Middle & High School CSTA Standards with Related GAISE II Concepts

Middle School

CSTA 2-AP-11 Create clearly named variables that represent different data types and perform operations on their values. *A variable is like a container with a name, in which the contents may change, but the name (identifier) does not. When planning and developing programs, students should decide when and how to declare and name new variables. Students should use naming conventions to improve program readability. Examples of operations include adding points to the score, combining user input with words to make a sentence, changing the size of a picture, or adding a name to a list of people.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Formulate Statistical Investigative Questions I.A.3** Pose summary (or descriptive) statistical investigative questions about one variable regarding small, well-defined groups (e.g., subset of a classroom, classroom, school, town) and extend these to include comparison and association statistical investigative questions between variables
- **Collect Data/ Consider Data II.A.4** Understand that within a data set there can be different types of variables (e.g., categorical or quantitative)

CSTA 2-AP-15 Seek and incorporate feedback from team members and users to refine a solution that meets user needs. *Development teams that employ user-centered design create solutions (e.g., programs and devices) that can have a large societal impact, such as an app that allows people with speech difficulties to translate hard-to-understand pronunciation into understandable language. Students should begin to seek diverse perspectives throughout the design process to improve their computational artifacts. Considerations of the end-user may include usability, accessibility, age-appropriate content, respectful language, user perspective, pronoun use, color contrast, and ease of use.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.C.6** Understand the issues of bias and confounding variables in observational studies and their implications for interpretation

CSTA 2-DA-07 Represent data using multiple encoding schemes. *Data representations occur at multiple levels of abstraction, from the physical storage of bits to the arrangement of information into organized formats (e.g., tables). Students should represent the same data in multiple ways. For example, students could represent the same color using binary, RGB values, hex codes (low-level representations), as well as forms understandable by people, including words, symbols, and digital displays of the color (high-level representations).*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Formulate Statistical Investigative Questions I.C.2** Pose summary, comparative, and association statistical investigative questions for surveys, observational studies, and experiments using primary or secondary data

- **Collect Data/ Consider Data II.B.1** Understand that data are information collected and recorded with a purpose and can be organized and stored in a variety of structures (e.g., spreadsheets)
- **Collect Data/ Consider Data II.B.4** Recognize that data can be collected using surveys and measurements, and develop a critical attitude in analyzing data collection methods
- **Analyze the Data III.A.2** Represent the variability of categorical variables or quantitative variables using appropriate displays (e.g., tables, picture graphs, dotplots, bar graphs)
- **Analyze the Data III.B.1** Represent the variability of quantitative variables using appropriate displays (e.g., dotplots, boxplots)

CSTA 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. *As students continue to build on their ability to organize and present data visually to support a claim, they will need to understand when and how to transform data for this purpose. Students should transform data to remove errors, highlight or expose relationships, and/or make it easier for computers to process. The cleaning of data is an important transformation for ensuring consistent format and reducing noise and errors (e.g., removing irrelevant responses in a survey). An example of a transformation that highlights a relationship is representing males and females as percentages of a whole instead of as individual counts.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.A.1** Understand that data are information; recognize that to answer a statistical investigative question, a person may collect data themselves **s**pecifically for that purpose, or a person may use data that have been collected by other people for another purpose
- **Collect Data/ Consider Data II.A.2** Understand how to collect and record information from the group of interest using surveys and measurements collected from observations and simple experiments
- **Collect Data/ Consider Data II.A.6** Understand that data are not always pristine but may contain errors, have missing values, etc., and that decisions have to be made about how to account for these issues
- **Collect Data/ Consider Data II.B.1** Understand that data are information collected and recorded with a purpose and can be organized and stored in a variety of structures (e.g., spreadsheets)
- **Analyze the Data III.B.1** Represent the variability of quantitative variables using appropriate displays (e.g., dotplots, boxplots)
- **Analyze the Data III.C.1** Use technology to subset and filter data sets and transform variables, including smoothing for time series data

CSTA 2-DA-09 Refine computational models based on the data they have generated. *A model may be a programmed simulation of events or a representation of how various data is related. In order to refine a model, students need to consider which data points are relevant, how data points relate to each other, and if the data is accurate. For example, students may make a prediction about how far a ball will travel based on a table of data related to the height and angle of a track. The students could then test and refine their model by comparing predicted versus actual results*

and considering whether other factors are relevant (e.g., size and mass of the ball). Additionally, students could refine game mechanics based on test outcomes in order to make the game more balanced or fair.

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.B.**3 Understand that data can be used to make comparisons between different groups at one point in time and the same group over time
- **Analyze the Data III.C.1** Use technology to subset and filter data sets and transform variables, including smoothing for time series data
- **Interpret Results IV.B.3** Generalize beyond the sample providing statistical evidence for the generalization and including a statement of uncertainty and plausibility when needed
- **Interpret Results IV.B.5** State the limitations of sample information (e.g., a sample may or may not be representative of the larger population, measurement variability)

CSTA 2-IC-21 Discuss issues of bias and accessibility in the design of existing technologies. *Students should test and discuss the usability of various technology tools (e.g., apps, games, and devices) with the teacher's guidance. For example, facial recognition software that works better for lighter skin tones was likely developed with a homogeneous testing group and could be improved by sampling a more diverse population. When discussing accessibility, students may notice that allowing a user to change font sizes and colors will not only make an interface usable for people with low vision but also benefits users in various situations, such as in bright daylight or a dark room.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.B.6** Understand how to interrogate the data to determine how the data were collected, from whom they were collected, what types of variables are in the data, how the variables were measured (including units used), and the possible outcomes for the variables

CSTA 2-IC-22 Collaborate with many contributors through strategies such as crowdsourcing or surveys when creating a computational artifact. *Crowdsourcing is gathering services, ideas, or content from a large group of people, especially from the online community. It can be done at the local level (e.g., classroom or school) or global level (e.g., age-appropriate online communities, like Scratch and Minecraft). For example, a group of students could combine animations to create a digital community mosaic. They could also solicit feedback from many people though use of online communities and electronic surveys.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.C.4** Understand the role of random selection in sample surveys and the effect of sample size on the variability of estimates

CSTA 2-IC-23 Describe tradeoffs between allowing information to be public and keeping information private and secure. *Sharing information online can help establish, maintain, and strengthen connections between people. For example, it allows artists and designers to display their talents and reach a broad audience. However, security attacks often start with personal information that is publicly available online. Social engineering is based on tricking people into revealing sensitive information and can be thwarted by being wary of attacks, such as phishing and spoofing.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.C.7** Understand practices for handling data that enhance reproducibility and ensure ethical use, including descriptions of alterations, and an understanding of when data may contain sensitive information
- **Collect Data/ Consider Data II.C.8** Understand how concerns about privacy and human subjects may affect the collection and distribution of data

High School

CSTA 3B-AP-12 Compare and contrast fundamental data structures and their uses. *Examples could include strings, lists, arrays, stacks, and queues.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.A.4** Understand that within a data set there can be different types of variables (e.g., categorical or quantitative)
- **Collect Data/ Consider Data II.A.5** Interrogate the data set to understand the context of the variables as they may relate to statistical investigative questions

CSTA 3A-AP-14 Use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables. *Students should be able to identify common features in multiple segments of code and substitute a single segment that uses lists (arrays) to account for the differences.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.A.4** Understand that within a data set there can be different types of variables (e.g., categorical or quantitative)
- **Analyze the Data III.C.3** Summarize and describe relationships among multiple variables

CSTA 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. *At this level, students should decompose complex problems into manageable subproblems that could potentially be solved with programs or procedures that already exist. For example, students could create an app to solve a community problem by connecting to an online database through an application programming interface (API).*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Formulate Statistical Investigative Questions I.A.4** Experience different types of questions in statistics: those used to frame an investigation, those used to collect data, and those used to guide analysis and interpretation

CSTA 3A-AP-19 Systematically design and develop programs for broad audiences by incorporating feedback from users. *Examples of programs could include games, utilities, and mobile applications. Students at lower levels collect feedback and revise programs. At this level, students should do so through a systematic process that includes feedback from broad audiences. Students might create a user satisfaction survey and brainstorm distribution methods that could yield feedback from a diverse audience, documenting the process they took to incorporate selected feedback in product revisions.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Formulate Statistical Investigative Questions I.B.3** Pose summary, comparative, and association statistical investigative questions about a broader population using samples taken from the population

- **Collect Data/ Consider Data II.A.2** Understand how to collect and record information from the group of interest using surveys and measurements collected from observations and simple experiments
- **Collect Data/ Consider Data II.B.4** Recognize that data can be collected using surveys and measurements, and develop a critical attitude in analyzing data collection methods

CSTA 3B-DA-06 Select data collection tools and techniques to generate data sets that support a claim or communicate information.

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Formulate Statistical Investigative Questions I.A.2** Pose statistical investigative questions of interest to students where the context is such that students can collect or have access to all required data
- **Collect Data/ Consider Data II.A.1** Understand that data are information; recognize that to answer a statistical investigative question, a person may collect data themselves specifically for that purpose, or a person may use data that have been collected by other people for another purpose
- **Collect Data/ Consider Data II.A.2** Understand how to collect and record information from the group of interest using surveys and measurements collected from observations and simple experiments
- **Collect Data/ Consider Data II.C.1** Apply an appropriate data collection plan when collecting primary data or selecting secondary data for the statistical investigative question of interest.

CSTA 3B-DA-07 Evaluate the ability of models and simulations to test and support the refinement of hypotheses.

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Interpret Results IV.B.3** Generalize beyond the sample providing statistical evidence for the generalization and including a statement of uncertainty and plausibility when needed

CSTA 3A-DA-10 Evaluate the tradeoffs in how data elements are organized and where data is stored. *People make choices about how data elements are organized and where data is stored. These choices affect cost, speed, reliability, accessibility, privacy, and integrity. Students should evaluate whether a chosen solution is most appropriate for a particular problem. Students might consider the cost, speed, reliability, accessibility, privacy, and integrity tradeoffs between storing photo data on a mobile device versus in the cloud.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.C.8** Understand how concerns about privacy and human subjects may affect the collection and distribution of data

CSTA 3A-DA-11 Create interactive data visualizations using software tools to help others better understand real-world phenomena. *People transform, generalize, simplify, and present large data sets in different ways to influence how other people interpret and understand the underlying*

information. Examples include visualization, aggregation, rearrangement, and application of mathematical operations. People use software tools or programming to create powerful, interactive data visualizations and perform a range of mathematical operations to transform and analyze data. Students should model phenomena as systems, with rules governing the interactions within the system and evaluate these models against real-world observations. For example, flocking behaviors, queueing, or life cycles. Google Fusion Tables can provide access to data visualization online.

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Analyze the Data III.A.2** Represent the variability of categorical variables or quantitative variables using appropriate displays (e.g., tables, picture graphs, dotplots, bar graphs)
- Analyze the Data III.B.1 Represent the variability of quantitative variables using appropriate displays (e.g., dotplots, boxplots)
- **Analyze the Data III.C.2** Identify appropriate ways to summarize quantitative or categorical data using tables, graphical displays, and numerical summary statistics, which includes using standard deviation as a measure of variability and a modified boxplot for identifying outliers

CSTA 3A-DA-12 (listed as Grade 5 but this is a HS standard) Create computational models that represent the relationships among different elements of data collected from a phenomenon or process. *Computational models make predictions about processes or phenomenon based on selected data and features. The amount, quality, and diversity of data and the features chosen can affect the quality of a model and ability to understand a system. Predictions or inferences are tested to validate models. Students should model phenomena as systems, with rules governing the interactions within the system. Students should analyze and evaluate these models against real-world observations. For example, students might create a simple producer–consumer ecosystem model using a programming tool. Eventually, they could progress to creating more complex and realistic interactions between species, such as predation, competition, or symbiosis, and evaluate the model based on data gathered from nature.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.B.3** Understand that data can be used to make comparisons between different groups at one point in time and the same group over time
- **Analyze the Data III.A.4** Recognize distributions can be used to compare two groups

CSTA 3A-IC-24 Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. *Computing may improve, harm, or maintain practices. Equity deficits, such as minimal exposure to computing, access to education, and training opportunities, are related to larger, systemic problems in society. Students should be able to evaluate the accessibility of a product to a broad group of end users, such as people who lack access to broadband or who have various disabilities. Students should also begin to identify potential bias during the design process to maximize accessibility in product design.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.B.6** Understand how to interrogate the data to determine how the data were collected, from whom they were collected, what types of variables are in the data, how the variables were measured (including units used), and the possible outcomes for the variables
- **Collect Data/ Consider Data II.C.3** Understand what constitutes good practice in designing a sample survey, an experiment, and an observational study
- **Collect Data/ Consider Data II.C.6** Understand the issues of bias and confounding variables in observational studies and their implications for interpretation
- **Interpret Results IV.B.5** State the limitations of sample information (e.g., a sample may or may not be representative of the larger population, measurement variability)

CSTA 3A-IC-25 Test and refine computational artifacts to reduce bias and equity deficits. *Biases could include incorrect assumptions developers have made about their user base. Equity deficits include minimal exposure to computing, access to education, and training opportunities. Students should begin to identify potential bias during the design process to maximize accessibility in product design and become aware of professionally accepted accessibility standards to evaluate computational artifacts for accessibility.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Interpret Results IV.B.5** State the limitations of sample information (e.g., a sample may or may not be representative of the larger population, measurement variability)
- **Interpret Results IV.C.5** Acknowledge the presence of missing values and understand how missing values may add bias to an analysis
- **Collect Data/ Consider Data II.C.6** Understand the issues of bias and confounding variables in observational studies and their implications for interpretation

CSTA 3A-IC-29 Explain the privacy concerns related to the collection and generation of data through automated processes that may not be evident to users. *Data can be collected and aggregated across millions of people, even when they are not actively engaging with or physically near the data collection devices. This automated and nonevident collection can raise privacy concerns, such as social media sites mining an account even when the user is not online. Other examples include surveillance video used in a store to track customers for security or information about purchase habits or the monitoring of road traffic to change signals in real time to improve road efficiency without drivers being aware. Methods and devices for collecting data can differ by the amount of storage required, level of detail collected, and sampling rates.*

Related GAISE II concepts that can be addressed while focused on this CSTA standard:

- **Collect Data/ Consider Data II.C.7** Understand practices for handling data that enhance reproducibility and ensure ethical use, including descriptions of alterations, and an understanding of when data may contain sensitive information
- **Collect Data/ Consider Data II.C.8** Understand how concerns about privacy and human subjects may affect the collection and distribution of data