# By the end of grade 8

## Computer Science 8.1

### A Computing Systems 8.1.8.CS

The study of human–computer interaction can improve the design of devices and extend the abilities of humans.

1 Recommend improvements to computing devices in order to improve the ways users interact with the devices. 8.1.8.CS.1

Software and hardware determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple considerations and potential trade-offs.

2 Design a system that combines hardware and software components to process data. 8.1.8.CS.2

3 Justify design decisions and explain potential system trade-offs. 8.1.8.CS.3

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.

4 Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems. 8.1.8.CS.4

### B Networks and the Internet 8.1.8.NI

Protocols, packets, and addressing are the key components for reliable delivery of information across networks.

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. 8.1.8.NI.1

2 Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication. 8.1.8.NI.2

The information sent and received across networks can be protected from unauthorized access and modification in a variety of ways. The evolution of malware leads to understanding the key security measures and best practices needed to proactively address the threat to digital data.

3 Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems. 8.1.8.NI.3

4 Explain how new security measures have been created in response to key malware events. 8.1.8.NI.4

## C Impacts of Computing 8.1.8.IC

Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.

1 Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options. 8.1.8.IC.1

2 Describe issues of bias and accessibility in the design of existing technologies. 8.1.8.IC.2

## D Data & Analysis 8.1.8.DA

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

1 Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.1

Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals. Data is organized and accessible based on the application used to store it.

2 Explain the difference between how the computer stores data as bits and how the data is displayed. 8.1.8.DA.2

3 Identify the appropriate tool to access data based on its file format. 8.1.8.DA.3

The purpose of cleaning data is to remove errors and make it easier for computers to process.

4 Transform data to remove errors and improve the accuracy of the data for analysis. 8.1.8.DA.4

Computer models can be used to simulate events, examine theories and inferences, or make predictions.

5 Test, analyze, and refine computational models. 8.1.8.DA.5

6 Analyze climate change computational models and propose refinements. 8.1.8.DA.6

## E Algorithms & Programming 8.1.8.AP

Individuals design algorithms that are reusable in many situations. Algorithms that are readable are easier to follow, test, and debug.

1 Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode. 8.1.8.AP.1

Programmers create variables to store data values of different types and perform appropriate operations on their values.

2 Create clearly named variables that represent different data types and perform operations on their values. 8.1.8.AP.2

Control structures are selected and combined in programs to solve more complex problems.

3 Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. 8.1.8.AP.3

Programs use procedures to organize code and hide implementation details. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.

4 Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs. 8.1.8.AP.4

5 Create procedures with parameters to organize code and make it easier to reuse. 8.1.8.AP.5

Individuals design and test solutions to identify problems taking into consideration the diverse needs of the users and the community.

6 Refine a solution that meets users' needs by incorporating feedback from team members and users. 8.1.8.AP.6

7 Design programs, incorporating existing code, media, and libraries, and give attribution. 8.1.8.AP.7

8 Systematically test and refine programs using a range of test cases and users. 8.1.8.AP.8

9 Document programs in order to make them easier to follow, test, and debug. 8.1.8.AP.9

## Design Thinking 8.2

### A Engineering Design 8.2.8.ED

Engineering design is a systematic, creative, and iterative process used to address local and global problems. The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes.

1. Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer. 8.2.8.ED.1
2. Identify the steps in the design process that could be used to solve a problem. 8.2.8.ED.2
3. Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). 8.2.8.ED.3
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. 8.2.8.ED.4

Engineering design requirements and specifications involve making trade-offs between competing requirements and desired design features.

5. Explain the need for optimization in a design process. 8.2.8.ED.5
6. Analyze how trade-offs can impact the design of a product. 8.2.8.ED.6
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). 8.2.8.ED.7

### B Interaction of Technology and Humans 8.2.8.ITH

Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.

1. Explain how the development and use of technology influences economic, political, social, and cultural issues. 8.2.8.ITH.1

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. New needs and wants may create strains on local economies and workforces. Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.

2. Compare how technologies have influenced society over time 8.2.8.ITH.2
3. Evaluate the impact of sustainability on the development of a designed product or system. 8.2.8.ITH.3
4. Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact. 8.2.8.ITH.4
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. 8.2.8.ITH.5

## C Nature of Technology 8.2.8.NT

Technology advances through the processes of innovation and invention which relies upon the imaginative and inventive nature of people. Sometimes a technology developed for one purpose is adapted to serve other purposes. Engineers use a systematic process of creating or modifying technologies that is fueled and constrained by physical laws, cultural norms, and economic resources. Scientists use systematic investigation to understand the natural world.

1. Examine a malfunctioning tool, product, or system and propose solutions to the problem. 8.2.8.NT.1
2. Analyze an existing technological product that has been repurposed for a different function. 8.2.8.NT.2
3. Examine a system, consider how each part relates to other parts, and redesign it for another purpose. 8.2.8.NT.3
4. Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product. 8.2.8.NT.4

## D Effects of Technology on the Natural World 8.2.8.ETW

Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve tradeoffs between environmental and economic needs, while others have positive effects for both the economy and environment

1. Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs. 8.2.8.ETW.1
2. Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital). 8.2.8.ETW.2
3. Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact. 8.2.8.ETW.3
4. Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best. 8.2.8.ETW.4

## E Ethics & Culture 8.2.8.EC

Technological disparities have consequences for public health and prosperity.

1. Explain ethical issues that may arise from the use of new technologies. 8.2.8.EC.1
2. Examine the effects of ethical and unethical practices in product design and development. 8.2.8.EC.2