Verona Public School District
Curriculum Overview

Introduction to Data Science

Curriculum Committee Members:
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Curriculum Developed:
Summer 2020
Summer 2021

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September 8, 2020
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Verona Public Schools
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Verona Public Schools Mission Statement:

In partnership with a supportive community, we inspire our students to be creative, critical thinkers and compassionate global citizens through dynamic teaching, meaningful curricula, and enriching experiences.

Course Description:

Introduction to Data Science is a semester-long elective course designed to introduce students to the basic concepts of data analysis and formatting to make analysis more efficient and productive. Students will learn an analytic concept and apply it to small data sets provided by the teacher. After multiple, related concepts are explored, students will be given an analysis project to perform on a data set of their choosing. The first half of the course will be focused on spreadsheet analysis of small data sets or student-collected data sets while the second half of the course will be focused on using the Python programming language to analyze large data sets that are difficult to navigate in a spreadsheet program. Proper presentation practices, visualization techniques, and identification of poor/misleading data will be embedded throughout the course.

Prerequisite(s):

- Algebra 1 (to aid in equation-writing)

Standard 8: Computer Science & Design Thinking Standards	
8.1: Computer Science	**8.2: Design Thinking**
Computing Systems (CS) Networks and the Internet (NI) Impacts of Computing (IC) **x** Data & Analysis (DA) Algorithms & Programming (AP)	**x** Engineering Design (ED) Interaction of Technology and Humans (ITH) Nature of Technology (NT) Effects of Technology on the Natural World (ETA) Ethics and Culture (EC)
Computer Science and Design Thinking Practices	
x 1. Fostering an Inclusive Computing and Design Culture **x** 2. Collaborating Around Computing and Design 3. Recognizing and Defining Computational Problems 4. Developing and Using Abstractions 5. Creating Computational Artifacts 6. Testing and Refining Computational Artifacts **x** 7. Communicating About Computing and Design	

SEL Competencies and Career Readiness, Life Literacies, and Key Skills Practices

The curricular expectation for the Standard 9: Career Readiness, Life Literacies, and Key Skills standards is infusion and integration throughout the curriculum. These are not intended to be standards for separate, stand alone lessons. The CLKS are to be incorporated into other disciplines and contexts as appropriate.

Social and Emotional Learning Core Competencies: *These competencies are identified as five interrelated sets of cognitive, affective, and behavioral capabilities*	**Career Readiness, Life Literacies, and Key Skills Practices:** *Career Readiness, Life Literacies, and Key Skills Practices describe the habits of the mind that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. These practices should be taught and reinforced in all content areas with increasingly higher levels of complexity and expectation as a student advances through a program of study.*
Self-awareness: The ability to accurately recognize one's emotions and thoughts and their influence on behavior. This includes accurately assessing one's strengths and limitations and possessing a well-grounded sense of confidence and optimism.	**CLKS6** Model integrity, ethical leadership, and effective management. **CLKS7** Plan education and career paths aligned to personal goals.
Self-management: The ability to regulate one's emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.	**CLKS2** Attend to financial well-being. **X CLKS4** Demonstrate creativity and innovation. **X CLKS5** Utilize critical thinking to make sense of problems and persevere in solving them. **X CLKS8** Use technology to enhance productivity, increase collaboration, and communicate effectively.
Social awareness: The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.	**CLKS1** Act as a responsible and contributing community member and employee. **CLKS6** Model integrity, ethical leadership, and effective management.
Relationship skills: The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.	**CLKS6** Model integrity, ethical leadership, and effective management. **X CLKS9** Work productively in teams while using cultural global competence.
Responsible decision making: The ability to make constructive and respectful choices about personal behavior and social interactions based on consideration of ethical standards, safety concerns, social norms, the realistic evaluation of consequences of various actions, and the well-being of self and others.	**CLKS3** Consider the environmental, social, and economic impact of decisions. **X CLKS5** Utilize critical thinking to make sense of problems and persevere in solving them. **X CLKS6** Model integrity, ethical leadership, and effective management.

Course Materials

Core Instructional Materials: *These are the board adopted and approved materials to support the curriculum, instruction, and assessment of this course.*	**Differentiated Resources**: *These are teacher and department found materials, and also approved support materials that facilitate differentiation of curriculum, instruction, and assessment of this course.*

• Google Slides for creating presentations
• Google Sheets for spreadsheet analysis
• Google Colab for programming in Python
• Google Forms for collecting answers to questions for analysis
	• Teacher created datasets
	• Behaviorist mock-client data set
	• Live-dissecting students responses to teacher surveys
	• Trojan Asteroid data https://minorplanetcenter.net/
	• Sports data https://www.sports-reference.com/
	• Lahman's baseball database www.seanlahman.com
	• Climate Change data https://data.giss.nasa.gov/gistemp/
	• Spreadsheet reference https://www.smartsheet.com/essential-google-spreadsheet-tutorial
	• Survey references:
	  o https://zapier.com/learn/forms-surveys/writing-effective-survey/
	  o https://www.qualtrics.com/blog/good-survey-questions/
	• Python reference https://www.w3schools.com/python/
	• Pandas reference (data frames):
	  o https://www.learndatasci.com/tutorials/python-pandas-tutorial-complete-introduction-for-beginners/
	  o https://www.freecodecamp.org/news/the-ultimate-guide-to-the-pandas-library-for-data-science-in-python/
	• 5 Ways Writers Use Misleading Graphs To Manipulate You
	• Pre-cleaned data source: www.kaggle.com

Verona High School — Introduction to Data Science

Unit 1: Statistics and Distributions	Unit Duration: One Marking Period

Stage 1: Desired Results

Established Subject Area Goals (NJSLS):

Computer Science

8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
8.1.12.DA.2: Describe the trade-offs in how and where data is organized and stored.
8.1.12.DA.5: Create data visualizations from large data sets to summarize,communicate,and support different interpretations of real-world phenomena
8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.

Mathematics

HSS.IC.B.4 - Use data from a sample survey to estimate a population mean or proportion
HSS.IC.B.3 - Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
HSS.IC.B.5 - Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
HSS.IC.B.6 - Evaluate reports based on data.
HSS.ID.A.1 - Represent data with plots on the real number line (dot plots, histograms, and box plots).
HSS.ID.A.4 - Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
HSS.ID.B.6 - Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
HSS.ID.B.6.A - Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
HSS.ID.B.6.C - Fit a linear function for a scatter plot that suggests a linear association.
HSS.ID.C.7 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
HSS.ID.C.8 - Compute (using technology) and interpret the correlation coefficient of a linear fit.
HSS.ID.C.9 - Distinguish between correlation and causation.

Science and Engineering Practices

Asking Questions and Defining Problems
A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Planning and Carrying Out Investigations
Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

Analyzing and Interpreting Data
Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engaging in Argument from Evidence
In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims

Using Mathematics and Computational Thinking
In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information
Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and design.

Disciplinary Core Ideas

ETS1.B Developing Possible Solutions
Both physical models and computers can be used in various way to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

ETS1.C: Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically , and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Crosscutting Concepts

Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Cause and Effect: Mechanism and Explanation
Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Interdisciplinary Standards (NJSLS):

NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.SL4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
NJSLSA.SL5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations

Technology Integration (NJSLS 8):

See Established Subject Area Goals (above)

21st Century Skills Integration (NJSLS 9):

CLKS4 Demonstrate creativity and innovation.
CLKS5 Utilize critical thinking to make sense of problems and persevere in solving them.
CLKS6 Model integrity, ethical leadership and effective management.

Verona High School — Introduction to Data Science

CLKS8 Use technology to enhance productivity, increase collaboration and communicate effectively.
CLKS9 Work productively in teams while using cultural/global competence.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience
9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately
9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations
9.4.12.IML.9: Analyze the decisions creators make to reveal explicit and implicit messages within information and media
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Transfer Goal:

******* Please note that Unit 1 and Unit 2 are very similar in terms of goals and standards. The major difference between units 1 and 2 is the amount of student independence. Unit 1 is primarily focused on acquiring background skills and knowledge and applying those skills to teacher-curated or teacher-collected data sets while unit 2 is primarily focused on students asking their own questions and answering them through data analysis.***

Students will be able to independently use their learning to perform a spreadsheet analysis of an experiment of their own and collect, analyse, interpret, and communicate the data to their peers. Students may physically perform an experiment, design a questionnaire to investigate the topic of their choice, or use at least two separate reliable data sets from online or print sources. Data analysis will be completed using a combination of Google Sheets and Google Colab and communicated using Google Slides. If a questionnaire is used, it will be created using Google Forms.

Students will understand that:

- numbers can be misleading
- data format matters
- data visualization matters
- central tendency does not tell the whole story
- different graphs tell different stories
- correlation does not imply causation
- A → B does not mean B → A
- Choices individuals make about how and where data is organized and stored affects cost, speed, reliability, accessibility, privacy, and integrity.
- Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information.
- The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data.

Essential Questions:

- How do I know if data is reliable?
- How do I identify misleading graphics?
- Is there a “best” method of analysis?
- How do I communicate my results clearly?
- How can I design my own experiment to answer a question?

Students will know:

- common misleading graphical “tricks”
- to check for format issues in data sets
- to use multiple methods of analysis on a data set
- how to structure and deliver a presentation

Students will be able to:

- “clean” data to make analysis easier
- use pivot tables for aggregate values/central tendency
- use graphs to determine trends
- use color to accent results
- present results and analysis clearly using Google Slides presentations
- identify misleading graphics
- design an experiment
- Individuals select digital tools and design automated processes to collect, transform, generalize, simplify, and present large data sets in different ways to influence how other people interpret and understand the underlying information.

Stage 2: Acceptable Evidence

Transfer Task & Unit Assessments:

******* Please note that Unit 1 and Unit 2 are very similar in terms of goals and standards. The major difference between units 1 and 2 is the amount of student independence. Unit 1 is primarily focused on acquiring background skills and knowledge and applying those skills to teacher-curated or teacher-collected data sets while unit 2 is primarily focused on students asking their own questions and answering them through data analysis.***

- Transfer task is the final project of the unit. (Project guidelines will have two tiers: more comfortable and less comfortable. This is to accommodate students with, and students without, prior spreadsheet and/or programming experience. (comfort level must be declared at beginning of assignment)
- Group projects and presentations
- Independent reflections on project process (data acquisition, cleaning, analysis, and presentation)

- The transfer task is the final project of the unit. Student differentiation will be present in the choice of software/technology that students use to complete their project. There is no requirement for how much of Google Sheets or Google Colab to use and is up to each individual student which they work with.
- Students work in groups to collect data but each student has their own section of the data that they are individually responsible for analyzing. The students in the group do not need to agree on how to analyze their individual data. For example, Student A may use spreadsheets exclusively for their data, student B may use Python exclusively for their data, and student C may use them in combination
- Students are responsible for an individual data report. Students must explain the following:
  - Research: where/how did you collect your data and did it need to be “cleaned” for errors (typos, formatting, etc.)
  - Visualization: what graph types were chosen and why
  - Analysis: what mathematical measures were used and why
  - Results: what is your conclusion as a result of your analysis

Other Evidence:

Formal:

- Providing written/oral response to the EQs
- Critiquing the work of their peers and providing constructive criticism
- Final Projects
- Presentations

Informal:

- Observations during group work
- Class discussions

Reference Materials

Teacher created datasets
Behaviorist mock-client data set
Live-dissecting students responses to teacher surveys

Spreadsheet reference https://www.smartsheet.com/essential-google-spreadsheet-tutorial

Survey references:
https://zapier.com/learn/forms-surveys/writing-effective-survey/
https://www.qualtrics.com/blog/good-survey-questions/

5 Ways Writers Use Misleading Graphs To Manipulate You

Accommodations and Modifications

Differentiation for Students with IEPs, 504s, and/or Students at Risk of Failure (IEP/504/RF)

- Provide alternate ways for the student to respond (verbal/pictographic answers instead of written)
- Access to accurate notes
- Provide additional time to complete assessments and assignments
- Model tasks by giving one or two examples before releasing students to work independently
- Break down to manageable units
- Check for understanding consistently and frequently
- Simplify written and verbal instructions
- Simplify the language, format, and directions of the assessment
- Provide Graphic Supports (Charts, Graphic organizers, Tables, Graphs, Timelines, Number lines)
- Present instructions both verbally and visually
- Provide organizers for notes
- Allow for alternate seating for proximity to peer helper or teacher as necessary
- Provide study guides prior to unit test and/or quiz
- Frequently ask questions
- Provide oral as well as written instructions/directions
- Allow for repetition and clarification during an assignment
- Read directions out loud, as needed
- Modification of tests/quizzes
- Allow the use of calculator
- Discuss behavioral issues privately with student
- Emphasize use of visual aids
- Provide a model to clarify content
- Provide graph paper, if needed
- Provide small group instruction
- Reteach materials to student, if needed
- Write out notes for student
- Adjust number of content item to student
- Provide word banks/choices to student
- Allow for oral follow up to help explain their written response

Differentiation for English Language Learners

- Provide alternate ways for the student to respond (verbal/pictographic answers instead of written)
- Substitute a hands-on activity or use of different media in projects for a written activity
- Provide word banks / word walls
- Prepare and distribute advance notes
- Provide model sentence frames and sentence starters for both oral responses and written responses
- Provide additional time to complete assessments and assignments
- Model and use gestures to aid in understanding
- Model tasks by giving one or two examples before releasing students to work independently
- Present instructions both verbally and visually
- Simplify written and verbal instructions
- Allow students to use eDictionaries
- Avoid slang and idiomatic expressions.
- Speak clearly and naturally, and try to enunciate words, especially their ending sounds.
- Provide Sensory Supports (Real-life objects, Manipulatives, Pictures & photographs, Illustrations, Diagrams, & drawings, Magazines & newspapers, Physical activities, Videos & films, Broadcasts, Models & figures)
- Provide Graphic Supports (Charts, Graphic organizers, Tables, Graphs, Timelines, Number lines)
- Provide Interactive Supports(Pair or Partner work, Group work, Peer Mentor)
- Simplify the language, format, and directions of the assessment
- Accept correct answers on test or worksheets in any written form such as lists, phrases, or using inventive spelling
- Allow editing and revision before grading
- Design projects and assessment for student that require reduced sentence or paragraph composition
- Give alternative homework or class work assignments suitable to the student's linguistic ability for activities and assessments
- Utilize alternate reading assignments/materials at the student's reading level.
- Allow for alternate seating for proximity to peer helper or teacher as necessary
- Assist student in building a picture file of key vocabulary (Pics4Learning, Webster's Visual Dictionary Online, ClipArt Etc, Shahi Visual Dictionary)
- When showing video used Closed Captioning. Some videos also allow for a slower replay so the speech is not as fast.
- Provide wait-time sufficient for English language learners who are trying to translate terms while formulating an explanation - Sufficient wait time is often said to be about 7-10 seconds
- Check for understanding consistently - ask students one-on-one what their questions are, monitor their progress on independent work and redirect as needed. They may not understand or be hesitant to verbalize what they do not understand at first, so monitor and give examples.
- Support use of student's primary language by translating key words in directions, or key vocabulary terms or giving students opportunities to communicate in their primary language (written or orally)

Additional Resources:

- 20 strategies to Support EAL Children
- What English Language Learners Wish Teachers Knew - Education Week
- A Starting Point: Tips and resources for working with ESL newcomers

Differentiation for Enrichment (G&T):

- Provide more challenging reading materials
- Provide independent learning opportunities
- Study problems that do not have a clear solution
- Use topics of interest to the student, relevant to how the world works, complex and worthwhile
- Challenge the student to revise a model used in class to show greater accuracy
- Allow students to assume ownership of their own learning through curriculum acceleration.
- Have students work together, teach one another, and actively participate in their own and their classmates' education
- Allow students to pursue independent projects based on their own individual interests.
- Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning.
- If possible, compact curriculum to allow gifted students to move more quickly through the material.
- Encourage students to make transformations - use a common task or item in a different way.

Additional Resources:

- Serving Gifted Students in General Ed Classrooms
- Practical Recommendations and Interventions: Gifted Students

Unit 2: Databases, Acquisition, and Cleaning	Unit Duration: One Marking Period

Stage 1: Desired Results

Established Subject Area Goals (NJSLS):

Computer Science

8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
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HSS.ID.C.7 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
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Science and Engineering Practices

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Disciplinary Core Ideas

ETS1.B Developing Possible Solutions
Both physical models and computers can be used in various way to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

ETS1.C: Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically , and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Crosscutting Concepts

Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Cause and Effect: Mechanism and Explanation
Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Interdisciplinary Standards (NJSLS):

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NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.SL4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
NJSLSA.SL5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations

Technology Integration (NJSLS 8):

See Established Subject Area Goals (above)

21st Century Skills Integration (NJSLS 9):

CLKS4 Demonstrate creativity and innovation.
CLKS5 Utilize critical thinking to make sense of problems and persevere in solving them.
CLKS6 Model integrity, ethical leadership and effective management.

Verona High School — Introduction to Data Science

CLKS8 Use technology to enhance productivity, increase collaboration and communicate effectively.
CLKS9 Work productively in teams while using cultural/global competence.
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9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience
9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately
9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations
9.4.12.IML.9: Analyze the decisions creators make to reveal explicit and implicit messages within information and media
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Transfer Goal:

******* Please note that Unit 1 and Unit 2 are very similar in terms of goals and standards. The major difference between units 1 and 2 is the amount of student independence. Unit 1 is primarily focused on acquiring background skills and knowledge and applying those skills to teacher-curated or teacher-collected data sets while unit 2 is primarily focused on students asking their own questions and answering them through data analysis.***

Students will be able to independently use their learning to perform an analysis of large data sets. Students will collect large amounts of data from multiple sources and analyse, interpret, and communicate the data to their peers. Data analysis will be completed using a combination of Google Sheets and Google Colab and communicated using Google Slides.

Students will understand that:

- numbers can be misleading
- data format matters
- data visualization matters
- central tendency does not tell the whole story
- different graphs tell different stories
- correlation does not imply causation
- A → B does not mean B → A
- Choices individuals make about how and where data is organized and stored affects cost, speed, reliability, accessibility, privacy, and integrity.
- Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information.
- The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data.

Essential Questions:

- How do I know if data is reliable?
- How do I identify misleading graphics?
- Is there a “best” method of analysis?
- How do I communicate my results clearly?
- How can I design my own experiment to answer a question?

Students will know:

- common misleading graphical “tricks”
- to check for format issues in data sets
- to use multiple methods of analysis on a data set
- how to structure and deliver a presentation

Students will be able to:

- “clean” data to make analysis easier
- use pivot tables for aggregate values/central tendency
- use graphs to determine trends
- use color to accent results
- present results and analysis clearly using Google Slides presentations
- identify misleading graphics
- design an experiment
- Individuals select digital tools and design automated processes to collect, transform, generalize, simplify, and present large data sets in different ways to influence how other people interpret and understand the underlying information.

Stage 2: Acceptable Evidence

Transfer Task & Unit Assessments:

******* Please note that Unit 1 and Unit 2 are very similar in terms of goals and standards. The major difference between units 1 and 2 is the amount of student independence. Unit 1 is primarily focused on acquiring background skills and knowledge and applying those skills to teacher-curated or teacher-collected data sets while unit 2 is primarily focused on students asking their own questions and answering them through data analysis.***

- Transfer task is the final project of the unit. (Project guidelines will have two tiers: more comfortable and less comfortable. This is to accommodate students with, and students without, prior spreadsheet and/or programming experience. (comfort level must be declared at beginning of assignment)
- Group projects and presentations
- Independent reflections on project process (data acquisition, cleaning, analysis, and presentation)

- The transfer task is the final project of the unit. Student differentiation will be present in the choice of software/technology that students use to complete their project. There is no requirement for how much of Google Sheets or Google Colab to use and is up to each individual student which they work with.
- Students work in groups to collect data but each student has their own section of the data that they are individually responsible for analyzing. The students in the group do not need to agree on how to analyze their individual data. For example, Student A may use spreadsheets exclusively for their data, student B may use Python exclusively for their data, and student C may use them in combination
- Students are responsible for an individual data report. Students must explain the following:
  - Research: where/how did you collect your data and did it need to be “cleaned” for errors (typos, formatting, etc.)
  - Visualization: what graph types were chosen and why
  - Analysis: what mathematical measures were used and why
  - Results: what is your conclusion as a result of your analysis

Other Evidence:

Formal:

- Providing written/oral response to the EQs
- Critiquing the work of their peers and providing constructive criticism
- Final Projects
- Presentations

Informal

- Observations during group work
- Class discussions

Reference Materials

Trojan Asteroid data (to lock up Google Sheets and give a reason for using Python) https://minorplanetcenter.net/
Sports data https://www.sports-reference.com/
Lahman’s baseball database www.seanlahman.com
Climate Change data https://data.giss.nasa.gov/gistemp/

Python reference https://www.w3schools.com/python/

Pandas reference (data frames):
https://www.learndatasci.com/tutorials/python-pandas-tutorial-complete-introduction-for-beginners/
https://www.freecodecamp.org/news/the-ultimate-guide-to-the-pandas-library-for-data-science-in-python/

Accommodations and Modifications

Differentiation for Students with IEPs, 504s, and/or Students at Risk of Failure (IEP/504/RF)

- Provide alternate ways for the student to respond (verbal/pictographic answers instead of written)
- Access to accurate notes
- Provide additional time to complete assessments and assignments
- Model tasks by giving one or two examples before releasing students to work independently
- Break down to manageable units
- Check for understanding consistently and frequently
- Simplify written and verbal instructions
- Simplify the language, format, and directions of the assessment
- Provide Graphic Supports (Charts, Graphic organizers, Tables, Graphs, Timelines, Number lines)
- Present instructions both verbally and visually
- Provide organizers for notes
- Allow for alternate seating for proximity to peer helper or teacher as necessary
- Provide study guides prior to unit test and/or quiz
- Frequently ask questions
- Provide oral as well as written instructions/directions
- Allow for repetition and clarification during an assignment
- Read directions out loud, as needed
- Modification of tests/quizzes
- Allow the use of calculator
- Discuss behavioral issues privately with student
- Emphasize use of visual aids
- Provide a model to clarify content
- Provide graph paper, if needed
- Provide small group instruction
- Reteach materials to student, if needed
- Write out notes for student
- Adjust number of content item to student
- Provide word banks/choices to student
- Allow for oral follow up to help explain their written response

Differentiation for English Language Learners

- Provide alternate ways for the student to respond (verbal/pictographic answers instead of written)
- Substitute a hands-on activity or use of different media in projects for a written activity
- Provide word banks / word walls
- Prepare and distribute advance notes
- Provide model sentence frames and sentence starters for both oral responses and written responses
- Provide additional time to complete assessments and assignments
- Model and use gestures to aid in understanding
- Model tasks by giving one or two examples before releasing students to work independently
- Present instructions both verbally and visually
- Simplify written and verbal instructions
- Allow students to use eDictionaries
- Avoid slang and idiomatic expressions.
- Speak clearly and naturally, and try to enunciate words, especially their ending sounds.
- Provide Sensory Supports (Real-life objects, Manipulatives, Pictures & photographs, Illustrations, Diagrams, & drawings, Magazines & newspapers, Physical activities, Videos & films, Broadcasts, Models & figures)
- Provide Graphic Supports (Charts, Graphic organizers, Tables, Graphs, Timelines, Number lines)
- Provide Interactive Supports(Pair or Partner work, Group work, Peer Mentor)
- Simplify the language, format, and directions of the assessment
- Accept correct answers on test or worksheets in any written form such as lists, phrases, or using inventive spelling
- Allow editing and revision before grading
- Design projects and assessment for student that require reduced sentence or paragraph composition
- Give alternative homework or class work assignments suitable to the student's linguistic ability for activities and assessments
- Utilize alternate reading assignments/materials at the student's reading level.
- Allow for alternate seating for proximity to peer helper or teacher as necessary
- Assist student in building a picture file of key vocabulary (Pics4Learning, Webster's Visual Dictionary Online, ClipArt Etc, Shahi Visual Dictionary)
- When showing video used Closed Captioning. Some videos also allow for a slower replay so the speech is not as fast.
- Provide wait-time sufficient for English language learners who are trying to translate terms while formulating an explanation - Sufficient wait time is often said to be about 7-10 seconds
- Check for understanding consistently - ask students one-on-one what their questions are, monitor their progress on independent work and redirect as needed. They may not understand or be hesitant to verbalize what they do not understand at first, so monitor and give examples.
- Support use of student's primary language by translating key words in directions, or key vocabulary terms or giving students opportunities to communicate in their primary language (written or orally)

Additional Resources:

- 20 strategies to Support EAL Children
- What English Language Learners Wish Teachers Knew - Education Week
- A Starting Point: Tips and resources for working with ESL newcomers

Differentiation for Enrichment (G&T):

- Provide more challenging reading materials
- Provide independent learning opportunities
- Study problems that do not have a clear solution
- Use topics of interest to the student, relevant to how the world works, complex and worthwhile
- Challenge the student to revise a model used in class to show greater accuracy
- Allow students to assume ownership of their own learning through curriculum acceleration.
- Have students work together, teach one another, and actively participate in their own and their classmates' education
- Allow students to pursue independent projects based on their own individual interests.
- Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning.
- If possible, compact curriculum to allow gifted students to move more quickly through the material.
- Encourage students to make transformations - use a common task or item in a different way.

Additional Resources:

- Serving Gifted Students in General Ed Classrooms
- Practical Recommendations and Interventions: Gifted Students