Computer Science Disciplinary Concepts

Computing Systems

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

Networks and the Internet

Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.

Impacts of Computing

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

Data & Analysis

Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.

Algorithms & Programming

An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.

Design Thinking Disciplinary Concepts

Engineering Design

People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.

Interaction of Technology and Humans

Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.

Nature of Technology

Human population patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.

Effects of Technology on the Natural World

Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.

Ethics & Culture

Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.

8.1 Computer Science			Grade Level: K-2
Computing Systems: People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.2.CS.1: Select and operate computing devices that perform a variety of tasks accurately and quickly based on user needs and preferences.	Individuals use computing devices to perform a variety of tasks accurately and quickly. Computing devices interpret and follow the instructions they are given literally.	https://online.maryville.edu/online-bachelors-degrees/management-information-systems/computer-skills-kids/	Observation Performance task
8.1.2.CS.2: Explain the functions of common software and hardware components of computing systems.	A computing system is composed of software and hardware.	https://www.youtube.com/watch?v=RmbFJq2jADY	Discussion
8.1.2.CS.3: Describe basic hardware and software problems using accurate terminology.	Describing a problem is the first step toward finding a solution when computing systems do not work as expected.	http://www.kathleenamorris.com/2011/08/01/troubleshooting-computer-problems/	Discussion Performance task Observation

8.1 Computer Science			Grade Level: K-2
Networks and the Internet: Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.2.NI.1: Model and describe how individuals use computers to connect to other individuals, places, information, and ideas through a network.	Computer networks can be used to connect individuals to other individuals, places, information, and ideas.	https://www.teacherspayteachers.com/Product/Email-Template-for-Kids-569334?epik=dj0yJnU9RjdLTXRaQnpMWklvY1VOVzdzdTAtOWNpamU3cjJrRGEmcD0wJm49NnJvTVJjTVg3cEkxaTRoLU12OVY1USZ0PUFBQUFBR0dJRVk4	Discussion Graphic Organizer Illustration
8.1.2.NI.2: Describe how the Internet enables individuals to connect with others worldwide.	The Internet enables individuals to connect with others worldwide.	https://www.youtube.com/watch?v=UXsomnDkntI	Discussion Graphic Organizer Illustration
8.1.2.NI.3: Create a password that secures access to a device. Explain why it is important to create unique passwords that are not shared with others.	Connecting devices to a network or the Internet provides great benefits, but care must be taken to use authentication measures.	https://curriculum.code.org/csf-19/coursec/2/	Observation Performance task Journal
8.1.2.NI.4: Explain why access to devices need to be secured.	Strong passwords should be used to protect devices and information from unauthorized access.		Observation Performance task Journal

8.1 Computer Science			Grade Level: K-2
Impacts of Computing: Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.2.IC.1: Compare how individuals live and work before and after the implementation of new computing technology.	Computing technology has positively and negatively changed the way individuals live and work (e.g., entertainment, communication, productivity tools).	https://www.youtube.com/watch?v=DENG7Q7VRgo https://www.teacherspayteachers.com/Product/Science-and-Technology-from-the-Past-and-Present-Activities-1528118?st=64d570b31f21b8866a10a4e41f98a4ed	Discussion Performance task Illustration Muli-media presentation

8.1 Computer Science			Grade Level: K-2
Data and Analysis: Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.2.DA.1: Collect and present data, including climate change data, in various visual formats.	Individuals collect, use, and display data about individuals and the world around them.	https://www.3cisd.com/data-collection	Performance task Formative assessment Graphic organizer Illustration/Graph

			Muli-media presentation
8.1.2.DA.2: Store, copy, search, retrieve, modify, and delete data using a computing device.	Computers store data that can be retrieved later. Data can be copied, stored in multiple locations, and retrieved.		Observation Performance task
8.1.2.DA.3: Identify and describe patterns in data visualizations.	Data can be used to make predictions about the world.	https://www.thecreativeeducator.com/2017/lessons/simple-surveys-and-great-graphs	Discussion
8.1.2.DA.4: Make predictions based on data using charts or graphs.		https://www.math4texas.org/Page/383	Discussion Journal Illustration/Chart

8.1 Computer Science			Grade Level: K-2
Algorithms and Programming: An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.2.AP.1: Model daily processes by creating and following algorithms to complete tasks.	Individuals develop and follow directions as part of daily life. A sequence of steps can be expressed as an algorithm that a computer can process.	https://www.coderkids.com/blog/top-10-free-coding-programs-for-kids https://scratch.mit.edu/	Illustration Performance task Flow chart/graphic organizer

8.1.2.AP.2: Model the may programs store and manipulate data by using numbers or other symbols to represent information.	Real world information can be stored and manipulated in programs as data (e.g., numbers, words, colors, images).		Role play Illustration Discussion
8.1.2.AP.3: Create programs with sequences and simple loops to accomplish tasks.	Computers follow precise sequences of steps that automate tasks.	https://www.coderkids.com/blog/top-10-free-coding-programs-for-kids	Performance task Simulation Observation
8.1.2.AP.4: Break down a task into a sequence of steps.	Complex tasks can be broken down into simpler instructions, some of which can be broken down even further.	https://code.org/	Performance task Simulation Observation
8.1.2.AP.5: Describe a program's sequence of events, goals, and expected outcomes.	People work together to develop programs for a purpose, such as expressing ideas or addressing problems.	https://code.org/	Discussion Journal Performance task
8.1.2.AP.6: Debug errors in an algorithm or program that includes sequences and simple loops.	The development of a program involves identifying a sequence of events, goals, and expected outcomes, and addressing errors (when necessary).	https://code.org/	Performance task

8.2 Design Thinking			Grade Level: K-2
Engineering Design: People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.2.ED.1: Communicate the function of a product or device.	Engineering design is a creative process for meeting human needs or wants that can result in multiple solutions.	https://www.sciencebuddies.org/stem-activities https://littlebinsforlittlehands.com/easy-simple-stem-activities-challenges/ https://www.weareteachers.com/kindergarten-stem-challenges/ http://stemteachingtools.org/brief/64	Discussion Observation
8.2.2.ED.2: Collaborate to solve a simple problem, or to illustrate how to build a product using the design process.			Observation Illustration
8.2.2.ED.3: Select and use appropriate tools and materials to build a product using the design process.			Observation Performance task
8.2.2.ED.4: Identify constraints and their role in the engineering design process.	Limitations (constraints) must be considered when engineering designs.		Observation Performance task

8.2 Design Thinking			Grade Level: K-2
Interaction of Technology and Humans: Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.2.ITH.1: Identify products that are designed to meet human wants or needs.	Human needs and desires determine which new tools are developed.	https://www.learningtogive.org/units/investing-others-k-2/define-wants-and-needs	Discussion Journal Structured dialogue Graphic organizer
8.2.2.ITH.2: Explain the purpose of a product and its value.		https://www.learningtogive.org/units/investing-others-k-2/define-wants-and-needs	Discussion Journal Structured dialogue Graphic organizer
8.2.2.ITH.3: Identify how technology impacts or improves life.	Technology has changed the way people live and work.	https://www.midlandisd.net/cms/lib01/tx01000898/centricity/domain/3308/kindergarten_social_studies_unit_04_exemplar_lesson_04__technology.pdf	Discussion Journal Structured dialogue Graphic organizer
8.2.2.ITH.4: Identify how various tools reduce work and improve daily tasks.	Various tools can improve daily tasks and quality of life.		Discussion Journal Structured dialogue Graphic organizer

8.2.2.ITH.5: Design a solution to a problem affecting the community in a collaborative team and explain the intended impact of the solution.			Discussion Journal Graphic organizer

8.2 Design Thinking			Grade Level: K-2
Nature of Technology: Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.2.NT.1: Model and explain how a product works after taking it apart, identifying the relationship of each part, and putting it back together.	Innovation and the improvement of existing technology involves creative thinking.	https://www.pinterest.ca/ascy0864/tinkering-take-apart-and-put-together/	Observation Discussion Journal Graphic organizer Illustration
8.2.2.NT.2: Brainstorm how to build a product, improve a designed product, fix a product that has stopped working, or solve a simple problem.		https://ngss.nsta.org/Resource.aspx?ResourceID=213 https://ngss.nsta.org/Resource.aspx?ResourceID=538	Discussion Observation Journal

8.2 Design Thinking			Grade Level: K-2
Effects of Technology on the Natural World: Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
1: Classify products as 8.2.2.ETW.resulting from nature or produced as a result of technology.	The use of technology developed for the human designed world can affect the environment, including land, water, air, plants, and animals.	https://www.generationgenius.com/videolessons/classification-of-materials-video-for-kids/	Observation Performance task Illustration Formative assessment
8.2.2.ETW.2: Identify the natural resources needed to create a product.	Technologies that use natural sources can have negative effects on the environment, its quality, and inhabitants.	https://betterlesson.com/lesson/637953/natural-resources-and-products-more-practice	Discussion
8.2.2.ETW.3: Describe or model the system used for recycling technology.	Reusing and recycling materials can save money while preserving natural resources and avoiding damage to the environment.	https://www.youtube.com/watch?v=S2lmPIa1iWE	Observation Model Simulation Illustration
8.2.2.ETW.4: Explain how the disposal of or reusing a product affects the local and global environment.			Observation Simulation Illustration

8.2 Design Thinking			Grade Level: K-2
Ethics and Culture: Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.2.EC.1: Identify and compare technology used in different schools, communities, regions, and parts of the world.	The availability of technology for essential tasks varies in different parts of the world.		Discussion

8.1 Computer Science			Grade Level: 3-5
Computing Systems: People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.5.CS.1: Model how computing devices connect to other components to form a system.	Computing devices may be connected to other devices to form a system as a way to extend their capabilities.	https://www.youtube.com/watch?v=3QhU9jd03a0	Illustration Discussion Performance task Simulation

8.1.5.CS.2: Model how computer software and hardware work together as a system to accomplish tasks.	Software and hardware work together as a system to accomplish tasks (e.g., sending, receiving, processing, and storing units of information).	https://www.youtube.com/watch?v=3QhU9jd03a0	Illustration Discussion Performance task Simulation
8.1.5.CS.3: Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.	Shared features allow for common troubleshooting strategies that can be effective for many systems.	http://www.kathleenamorris.com/2011/08/01/troubleshooting-computer-problems/	Illustration Discussion Performance task Graphic organizer

8.1 Computer Science			Grade Level: 3-5
Networks and the Internet: Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.5.NI.1: Develop models that successfully transmit and receive information using both wired and wireless methods.	Information needs a physical or wireless path to travel to be sent and received.	https://www.generationgenius.com/information-transfer-lesson-for-kids/	Observation Performance task
8.1.5.NI.2: Describe physical and digital security measures for protecting sensitive personal information.	Distinguishing between public and private information is important for safe and secure online interactions.	https://www.kpbsd.k12.ak.us/Workarea/DownloadAsset.aspx?id=33708	Discussion Journal Summative assessment

	Information can be protected using various security measures (i.e., physical and digital).	https://study.com/academy/lesson/computer-security-threat-prevention-for-individuals-organizations.html	Observation Discussion

8.1 Computer Science			Grade Level: 3-5
Impacts of Computing: Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.5.IC.1: Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.	The development and modification of computing technology is driven by an individual's needs and wants and can affect individuals differently.	https://streaming.discoveryeducation.com/teacherCenter/lessonPlans/pdfs/3-5_Science_TechnologyItsBenefitsAndNegativeEffects.pdf	Discussion Essay Performance task Multimedia presentation
8.1.5.IC.2: Identify possible ways to improve the accessibility and usability of computing technologies to address the diverse needs and wants of users.		https://www.okaloosaschools.com/fwb/sites/okaloosaschools.com.fwb/files/users/anthonybryant/wds_v1.1_ssg_l06.pdf	Discussion Essay Performance task Multimedia presentation

8.1 Computer Science			Grade Level: 3-5
Data and Analysis: Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.	Data can be organized, displayed, and presented to highlight relationships.	https://www.education.com/lesson-plan/organize-your-data/	Discussion Performance task Multimedia presentation Illustration
8.1.5.DA.2: Compare the amount of storage space required for different types of data.	The type of data being stored affects the storage requirements.	https://www.education.com/lesson-plan/capacity-comparison/	Illustration Multimedia presentation
8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.	Individuals can select, organize, and transform data into different visual representations and communicate insights gained from the data.	https://www.education.com/lesson-plan/organize-your-data/	Illustration Multimedia presentation Performance task
8.1.5.DA.4: Organize and present climate change data visually to highlight relationships or support a claim.		https://www.climate.gov/maps-data	Illustration Multimedia presentation Performance task

8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.	Many factors influence the accuracy of inferences and predictions.		Illustration Multimedia presentation Performance task

8.1 Computer Science			Grade Level: 3-5
Algorithms and Programming: An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most appropriate.	Different algorithms can achieve the same result. Some algorithms are more appropriate for a specific use than others.	https://code.org/ https://www.tynker.com/	Observation Performance task
8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.	Programming languages provide variables, which are used to store and modify data.	https://quorumlanguage.com/lessons/code/Algorithm-Programming/Lesson5.html	Observation Performance task

8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.	A variety of control structures are used to change the flow of program execution (e.g., sequences, events, loops, conditionals).	https://code.org/ https://www.tynker.com/	Observation Performance task
8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development.	Programs can be broken down into smaller parts to facilitate their design, implementation, and review.	https://code.org/ https://www.tynker.com/	Observation Performance task
8.1.5.AP.5: Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.	Programs can also be created by incorporating smaller portions of programs that already exist.	https://code.org/ https://www.tynker.com/	Observation Performance task
8.1.5.AP.6: Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.	Individuals develop programs using an iterative process involving design, implementation, testing, and review.	https://code.org/ https://www.tynker.com/	Observation Performance task

8.2 Design Thinking			Grade Level: 3-5
Engineering Design: People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.5.ED.1: Explain the functions of a system and its subsystems.	Engineering design is a systematic and creative process of communicating and collaborating to meet a design challenge. Often, several design solutions exist, each better in some way than the others.	https://www.generationgenius.com/videolessons/engineering-design-process-video-for-kids/	Observation Performance task Discussion Illustration
8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.		https://www.teachengineering.org/ https://www.teachengineering.org/activities/view/ucd_derby_activity1 https://www.teachengineering.org/activities/view/cub_mars_lesson03_activity1 https://www.teachengineering.org/activities/view/cub_mechanics_lesson10_activity1 https://www.teachengineering.org/activities/view/cub_art_lesson01_activity2	Observation Performance task Multimedia presentation Illustration
8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.			Observation Performance task
• 8.2.5.ED.4: Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).	Engineering design requirements include desired features and limitations that need to be considered.		Observation Performance task Journal/essay

8.2.5.ED.5: Describe how specifications and limitations impact the engineering design process.			Journal/essay Summative assessment
8.2.5.ED.6: Evaluate and test alternative solutions to a problem using the constraints and tradeoffs identified in the design process.		https://ny.pbslearningmedia.org/resource/introduction-engineering-design/introduction-to-the-engineering-design-process-engineering-for-good/	Observation

8.2 Design Thinking			Grade Level: 3-5
Interaction of Technology and Humans: Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system.	Societal needs and wants determine which new tools are developed to address real-world problems.	https://www.teachengineering.org/activities/view/usu-1961-everyday-problems-introduction-engineering-design	Discussion Journal/essay

8.2.5.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.	A new tool may have favorable or unfavorable results as well as both positive and negative effects on society.	https://study.com/academy/lesson/how-a-new-product-is-adopted-by-consumers.html	Observation Discussion Essay Performance task
8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.			Observation Discussion Essay Performance task
8.2.5.ITH.4: Describe a technology/tool that has made the way people live easier or has led to a new business or career.	Technology spurs new businesses and careers.	https://www.edureka.co/blog/top-10-trending-technologies/	Observation Discussion Essay Performance task

8.2 Design Thinking			Grade Level: 3-5
Nature of Technology: Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.5.NT.1: Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.	Technology innovation and improvement may be influenced by a variety of factors.	https://www.teachengineering.org/lessons/view/cla_lesson2_problem_solving	Observation Discussion Essay Performance task
8.2.5.NT.2: Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.		https://www.edureka.co/blog/top-10-trending-technologies/	Discussion Multimedia presentation Performance task
8.2.5.NT.3: Redesign an existing product for a different purpose in a collaborative team.	Engineers create and modify technologies to meet people's needs and wants; scientists ask questions about the natural world.	https://studylib.net/doc/7336650/lesson-plan--a-more-perfect-product-	Observation Performance task
8.2.5.NT.4: Identify how improvement in the understanding of materials science impacts technologies.		https://pbskids.org/designsquad/parentseducators/lesson-plans/green_design.html	Discussion Essay Performance task

8.2. Design Thinking			Grade Level: 3-5
Effects of Technology on the Natural World: less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.	The technology developed for the human designed world can have unintended consequences for the environment.	https://www.nationalgeographic.org/media/teaching-idea-human-impacts-environment/ https://www.pbs.org/newshour/extra/lessons-plans/lesson-plan-invent-an-eco-friendly-solution-to-an-environmental-problem/	Discussion Essay Performance task Formative assessment
8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.			Discussion Essay Performance task Formative assessment
8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.			Discussion Essay Performance task Formative assessment Multimedia presentation
8.2.5.ETW.4: Explain the impact that resources, such as energy and materials used to develop technology, have on the environment.	Technology must be continually developed and made more efficient to reduce the need for non-renewable resources.		Discussion Essay Performance task Formative assessment Multimedia presentation

8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change.		https://edinburghsensors.com/news-and-events/impact-of-technology-on-the-environment-and-environmental-technology/ https://www.amnh.org/explore/ology/earth/ask-a-scientist-about-our-environment/how-can-kids-help-prevent-global-warming	Discussion Essay Performance task Formative assessment Multimedia presentation

8.2 Design Thinking			Grade Level: 3-5
Ethics and Culture: Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.5.EC.1: Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects.	Technological choices and opportunities vary due to factors such as differences in economic resources, location, and cultural values.	https://www.unescap.org/sites/default/files/06Chapter4.pdf	Discussion Essay Performance task Formative assessment Multimedia presentation

8.1 Computer Science			Grade Level: 6-8
Computing Systems: People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.8.CS.1: Recommend improvements to computing devices in order to improve the ways users interact with the devices.	The study of human–computer interaction can improve the design of devices and extend the abilities of humans.		Discussion Essay Performance task Formative assessment Multimedia presentation
8.1.8.CS.2: Design a system that combines hardware and software components to process data.	Software and hardware determine a computing system's capability to store and process information.		Observation Performance assessment
8.1.8.CS.3: Justify design decisions and explain potential system trade-offs.	The design or selection of a computing system involves multiple considerations and potential trade-offs.	https://www.consumerreports.org/cro/computers/buying-guide/index.htm	Essay/journal Performance task Formative assessment Multimedia presentation
8.1.8.CS.4: Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.	Troubleshooting a problem is more effective when knowledge of the specific device along with a systematic process is used to identify the source of a problem.	https://askatechteacher.com/5-free-problem-solving-posters/	Observation Discussion

8.1 Computer Science			Grade Level: 6-8
Networks and the Internet: Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.8.NI.1: Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.	Protocols, packets, and addressing are the key components for reliable delivery of information across networks.	https://www.youtube.com/watch?v=3QhU9jd03a0	Observation Illustration Graphic organizer
8.1.8.NI.2: Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.		https://www.youtube.com/watch?v=3QhU9jd03a0	Observation Illustration Graphic organizer
8.1.8.NI.3: Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems.	The information sent and received across networks can be protected from unauthorized access and modification in a variety of ways.	https://www.youtube.com/watch?v=3QhU9jd03a0	Discussion Formative assessment Essay

8.1.8.NI.4: Explain how new security measures have been created in response to key malware events.	The evolution of malware leads to understanding the key security measures and best practices needed to proactively address the threat to digital data.	https://www.youtube.com/watch?v=QozdEbyMK5E	Discussion Formative assessment Essay

8.1 Computer Science			Grade Level: 6-8
Impacts of Computing: Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect an individual's everyday activities and career options.	Advancements in computing technology can change individuals' behaviors.	https://www.youtube.com/watch?xRIdL2CDBk https://www.youtube.com/watch?v=ottnH427Fr8&t=74s	Discussion Essay Illustration Multimedia presentation
8.1.8.IC.2: Describe issues of bias and accessibility in the design of existing technologies.	Society is faced with trade-offs due to the increasing globalization and automation that computing brings.		Discussion Essay Illustration Multimedia presentation

8.1 Computer Science			Grade Level: 6-8
Data and Analysis: Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.	People use digital devices and tools to automate the collection, use, and transformation of data. The manner in which data is collected and transformed is influenced by the type of digital device(s) available and the intended use of the data.	https://leafandstemlearning.com/2021/04/teaching-data-analysis-with-fun-data-collection/ https://classroom.synonym.com/data-activities-middle-school-students-6395544.html	Discussion Multimedia presentation Performance assessment
8.1.8.DA.2: Explain the difference between how the computer stores data as bits and how the data is displayed.	Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals.	https://www.youtube.com/watch?v=p3q5zWCw8J4	Discussion Essay Illustration Multimedia presentation
8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.	Data is organized and accessible based on the application used to store it.	https://guides.library.oregonstate.edu/research-data-services/data-management-types-formats	Performance task Observation
8.1.8.DA.4: Transform data to remove errors and improve the accuracy of the data for analysis.	The purpose of cleaning data is to remove errors and make it easier for computers to process.		Performance task Observation

8.1.8.DA.5: Test, analyze, and refine computational models.	Computer models can be used to simulate events, examine theories and inferences, or make predictions.	https://www.nsta.org/science-and-children/science-and-children-mayjune-2021/integrating-computational-modeling-science http://cadrek12.org/sites/default/files/Models%206-12%20Handout%203.13.18.pdf	Performance task Observation
8.1.8.DA.6: Analyze climate change computational models and propose refinements.		https://www.climate.gov/maps-data/climate-data-primer/predicting-climate/climate-models	Performance task Observation Multimedia presentation

8.1 Computer Science			Grade Level: 6-8
Algorithms and Programming: An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.1.8.AP.1: Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.	Individuals design algorithms that are reusable in many situations. Algorithms that are readable are easier to follow, test, and debug.	https://erajasekar.medium.com/how-you-can-teach-computer-science-algorithms-to-middle-school-students-873310874c92	Observation Illustration Multimedia presentation Graphic organizer/flow chart Performance task

8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.	Programmers create variables to store data values of different types and perform appropriate operations on their values.	https://www.youtube.com/watch?v=xjZDZ1TJe4o https://www.tynker.com/blog/articles/ideas-and-tips/how-to-teach-variables-to-kids/	Observation Performance task
8.1.8.AP.3: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.	Control structures are selected and combined in programs to solve more complex problems.	https://codewizardshq.com/coding-websites-for-kids/ https://code.org/student/middle-high	Observation Performance task
8.1.8.AP.4: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.	Programs use procedures to organize code and hide implementation details. Procedures can be repurposed in new programs.		Observation Performance task
8.1.8.AP.5: Create procedures with parameters to organize code and make it easier to reuse.	Defining parameters for procedures can generalize behavior and increase reusability.		Observation Performance task
8.1.8.AP.6: Refine a solution that meets users' needs by incorporating feedback from team members and users.	Individuals design and test solutions to identify problems taking into consideration the diverse needs of the users and the community.		Observation Performance task

8.1.8.AP.7: Design programs, incorporating existing code, media, and libraries, and give attribution.			Observation Performance task
8.1.8.AP.8: Systematically test and refine programs using a range of test cases and users.			Observation Performance task
8.1.8.AP.9: Document programs in order to make them easier to follow, test, and debug.			Observation Performance task Graphic organizer/flow chart

8.2 Design Thinking			Grade Level: 6-8
Engineering Design: People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.	Engineering design is a systematic, creative, and iterative process used to address local and global problems.	http://www-tc.pbskids.org/designsquad/pdf/parentseducators/DS_TG_DesignProcess.pdf	Observation Performance task

8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.		https://start-engineering.com/start-engineering-now/2019/4/3/8-great-videos-to-teach-the-engineering-design-process	Discussion Observation Performance task Journal/essay
8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).	The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes.	https://www.kqed.org/mindshift/28303/a-design-challenge-to-students-solve-a-real-world-problem	Performance task Illustration Formative assessment
8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.		https://resilienteducator.com/classroom-resources/real-world-stem-projects/	Performance task Multimedia presentation
8.2.8.ED.5: Explain the need for optimization in a design process.	Engineering design requirements and specifications involve making trade-offs between competing requirements and desired design features.	https://ny.pbslearningmedia.org/subjects/engineering--technology/engineering-design-and-practices/developing-and-using-models/optimizing-the-design-solution/	Performance assessment Essay Formative assessment
8.2.8.ED.6: Analyze how trade-offs can impact the design of a product.			Discussion Performance assessment Essay Formative assessment

8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).		https://resilienteducator.com/classroom-resources/real-world-stem-projects/	Performance assessment Formative assessment Demonstration

8.2 Design Thinking			Grade Level: 6-8
Interaction of Technology and Humans: Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.8.ITH.1: Explain how the development and use of technology influences economic, political, social, and cultural issues.	Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.	https://ny.pbslearningmedia.org/subjects/engineering--technology/technology-and-society/cultural-social-economic-and-political-effects-of-technology/	Discussion Performance assessment Essay Formative assessment
8.2.8.ITH.2: Compare how technologies have influenced society over time.	Technology interacts with society, sometimes bringing about changes in a society's economy, politics, and culture, and often leading to the creation of new needs and wants.	https://www.brainspire.com/blog/technology-and-society-how-technology-changed-our-lives	Discussion Performance assessment Essay Formative assessment Multimedia presentation

8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or system.		https://www.weforum.org/agenda/2020/11/heres-how-technology-has-changed-and-changed-us-over-the-past-20-years/	Discussion Performance assessment Essay Formative assessment Multimedia presentation
8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.	New needs and wants may create strains on local economies and workforces.	https://kidslox.com/blog/top-5-negative-effects-of-technology-you-even-dont-suspect/	Discussion Performance assessment Essay Formative assessment Multimedia presentation
8.2.8.ITH.5: Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.	Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.	https://www.medicalnewstoday.com/articles/negative-effects-of-technology#psychological-effects	Discussion Performance assessment Essay Formative assessment Multimedia presentation

8.2 Design Thinking			Grade Level: 6-8
Nature of Technology: Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments

8.2.8.NT.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem.	Technology advances through the processes of innovation and invention which relies upon the imaginative and inventive nature of people.	https://www.urban-hub.com/technology/ten-technological-advances-transforming-our-lives/	Discussion Performance assessment Essay Formative assessment
8.2.8.NT.2: Analyze an existing technological product that has been repurposed for a different function.	Sometimes a technology developed for one purpose is adapted to serve other purposes.	https://www.mentalfloss.com/article/57861/11-successful-products-originally-invented-something-else	Discussion Performance assessment Essay
8.2.8.NT.3: Examine a system, consider how each part relates to other parts, and redesign it for another purpose.	Engineers use a systematic process of creating or modifying technologies that is fueled and constrained by physical laws, cultural norms, and economic resources.	https://www.commonsense.org/education/lesson-plans/redesign-your-school https://www.teachengineering.org/activities/view/cub_creative_activity6	Observation Illustration Demonstration
8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product.	Scientists use systematic investigation to understand the natural world.	https://www.teachengineering.org/lessons/view/cub_brid_lesson01	Discussion Performance assessment Essay Formative assessment Multimedia presentation

8.2 Design Thinking	Grade Level: 6-8

Effects of Technology on the Natural World: Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.8.ETW.1: Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs.	Resources need to be utilized wisely to have positive effects on the environment and society.	https://www.techlicious.com/guide/10-cool-upcycled-repurposed-products/?__cf_chl_captcha_tk__=65rITDwLlVmr4QEY8Uqupd69wKv5XWWTeHna4Yp3CpQ-1636316309-0-gaNycGzNCNE	Discussion Performance assessment Illustration Multimedia presentation
8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).		https://www.wired.com/gallery/our-favorite-upcycled-and-recycled-products/	Discussion Performance assessment Essay Formative assessment Multimedia presentation
8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.	Some technological decisions involve tradeoffs between environmental and economic needs, while others have positive effects for both the economy and environment.	https://wowelifestyle.com/blogs/better-living/8-everyday-items-that-are-harmful-to-the-environment	Discussion Performance assessment Essay Formative assessment Multimedia presentation
8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.		https://news.sky.com/story/climate-change-seven-technology-solutions-that-could-help-solve-crisis-12056397	Discussion Performance assessment Essay Formative assessment Multimedia presentation

8.2 Design Thinking			Grade Level: 6-8
Ethics and Culture: Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.			
Learning Standard	Core Ideas	Resources	Benchmarks/Assessments
8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.	Technological disparities have consequences for public health and prosperity.	https://connect.comptia.org/blog/ethical-issues-in-technology	Discussion Performance assessment Essay Formative assessment Multimedia presentation
8.2.8.EC.2: Examine the effects of ethical and unethical practices in product design and development.		https://techandcurriculum.pressbooks.com/chapter/unethical-use/ https://study.com/blog/ethical-issues-with-using-technology-in-the-classroom.html	Discussion Performance assessment Essay Formative assessment Multimedia presentation

Assessments	Teacher observation, oral presentations, student projects, rubrics, class projects, class discussion, performance assessment, formative assessment, research project, journal/essay, graphic organizer, multimedia presentation
21st Century Skills and Career Integration	(From the U.S. Dept. of Ed) Given the tremendous career opportunities that a foundation in computer science can provide, it makes sense that we do what we can to improve access to high-quality computer science learning

	experiences for all students. Computer science (CS) is not about understanding how to use a word processor or create a spreadsheet. CS is about gaining computational thinking skills and is a critical skill set that all students should have in the 21st century workforce—and states, districts, schools, educators, and their partners are doing their part to expand opportunities to computer science for all.
Interdisciplinary Integration	ELA: online annotations, class webpage, email exchange, multimedia presentations, podcast, webquest, virtual field trip, online mind maps/graphic organizers Math: virtual manipulatives, create spreadsheets with formulas, simulations Science: create spreadsheets to record and analyze data, webquests, videos, simulations Social Studies: google earth and mapping sites, videos, webquests, simulations
Core Instruction and Supplemental Materials	Internet sources
Modifications and Accommodations	ELL: translation websites, scribing, speech to text, audio books Special Education: small group instruction; modified assessments G&T: leveled readers: enrichment activities; small group instruction

Standards in Action: Climate Change Although the future of work is unclear, thought leaders assert that artificial intelligence, the Internet of Things, robotics, and machine learning will be ubiquitous in tomorrow's workplaces (Malyn-Smith et al, 2018). This vision of the future includes a new machine age, where humans will shape technology, technology will shape human interaction, and where technologies and humans will collaborate to discover and innovate (Mervis, 2016; Van Opstal, Evans, Bates, & Knuckles, 2008). At the core of computer science and design thinking education, is the goal to prepare students with the essential knowledge and skills to make their local and global communities a better place to live. Learning experiences that enable students to apply content knowledge and employ computational thinking skills prepare students for the work of tomorrow by proposing solutions concerning the balancing of societal, environmental, and economic needs for a sustainable future. Further, leveraging topics such as computational sustainability and clean technology (Cleantech), technologies that either reduce or optimize the use of natural resources while reducing the negative effect that technology has on the planet and its ecosystems, is essential for developing a populace with the knowledge and skills necessary to mitigate the effects of climate change.

Structure of the NJSLS - Computer Science and Design Thinking The core ideas are derived from the disciplinary concepts and students' understandings increase in sophistication over time as they engage with these ideas in new and varied contexts. The core ideas are what is most essential for students to learn and represent the knowledge and skills that they should be able to apply to new situations outside of the school experience. Curriculum writers and educators can use these core ideas as the basis for formative, summative, and benchmark assessments. The performance expectations describe what students should know and be able to do. It is expected that curriculum writers and educators will bundle these performance expectations together in meaningful ways as a basis for classroom instruction and to guide the creation of formative, summative, and benchmark assessments. Coding of Performance Expectations To promote a unified vision of the NJSLS-CSDT, an abbreviated form of the disciplinary concepts is included in the alphanumeric code. The disciplinary concepts are abbreviated as follows: • Computing Systems (CS) • Networks and the Internet (NI) • Impacts of Computing (IC) • Data & Analysis (DA) • Algorithms & Programming (AP) • Engineering Design (ED) • Interaction of Technology and Humans (ITH) • Nature of Technology (NT) • Effects of Technology on the Natural World (ETW) • Ethics & Culture (EC)

Computer Science and Design Thinking Practices The practices describe the behaviors and ways of thinking that computationally literate students use to fully engage in today's data-rich and interconnected world. Computational thinking is at the heart of the practices and refers to the thought processes involved in expressing solutions as computational steps that can be carried out by a computer. It requires understanding the capabilities of computers, formulating problems addressed by a computer, and designing algorithms that a computer can execute. Curriculum writers and educators will want to consider how they can design learning experiences that will enable their students to develop these skills in conjunction with the content knowledge reflected in the core ideas and performance expectations.

Practice	Description
1 Fostering an Inclusive Computing and Design Culture	Building an inclusive and diverse computing culture requires strategies for incorporating perspectives from people of different genders, ethnicities, and abilities. Incorporating these perspectives involves understanding the personal, ethical, social, economic, and cultural contexts in which people operate. Considering the needs of diverse users during the design process is essential to producing inclusive computational products. When engaging in this practice, students: • Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products. • Address the needs of diverse end users during the design process to produce artifacts with broad accessibility and usability. • Employ self- and peer-advocacy to address bias in interactions, product design, and development methods.
2 Collaborating Around Computing and Design	Collaborative computing is the process of performing a computational task by working on pairs in teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to effectively work together and to create complex artifacts. When engaging in this practice, students: • Cultivate working relationships with individuals possessing diverse perspectives, skills, and personalities. • Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness. • Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders. Evaluate and select technological tools that can be used to collaborate on a project.
3 Recognizing and Defining Computational Problems	The ability to recognize appropriate and worthwhile opportunities to apply computation is a skill that develops over time and is central to computing. Solving a problem with a computational approach requires defining the problem, breaking it down into parts, and evaluating each part to determine whether a computational solution is appropriate. When engaging in this practice, students: • Identify complex, interdisciplinary, real-world problems that can be solved computationally. • Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or

	procedures . • Evaluate whether it is appropriate and feasible to solve a problem computationally.
4 Developing and Using Abstractions	Abstractions are formed by identifying patterns and extracting common features from specific examples in order to create generalizations. Using generalized solutions and parts of solutions designed for broad reuse simplifies the development process by managing complexity. When engaging in this practice, students: • Extract common features from a set of interrelated processes or complex phenomena. • Evaluate existing technological functionalities and incorporate them into new designs. • Create modules and develop points of interaction that can apply to multiple situations and reduce complexity. • Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.
5 Creating Computational Artifacts	The process of developing computational artifacts embraces both creative expression and the exploration of ideas to create prototypes and solve computational problems. Students create artifacts that are personally relevant or beneficial to their community and beyond. Computational artifacts can be created by combining and modifying existing artifacts or by developing new artifacts. Examples of computational artifacts include programs, simulations, visualizations, digital animations, robotic systems, and apps. When engaging in this practice, students: • 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. • Create a computational artifact for practical intent, personal expression, or to address a societal issue. • Modify an existing artifact to improve or customize it.
6 Testing and Refining Computational Artifacts	Testing and refinement is the deliberate and iterative process of improving a computational artifact. This process includes debugging (identifying and fixing errors) and comparing actual outcomes to intended outcomes. Students also respond to the changing needs and expectations of end users and improve the performance, reliability, usability, and accessibility of artifacts. When engaging in this practice, students: • Systematically test computational artifacts by considering all scenarios and using test cases. • Identify and fix errors using a systematic process. • Evaluate and refine a computational artifact, multiple times, to enhance its performance, reliability, usability, and accessibility.

7 Communicating About Computing and Design	Communication involves personal expression and exchanging ideas with others. In computer science, students communicate with diverse audiences about the use and effects of computation and the appropriateness of computational choices. Students write clear comments, document their work, and communicate their ideas through multiple forms of media. Clear communication includes using precise language and carefully considering possible audiences. When engaging in this practice, students: • Select, organize, and interpret large data sets from multiple sources to support a claim. • Describe, justify, and document computational and/or design processes and solutions using appropriate terminology consistent with the intended audience and purpose. • Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution.