West Windsor-Plainsboro Regional School District
Introduction to Data Science
Spring 2023

Math Equity Statement
ALL learners should have access to rigorous, high-level mathematical content in an environment where risk-taking, deep conceptual understanding, and growth mindset are the norm.

Core Beliefs:
Our district's strategic goals prioritize teaching and learning from a productive standpoint. Building upon the principles of *Catalyzing Change in High School Mathematics*, we aim to cultivate equitable mathematics practices and shift from deficit-based to productive beliefs. According to the National Council of Teachers of Mathematics (NCTM, 2020), "Mathematics education must be equitable, ensuring that each and every student has access to high-quality mathematics teaching and learning opportunities." Our objective is for every student to perceive themselves as capable, knowledgeable, and meaning-makers in mathematics.

Drawing from *Catalyzing Change* and *Mathematical Mindsets* by Jo Boaler (2016), we embrace the following beliefs:

- All students are capable of learning mathematics at high levels.
- All students will progress on their mathematical journey.
- Developing a growth mindset is essential for learning.
- Visual and deep thinking enhance mathematical understanding.
- Mathematics learning is fostered through discourse and collaboration.
- Mistakes are integral to the learning process.

Math Workshop:
Catalyzing Change states that teaching should provide opportunities for each and every student to develop a positive mathematical identity, recognizing their own mathematical abilities and potential. The Math Workshop instructional model enables meaningful mathematics engagement, reflection, and the realization of students' potential as mathematicians. By incorporating student choice, problem-solving, targeted small group instruction, and deliberate practice of critical grade-level concepts (Lempp, 2017), Math Workshop creates an environment where students feel comfortable taking intellectual risks. Sienna (2009) outlines four values to support students in taking risks and fostering discourse, which include:

- Valuing the thinking process alongside correct answers.
- Valuing problems that allow for multiple solutions.
- Valuing inquisitive responses.
- Valuing tolerance for mistakes (Sienna, 2009, p. 68).

Math Workshop embraces these values and fosters a supportive, collaborative learning environment for all students. It is the instructional model employed by our dedicated teachers.

Unit 1: Data Tells a Story	
Content Area: Mathematics	
Course & Grade Level: Data Science, grades 9-12	
Summary and Rationale	
In this unit students will be introduced to data science through a reflection of their own experiences using self-generated data, an exploration of a larger dataset of people's media use, and/or an analysis of business data. Through these activities students will learn about the data science process, begin using data to tell stories, and think about the ethics involved in working with data. As students learn about data, they will be introduced to many different ways to represent data and will explore univariate, bivariate, and multivariate data. From the data visualizations they will consider what story they can tell from their data.	
Recommended Pacing	
5 days	
New Jersey Student Learning Standards for Mathematics	
Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with Mathematics.
5	Use appropriate tools strategically.
6	Attend to precision
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning

Standard: S-ID.A Summarize, represent, and interpret data on a single count or measurement variable	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
Standard: S-ID.B Summarize, represent, and interpret data on two categorical and quantitative variables	
CPI #	**Cumulative Progress Indicator (CPI)**
5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
Standard: S-IC.b Make inferences and justify conclusions from sample surveys, experiments, and observational studies	
CPI #	**Cumulative Progress Indicator (CPI)**
6	Evaluate reports based on data.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a).
9.4.5.CT.3	Describe how digital tools and technology may be used to solve problems.
9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).
New Jersey Student Learning Standards for Computer Science and Design Thinking	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
Interdisciplinary Standards Science	
MS-PS3-1	Construct and interpret graphical displays of data to identify linear and nonlinear relationships.
Instructional Focus	
Unit Enduring Understandings	
● Data tells a story ● Data can be interpreted differently.	
Unit Essential Questions	
● How is data generated? ● What are variability, data, and models? ● What is the story I can tell from this data? ● What is ethical when it comes to analyzing data?	

Objectives

We are learning to/that:

- Interpret results in the context of a situation to identify important quantities in a practical situation and map their relationships.
- Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.
- Identify, analyze, and synthesize relevant external resources to pose or solve problems arising in everyday life, society, and the workplace.
- Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem.

Evidence of Learning

- ☑ **Formative Assessment:**
- ☑ **Summative Assessment:**
- ☑ **Alternative Assessment**
- ☑ **Benchmark**

Assessment plan includes teacher-designed formative and summative assessments, a district common assessment, self-assessments, and performance tasks. During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.

Resources

Core Text: youcubed®
Teacher made resources

Unit 2: Quantitative Bivariate Data

Content Area: Mathematics

Course & Grade Level: Data Science, grades 9-12

Summary and Rationale

In this unit, students will learn about bivariate data through discussions and data explorations around the theme of water usage. Students will explore scatter plots as a visual way to represent the relationship between two variables, draw their own lines of best fit, and learn how data scientists determine and analyze lines of best fit . Throughout the unit, students will use Desmos and analytic thinking to make and refine claims based on both self-collected data and large, publicly available data sets.

Recommended Pacing

5 days

New Jersey Student Learning Standards for

Standards for Mathematical Practice

CPI #	Cumulative Progress Indicator (CPI)
1	Make sense of problems and persevere in solving them
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with Mathematics.
5	Use appropriate tools strategically.
6	Attend to precision
7	Look for and make use of structure.

8	Look for and express regularity in repeated reasoning
Standard: S-ID.B Summarize, represent, and interpret data on two categorical and quantitative variables	
CPI #	**Cumulative Progress Indicator (CPI)**
5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
6	1. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data (including with the use of technology); 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 and exponential models. b. Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology. c. Fit a linear function for a scatter plot that suggests a linear association.
Standard: S-ID.C Interpret linear models	
CPI #	**Cumulative Progress Indicator (CPI)**
7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8	Compute (using technology) and interpret the correlation coefficient of a linear fit.
9	Distinguish between correlation and causation.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a).
9.4.5.CT.3	Describe how digital tools and technology may be used to solve problems.
9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).
New Jersey Student Learning Standards for Computer Science and Design Thinking	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
Instructional Focus	
Unit Enduring Understandings	
● Linear regression and bivariate data ● Make connections between the trend and the context to make predictions ● Spurious correlations, confounding and mediating variables and data ethics ● Evaluating claims: spurious correlation vs causality	
Unit Essential Questions	
● What is data and what is it good for?	

- What can you do with data?

Objectives

We are learning to/that:

- Explore the features of a scatter plot and understand the meaning of bivariate data and the line of best fit.
- Analyze a scatter plot and approximate a line of best fit using Desmos.
- Compare R^2 values and make a connection between R^2 and correlation.
- Use R^2 and the least squares regression line to make statements about data.
- Compare and contrast different statements about data.
- Identify spurious correlations and distinguish between confounding and mediating variables.
- Gather observations and evidence about data visuals to write claims and tell stories.
- Investigate correlation, causation, and third variables.

Evidence of Learning

- ☑ **Formative Assessment**
- ☐ **Summative Assessment**
- ☑ **Alternative Assessment**
- ☑ **Benchmark**

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Unit 3: Skin Tones and Representation

Content Area: Mathematics

Course & Grade Level: Data Science, grades 9-12

Summary and Rationale

In this unit, students explore the issues around skin tone representation in the media through a data-based exploration of skin tone representation in magazines. Students conduct both a categorical and a numerical analysis and compare the benefits and drawbacks of both. In their categorical analysis students create two-way tables based on their interpretation of the skin tones of the people pictured, and in the numerical analysis they use the RGB values of the images themselves.

Recommended Pacing

5 days

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7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning
Standard: S-ID.B Summarize, represent, and interpret data on two categorical and quantitative variables	
CPI #	**Cumulative Progress Indicator (CPI)**
5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data (including with the use of technology); 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 and exponential models. b. Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology. c. Fit a linear function for a scatter plot that suggests a linear association.
Standard: S-IC.B Make inferences and justify conclusions from sample surveys, experiments, and observational studies	
CPI #	**Cumulative Progress Indicator (CPI)**
6	Evaluate reports based on data.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics
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8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
Interdisciplinary Standards Science	

MS-PS3-1	Construct and interpret graphical displays of data to identify linear and nonlinear relationships.

Instructional Focus

Unit Enduring Understandings

- Data scientists gather, classify, and interpret information and visual data in order to recognize how organisms, places, and events shape our world.

Unit Essential Questions

- Why and how do data scientists gather, classify, and interpret information and visual data?
- How can we use technology to gather, classify, and interpret information and visual data?

Objectives

We are learning to/that:

- Students will be introduced to categorical data and watch and discuss a TEDx Talk on colorism as an introduction to the unit.
- Students will explore colorism in technology and around the world.
- Students will explore possible magazines that they can use to analyze skin tone representation in ads and articles.
- Students will consider and discuss the class decisions they need to make about their data collection.
- Students will collect data from their magazine in groups by taking screenshots and organizing them in folders.
- Students will discuss and decide what categories to use to sort their skin tone data in order to compile data across magazines.
- Students will categorize their data into two-way tables to determine the percentage of each of their skin tone categories.
- Students will look at the analysis across different magazines and discuss what was learned about skin tone representation.
- Students will be introduced to RGB by exploring images, a color app, and a visualization graph in GeoGebra 3D Calculator.
- Students will collect numerical data (RGB) values for each person in the images they collected using a color app, generate 3D scatter plots of their data in GeoGebra 3D Calculator and analyze the results by making summary statements.
- Students will discuss what their analyses reveal about skin tone representation in the advertisements and articles of magazines.
- Students will consider categorical and numerical approaches to collecting data, compare the two, and discuss bias in datasets.

Evidence of Learning

- ☑ **Formative Assessment**
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