Transition to College Mathematics Scope and Sequence, 2021-22
Launch Years Transition to College Mathematics Student Learning Outcomes

The goal of the Transition to College Mathematics course is to develop quantitative, statistical, and algebraic reasoning abilities, thus preparing students for college success in multiple mathematics pathways. The course addresses a variety of mathematical topics needed to prepare students for success in college-level mathematics. In this course students will connect and use multiple strands of mathematics in situations and problems as well as in the study of other disciplines. In addition, the course supports students in developing skills and strategies needed to succeed in college. Mathematics topics include: numeracy with an emphasis on estimation and fluency with large numbers; manipulating and evaluating expressions and formulas, to include area, perimeter, surface area, and volume, as well as spreadsheet formulas; rates, ratios, and proportions; percentages; probability; geometric concepts, including the Pythagorean Theorem, trigonometric ratios, measurement, and coordinate geometry; finance, including simple and compound interest, sales tax, and discounts or markups; linear equations and inequalities; systems of equations, including linear and quadratic equations; absolute value, exponential, logarithmic, quadratic, rational, and square root models, including equations; data interpretations including graphs and tables; and verbal, algebraic, and graphical interpretations of functions. This course is intended for students who have completed three years of math but are not yet college ready.

Classroom instruction for this course should engage students in meaningful interactions that amplify the learning through social interaction; facilitate transfer of math and SEAD (Social Emotional and Academic Development) skills; and create an inclusive learning context for all learners, particularly for students who feel disconnected from mathematics and disaffected by the learning process.

The following design principles describe how classroom instruction for the transition course should be structured to support a coherent and engaging experience. Educators should use the design principles when building a repertoire of pedagogical strategies for use in teaching the course.

Active Learning. The course provides regular opportunities for students to actively engage in discussions and tasks using a variety of different instructional strategies (e.g., hands-on and technology-based activities, small group collaborative work, facilitated student discourse, interactive lectures).

Constructive Perseverance. The course supports students in developing the tenacity, persistence, and perseverance necessary for learning mathematics and statistics, for using mathematics and statistics to tackle authentic problems, and for being successful in post-high school endeavors.

Problem Solving. The course provides opportunities for students to make sense of problems and persist in solving them.

Authenticity. The course presents mathematics and statistics as necessary tools to model and solve problems that arise in the real world.

Context and Interdisciplinary Connections. The course presents mathematics and statistics in context and connects mathematics and statistics to various disciplines and everyday experiences.

Communication. The course develops students' ability to communicate about and with mathematics and statistics in contextual situations.

Technology. The course leverages technology to develop conceptual understanding and to facilitate active learning by enabling students to directly engage with and use mathematical concepts.

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Lessons	Parts	Launch Years Recommended Framework for Transition to College Mathematics Student Learning Outcomes • Outcomes in black are the primary instructional focus of the topic. • Outcomes in gray support content or indicate foundations for future work.
Unit 1: In this unit, students solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. They demonstrate an understanding of rational numbers (including large and small numbers) by interpreting, communicating with, and comparing different forms. They use quantitative information to explore the impact of policies or behaviors on a population, and identify erroneous, misleading, or conflicting information in advertising or consumer information or regarding social, economic, and environmental issues. **(4 weeks)**		
1: Building the foundation for our success	Building the foundation for our success -- *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.1** Recognize situations for which collaboration is an effective strategy, identify features of effective and productive collaborative work groups, and develop strategies for overcoming group work challenges. **SEAD.3** Engage in productive academic behaviors, including help-seeking, self-regulation, and utilizing feedback. **SEAD.3.b** Monitor and adjust attitudes, emotions, and thoughts when facing challenging tasks or academic setbacks. **SEAD.3.c** Actively seek and listen to feedback and act on feedback to improve performance.
2: Getting started	A. How big is a billion -- *Quantitative reasoning, large numbers* B. Building a learning community -- *Student success focus* C. How big is a billion (cont.) -- *Quantitative reasoning, large numbers, ratio reasoning*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.1** Recognize situations for which collaboration is an effective strategy, identify features of effective and productive collaborative work groups, and develop strategies for overcoming group work challenges. **Numeric reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will:

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	D. Building a learning community (cont.) -- *Student success focus*	**NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.f** Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately. *For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.* **NR.2.b** Identify, use, and record appropriate units of measure within data displays, on graphs, and when solving contextual geometric problems. Use units as a way to understand formulas and problems and to guide the solution of multi-step problems. *For example: Identify the appropriate units for perimeter, area, and volume, such as when calculating the amount of paint needed to paint a non-rectangular surface. Choose and interpret units consistently in formulas, such as when calculating interest or when determining a time given a constant velocity and distance. Choose and interpret the scale and the origin in graphs and data displays. Solve measurement problems that require using the Pythagorean Theorem, attending to appropriate use of units.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.a** Use rate reasoning to convert between units of measurement in authentic situations.

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		For example: Use double number lines to convert between currencies. Use ratio tables to solve problems involving dosages of medicine. Relate rate reasoning to dimensional analysis, and know why and how the process works and when to use it.
3: Working In groups and creating success teams	A. Working in groups – *Student success focus* B. Creating success teams– *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.1** Recognize situations for which collaboration is an effective strategy, identify features of effective and productive collaborative work groups, and develop strategies for overcoming group work challenges. **SEAD.3** Engage in productive academic behaviors, including help-seeking, self-regulation, and utilizing feedback. **SEAD.3.a** Recognize when help is needed with a task, identify sources of help, and develop and apply a variety of strategies for seeking help.
4: Ratios and numbers	A. Doubling population -- *Large numbers, doubling, rates*, *Introduction to note taking* B. Scientific notation -- *Representing numbers in scientific notation, converting back to standard notation* C. Ratios in water use -- *Large numbers, ratios, scientific notation* D. Analyzing water footprints -- *Scientific notation, ratios*	**Numeric reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.f** Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately. *For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.*

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		NR.2.c Find and use quantitative information to explore the impact of policies or behaviors, including those with social, economic, or environmental implications, on a population. *For example: Assess the effects of a small decrease in individual water use on the amount needed by a large population over time. Determine if the minimum wage has kept pace with inflation over time.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units.
5: Using numbers	A. Large numbers in the media -- *Misinformation, strategies for testing information* B. Seeking help -- *Student success focus*: *Campus resources, seeking and offering help* C. Estimating sales prices -- *Estimation, benchmark percentages* D. Calculating sales prices -- *Calculating, using estimation to check reasonableness* E. Developing self-regulation -- *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.1** Recognize situations for which collaboration is an effective strategy, identify features of effective and productive collaborative work groups, and develop strategies for overcoming group work challenges. **SEAD.3** Engage in productive academic behaviors, including help-seeking, self-regulation, and utilizing feedback. **SEAD.3.a** Recognize when help is needed with a task, identify sources of help, and develop and apply a variety of strategies for seeking help. **SEAD.3.c** Actively seek and listen to feedback and act on feedback to improve performance. **Numeric reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations.

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		NR.1.b Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.* **NR.1.f** Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately. *For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units.

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6: Charts and spreadsheets	A. Budgeting operations -- *Use of order of operations, properties, pie charts* B. Budgeting with spreadsheets -- *Algebraic reasoning through the use of spreadsheet formulas* C. Graph analysis -- *Introduction to visual displays, misleading scale, relative change over time* D. Using graphs to understand change -- *Relative size*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.d** Represent rational numbers in equivalent forms using fractions, decimals, and percentages. Compare the size of numbers in different forms and interpret the meaning of numbers in different forms. *For example: Interpret the meaning of percentages greater than 100% and justify whether such a percentage is possible in a given context. Solve authentic problems involving numbers in different forms, such as comparing growth of a population expressed as a fraction versus as a percentage.* **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of*

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		rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd. **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units. **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.*

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Unit 2: This unit addresses data analysis, proportional reasoning, complex use of percentages, and probabilistic reasoning. Students read, interpret and make decisions about data summarized numerically and in graphical displays such as line graphs, bar graphs, scatterplots, histogram, and Venn diagrams. They learn to interpret statements about chance, risk, and probability that appear in everyday media. **(6 weeks)**		
7: The plastic brain and smart thinking	A. The plastic brain – *Student success focus* B. Smart thinking -- *Student success focus* C. The Value of Journaling (optional) – *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.2** Learn that intelligence is malleable and understand how purposeful engagement, persistence, and intelligence are related. **SEAD.4** Maintain motivation and persistence through a variety of strategies, including identifying and adjusting habits and beliefs that have interfered with success; applying metacognitive awareness to plan, monitor, evaluate, and reflect on learning; and setting and monitoring goals.
8: Displaying data	A. Displaying table data -- *Stem-and-leaf plots, back-to-back comparison* B. Relative frequency tables -- *Construct and analyze frequency, relative frequency, cumulative frequency* C. Displaying data: Histograms -- *Convert frequency table from histograms* D. Shapes of distributions -- *Dot plots used to introduce symmetry and skewness*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining*

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		how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid. **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.1** Summarize, represent, and interpret univariate and categorical data, with and without technology, to describe and compare distributions. **SR.1.a** Create appropriate graphical representations for univariate data, including dot plots, histograms, ~~box plots,~~ and stem-and-leaf plots. Analyze the shape of the graph ~~to determine which measure of center (mean, median, mode) and variability (interquartile range, mean absolute deviation, standard deviation) is the best choice for describing center and variability.~~
9: Statistical summaries	A. Measures of central tendency -- *Mean, median, mode, conclusions from statistical summaries, create data sets to meet criterion* B. Variability relative to the mean -- *Variance, mean absolute deviation, standard deviation* C. Making decisions with data -- *Use statistical*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.2** Learn that intelligence is malleable and understand how purposeful engagement, persistence, and intelligence are related. **Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations.

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	summaries to make decisions D. Brain power -- *Student success focus: How the brain learns* E. Boxplots -- *Analyze a data set via five-number summary*	**Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.1** Summarize, represent, and interpret univariate and categorical data, with and without technology, to describe and compare distributions. **SR.1.a** Create appropriate graphical representations for univariate data, including dot plots, histograms, box plots, and stem-and-leaf plots. Analyze the shape of the graph to determine which measure of center (mean, median, mode) and variability (interquartile range, mean absolute deviation, standard deviation) is the best choice for describing center and variability. **SR.1.b** Create and interpret appropriate numerical summaries for center (mean, median, mode) and variability (interquartile range, mean absolute deviation, standard deviation) for univariate data, accounting for possible effects of extreme data points (outliers). **SR.1.c** Use measures of center and variability appropriate to the shape of the data distribution to compare two or more different data sets to infer possible differences in the populations from which the data were drawn.
10: Credit and tax	A. The credit crunch -- *Reading strategies to understand financial information* B. More credit crunch -- *Estimate and calculate credit card interest* C. A taxing situation -- *Understand and complete tax forms* D. A taxing situation (cont.) -- *Convert the tax instructions into mathematical expressions*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.* **NR.1.f** Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately.

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		For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%. **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.*
11: Creating motivation goals	A. Value of Goals -- *Student success focus* B. Nine Boxes – *Student success focus* C. Ensuring that your goals motivate – *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.3** Engage in productive academic behaviors, including help-seeking, self-regulation, and utilizing feedback. **SEAD.3b** Monitor and adjust attitudes, emotions, and thoughts when facing challenging tasks or academic setbacks. **SEAD.4** Maintain motivation and persistence through a variety of strategies, including identifying and adjusting habits and beliefs that have interfered with success; applying metacognitive awareness to plan, monitor, evaluate, and reflect on learning; and setting and monitoring goals.
12: Determining probabilities	A. Using Venn diagrams B. Using tree diagrams C. Using area models D. All-American breakfast choices -- *Conditional probability*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1a** Recognize subsets of real numbers and the notation used to describe the subsets, ~~including the roster method, set builder notation, and interval notation,~~ used in contextual settings. Use a Venn diagram to describe the relationship between subsets of real numbers. Know when different sets of numbers are appropriate to use. *For example: Recognize why the natural numbers are useful for describing terms in a sequence to model the concentration of a drug present in the blood stream at set time intervals after the initial dose. Choose and use*

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		set notation and symbols as appropriate for subsets of numbers, such as domains and ranges of functions, and sample spaces and events for chance experiments. **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.* **Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.3** Analyze statements of chance, risk, and probability that appear in everyday media (including terms such as "unlikely," "rare," or "impossible"). Determine and interpret probabilities of events. *For example: Interpret statements such as "For a certain population, the lifetime risk of a particular disease is 0.005." Compare incidences of side effects in unequal group sizes. Identify inappropriate risk statements, such as when the size of reference groups is unknown (e.g., in California in 2009, 88% of motorcycle accident fatalities were helmeted, 12% were unhelmeted).* **SR.3.a** Make lists, tables, Venn diagrams, and tree diagrams to represent all possible outcomes in a sample space of a chance experiment to compute the probability of an event and its complement; interpret their meanings in context. Conduct an experiment or simulation to compute the empirical probability of an event and its complement to draw conclusions or make decisions. **SR.3.c** Explain the meaning of conditional probability. Compute conditional and joint probabilities from a given table of data. *For example: From a two-way frequency table summarizing test outcomes for 500 people, some of whom have cancer and some who do not, determine the probability of having cancer given a positive test result and the probability of having a positive test result given cancer. Choose the probability that is the most informative for a given purpose.*
13: More with probability (Optional)	A. Probability in games B. Driving and risk	**Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations

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		based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.3** Analyze statements of chance, risk, and probability that appear in everyday media (including terms such as "unlikely," "rare," or "impossible"). Determine and interpret probabilities of events. *For example: Interpret statements such as "For a certain population, the lifetime risk of a particular disease is 0.005." Compare incidences of side effects in unequal group sizes. Identify inappropriate risk statements, such as when the size of reference groups is unknown (e.g., in California in 2009, 88% of motorcycle accident fatalities were helmeted, 12% were unhelmeted).* **SR.3.a** Make lists, tables, Venn diagrams, and tree diagrams to represent all possible outcomes in a sample space of a chance experiment to compute the probability of an event and its complement; interpret their meanings in context. Conduct an experiment or simulation to compute the empirical probability of an event and its complement to draw conclusions or make decisions. **SR.3.c** Explain the meaning of conditional probability. Compute conditional and joint probabilities from a given table of data. *For example: From a two-way frequency table summarizing test outcomes for 500 people, some of whom have cancer and some who do not, determine the probability of having cancer given a positive test result and the probability of having a positive test result given cancer. Choose the probability that is the most informative for a given purpose.*
14: Risk	A. What's the risk? -- *Absolute and relative measures of risk, comparing fraction and decimal forms* B. An apple a day -- *Evaluate measures of risk* C. Reducing the risk -- *Percentages, risk reduction* D. Is reducing the risk worth it? -- *Evaluation risk reduction vs. side effects*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance,*

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		such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid. **NR.1.f** Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately. *For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.b** Use rate reasoning to solve problems involving unit rates, such as those related to pricing and speed. **PR.1.c** Use ratio and rate reasoning to explore policies or behaviors, including those with social, economic, or environmental implications, in a population. *For example: Use individual water-use rates to predict the water used by a population. Use the Consumer Price Index to compare prices over time. Interpret a percentage as a number out of 1,000 (as is common in medical research). Compare risks expressed in ratios with unequal denominators (e.g., 1 in 8 people will have side effects versus 3 in 14). If one YouTube video has approximately 5 dislikes for every 300 likes, and the like-to-dislike ratio for a second video is 400 to 7, determine which video is better liked by generating various representations.* **Statistical and Probabilistic Reasoning**

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		Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.3** Analyze statements of chance, risk, and probability that appear in everyday media (including terms such as "unlikely," "rare," or "impossible"). Determine and interpret probabilities of events. *For example: Interpret statements such as "For a certain population, the lifetime risk of a particular disease is 0.005." Compare incidences of side effects in unequal group sizes. Identify inappropriate risk statements, such as when the size of reference groups is unknown (e.g., in California in 2009, 88% of motorcycle accident fatalities were helmeted, 12% were unhelmeted).*
15: Analyzing data	A. Comparing categorical data -- *Two-way tables, importance of base value* B. Interpreting percentages -- *Analysis of abstract information* C. Do you trust the test? -- *Two-way tables, accuracy in test results, independence* D. Do you trust the test? (cont.) -- *Two-way tables, false-positive and false-negative test results*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals).

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		PR.2 Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units. **Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.1** Summarize, represent, and interpret univariate and categorical data, with and without technology, to describe and compare distributions. **SR.1.d** Summarize categorical data in a two-way frequency table and recognize possible associations and trends in the data. Choose the appropriate direction of conditioning for a given context and calculate the applicable marginal, joint, and conditional relative frequencies. (Note: It is not expected that students name or define these specific terms, but rather that they can determine the indicated types of frequencies as appropriate based on context.) *For example: From a two-way frequency table summarizing test outcomes for 500 people, some of whom have cancer and some who do not, determine the number of people with cancer given a positive test result and the number of people with a positive test result given that they have cancer. Choose the relative frequency that is the most informative for a given purpose.* **SR.3** Analyze statements of chance, risk, and probability that appear in everyday media (including terms such as "unlikely," "rare," or "impossible"). Determine and interpret probabilities of events. *For example: Interpret statements such as "For a certain population, the lifetime risk of a particular disease is 0.005." Compare incidences of side effects in unequal group sizes. Identify inappropriate risk statements, such as when the size of reference groups is unknown (e.g., in California in 2009, 88% of motorcycle accident fatalities were helmeted, 12% were unhelmeted).* **SR.3.b** Determine whether events are independent or dependent (including through the use of the multiplication rule) and use this information appropriately to determine probabilities. **SR.3.c** Explain the meaning of conditional probability. Compute conditional and joint probabilities from a given table of data. *For example: From a two-way frequency table summarizing test outcomes for 500 people, some of whom have cancer and some who do not, determine the probability of having cancer given a positive test result and the probability of having a positive test result given cancer. Choose the probability that is the most informative for a given purpose.*

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16: Statistical studies	A. Statistical studies -- *Observational studies vs. experiments* B. Conclusions from data -- *Generalizing conclusions*	**Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.4** Recognize the purposes of different types of statistical studies and how randomization relates to each. Use statistics to make informed, evidence-based inferences and justify conclusions from each type of study. *For example: Given a scenario, determine if it is a survey, experiment, or observational study and what method of randomization (if any) was used. Given a question, determine which data collection method would be the most appropriate way to collect data to answer the question.* **SR.5** Evaluate reports based on data for appropriateness of the study design, analysis methods, and statistical measures used.
Unit 3: This unit addresses data analysis, geometric reasoning, the concept of a variable and solving equations. Students analyze and solve real-world problems involving proportional relationships, including indirect measurement, with attention to appropriate use of units. **(4 weeks)**		
17: Metacognition	Metacognition -- *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.3** Engage in productive academic behaviors, including help-seeking, self-regulation, and utilizing feedback. **SEAD.3.a** Recognize when help is needed with a task, identify sources of help, and develop and apply a variety of strategies for seeking help. **SEAD.4** Maintain motivation and persistence through a variety of strategies, including identifying and adjusting habits and beliefs that have interfered with success; applying metacognitive awareness to plan, monitor, evaluate, and reflect on learning; and setting and monitoring goals.
18: Identifying important information as you read	A. Using the SQ4R model to engage with course texts – *Student success focus* B. What information is important in math? – *Student success focus*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will:

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		SEAD.4 Maintain motivation and persistence through a variety of strategies, including identifying and adjusting habits and beliefs that have interfered with success; applying metacognitive awareness to plan, monitor, evaluate, and reflect on learning; and setting and monitoring goals.
19: Proportions	A. Population density -- *Ratios, proportional reasoning* B. Density proportions -- *Scaling, dimensional analysis* C. State population densities (Optional) -- *Estimation strategies, optional spreadsheet use* D. Apportionment -- *Effect of relative change on representation*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.c** Engage in problem solving that uses appropriate notation for radicals in terms of rational exponents. Reason quantitatively to emphasize number sense and reasonableness when estimating the value of a radical and when distinguishing between exact and approximate values. *For example: Approximate the value of an irrational number like $\sqrt{52}$ or $\sqrt[3]{10}$ using perfect squares or perfect cubes, and locate the rational number approximation of the radical on a number line. Know that the exact value of a distance found by the distance formula may be left in radical form, but an approximation of distance may be more useful in context.* **NR.1.d** Represent rational numbers in equivalent forms using fractions, decimals, and percentages. Compare the size of numbers in different forms and interpret the meaning of numbers in different forms. *For example: Interpret the meaning of percentages greater than 100% and justify whether such a percentage is possible in a given context. Solve authentic problems involving numbers in different forms, such as comparing growth of a population expressed as a fraction versus as a percentage.* **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.*

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		NR.1.f Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately. *For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.* **NR.2.c** Find and use quantitative information to explore the impact of policies or behaviors, including those with social, economic, or environmental implications, on a population. *For example: Assess the effects of a small decrease in individual water use on the amount needed by a large population over time. Determine if the minimum wage has kept pace with inflation over time.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.a** Use rate reasoning to convert between units of measurement in authentic situations. *For example: Use double number lines to convert between currencies. Use ratio tables to solve problems involving dosages of medicine. Relate rate reasoning to dimensional analysis, and know why and how the process works and when to use it.* **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units.
20: Working with geometric formulas	A. Formulating a plan -- *Variables, evaluate expressions (geometric formulas)*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships.

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	B. The costs of geometry -- *Building on work with formulas* C. Modifying and combining formulas -- *Semicircle area, volume* D. Water troughs -- *Volume of prism with right triangle work*	Students will: **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.* **NR.2.b** Identify, use, and record appropriate units of measure within data displays, on graphs, and when solving contextual geometric problems. Use units as a way to understand formulas and problems and to guide the solution of multi-step problems. *For example: Identify the appropriate units for perimeter, area, and volume, such as when calculating the amount of paint needed to paint a non-rectangular surface. Choose and interpret units consistently in formulas, such as when calculating interest or when determining a time given a constant velocity and distance. Choose and interpret the scale and the origin in graphs and data displays. Solve measurement problems that require using the Pythagorean Theorem, attending to appropriate use of units.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.a** Use rate reasoning to convert between units of measurement in authentic situations. *For example: Use double number lines to convert between currencies. Use ratio tables to solve problems involving dosages of medicine. Relate rate reasoning to dimensional analysis, and know why and how the process works and when to use it.* **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will:

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		AF.1 Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.*
21: Multi-step problems	A. Texting distance -- *Dimensional analysis* B. The cost of driving -- *Unit rates to compare two options* C. The true cost of driving -- *Multiple pieces of information, multiple step work* D. Can the true cost vary? -- *Concrete to abstract approach to a system*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.f** Demonstrate an understanding of large and small numbers by interpreting and communicating with different forms (including words, fractions, decimals, standard notation, and scientific notation) and compare magnitudes in context, using inequality symbols appropriately. *For example: Compare large numbers in context, such as the population of the U.S. compared to the population of the world, using appropriate representations such as scientific notation. Calculate ratios with large numbers such as water use per capita for a large population. Interpret a growth rate less than 1%.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will:

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		PR.1 Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.a** Use rate reasoning to convert between units of measurement in authentic situations. *For example: Use double number lines to convert between currencies. Use ratio tables to solve problems involving dosages of medicine. Relate rate reasoning to dimensional analysis, and know why and how the process works and when to use it.* **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units.
22: Algebraic formulas	A. Algebra reaction -- *More complex, unfamiliar formulas* B. Breaking down a formula -- *Reading to understand/apply a complex formula* C. Analyzing change in variables -- *Analyze effect of changing values of one variable while other variables remain fixed* D. Analyzing change in variables (cont.) -- *Analyze effect of changing values of one variable while other variables remain fixed*	**Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.b** Use rate reasoning to solve problems involving unit rates, such as those related to pricing and speed. **PR.2.a** Use various representations to determine whether a proportional relationship exists between two quantities based on how the change in one value is associated with the change in the other. **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.*

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23: Problem solving	A. Body mass index -- *Evaluate and record sequence of steps (multiplication and division only)* B. Target weight -- *Given target output, undo steps to find input value* C. Blood alcohol content -- *Evaluate and record sequence of steps (multiplication/division and addition/subtraction)* D. Balancing blood alcohol -- *Given target output, undo steps to find input value*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.*
Unit 4: This unit focuses on linear relationships, equations, and inequalities. Students determine whether a proportional relationship exists between two quantities, based on how the change in one quantity influences the other quantity. Students determine and interpret rates of change and construct linear models to represent situations. Students examine trend lines for approximately linear data. Students then compare linear relationships to non-linear relationships in finance contexts. **(5 weeks)**		
24: Proportional reasoning	A. Proportional reasoning in art -- *Determine whether proportions are equivalent* B. Proportion solutions -- *Solve algebraic proportions* C. Solving equations -- *Additional practice with solving*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers.

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	D. More work with equations (Optional) -- *Equations chosen by instructor* E. Proportional viewing (Optional) -- *Proportional relationships* F. Javier builds a model -- *Three-dimensional scaling, surface area, volume* G. Ancient ruins -- *Similarity, indirect measure* H. Towers -- *Trigonometric ratios* I. Ramps -- *Inverse trigonometric ratios*	*For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.* **AF.2** Rewrite expressions and equations in equivalent forms to reveal and explain properties of the quantity or relationship represented by the expression or equation. **AF.2.a** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units. **PR.2.a** Use various representations to determine whether a proportional relationship exists between two quantities based on how the change in one value is associated with the change in the other. **PR.2.b** Analyze when scaling and shrinking lead to proportional and non-proportional results (e.g., the impact of changing various dimensions on perimeter, area, and volume) and determine whether two figures are similar. *For example: Determine whether an 8 x 10 inch photo is similar to a 5 x 7 inch photo, using a ratio table or a double number line.*

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		PR.2.c Use proportional reasoning to solve authentic, indirect measurement problems. *For example: Use a scale to calculate measurements in a graphic or diagram. Apply the 1:12 Americans with Disabilities Act (ADA) standard to design a wheelchair ramp for a 28-inch change in elevation.*
25: Rates	A. Describing rates -- *Slope as a unit rate (y-intercept = 0)* B. Comparing rates -- *Compare/contrast slopes (y-intercept = 0)* C. Interpreting change -- *Calculating slope from points, (y-intercept $\neq 0$)* D. Where do we start? -- *Calculating y-intercept by backing out the effect of the variable term.* E. Predicting costs -- *Formalizing the calculation of y-intercept*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.1.a** Use rate reasoning to convert between units of measurement in authentic situations. *For example: Use double number lines to convert between currencies. Use ratio tables to solve problems involving dosages of medicine. Relate rate reasoning to dimensional analysis, and know why and how the process works and when to use it.* **PR.1.b** Use rate reasoning to solve problems involving unit rates, such as those related to pricing and speed. **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units. **PR.2.a** Use various representations to determine whether a proportional relationship exists between two quantities based on how the change in one value is associated with the change in the other. **Algebraic Operations and Functional Analysis**

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		Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.* **AF.3** Understand solving a linear equation ~~or inequality~~, or a system of linear equations or inequalities, as a process of determining which values from a specified set, if any, make the equation, inequality, or system true. Connect numerical, graphical, and symbolic representations of solutions. **AF.3.a** Recognize that the solution to a linear equation ~~or inequality~~ in one variable, if it exists, is a value or set of values that makes the equation or inequality true, and that the solution corresponds to a single point or an interval on the real number line. **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear; ~~quadratic; exponential; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5)~~ that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.* **AF.5** Use linear ~~and quadratic~~ functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through

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		estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.
26: Linear relationships	A. Expressing linear relationships -- *Graphs, tables, algebraic, and verbal representations intersecting lines* B. Making the call -- *Using multiple representations to make decisions* *C.* Taxi ride -- *Algebraic inequalities* D. Shopping -- *Algebraic inequalities* E. First-aid supplies -- *Algebraic inequalities* F. Close enough -- *Scatterplots and trend lines, including correlation* G. Predicting budget increases -- *Using a trend line to interpolate and extrapolate*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.c** Find and use quantitative information to explore the impact of policies or behaviors, including those with social, economic, or environmental implications, on a population. *For example: Assess the effects of a small decrease in individual water use on the amount needed by a large population over time. Determine if the minimum wage has kept pace with inflation over time.* **Statistical and Probabilistic Reasoning** Students should use the language and tools of probability and statistics to quantify uncertainty in a variety of real-world contexts. They should make informed, evidence- based decisions and justify conclusions about populations based on a random sample from that population. They should be able to critically evaluate statements that appear in the popular media involving risk and arguments based on probability. Students will: **SR.2** Summarize, represent, and interpret bivariate data to investigate relationships and make predictions. **SR.2.a** For linear ~~and exponential~~ models, represent paired quantitative data on a scatterplot, use technology to fit a model to the data (using function transformations or regression), and interpret the model in the context of the data. Use the model to make predictions, where appropriate, evaluate the reasonableness of the prediction, and discuss any limitations of the model. **SR.2.b** For linear models, use technology to compute the correlation coefficient "r", interpret the value of the correlation coefficient, and relate it to the strength and direction of the relationship displayed in a scatterplot. Calculate and interpret the vertical distance between a predicted *y*-value and an observed *y*-value from the data (a residual).

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SR.2.c Distinguish between correlation and causation.

Algebraic Operations and Functional Analysis

Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems.

Students will:

AF.1 Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context.

For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.

AF.3 Understand solving a linear equation or inequality, or a system of linear equations or inequalities, as a process of determining which values from a specified set, if any, make the equation, inequality, or system true. Connect numerical, graphical, and symbolic representations of solutions.

AF.3.a Recognize that the solution to a linear equation or inequality in one variable, if it exists, is a value or set of values that makes the equation or inequality true, and that the solution corresponds to a single point or an interval on the real number line.

AF.4 Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear; ~~quadratic; exponential; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5)~~ that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.

For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.

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		AF.5 Use linear ~~and quadratic~~ functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.
27: Finance	A. Pricing your product -- *Developing formulas for product markups and discounts* B. Backing out the sales tax -- *Determining the original amount, Note: Optional mini-project available* C. Compound interest makes cents -- *Develop exponential formula for annual interest* D. Long-term growth -- *Continue work with annual compounding*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.b** Engage in problem solving that demonstrates fluency with arithmetic operations on rational numbers. Use precise mathematical language when communicating about rational numbers. *For example: Predict the effects of multiplying any real number by a rational number between 0 and 1. Represent real numbers on a number line. Use the order of operations to simplify expressions including exponents and to solve problems (e.g., to identify errors in formulas in a spreadsheet).* **NR.1.e** Solve authentic problems involving calculations with percentages and interpret the results. *For example: Calculate and understand the impact of a percentage increase or decrease in a contextual situation, such as the difference between a discount of 30% and two consecutive discounts of 15%. Calculate absolute change and explain how it differs from relative change. Solve problems related to personal finance, such as calculating the interest paid on credit card debt in which the rate is based on a credit score; explaining how the length of the pay-off period affects the total interest paid; or demonstrating the relationship between a percentage rate and the amount of interest paid.* **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.a** Use estimation skills to solve authentic problems, and know why, how, and when to estimate values. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example: Decide when and how to estimate costs in a context and when exact values are necessary. Estimate the number of seats in a large auditorium by counting one row and multiplying by the number of rows. Estimate the number of people in attendance at a large concert by counting the number of people in a random square unit and estimating the area of the crowd.* **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key

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		characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.* **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear; ~~quadratic;~~ exponential; ~~simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$;~~ ~~and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5)~~ that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.* **AF.6** Use exponential functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables or by inspection for integer values.
28: Borrowing money	A. More compounding -- *Compounding monthly then abstract to general form* B. Depreciation -- *Exponential decay, Note:*	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems.

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	Optional project available C. Payday loans -- *Effect of extremely high interest* D. Neither a borrower . . . -- *Linear loan model* E. Credit card repayment (Optional) -- *Effect of making minimum payments*	Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.* **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function ~~(linear; quadratic;~~ exponential~~; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5~~) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.* **AF.5** Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate. **AF.6** Use exponential functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables or by inspection for integer values.

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Transition to College Mathematics Scope and Sequence, 2021-22
Launch Years Transition to College Mathematics Student Learning Outcomes

Unit 5: This unit address linear and exponential function models, as well as absolute value and piecewise defined functions. Students move from exploring relationships to formalizing work with functions and covariation. Students solve equations that arise from the function models. **(5 weeks)**

29: Functions	A. Talking about quantities – *Variables and formulas* B. Our learning community – *Student success focus* C. Talking about quantities (cont.) D. Functions – *Function notation*	**Social, Emotional, and Academic Development** Students should develop and strengthen social-emotional skills and competencies critical to academic success, including competencies in the cognitive, social and interpersonal, and emotional domains. Students will: **SEAD.1** Recognize situations for which collaboration is an effective strategy, identify features of effective and productive collaborative work groups, and develop strategies for overcoming group work challenges. **SEAD.3** Engage in productive academic behaviors, including help-seeking, self-regulation, and utilizing feedback. **SEAD.3.a** Recognize when help is needed with a task, identify sources of help, and develop and apply a variety of strategies for seeking help. **SEAD.3.c** Actively seek and listen to feedback and act on feedback to improve performance. **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.* **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear; quadratic; ~~exponential; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5~~) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.

		For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions. **AF.5** Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.
30: More about functions	A. Independence and dependence -- *Includes set notation* B. Processes – *Multiple representations* C. Domain and range -- *Includes inequality and set notations* D. More with function notation – *Simple transformations from function notation*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.a** Recognize subsets of real numbers and the notation used to describe the subsets, including the roster method, set builder notation, and interval notation, used in contextual settings. Use a Venn diagram to describe the relationship between subsets of real numbers. Know when different sets of numbers are appropriate to use. *For example: Recognize why the natural numbers are useful for describing terms in a sequence to model the concentration of a drug present in the blood stream at set time intervals after the initial dose. Choose and use set notation and symbols as appropriate for subsets of numbers, such as domains and ranges of functions, and sample spaces and events for chance experiments.* **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear; quadratic; ~~exponential; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of~~

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		~~the form $p(x)=ax^n$, where n = 2, 3, 4, or 5~~) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.* **AF.5** Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.
31: Linear functions and equations	A. Linear functions and equations -- *Identifying linear relationships using a (constant) rate of change* B. Linear functions and equations (cont.) C. Straight talk about lines – *Using slope-intercept and point-slope formulas to find the equation of a line* D. Straight talk about lines (cont.) E. Slope and intercept -- *Using slope and vertical intercept to graph a function*	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear~~;~~ ~~quadratic; exponential; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5~~) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.*

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	F. Golfing on the moon -- *Reversing a linear function* G. Finding intersections of lines -- *Determining the exact intersection of lines algebraically*	AF.5 **Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.**
32: Systems of linear equations	A. Solving systems of equations graphically -- *Finding the intersection of two lines* B. Determining the number of solutions -- *Relating the number of solutions of a system of linear equations using the slopes and vertical intercepts* C. Solving systems by substitution -- *Solving systems of linear equations algebraically* D. Elimination by addition -- *Solving a system of linear equations using elimination by addition* E. Maximum heart rate -- *Interpreting the solution of a system within a given context* F. Quite a quilt -- *Coordinate geometry*	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.1** Use variables to write an algebraic expression to represent a quantity in a problem and interpret expressions that represent a quantity in terms of its context. *For example: Be able to use variables in context and use variables as placeholders, as in formulas such as the compound interest formula, $A = P(1 + r/n)^{nt}$. Write a spreadsheet formula to calculate prices based on percentage mark-up. Write the expression 4s + 4 to represent the total number of square-foot tiles needed to completely surround a square pool that is s feet on each side; recognize that s represents the length of a side of the pool, that the factor of 4 represents the 4 sides of the pool, and that the addend of 4 represents the tiles needed for 4 corners of the border.* **AF.3** Understand solving a linear equation or inequality, or a system of linear equations or inequalities, as a process of determining which values from a specified set, if any, make the equation, inequality, or system true. Connect numerical, graphical, and symbolic representations of solutions. **AF.3.b** Recognize that the solution to a linear equation or inequality in two variables is the set of ordered pairs that makes the equation or inequality true, and that the solution corresponds to a line or a half plane in the coordinate plane. **AF.3.c** Recognize that a solution to a system of linear equations in two variables, if it exists, is the ordered pair or set of ordered pairs that satisfies both equations in the system, and that the solution to a system of linear equations in two variables corresponds to the point or points of intersection of their graphs. **AF.3.d** Recognize that solutions to a system of linear inequalities in two variables correspond to points lying in the intersection of the half-planes that contain the solutions to each inequality in the system.

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33: Linear vs. exponential models	A. Comparing linear and exponential models -- *Exponential functions* B. Linear population growth C. Take your seat -- *Arithmetic sequences* D. Models of exponential growth and decay E. The marvel of medicine -- *Exponential decay* F. College tuition -- *Applying exponential functions* G. Bright lights -- *Applying exponential functions* H. Comparing job offers -- *Geometric sequences*	**Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.1** Solve real-world problems involving ratios and rates, using a variety of representations (including ratio tables, double number lines, percentages, fractions, and decimals). **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units. **PR.2.a** Use various representations to determine whether a proportional relationship exists between two quantities based on how the change in one value is associated with the change in the other. **PR.2.c** Use proportional reasoning to solve authentic, indirect measurement problems. *For example: Use a scale to calculate measurements in a graphic or diagram. Apply the 1:12 Americans with Disabilities Act (ADA) standard to design a wheelchair ramp for a 28-inch change in elevation.* **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (linear~~; quadratic; exponential; simple rational of the form $r(x)=\frac{a}{x}$; $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5~~) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the*

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		time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions. **AF.6** Use exponential functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables or by inspection for integer values.
34: Piecewise and absolute value functions	A. Introduction to piecewise functions B. Changing distances – *Absolute value functions, equations, and inequalities* C. Changing distances (cont.)	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.5** Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.
Unit 6: This unit addresses nonlinear models; specifically, quadratic, square root, and rational functions. Students use these functions to model and answer questions about a variety of real-world situations and solve equations arising from problem situations. **(5 weeks)**		
35: Quadratic functions and equations	A. Quadratic functions -- *Multiplying two linear factors to obtain a formula for a quadratic function* B. Properties of quadratic functions -- *Computing the first and second differences of a function* C. Unit cost -- *Simplifying a quadratic function* D. Transformations of quadratic functions -- *Shifting and scaling quadratic functions*	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (~~linear;~~ quadratic;~~ exponential; simple rational of the form~~ $~~r(x)=\frac{a}{x}$~~$, $~~p(x)=\frac{a}{x^2}$~~ , and $~~g(x)=\frac{a}{x-c}$~~ ~~; and monomial of the form~~ $~~p(x)=ax^n$~~ , where n = 2, 3, 4, or 5~~) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a*

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	E. Modeling with quadratic functions -- *Modeling quantities using quadratic functions* F. Solving quadratic equations -- *Relating height to volume of a container* G. Torricelli's Law -- *System of linear and quadratic equations*	*quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.* **AF.5** Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate.
36: Square root functions and equations and radical expressions	A. Reversing a quadratic function -- *Reversing the process with square roots* B. The inverse of a quadratic function -- *Restricting the domain of a quadratic function* C. I can see forever -- *Applying square root functions* D. Tic toc -- *Applying square root functions* E. Fractional exponents -- *Applying the rules of exponents to simplify fractional exponents*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.1** Engage in problem solving that demonstrates an understanding of real numbers, including notation and operations. **NR.1.c** Engage in problem solving that uses appropriate notation for radicals in terms of rational exponents. Reason quantitatively to emphasize number sense and reasonableness when estimating the value of a radical and when distinguishing between exact and approximate values. *For example: Approximate the value of an irrational number like $\sqrt{52}$ or $\sqrt[3]{10}$ using perfect squares or perfect cubes, and locate the rational number approximation of the radical on a number line. Know that the exact value of a distance found by the distance formula may be left in radical form, but an approximation of distance may be more useful in context.* **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.2** Rewrite expressions and equations in equivalent forms to reveal and explain properties of the quantity or relationship represented by the expression or equation.

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		AF.2.b Use algebraic properties and procedures to combine and transform expressions to solve problems, such as factoring to reveal zeros of a function defined by an expression or completing the square to reveal the maximum or minimum value of a function defined by a quadratic expression. **AF.5** Use linear and quadratic functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables, inspection for simple cases, or algebraic techniques (including factoring and the quadratic formula), when appropriate. **AF.6** Use exponential functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables or by inspection for integer values.
37: Power functions	A. Introduction to power functions -- *Applying second- and third-degree power functions* B. Higher order power functions -- *Applying third-, fourth-, and fifth-degree power functions* C. Power functions with negative exponents D. Illuminance -- *Analyzing rate of change of power functions with negative exponents*	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (~~linear; quadratic; exponential; simple rational of the form~~ $~~r(x)=\frac{a}{x}$~~$, $~~p(x)=\frac{a}{x^2}$~~, and $~~g(x)=\frac{a}{x-c}$~~; and~~ monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5) that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.*

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38: Rational functions, expressions, and equations	A. Saline solution -- *Applying rational functions* B. Discontinuities of rational functions C. Vertical asymptotes -- *Determining discontinuities of rational functions* D. Behavior near vertical asymptotes E. Vertical asymptotes vs. holes -- *Nonremovable discontinuities of rational functions* F. Strategies for understanding vertical asymptotes G. Reducing pollution -- *Applications of systems of linear and rational equations* H. Paintings on a wall -- *Applying rational functions* I. Adding it all up -- *Adding rational expressions* J. Adding rational functions -- *Forming new rational functions*	**Numeric Reasoning** Students should solve authentic problems in a variety of contexts that require number sense and the ability to apply concepts of numeracy to investigate and describe quantitative relationships. Students will: **NR.2** Use numbers and units appropriately to model and solve real-world problems. **NR.2.c** Find and use quantitative information to explore the impact of policies or behaviors, including those with social, economic, or environmental implications, on a population. *For example: Assess the effects of a small decrease in individual water use on the amount needed by a large population over time. Determine if the minimum wage has kept pace with inflation over time.* **Proportional Reasoning** Students should represent and solve authentic problems using proportional reasoning with ratios, rates, proportions, and scaling. They should be able to strategically and flexibly utilize various representations to describe, make sense of, and draw conclusions in situations involving proportional reasoning. Students will: **PR.2** Analyze, represent, and solve real-world problems involving proportional relationships, with attention to appropriate use of units. **PR.2.a** Use various representations to determine whether a proportional relationship exists between two quantities based on how the change in one value is associated with the change in the other. **Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (~~linear, quadratic; exponential~~; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; ~~and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5)~~ that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the*

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		function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.
39: The inverse of an exponential function (Optional) -- *While logarithmic functions are not explicitly addressed in the course framework, students may benefit from the analysis of their behavior as it relates to the behavior of exponential functions*	A. Inverse exponentials -- *Discovering the inverse operation of an exponential* B. Graphing logs -- *Exploring the graphs of logarithmic functions*	**Algebraic Operations and Functional Analysis** Students should investigate problems that facilitate the transition from specific and numeric reasoning to general and algebraic reasoning. They should use the language, symbols, and structure of algebra and the key characteristics of functions and their representations (symbols, graphs, tables) to investigate, represent, and solve those problems. Students will: **AF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function (~~linear; quadratic; exponential; simple rational of the form $r(x)=\frac{a}{x}$, $p(x)=\frac{a}{x^2}$, and $g(x)=\frac{a}{x-c}$; and monomial of the form $p(x)=ax^n$, where n = 2, 3, 4, or 5)~~ that models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *For example: For linear situations, describe the rate of change using appropriate units, determine the contextual meaning of the rate of change and of the intercepts, and create an algebraic model to represent the function. For exponential situations, interpret the intercept and connect end behavior to growth or decay. For a quadratic function that models the height of a projectile, interpret the maximum value of the function in context. For a simple rational function that represents the relationship between the speed of a train and the time it takes to complete a trip of constant distance, interpret the asymptotes in the context of the situation. Compare the symmetries and the local and end behavior of monomial functions.* **AF.6** Use exponential functions and equations to model and solve problems from a variety of contexts and to make predictions/decisions. Recognize the limitations of the model and identify an appropriate domain or range for which the model might be used to make reasonable predictions. Solve equations through estimation using graphs and tables or by inspection for integer values.

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