

# SAMPLE OF STATE FRAMEWORKS FOR DIGITAL AND MEDIA LITERACY IN THE UNITED STATES

## STATE OF MINNESOTA

### ENGLISH LANGUAGE ARTS K-12, 2010

#### Grades K- 2

0.8.7.7 Distinguish among different types of print, digital, and multimodal media.

- a. Recognize common signs and logos.
- b. Identify commercials or advertisements.

1.8.7.7 Distinguish among and understand purposes of different types of print, digital, and multimodal media.

- a. Demonstrate understanding of media by asking and answering appropriate questions about what is read, heard or viewed.
- b. Summarize ideas from media in own words.

2.8.7.7 Distinguish, understand, and use different types of print, digital, and multimodal media.

- a. Use tools for locating print and electronic materials appropriate to the purpose.

0.8.8.8 With prompting and support, create an individual or shared multimedia work for a specific purpose (e.g., to share lived or imagined experiences, to present information, to entertain, or as artistic expression.)

- a. With prompting and support, critique each found image under consideration for use in a multimedia project for its appropriateness to purpose, its effectiveness in conveying the message, and its effect on the intended audience and justify its use in the project.
- b. Share the work with an audience.

#### GRADES 3 - 5

3.8.7.7 Distinguish among, understand, and use different types of print, digital, and multimodal media.

- a. Make informed judgments about messages promoted in the mass media (e.g., film, television, radio, magazines, advertisements, newspapers).
- b. Locate and use information in print, non-print, and digital resources, and identify reasons for choosing information used.
- c. Check for accuracy in pictures and images.
- d. Recognize safe practices in personal media communications.
- e. Recognize ethical standards and safe practices in social and personal media communications.

## GRADES 6 – 12 – MEDIA ANALYSIS

6.9.7.7 Understand, analyze, and use different types of print, digital, and multimodal media.

- a. Evaluate mass media with regard to quality of production (e.g., film, television, radio, advertisements).
- b. Evaluate mass media with regard to accuracy of information, bias, stereotype, purpose, message and target audience (e.g., film, television, radio, video games, print and digital media, advertisements).
- c. Recognize ethical standards and safe practices in social and personal media communications.

7.9.7.7 Understand, analyze, and use different types of print, digital, and multimodal media.

- a. Evaluate mass media with regard to quality of production, accuracy of information, bias, stereotype, purpose, message and target audience (e.g., film, television, radio, video games, and advertisements).
- b. Analyze the messages and points of view employed in different media (e.g., advertising, news programs, websites, video games, blogs, documentaries).
- c. Recognize ethical standards and safe practices in social and personal media communications.

8.9.7.7 Understand, analyze, and use different types of print, digital, and multimodal media.

- a. Evaluate mass media with regard to quality of production, accuracy of information, bias, stereotype, purpose, message and target audience (e.g., film, television, radio, video games, advertisements).
- b. Critically analyze the messages and points of view employed in different media (e.g., advertising, news programs, websites, video games, blogs, documentaries).
- c. Analyze design elements of various kinds of media productions to observe that media messages are constructed for a specific purpose

## GRADES 6 – 12 – CREATE MEDIA

6.9.8.8 As an individual or in collaboration, create an informative multimedia work or a piece of digital communication or contribute to an online collaboration for a specific purpose.

- a. Demonstrate a developmentally appropriate understanding of copyright, attribution, principles of Fair Use, Creative Commons licenses and the effect of genre on conventions of attribution and citation.
- b. Publish the work and share with an audience.

# STATE OF MASSACHUSETTS

## Grade 8 CIVICS Standards

Topic 7: Freedom of the Press and News/Media Literacy

Supporting Question: How does a free press support a democratic government?

1. Explain why freedom of the press was included as a right in the First Amendment to the United States Constitution and in Article 16 of the Massachusetts Constitution; explain that freedom of the press means the right to express and publish views on politics and other topics without government sponsorship, oversight, control, or censorship.
2. Give examples of how a free press can provide competing information and views about government and politics.
3. Explain the different functions of news articles, editorials, editorial cartoons, and “op-ed” commentaries.
4. Evaluate the benefits and challenges of digital news and social media to a democratic society.
5. Explain methods for evaluating information and opinion in print and online media (e.g., determining the credibility of news articles; analyzing the messages of editorials and op-ed commentaries; assessing the validity of claims and sufficiency of evidence).
6. Analyze the point of view and evaluate the claims of an editorial, editorial cartoon, or op-ed commentary on a public policy issue at the local, state, or national level (e.g., a mayoral or school committee decision, an action by a state legislature or Governor, a vote in Congress or an action by the President).

## STATE OF MASSACHUSETTS

### 1<sup>st</sup>–2<sup>nd</sup> Grade Media Arts Standards

#### Creating

1. **Generate and conceptualize artistic ideas and work.** Generate ideas using a variety of platforms (e.g., webpages, animation, videos). (1-2.MA.Cr.01)
2. **Organize and develop artistic ideas and work.** Develop plans for media arts productions (e.g., a student says before starting a media project, "I'm going to make an animation using only triangles"). (1-2.MA.Cr.02)
3. **Refine and complete artistic work.** Refine ideas using artistic elements (e.g. color, movement) for moving imagery or interactive art. (1-2.MA.Cr.03)

#### Presenting

4. **Select, analyze and interpret artistic work for presentation.** Identify different times, places, audiences, and contexts for presenting media artwork. (1-2.MA.P.04)
5. **Develop and refine artistic techniques and work for presentation.** Organize artwork with artistic intent (e.g. by theme, concept, or other organizational principle). (1-2.MA.P.05)
6. **Convey meaning through the presentation of artistic work.** Identify one's best work or one's favorite work for sharing. (1-2.MA.P.06)

#### Responding

7. **Perceive and analyze artistic work.** With support, identify the basic elements of media art (collections of images and sound, technology, interactivity). (1-2.MA.R.07)
8. **Interpret intent and meaning in artistic work.** Categorize artwork by subject matter and mood. (1-2.MA.R.08)
9. **Apply criteria to evaluate artistic work.** Demonstrate close observation of artistic work (e.g. noticing details, making connections). (1-2.MA.R.09)  
 STE Connection: Students use media to observe and compare different kinds of living things in an area. (STE.2.LS4.01)

#### Connecting

10. **Synthesize and relate knowledge and personal experiences to make art.** Make connections between an artwork and their personal experience. (1-2.MA.Co.10)  
 HSS Connection: Students reflect on their own reactions to the work of immigrant artists, such as Korean-born media artist Nam June Paik. (HSS.2.T3.01)
11. **Relate artistic ideas and works to societal, cultural and historical contexts to deepen understanding.** Identify examples of different contexts within media artworks. (1-2.MA.Co.11)

## 5<sup>th</sup>–6<sup>th</sup> Grade Media Arts Standards

### Creating

1. **Generate and conceptualize artistic ideas and work.** Generate integrative approaches to produce content for different audiences. (5-6.MA.Cr.01)
2. **Organize and develop artistic ideas and work.** Organize and plan an idea using a variety of self-selected strategies (e.g., storyboards, flowcharts, or prototypes). (5-6.MA.Cr.02)
3. **Refine and complete artistic work.** Refine a media arts idea by making changes in how images, interactivity, or sound are used. (5-6.MA.Cr.03)

### Presenting

4. **Select, analyze and interpret artistic work for presentation.** Explain artistic choices by developing an artist statement. (5-6.MA.P.04)
5. **Develop and refine artistic techniques and work for presentation.** Develop a visual plan for displaying a media artwork, analyzing where viewers will interact with the work and other needs of the viewer. (5-6.MA.P.05)
6. **Convey meaning through the presentation of artistic work.** Formally present a media artwork piece that makes connections to other disciplines. (5-6.MA.P.06)  
 Visual Arts Connection: Students sketch out a script for a stop-motion animation, then paint a landscape to use as a backdrop in the film. (5-6.V.Cr.01)

### Responding

7. **Perceive and analyze artistic work.** Analyze how an artwork's form supports the artist's intention. (5-6.MA.R.07).  
 HSS Connection: Students design graphic symbols to deliver a message or story, such as shown on the quilts of Harriet Powers. (HSS.5.T1.07)
8. **Interpret intent and meaning in artistic work.** Use specific vocabulary to identify details about a media arts work. (5-6.MA.R.08)
9. **Apply criteria to evaluate artistic work.** Apply a rubric to evaluate a media piece. (5-6.MA.R.09)

### Connecting

10. **Synthesize and relate knowledge and personal experiences to make art.** Describe and demonstrate one's own artistic style, and preferences in media arts. (5-6.MA.Co.10)
11. **Relate artistic ideas and works to societal, cultural and historical contexts to deepen understanding.** Identify influential media works and how they impacted media arts. (5-6.MA.Co.11)

## 7<sup>th</sup>–8<sup>th</sup> Grade Media Arts Standards

### Creating

1. **Generate and conceptualize artistic ideas and work.** Generate media arts ideas that integrate multiple images, sound and interactivity in a variety of ways. (7-8.MA.Cr.01)  
STE Connection: Students plan an app that visually explains to users how the earth has changed both locally and globally. (STE.7.ESS.2.02)
2. **Organize and develop artistic ideas and work.** Develop artistic plans that are clear enough for others to implement those ideas. (7-8.MA.Cr.02)
3. **Refine and complete artistic work.** Apply strategies to overcome creative blocks. (7-8.MA.Cr.03)

### Presenting

4. **Select, analyze and interpret artistic work for presentation.** Prepare a theme-based exhibition. (7-8.MA.P.04)
5. **Develop and refine artistic techniques and work for presentation.** Utilize different approaches to share media work. (7-8.MA.P.05)
6. **Convey meaning through the presentation of artistic work.** Match a media work with expressed intent (e.g. wanting the audience to feel tension between two positions). (7-8.MA.P.06)

### Responding

7. **Perceive and analyze artistic work.** Analyze how culture is reflected in a diverse range of media works. (7-8.MA.R.07)
8. **Interpret intent and meaning in artistic work.** Explain how a media artwork is connected to the particular cultural, historical context where it was created. (7-8.MA.R.08)
9. **Apply criteria to evaluate artistic work.** Develop criteria for evaluating a collection of media artwork (e.g., students create criteria for a media exhibition that is juried by students). (7-8.MA.R.09)

### Connecting

10. **Synthesize and relate knowledge and personal experiences to make art.** Describe and demonstrate influences of personal artistic style and preferences in media arts. (7-8.MA.Co.10)  
HSS Connection: Students employ personal style to design an animated cartoon about ancient Greek gods, goddesses, heroes, or events and explain why their style is appropriate to the subject matter. (HSS.7.T4b.07)
11. **Relate artistic ideas and works to societal, cultural and historical contexts to deepen understanding.** Explain and demonstrate how the media art are evolving in different cultures (e.g., how media arts are evolving differently in Korea versus the United States). (7-8.MA.Co.11)

## High School Media Arts Standards

### Creating

1. **Generate and conceptualize artistic ideas and work.** Create media arts ideas that are characteristic of different media genres. (F.MA.Cr.01)
2. **Organize and develop artistic ideas and work.** Create multiple different plans for a work prior to selecting one to implement. (F.MA.Cr.02)
3. **Refine and complete artistic work.** Refine concepts and content by focusing on a specific element such as interactivity, temporality, or heterogeneity. (F.MA.Cr.03)

### Presenting

4. **Select, analyze and interpret artistic work for presentation.** Justify choices for curating and presenting artwork for a specific exhibit or event (e.g., students complete a proposal for a juried show within the community.) (F.MA.P.04)
5. **Develop and refine artistic techniques and work for presentation.** Develop a proposal for an installation, artwork, or digital space that transforms the perception and experience of a particular place. (F.MA.P.05)
6. **Convey meaning through the presentation of artistic work.** Describe how decisions about how a media artwork is presented are connected to what the student wants to express, evoke, or communicate. (F.MA.P.06)

### Responding

7. **Perceive and analyze artistic work.** Analyze the style of a media artist, and how the style manifests itself in a given media artwork. (F.MA.R.07)
8. **Interpret intent and meaning in artistic work.** Identify artistic elements from a work that connect it to a specific genre or style. (F.MA.R.08)  
HSS Connection: Students study the structure and meanings of Ghanaian adinkra cloth stamp designs and apply similar symbolic pattern elements in contemporary graphic design (HSS.WHI.T3.02).
9. **Apply criteria to evaluate artistic work.** Compare and contrast different rubrics or criteria for evaluating media artwork. (F.MA.R.09)

### Connecting

10. **Synthesize and relate knowledge and personal experiences to make art.** Describe what has influenced changes in one's own artistic style and preferences in media arts. (F.MA.Co.10)
11. **Relate artistic ideas and works to societal, cultural and historical contexts to deepen understanding.** Identify the connections between historical and cultural context and defining stylistic elements of multiple media artworks (e.g., shifting styles due to the birth of computer animation). (F.MA.Co.11)

## Advanced HS Course Media Arts Standards

### Creating

- 1. Generate and conceptualize artistic ideas and work.** Consistently apply research to support development of artistic ideas. (e.g., a student researches different ways media artists have used background sound to emphasize surprise). (P.MA.Cr.01)
- 2. Organize and develop artistic ideas and work.** Independently document an original multi-part media arts idea (e.g. wireframe, story board). (P.MA.Cr.02)  
Theatre Connection: Students develop a screenplay that they turn into a short film. (P.T.R.07)
- 3. Refine and complete artistic work.** Refine draft arrangements for different audiences. (P.MA.Cr.03)

### Presenting

- 4. Select, analyze and interpret artistic work for presentation.** Explain how one uses specific techniques to evoke, express, or communicate ideas in a media arts work or collection of such works. (P.MA.P.04)
- 5. Develop and refine artistic techniques and work for presentation.** Contribute a work that explores a personally meaningful theme, idea, or concept to a media arts show (e.g., select work to include, develop feedback on presentation ideas). (P.MA.P.05)
- 6. Convey meaning through the presentation of artistic work.** Modify a media artwork to clarify its artistic intent by anticipating viewers' responses. (P.MA.P.06)

### Responding

- 7. Perceive and analyze artistic work.** Analyze the qualities and relationships of components in various media artworks and consider how they impact an audience. (P.MA.R.07)  
HSS Connection: Students examine illustrations by Aaron Douglas and Elizabeth Catlett made during the Harlem Renaissance period and analyze the influence of their work on modern graphic design. (HSS.USII.T2.01.a)
- 8. Interpret intent and meaning in artistic work.** Compare and contrast the artistic elements that make media arts unique from other artistic disciplines. (P.MA.R.08)
- 9. Apply criteria to evaluate artistic work.** Choose and defend different criteria for evaluating media artwork. (P.MA.R.09)

### Connecting

- 10. Synthesize and relate knowledge and personal experiences to make art.** Describe how media arts includes content from other academic disciplines (e.g., how one might use mathematical patterns to make images and sound in a media artwork). (P.MA.Co.10)
- 11. Relate artistic ideas and works to societal, cultural and historical contexts to deepen understanding.** Explain the relationship between media artworks and commercialization or propaganda (e.g. how memes get used to communicate political messages). (P.MA.Co.11)

## STATE OF MASSACHUSETTS

### High School Standards for News/Media Literacy

These standards, based in part on the Massachusetts Digital Literacy and Computer Science Standards, are designed to be taught for a quarter to a half of a school year. The topics below could be taught as a separate course or adapted for use in a history and social science, English, journalism, business, or college and career readiness curriculum.

#### News/Media Literacy Topics

- Topic 1. Freedom of the press and news/media literacy
- Topic 2. History of journalism
- Topic 3. The challenges of news/media literacy in contemporary society
- Topic 4. Analyzing the news and other media
- Topic 5. Gathering and reporting information, using digital media

#### Literacy in History and Social Science

In studying these topics, students apply grades 9–10 or 11–12 reading, writing and speaking and listening skills and learn vocabulary and concepts related to history and social science.

Connections to Middle and High School History and Social Science Students were introduced to concepts of media literacy in the grade 8 civics class. These high school standards are designed to inspire reflection on how current events are reported and to give students ways of determining the purpose, point of view, and accuracy of the reports they see, hear, and view on social media, online, and in print.

Standards for History and Social Science Practice, Pre-K–12\*

1. Demonstrate civic knowledge, skills, and dispositions.
2. Develop focused questions or problem statements and conduct inquiries.
3. Organize information and data from multiple primary and secondary sources.
4. Analyze the purpose and point of view of each source; distinguish opinion from fact.
5. Evaluate the credibility, accuracy, and relevance of each source.
6. Argue or explain conclusions, using valid reasoning and evidence.
7. Determine next steps and take informed action, as appropriate.

#### Topic 1. Freedom of the press and news/media literacy

Supporting Question: Why does news/media literacy matter?

1. Evaluate the importance of a free flow of information in a democratic society.
2. Explain why freedom of the press was included as a right in the First Amendment to the United States Constitution and in Article 16 of the Massachusetts Constitution; explain that freedom of the press means the right to express and publish views on politics and other topics without government sponsorship, oversight, control, or censorship.

3. Give examples of how a free press can provide competing information and views about government, policies, and politics.
4. Provide examples of government control of information or government censorship from history or the present.
5. Differentiate between news and opinion and explain the different functions of news articles, editorials, editorial cartoons, and “op-ed” commentaries.

## Topic 2. History of journalism

Supporting Question: How has journalism affected past and present society?

1. Explain the ways in which the dissemination of information has changed over time, noting the impact of some of the key technological developments that have driven those changes (e.g., the invention of papermaking, the printing press, moveable type, wood engraving, the typewriter, mechanical typesetting, high-speed printing, photography, film, video, the telegraph, telephone, radio, television and the Internet).
2. Analyze an aspect of journalism in the United States, focusing a case study on one of the topics below:
  - the role of newspapers in influencing support for the American Revolution and in the debates over ratifying the Constitution
  - the connections among the expansion of public education in the 19th and 20th centuries, increased literacy rates, and the rise of weekly newspapers and magazines with mass national circulation (e.g., Harper’s Weekly, the Atlantic, Life, Time)
  - the impact of newspapers and magazines owned, written and published by and for African Americans in the 19th and 20th centuries in uniting the African American community and supporting the movement for equal rights
  - the role of foreign language newspapers, radio, and television in the United States in serving immigrant communities and preserving language and culture
  - The influence of newspapers on public opinion during the Civil War, World War I, and the Progressive Era
  - The combined influence of print, radio, and film as news media in the 1930s–1950s • The impact of broadcast journalism on television in the 1950s–1990s, and the Internet and social media from the 1990s–21st century

## Topic 3. The challenges of news/media literacy in contemporary society

Supporting Question: How have developments in the Digital Age and in the structure of media organizations redefined what it means to be an informed participant in civic life?

1. Evaluate the benefits and challenges of digital news and social media to a democratic society (e.g. weighing such factors as the availability of information, the speed with which it is available, the volume of information and the diversity and number of media outlets).
2. Explain the conventions investigative journalists use and the steps they take in developing and checking the facts in news articles.

3. Explain how new technologies broaden the influence of the media and corporate or public interest groups.
4. Explain how structural changes in the news industry (e.g., the consolidation of ownership of news outlets, the transition from print to digital journalism) affect news consumers.
5. Explain how becoming a discerning news consumer can change individual lives and have an impact on the integrity of a democratic system of government.

## Topic 4. Analyzing the news and other media

Supporting Question: How can individuals become informed consumers of news and media?

1. Explain the importance of determining the sources of information on a website (e.g., partisan or non-partisan groups, sponsors, signed or anonymous authors), potential biases, what evidence is available, and what perspectives other sources offer.
2. Explain methods for evaluating information and opinion in print and online media (e.g., determining the credibility of news articles including the use of such websites as Factcheck.org; analyzing the messages of editorials and “op-ed” commentaries; assessing the validity of claims and sufficiency of evidence).
3. Analyze how assertion differs from verification, evidence differs from inference.
4. Evaluate and deconstruct news reports, social media posts, editorials, editorial cartoons, or oped commentaries on a public policy issue at the local, state, or national level, reviewing them for the quality of evidence presented, the reliability of sources, and perspectives available from other sources.

## Topic 5. Gathering and reporting information, using digital media

Supporting Question: How do media literacy skills apply to generating news reporting and other content across all types of media?

1. Gather, organize, analyze, and synthesize information using a variety of digital tools; perform advanced searches to locate information and/or design a data-collection approach to gather original data (e.g., qualitative interviews, surveys).
2. Write an accurate factual report and an editorial about a public event or policy (e.g., a decision made at a School Committee meeting); explain how the two types of writing differ.
3. Use digital tools (e.g., drawing, photography, and editing software, video production tools) to communicate visually in reporting or opinion pieces.
4. Use digital tools to design and produce a significant digital artifact (e.g., multipage website, online portfolio, podcast).
5. Collaborate on a substantial project with outside experts and others through online digital tools (e.g., public policy debate, community service learning project, capstone project).

# STATE OF MASSACHUSETTS

## DIGITAL LITERACY AND COMPUTER SCIENCE

3-5

### Grades 3 to 5: Computing Systems [CS]

#### Computing Devices [3-5.CS.a]

1. Identify a broad range of computing devices (e.g., computers, smart phones, tablets, robots, e-textiles) and appropriate uses for them.
2. Describe the function and purpose of various input and output devices (e.g., monitor, keyboard, speakers, controller, probes, sensors, Bluetooth transmitters, synthesizers).
3. Demonstrate an appropriate level of proficiency (connect and record data, print, send command, connect to Internet, search) in using a range of computing devices (e.g., probes, sensors, printers, robots, computers).
4. Identify and solve simple hardware and software problems that may occur during everyday use (e.g., power, connections, application window or toolbar).
5. Describe the differences between hardware and software.
6. Identify and explain that some computing functions are always active (e.g., locations function on smart phones).

#### Human and Computer Partnerships [3-5.CS.b]

1. Compare and contrast human and computer performance on similar tasks (e.g., sorting alphabetically, finding a path across a cluttered room) to understand which is best suited to the task.
2. Explain how hardware and applications [e.g., Global Positioning System (GPS) navigation for driving directions, text-to-speech translation, language translation] can enable everyone, including people with disabilities, to do things they could not do otherwise.
3. Explain advantages and limitations of technology (e.g., a spell-checker can check thousands of words faster than a human could look them up, however, a spell-checker might not know whether ‘underserved’ is correct or if the author’s intent was to type ‘undeserved’).

#### Networks [3-5.CS.c]

1. Describe how a network is made up of a variety of components and identify the common components (e.g., links, nodes, networking devices).
2. Describe the need for authentication of users and devices as it relates to access permissions, privacy, and security.
3. Define and explain why devices are numbered/labeled in networks [e.g., the World Wide Web Uniform Resource Locator (URL), the Internet Protocol (IP) address, the Machine Access Code (MAC)].
4. Recognize that there are many sources of and means for accessing information within a network (e.g., websites, e-mail protocols, search engines)

## Services [3-5.CS.d]

1. Identify common services (e.g., driving directions apps that access remote map services, digital personal assistants that access remote information services).

3-5

## Grades 3 to 5: Computational Thinking [CT]

### Abstraction [3-5.CT.a]

1. Use numbers or letters to represent information in another form (e.g., secret codes, Roman numerals, abbreviations).
2. Organize information in different ways to make it more useful/relevant (e.g., sorting, tables).
3. Make a list of sub-problems to consider, while addressing a larger problem.

### Algorithms [3-5.CT.b]

1. Define an algorithm as a sequence of instructions that can be processed by a computer.
2. Recognize that different solutions exist for the same problem (or sub-problem).
3. Use logical reasoning to predict outcomes of an algorithm.
4. Individually and collaboratively create an algorithm to solve a problem (e.g., move a character/robot/person through a maze).
5. Detect and correct logical errors in various algorithms (e.g., written, mapped, live action, or digital).

### Data [3-5.CT.c]

1. Describe examples of databases from everyday life (e.g., library catalogs, school records, telephone directories, contact lists).
2. Individually and collaboratively collect and manipulate data to answer a question using a variety of computing methods (e.g., sorting, totaling, averaging) and tools (such as a spreadsheet) to collect, organize, graph, and analyze data.

### Programming and Development [3-5.CT.d]

1. Individually and collaboratively create, test, and modify a program in a graphical environment (e.g., block-based visual programming language).
2. Use arithmetic operators, conditionals, and repetition in programs.
3. Use interactive debugging to detect and correct simple program errors.
4. Recognize that programs need known starting values (e.g., set initial score to zero in a game).

### Modeling and Simulation [3-5.CT.e]

1. Individually and collaboratively create a simple model of a system (e.g., water cycle, solar system) and explain what the model shows and does not show.
2. Identify the concepts, features, and behaviors illustrated by a simulation (e.g., object motion, weather, ecosystem, predator/prey) and those that were not included.
3. Individually and collaboratively, use data from a simulation to answer a question.

## Grades 6 to 8: Computing Systems [CS]

### Computing Devices [6-8.CS.a]

1. Describe the main functions of an operating system.
2. Recognize that there is a wide range of application software.
3. Identify and describe the function of the main internal parts of a basic computing device [e.g., motherboard, hard drive, Central Processing Unit (CPU)].
4. Identify and describe the use of sensors, actuators, and control systems in an embodied system (e.g., a robot, an e-textile, installation art, smart room).
5. Individually and collaboratively design and demonstrate the use of a device (e.g., robot, e-textile) to accomplish a task.
6. Use a variety of computing devices [e.g., probes, sensors, handheld devices, Global Positioning System (GPS)] to individually and collaboratively collect, analyze, and present information for content-related problems.
7. Identify steps involved in diagnosing and solving routine hardware and software problems (e.g., power, connections, application window or toolbar, cables, ports, network resources, video, sound) that occur during everyday computer use.

### Human and Computer Partnerships [6-8.CS.b]

1. Explain why some problems can be solved more easily by computers or humans based on a general understanding of types of tasks at which each excels.
2. Describe how humans and machines interact to solve problems that cannot be solved by either alone (e.g., “big data” experiments that involve drawing conclusions by analyzing vast amounts of data).

### Networks [6-8.CS.c]

1. Explain the difference between physical (wired), local and wide area, wireless, and mobile networks.
2. Model the components of a network, including devices, routers, switches, cables, wires, and transponders.
3. Describe how information, both text and non-text, is translated and communicated between digital devices over a computer network.

### Services [6-8.CS.d]

1. Identify capabilities of devices that are enabled through services (e.g., a wearable device that stores fitness data in the cloud, a mobile device that uses location services for navigation).

## Grades 6 to 8: Computational Thinking [CT]

### Abstraction [6-8.CT.a]

1. Describe how data is abstracted by listing attributes of everyday items to represent, order and compare those items (e.g., street address as an abstraction for locations; car make, model, and license plate number as an abstraction for cars).
2. Define a simple function that represents a more complex task/problem and can be reused to solve similar tasks/problems.
3. Use decomposition to define and apply a hierarchical classification scheme to a complex system, such as the human body, animal classification, or in computing.

### Algorithms [6-8.CT.b]

1. Design solutions that use repetition and conditionals.
2. Use logical reasoning to predict outputs given varying inputs.
3. Individually and collaboratively, decompose a problem and create a sub-solution for each of its parts (e.g., video game, robot obstacle course, making dinner).
4. Recognize that more than one algorithm can solve a given problem.
5. Recognize that boundaries need to be taken into account for an algorithm to produce correct results.

### Data [6-8.CT.c]

1. Demonstrate that numbers can be represented in different base systems (e.g., binary, octal, and hexadecimal) and text can be represented in different ways [e.g., American Standard Code for Information Interchange (ASCII)].
2. Describe how computers store, manipulate, and transfer data types and files (e.g., integers, real numbers, Boolean Operators) in a binary system.
3. Create, modify, and use a database (e.g., define field formats, add new records, manipulate data), individually and collaboratively, to analyze data and propose solutions for a task/problem.
4. Perform a variety of operations such as sorting, filtering, and searching in a database to organize and display information in a variety of ways such as number formats (scientific notation and percentages), charts, tables, and graphs.
5. Select and use data-collection technology (e.g., probes, handheld devices, geographic mapping systems) to individually and collaboratively gather, view, organize, analyze, and report results for content-related problems.

### Programming and Development [6-8.CT.d]

1. Individually and collaboratively compare algorithms to solve a problem, based on a given criteria (e.g., time, resource, accessibility).
2. Use functions to hide the detail in a program.
3. Create a program, individually and collaboratively, that implements an algorithm to achieve a given goal.

4. Implement problem solutions using a programming language, including all of the following: looping behavior, conditional statements, expressions, variables, and functions.
5. Trace programs step-by-step in order to predict their behavior.
6. Use an iterative approach in development and debugging to understand the dimensions of a problem clearly.

#### Modeling and Simulation [6-8.CT.e]

1. Create a model of a real-world system and explain why some details, features and behaviors were required in the model and why some could be ignored.
2. Use and modify simulations to analyze and illustrate a concept in depth (e.g., light rays/mechanical waves interaction with materials, genetic variation).
3. Select and use computer simulations, individually and collaboratively, to gather, view, analyze, and report results for content-related problems (e.g., migration, trade, cellular function).

## Grades 9 to 12: Digital Tools and Collaboration [DTC]

#### Digital Tools [9-12.DTC.a]

1. Use digital tools to design and develop a significant digital artifact (e.g., multipage website, online portfolio, simulation).
2. Select digital tools or resources based on their efficiency and effectiveness to use for a project or assignment and justify the selection.

#### Collaboration and Communication [9-12.DTC.b]

1. Communicate and publish key ideas and details to a variety of audiences using digital tools and media-rich resources.
2. Collaborate on a substantial project with outside experts or others through online digital tools (e.g., science fair project, community service project, capstone project).

#### Research [9-12.DTC.c]

1. Generate, evaluate, and prioritize questions that can be researched through digital resources or tools.
2. Perform advanced searches to locate information and/or design a data-collection approach to gather original data (e.g., qualitative interviews, surveys, prototypes, simulations).
3. Evaluate digital sources needed to solve a given problem (e.g., reliability, point of view, relevancy).
4. Gather, organize, analyze, and synthesize information using a variety of digital tools.
5. Create an artifact that answers a research question, communicates results and conclusions, and cites sources.

## Grades 9 to 12: Computing Systems [CS]

### Computing Devices [9-12.CS.a]

1. Select computing devices (e.g., probe, sensor, tablet) to accomplish a real-world task (e.g., collecting data in a field experiment) and justify the selection.
2. Examine how the components of computing devices are controlled by and react to programmed commands.
3. Apply strategies for identifying and solving routine hardware and software problems that occur in everyday life (e.g., update software patches, virus scan, empty trash, run utility software, close all programs, reboot, use help sources).
4. Explain and demonstrate how specialized computing devices can be used for problem solving, decision-making and creativity in all subject areas.
5. Describe how computing devices manage and allocate shared resources [e.g., memory, Central Processing Unit (CPU)].
6. Examine the historical rate of change in computing devices (e.g., power/energy, computation capacity, speed, size, ease of use) and discuss the implications for the future.

### Human and Computer Partnerships [9-12.CS.b]

1. Identify a problem that cannot be solved by humans or machines alone and design a solution for it by decomposing the task into sub-problems suited for a human or machine to accomplish (e.g., a human-computer team playing chess, forecasting weather, piloting airplanes).

### Networks [9-12.CS.c]

1. Explain how network topologies and protocols enable users, devices, and systems to communicate with each other.
2. Examine common network vulnerabilities (e.g., cyberattacks, identity theft, privacy) and their associated responses.
3. Examine the issues (e.g., latency, bandwidth, firewalls, server capability) that impact network functionality.

### Services [9-12.CS.d]

1. Compare the value of using an existing service versus building the equivalent functionality (e.g., using a reference search engine versus creating a database of references for a project).
2. Explain the concept of quality of service (e.g., security, availability, performance) for services providers (e.g., online storefronts that must supply secure transactions for buyer and seller).

## Grades 9 to 12: Computational Thinking [CT]

### Abstraction [9-12.CT.a]

1. Discuss and give an example of the value of generalizing and decomposing aspects of a problem in order to solve it more effectively.

### Algorithms [9-12.CT.b]

1. Recognize that the design of an algorithm is distinct from its expression in a programming language.
2. Represent algorithms using structured language, such as pseudocode.
3. Explain how a recursive solution to a problem repeatedly applies the same solution to smaller instances of the problem.
4. Describe that there are ways to characterize how well algorithms perform and that two algorithms can perform differently for the same task.
5. Explain that there are some problems, which cannot be computationally solved.

### Data [9-12.CT.c]

1. Describe how data types, structures, and compression in programs affect data storage and quality (e.g., digital image file sizes are affected by resolution and color depth).
2. Create an appropriate multidimensional data structure that can be filtered, sorted, and searched (e.g., array, list, record).
3. Create, evaluate, and revise data visualization for communication and knowledge.
4. Analyze a complex data set to answer a question or test a hypothesis (e.g., analyze a large set of weather or financial data to predict future patterns).
5. Identify different problems (e.g., large or multipart problems, problems that need specific expertise, problems that affect many constituents) that can benefit from collaboration when processing and analyzing data to develop new insights and knowledge.

### Programming and Development [9-12.CT.d]

1. Use a development process in creating a computational artifact that leads to a minimum viable product and includes reflection, analysis, and iteration (e.g., a data-set analysis program for a science and engineering fair, capstone project that includes a program, term research project based on program data).
2. Decompose a problem by defining functions, which accept parameters and produce return values.
3. Select the appropriate data structure to represent information for a given problem (e.g., records, arrays, lists).
4. Analyze trade-offs among multiple approaches to solve a given problem (e.g., space/time performance, maintainability, correctness, elegance).
5. Use appropriate looping structures in programs (e.g., FOR, WHILE, RECURSION).
6. Use appropriate conditional structures in programs (e.g., IF-THEN, IF-THEN-ELSE, SWITCH).
7. Use a programming language or tool feature correctly to enforce operator precedence.

8. Use global and local scope appropriately in program design (e.g., for variables).
9. Select and employ an appropriate component or library to facilitate programming solutions [e.g., turtle, Global Positioning System (GPS), statistics library].
10. Use an iterative design process, including learning from making mistakes, to gain a better understanding of the problem domain.
11. Engage in systematic testing and debugging methods to ensure program correctness.
12. Demonstrate how to document a program so that others can understand its design and implementation.

#### Modeling and Simulation [9-12.CT.e]

1. Create models and simulations to help formulate, test, and refine hypotheses.
2. Form a model from a hypothesis generated from research and run a simulation to collect and analyze data to test that hypothesis.

## Grades 9 to 12: Computing and Society [CAS]

#### Safety and Security [9-12.CAS.a]

1. Evaluate and design an ergonomic work environment.
2. Explain safe practices when collaborating online, including how to anticipate potentially dangerous situations.
3. Construct strategies to combat cyberbullying/harassment.
4. Identify the mental health consequences of cyberbullying/harassment.
5. Explain how peer pressure in social computing settings influences choices.
6. Apply strategies for managing negative peer pressure and encouraging positive peer pressure.

#### Ethics and Laws [9-12.CAS.b]

1. Model mastery of the school's Acceptable Use Policy (AUP).
2. Identify computer-related laws and analyze their impact on digital privacy, security, intellectual property, network access, contracts, and consequences of sexting and harassment.
3. Discuss the legal and ethical implications associated with malicious hacking and software piracy.
4. Interpret software license agreements and application permissions.

#### Interpersonal and Societal Impact [9-12.CAS.c]

1. Explain the impact of the digital divide on access to critical information.
2. Discuss the impact of computing technology on business and commerce (e.g., automated tracking of goods, automated financial transaction, e-commerce, cloud computing).
3. Describe the role that assistive technology can play in people's lives.

4. Create a digital artifact that is designed to be accessible (e.g., closed captioning for audio, alternative text for images).
5. Analyze the beneficial and harmful effects of computing innovations (e.g., social networking, delivery of news and other public media, intercultural communication).
6. Cultivate a positive web presence (e.g., digital resume, portfolio, social media).
7. Identify ways to use technology to support lifelong learning.
8. Analyze the impact of values and points of view that are presented in media messages (e.g., racial, gender, political).
9. Discuss the social and economic implications associated with malicious hacking, software piracy, and cyber terrorism.