple computing platforms
2 v. use version control systems, integrated development environments, and
3 collaborative tools and practices in a group software project
4 w. develop and use a series of test cases to verify that a program performs
5 according to its design specifications
6 x. modify an existing program to add additional functionality and discuss intended
7 and unintended implications
8 y. evaluate key qualities of a program through a process such as a code review
9 z. compare multiple programming languages and discuss how their features make
10 them suitable for solving different types of problems
- 11 2. Computer science computing systems standards for ninth through twelfth grades are:
12 a. explain how abstractions hide the underlying implementation details of computing
13 systems embedded in everyday objects
14 b. compare levels of abstraction and interactions between application software,
15 system software, and hardware layers
16 c. categorize the roles of operating system software
17 d. develop guidelines that convey systematic troubleshooting strategies that others
18 can use to identify and fix errors
19 e. illustrate ways computing systems implement logic, input, and output through
20 hardware components
- 21 3. Computer science data and analysis standards for ninth through twelfth grades are:
22 a. create interactive data visualizations using software tools to help others better
23 understand authentic phenomena
24 b. use data analysis tools and techniques to identify patterns in data representing
25 complex systems
26 c. select data collection tools and techniques to generate data sets that support a
27 claim or communicate information
28 d. translate between different bit representations of authentic phenomena, including
29 characters, numbers, and images
30 e. evaluate the tradeoffs in how data elements are organized and where data is
31 stored
32 f. create computational models that represent the relationships among different
33 elements of data collected from a phenomenon or process
34 g. evaluate the ability of models and simulations to test and support the refinement
35 of hypotheses
- 36 4. Computer science impacts of computing standards for ninth through twelfth grades are:
37 a. evaluate the ways computing technologies, globally and locally, impact personal,
38 ethical, social, economic, and cultural practices, including those of American
39 Indians
40 b. test and refine computational artifacts to reduce bias and equity deficits
41 c. demonstrate ways a given algorithm applies to problems across disciplines

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- 1 d. evaluate computational artifacts to maximize their beneficial effects and minimize
2 harmful effects on society
- 3 e. evaluate the impact of equity, access, and influence on the distribution of
4 computing resources in a global society, including with respect to American
5 Indians
- 6 f. predict how computational innovations that have revolutionized aspects of our
7 culture might evolve
- 8 g. use tools and methods for collaboration on a project to increase connectivity of
9 people in different cultures and career fields
- 10 h. explain the beneficial and harmful effects that intellectual property laws can have
11 on innovation
- 12 i. explain the privacy concerns related to the collection and generation of data
13 through automated processes that may not be evident to users
- 14 j. evaluate the social and economic implications of privacy in the context of safety,
15 law, or ethics
- 16 k. debate laws and regulations that impact the development and use of software
- 17 5. Computer science networks and the internet standards for ninth through twelfth grades
18 are:
- 19 a. recommend security measures to address various scenarios based on factors
20 including efficiency, feasibility, and ethical impacts
- 21 b. explain tradeoffs when selecting and implementing cybersecurity
22 recommendations
- 23 c. compare ways software developers protect devices and information from
24 unauthorized access
- 25 d. evaluate the scalability and reliability of networks by describing the relationship
26 between routers, addressing, switches, servers, and topology
- 27 e. give examples to illustrate how sensitive data can be affected by malware and
28 other attacks
- 29 f. compare various security measures, considering tradeoffs between the usability
30 and security of a computing system
- 31 g. discuss the issues that impact functionality

Commented [MK3]: NOTE re 4.e and 4.g:
Committee members are reviewing these more closely
during the interim will have additional discussion in January.

Commented [MK4]: NOTE:
See above re 4.e.

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1 **COMPUTER SCIENCE PROGRAM DELIVERY STANDARDS**

2 **Administrative Rules of Montana Chapter 55 – NEW RULE PROPOSAL**

3 Because this is a new content area, there are no previous program delivery standards to
4 compare.

5 1. In general, a basic program in computer science education shall:

6 a. meet the following conditions:

7 i. provide a well-articulated integrated curriculum that challenges students
8 to learn increasingly more sophisticated computer science concepts
9 across all grade levels and content areas wherever appropriate

10 ii. foster a collaborative environment that embraces creativity,
11 communication, and problem solving

12 b. include the following practices:

13 i. ensure students become informed citizens who can critically engage in
14 public discussion on computer science related topics

15 ii. ensure students develop as learners, users, and creators of computer
16 science knowledge and artifacts

17 iii. ensure students understand the role and impact of computing in the world
18 around them, leveraging computer technology to create solutions

19 iv. increase career and college readiness
20

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COMMITTEE MEMBERS

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