Mathematics Curriculum Guide

Precalculus

2017-18

Teaching for Understanding

- **Effective instruction begins with clarity about desired learning outcomes and about evidence that indicates learning has occurred, better known as "beginning with the end in mind." By starting with long-term results and working "backward," effective lesson planning occurs. The "backward planning" stages for a mathematics unit are:**

Stage One – Desired Results

"What are the long-term learning outcomes for my students?"

Teacher Actions:

- Review the Standards, Understandings, Essential Questions, Knowledge and Skills for the unit.
- Develop a deeper understanding of each math skill (*What is there to understand?*).
- Build connections within and between the unit's skills (*How are these understandings connected?*).

Stage Two – Evidence of Learning

"How will I know if my students understand the content?"

Teacher Actions:

- Design formative and summative assessments to inform instruction and gauge student progress towards desired results (Stage One).

Stage Three – Learning Experiences and Instruction

"What learning progression best supports my students? What learning experiences will build deep understanding and achieve my desired results?"

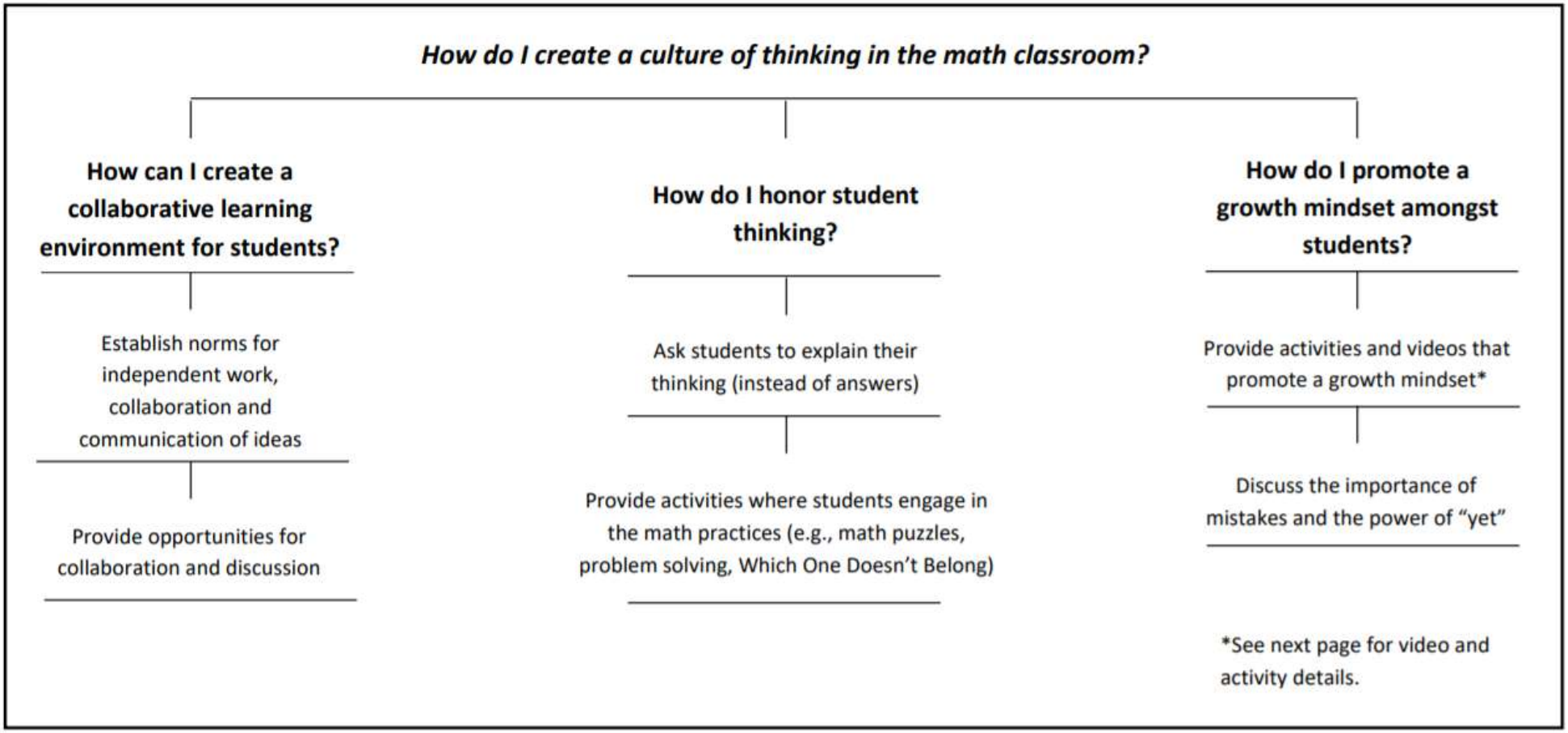
Teacher Actions:

- Determine students' understanding of prerequisite skills.
- With learning goals in mind, plan tasks that build conceptual knowledge, promote meaning making, connect mathematical concepts, and promote the mathematical practices.
- Teach for understanding.

- During the first three weeks of school, teachers will dedicate time during math instruction to create a mathematical mindset. A menu of activities can be selected by teachers to establish a healthy classroom environment, prepare students to engage in inquiry and problem-solving, and promote a positive growth mindset (see pages 3-4).

Create a Culture of Thinking

- **Creating a culture of thinking in the math classroom is a dedicated process that takes place throughout the entire school year. In order to lay the foundation, teachers will spend time during the first three days of school providing students with activities that establish an engaging learning community focused on problem solving, discourse and metacognition.**



Creating a Growth Mindset

Background

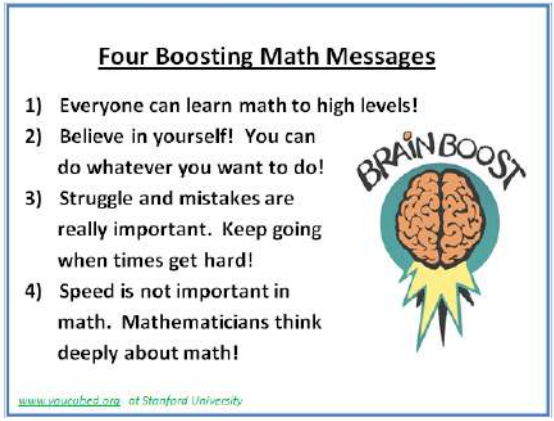
- The way a student reacts to academic challenges is directly related to whether or not the student has a growth mindset. The gap in student performance widens over time between those with a growth mindset and those with a fixed mindset.
- Teachers play a key role in developing growth mindset in students. To create a growth mindset culture, focus on the power of mistakes (download Jo Boaler's "Positive Classroom Norms"). Praise the process, not the person.
- Simply telling students to have a growth mindset can backfire. A scientific explanation about how intelligence works – that the brain can get stronger and smarter with new learning – has been demonstrated to be effective.
- Reiterating the message "just try harder" can also be problematic. A growth mindset isn't about trying harder. Students need to understand why they should put in effort and how to deploy that effort.

Secondary Videos

- Neuroplasticity (2:03) https://www.youtube.com/watch?v=ELpfYCZa87g
- The science behind Growth Mindset (3:04) https://www.youtube.com/watch?v=WtKJrB5rOKs
- Four Boosting Math Messages from Jo and Her Students (8:35) https://www.youcubed.org/students/
- John Legend: Success through effort (2:01) https://www.youtube.com/watch?v=LUtcigWSBsw

Discussion Questions

- How do you feel when you make a mistake? Why?
- How do you think other people see you when you make a mistake?
- Have you ever discovered something new from making a mistake?
- Have you ever felt proud of making a mistake?
- Has a mistake ever made you think more deeply about a problem? (start non-academic and then talk about how the lessons apply to academics)



The Power of "Yet"

- Turn a fixed mindset comment into a growth mindset statement by adding 'yet' to the end of the comment.
- Video: Sesame Street: Janelle Monae – Power of Yet (2:41) https://www.youtube.com/watch?v=XLeUvZvuvAs
- When grading student work, be it formative or summative, create a cut off point for what you would consider mastery. All work that does not meet this expectation is marked NOT YET. When returned to students, explain that they are to revise work and provide guidelines and structure for students to fix their assignments and demonstrate mastery.

Activities

- Design a poster comparing growth and fixed mindsets
- Write growth mindset hashtags and post around the classroom
- Turn the transfer goals into "I will…" statements
- Challenge students with a math puzzle and focus on using growth mindset language (I can't get the answer… yet)
- Answer a "Dear Abby" letter from a student who feels like a failure
- Give each student a piece of paper. Ask them to crumple it up and throw it at the board with the feelings they have when they make a mistake in math. Get them to retrieve the paper, uncrumple it, and color each line with different colors. Tell your students that these lines represent all the synaptic activity that happens when a mistake is made. Explain how they can learn from mistakes. Ask them to keep the paper and stick it into a notebook or folder to look at when they make a mistake. This physical reminder prompts students to use mistakes to strengthen their brain every time they open their notebook.

Topic 1: Functions & Graphs (Lessons P.1, P.5, & 1.1-1.8, 1.10)

In this unit students will begin with a basic review of algebraic expressions, mathematical models, real numbers, and factoring polynomials. Then students will expand their basic understandings and skills related to functions, equations, and graphs. Students will create formulas, called functions, that model data. Additionally, students will work with functions to identify the different kinds of transformations that result in changes to graphs and functions. The ultimate goal of this unit is to review basic skill as well as expand graphing skills with transformations for functions to prepare for the upcoming polynomial and rational functions unit.

Common Misconceptions:

- **Transformations:** Errors occur when students do not know in what direction to translate a graph. Vertical translations are relatively intuitive: -*k* translates a graph down *k* units while *k* translates the graph up *k* units. However, horizontal translations may confuse students because they are the opposite of what might be expected: -*h* translates the graph right *h* units while *h* translates the graph left *h* units.

Topic 1: Functions & Graphs (Lessons P.1, P.5, & 1.1-1.8, 1.10)

Transfer Goals

1) Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.
2) Effectively communicate orally, in writing, and using models (e.g., concrete, representational, abstract) for a given purpose and audience.
3) Construct viable arguments and critique the reasoning of others using precise mathematical language.

Timeframe: 4 weeks/19 days
Start Date: August 17, 2017
Assessment Dates: Sept. 12-13, 2017

Standards

A-CED 1
A-CED 2

A-REI 10
A-REI 11

F-IF 1
F-IF 2
F-IF 4
F-IF 5
F-IF 6

F-IF 7
F-IF 8
F-IF 9

F-BF 1
F-BF 3
F-BF 4

A-SSE 3

N-Q 1

Meaning-Making

Understandings

Students will understand that…

- Functions are use usually given in terms of equations involving x and y. **(F-IF 1)**
- Functions are used to determine the function's domain and its range. **(F-IF 1, 3)**
- Ordered pair describes the order of the coordinate and makes a difference in a point's location. **(A-REI 10)**
- A parent function is the simplest form of a set of functions that forma a family. Each function in the family is a transformation of the parent function. **(F-IF 7)**
- A function involving more than one transformation can be graphed in the following order: horizontal shifting, stretching or shrinking, reflecting and vertical shifting. **(F-BF 3)**
- Transformations help to understand the relationship between graphs that have similarities but are not the same. **(F-BF 3)**
- Functions and graphs form the basis for understanding mathematics and applications. **(A-CED 1, 2)**
- The ratio of the vertical change to the horizontal change is constant. That constant ratio describes the slope of the line. **(F-IF 6)**
- Linear functions can be graphed using the slope and the y-intercept. Linear equations in standard form can be graphed using the x and y intercepts. **(A-REI 10)**
- Operations of functions are performed same as for real numbers. One difference is that the domain of each function must be considered. **(F-BF 1)**
- Numerical, algebraic, and graphical models provide different methods to visualize, analyze, and understand data. (**A-CED 1, 2)**

Essential Questions

Students will keep considering…

- How do represent functions graphically and interpret information given by the graphs?
- How are domains affected when functions are combined arithmetically or composed?
- How can inverse functions be determined, verified, and graphed?
- How can verbal models are used to obtain functions from verbal descriptions?

Acquisition

Knowledge

Students will know…

Vocabulary: Zeros, intercepts, domain, range, function, interval notation, vertical line test, increasing, decreasing, minimum, maximum, regression, vertical and horizontal shift and stretch, reflection, composition, inverse functions, horizontal line test, one-to-one function, verbal models

- Properties of the twelve basic functions.
- The graph of *f* has x-intercepts at the real zeros, intervals of increasing, decreasing, and relative maximum and minimum.
- A function involving more than one transformation can be graphed in the following order: horizontal shifting, stretching or shrinking, reflecting and vertical shifting.
- Transformations help to understand the relationship between graphs that have similarities but are not the same.
- If a function does not model a verbal condition, its domain is the largest set of real numbers for which the value of f(x) is a real number, excluding real numbers that cause division by zero and real numbers that result in an event root of a negative numbers.
- Most functions can be created by combining or modifying other functions.

Skills

Students will be skilled at and able to do the following…

- Investigate end behavior.
- Identify different forms of linear equations.
- Graph linear equations from a given form.
- Identify graphs of the twelve basic functions.
- Analyze functions both algebraically and graphically for various properties including domain, range, continuity, intervals of increasing and decreasing, local extrema, symmetry, and end behavior.
- Identify algebraically and graphically representations of translations, reflections, stretches, and shrinks of functions.
- Perform transformations of graph, which include vertical and horizontal shifts, reflections, vertical stretching and shrinking, and horizontal stretching and shrinking.
- Perform operations that apply to all types of functions and build new functions from existing functions.
- Consider the domain of functions as the largest set of real numbers, excluding real numbers that cause division by zero and real numbers that result in an event root of a negative numbers.
- Find the inverse functions by restricting the domain using algebraic method, using tables, and using graphs.
- Verify inverse functions by composing the functions in both orders.
- Identify appropriate basic functions with which to model real-world problems and be able to produce specific functions to model data, formulas, graphs, and verbal descriptions.

Topic 1: Functions & Graphs (Lessons P.1, P.5, & 1.1-1.8, 1.10)

Transfer is a student's ability to independently apply understanding in a novel or unfamiliar situation. In mathematics, this requires that students use reasoning and strategy, not merely plug in numbers in a familiar-looking exercise, via a memorized algorithm.

Transfer goals highlight the effective uses of understanding, knowledge, and skills we seek in the long run – that is, what we want students to be able to do when they confront new challenges, both in and outside school, beyond the current lessons and unit. These goals were developed so all students can apply their learning to mathematical or real-world problems while simultaneously engaging in the Standards for Mathematical Practices. In the mathematics classroom, assessment opportunities should reflect student progress towards meeting the transfer goals.

With this in mind, the revised **PUSD transfer goals** are:

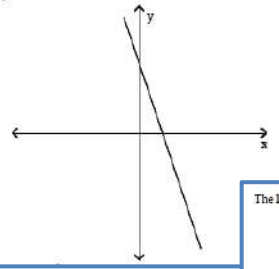
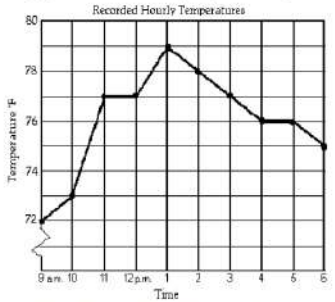
1) **Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.**
2) **Effectively communicate orally, in writing, and by using models (e.g., concrete, representational, abstract) for a given purpose and audience.**
3) **Construct viable arguments and critique the reasoning of others using precise mathematical language.**

Multiple measures will be used to evaluate student acquisition, meaning-making and transfer. Formative and summative assessments play an important role in determining the extent to which students achieve the desired results in stage one.

Formative Assessment	Summative Assessment
Aligning Assessment to Stage One	
• What constitutes evidence of understanding for this lesson? • Through what other evidence during the lesson (e.g. response to questions, observations, journals, etc.) will students demonstrate achievement of the desired results? • How will students reflect upon, self-assess, and set goals for their future learning?	• What evidence must be collected and assessed, given the desired results defined in stage one? • What is evidence of understanding (as opposed to recall)? • Through what task(s) will students demonstrate the desired understandings?
Opportunities	
• Discussions and student presentations • Checking for understanding (using response boards) • Ticket out the door, Cornell note summary, and error analysis • *Performance Tasks* within a Unit • Teacher-created assessments/quizzes	• Unit assessments • Teacher-created quizzes and/or mid-unit assessments • *Illustrative Mathematics* tasks (https://www.illustrativemathematics.org/) • Performance tasks

Topic 1: Functions & Graphs (Lessons P.1, P.5, & 1.1-1.8, 1.10)

The following pages address how a given skill may be assessed. Assessment guidelines, examples and possible question types have been provided to assist teachers in developing formative and summative assessments that reflect the rigor of the standards. *These exact examples cannot be used for instruction or assessment, but can be modified by teachers.*

Unit Skills	SBAC Targets (DOK)	Selected Standards	Examples
• Investigate end behavior. • Identify different forms of linear equations. • Graph linear equations from a given form. • Identify graphs of the twelve basic functions. • Analyze functions both algebraically and graphically for various properties including domain, range, continuity, intervals of increasing and decreasing, local extrema, symmetry, and end behavior. • Perform operations that apply to all types of functions and build new functions from existing functions. • Identify appropriate basic functions with which to model real-world problems and be able to produce specific functions to model data, formulas, graphs, and verbal descriptions.	Create equations that describe numbers or relationships. (1,2) Understand the concept of a function and use function notation (1,2) Analyze functions using different representations. (1,2) Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas). (1,2,3)	**A-CED 1** Create equations and inequalities in one variable including ones with absolute value and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. **A-CED 2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **A-SSE 1b** Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of *P* and a factor not depending on *P*.	Use the vertical line test to determine whether or not the graph is a graph in which y is a function of x. 1)  **Determine whether the relation is a function.** 1) {(−1, −6), (2, −5), (4, 9), (8, −5), (10, 3)} **Graph the equation.** 7) $2x + 3y - 10 = 0$ The line graph shows the recorded hourly temperatures in degrees Fahrenheit at an airport.  1) At what time was the temperature the highest? A) 1 p.m. B) 5 p.m. C) 11 a.m. D) 2 p.m. 2) At what time was the temperature its lowest? A) 9 a.m. B) 6 p.m. C) 4 p.m. D) 1 p.m. 3) What temperature was recorded at 6 p.m.? A) 75 °F B) 77 °F C) 73 °F D) 76 °F 4) During which hour did the temperature increase the most? A) 10 a.m. to 11 a.m. B) 1 p.m. to 2 p.m. C) 12 p.m. to 1 p.m. D) 9 a.m. to 10 a.m. 5) At what time was the temperature 72°? A) 9 a.m. B) 10 a.m. C) 6 p.m. D) 9 a.m. and 10 a.m. **Evaluate the piecewise function at the given value of the independent variable.** 1) $f(x) = \begin{cases} 3x+3 & \text{if } x < -4 \\ 4x+2 & \text{if } x \geq -4 \end{cases}$; f(−2) **Use the given conditions to write an equation for the line in the indicated form.** 3) Passing through (5, 4) and parallel to the line whose equation is $y = 2x - 6$; point–slope form A) $y - 4 = 2(x - 5)$ B) $y - 5 = 2(x - 4)$ C) $y - 4 = x - 5$ D) $y = 2x$ 4) Passing through (2, 2) and perpendicular to the line whose equation is $y = 4x + 7$; point–slope form A) $y - 2 = -\frac{1}{4}(x - 2)$ B) $y - 2 = \frac{1}{4}(x + 2)$ C) $y - 2 = \frac{1}{4}(x - 2)$ D) $y = -4x - 10$ 3) Slope $= \frac{8}{9}$, passing through (3, 7) A) $y - 7 = \frac{8}{9}(x - 3)$ B) $y + 7 = \frac{8}{9}(x + 3)$ C) $x - 7 = \frac{8}{9}(y - 3)$ D) $y = \frac{8}{9}x + 3$ 4) Passing through (7, 2) and (8, 8) A) $y - 2 = 6(x - 7)$ or $y - 8 = 6(x - 8)$ B) $y - 2 = 6(x - 8)$ or $y - 8 = 6(x - 7)$ C) $y + 2 = 6(x + 7)$ or $y + 8 = 6(x + 8)$ D) $y - 2 = 7(x + 7)$ or $y - 8 = 8(x - 2)$

Topic 1: Functions & Graphs (Lessons P.1, P.5, & 1.1-1.8, 1.10)

Unit Skills	SBAC Targets (DOK)	Selected Standards	Examples
• Identify algebraically and graphically representations of translations, reflections, stretches, and shrinks of functions. • Perform transformations of graph, which include vertical and horizontal shifts, reflections, vertical stretching and shrinking, and horizontal stretching and shrinking. • Consider the domain of functions as the largest set of real numbers, excluding real numbers that cause division by zero and real numbers that result in an event root of a negative numbers. • Find the inverse functions by restricting the domain using algebraic method, using tables, and using graphs. • Verify inverse functions by composing the functions in both orders.	Understand the concept of a function and use function notation (1,2) Analyze functions using different representations. (1,2) Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas). (1,2,3)	**F-IF 1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y=f(x)*. **F-IF 9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions. **F-BF 3** Identify the effect on the graph of replacing f(x) by f(x)+k, f(kx), and f(x+k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.	The function $g(x) = -\frac{1}{2}(x+2)^2 + 3$ is a transformation of the function $f(x) = x^2$. Graph $g(x)$. Find the domain of the function. 11) $f(x) = \frac{1}{x-2} + \frac{4}{x+8}$ A) $(-\infty, -8) \cup (-8, 2) \cup (2, \infty)$ B) $(-\infty, \infty)$ C) $(-\infty, -8) \cup (-8, \infty)$ D) $(-\infty, 2) \cup (2, \infty)$ 3) $f(x) = 7x + 15$, $g(x) = 5x - 1$ $(f \circ g)(x)$ A) $35x + 8$ B) $35x + 22$ C) $35x + 14$ D) $35x + 74$ 4) $f(x) = -5x + 7$, $g(x) = 6x + 4$ $(g \circ f)(x)$ A) $-30x + 46$ B) $-30x + 27$ C) $30x + 46$ D) $-30x - 38$

Topic 1: Functions & Graphs (Lessons P.1, P.5, & 1.1-1.8, 1.10)

Transfer Goals
1) Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution. 2) Effectively communicate orally, in writing, and using models (e.g., concrete, representational, abstract) for a given purpose and audience. 3) Construct viable arguments and critique the reasoning of others using precise mathematical language.

Essential Questions:

- How do represent functions graphically and interpret information given by the graphs?
- How are domains affected when functions are combined arithmetically or composed?
- How can inverse functions be determined, verified, and graphed?
- How can verbal models are used to obtain functions from verbal descriptions?

Standards: A-CED 1, A-CED 2, A-REI 10, A-REI 11, F-IF 1, F-IF 2, F-IF 4, F-IF 5, F-IF 6, F-IF 7, F-IF 8, F-IF 9, F-BF 1, F-BF 3, F-BF 4, A-SSE 3, N-Q 1

Suggested Timeframe: 4 weeks/19 days
Start Date: August 17, 2017
Assessment Dates: September 12-13, 2017

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Resources
2 days (Aug. 17-18)	**Review concepts of Algebra** (Sections P.1,P.5)	**Focus Questions** • How do you recognize subsets of the real numbers and identify their properties to simplify algebraic expressions? • Is a rule that can help to determine the factors of an expression? **Inquiry Question** p. 19 #134	• The set of real numbers contains rational and irrational numbers • Mathematical modeling is the process of finding an equation to describe real-world phenomena • Rules of factorization	**Vocabulary:** real numbers, union, intersection, algebraic expression, absolute value, mathematical modeling, factoring, greatest common factor	• Simplify algebraic expressions • Identify intersection and union of sets • Use the properties of real numbers • Factoring expressions	**Common Core Problems:** **P.1:** #129-133, 148-155 **P.5:** #115-129, 137-137
1 day (Aug. 21)	**Lesson 1-1: Graphs and Graphing Utilities** (pp. 142-153) F-IF 1	**Focus Questions** • How do you graph functions and interpret information given by the graphs? • Are single numbers the only way to represent intercepts? Can ordered pairs also be used? **Inquiry Question** p. 151 #57-60	• Functions are use usually given in terms of equations involving x and y • Functions are used to determine the function's domain, range and intercepts. • Ordered pair describes the order of the coordinates and makes a difference in a point's location.	**Vocabulary:** x and y axis, quadrants, ordered pair, x and y intercept, origin, equation in two variables. **Concepts:** Ordered pairs satisfy solutions of equations.	• Plot points and graph equations in the rectangular system. • Use a graph to determine intercepts. • Interpret information given by graphs. • Use a graphing Utility	**Common Core Problems:** **1.1:** #55-65, 67-74, 79-86 **Test Prep:** **1.1:** #13-19

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 days (Aug. 22-23)	**Lessons 1.2: Basics of Functions and Their Graphs** (p. 154 – 172) **F-IF 5, F-IF 7 & 9** **Lesson 1.3: More on Functions and Their Graphs** (p. 173 – 187)	**Focus Question** How do you graph relations and identify their properties? **Inquiry Question** Pg. 185 Chose from 83-90	• A relation is identified as a function if it passes the vertical line test and its domain values appear only once. • Dots, open dots, or arrows on the left and right sides of a graph give information about a function. • The x-coordinate and not the y coordinate describe the interval where the functions increase, decrease, or are constant.	**Vocabulary:** domain, range, function, vertical line test, intercepts, intervals notation, open interval, interval of increasing, decreasing, or constant, symmetry, local maximum and minimum. **Concepts:** • F(x) notation describes the value of the function at x.	• Identify the graphs of twelve basic functions. • Obtain information about a function from its graph and visualize that lines will or will not extend on both sides of the line depending on a dot, open dot or arrow. • Analyze functions both algebraically and graphically for various properties including domain and range, intervals of increasing and decreasing, local and absolute extrema, symmetry, asymptotes and end behavior.	**Common Core Problems:** **1.2:** #99-116, 118-128 **1.3:** #79-82, 83-105, 114-120 **Test Prep:** **1.2:** #1-10, 55-64 **1.3:** #33-36, 37-42, 55-76
2 days (Aug. 24-25)	**Lesson 1.4: Linear Functions and Slope** (p. 188 - 202) **A-REI 10** **Lesson 1.5: More on Slope** (p. 203 - 215) **F-IF 6, F-IF 7, 8, 9**	**Focus Question.** How do you write and graph linear equations? **Inquiry Question** Explain how to derive the slope-intercept form of line's equation, $y = mx + b$ from the point-intercept form, $y - y_1 = m(x - x_1)$.	• The ratio of the vertical change to the horizontal change is constant. That constant ratio describes the slope of the line. • Linear functions can be graphed using the slope and the y-intercept. • Linear equations in standard form can be graphed using the x and y intercepts.	**Vocabulary:** slope, scatter plot, intercept form, point slope form, horizontal and vertical lines, parallel and perpendicular lines, rate of change. **Concepts:** Parallel lines have the same slope. Perpendicular lines slopes are opposite reciprocals.	• Identify different forms of linear equations. • Know the different forms of a linear function. • Graph linear equations from a given form.	**Common Core Problems:** **1.4:** #87-99, 105-114 **1.5:** #27-38, 40-45 **Test Prep:** **1.4:** #25-34, 87-88, 118, 119 **1.5:** #5-12, 21-26
2 days (Aug. 28-29)	**Lesson 1.6: Transformations of functions** (p. 215 - 230) **F-IF 7** **F-BF 3**	**Focus Question** How transformations could help you to understand the relationship between graphs that have similarities but are not the same? **Inquiry Question** Pg. 229 # 128	• A parent function is the simplest form of a set of functions that forma a family. Each function in the family is a transformation of the parent function. • A function involving more than one transformation can be graphed in the following order: horizontal shifting, stretching or shrinking, reflecting and vertical shifting. • Transformations help to understand the relationship between graphs that have similarities but are not the same.	**Vocabulary:** common functions, vertical and horizontal shift, reflections, vertical and horizontal stretching and shrinking, **Concepts:** • Graphing procedures • Transformation of a familiar graph makes graphing easier.	• Identify algebraically and graphically representations of translations, reflections, stretches, and shrinks of functions. • Perform transformations of graph, which include vertical and horizontal shifts, reflections, vertical stretching and shrinking, and horizontal stretching and shrinking.	**Common Core Problems:** **1.6:** #127-134, 137-152 **Test Prep:** **1.6:** #17-24, 53-66, 81-94

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 days (Aug. 30-31)	**Lesson 1.7: Combinations of functions: Composite Functions** (p. 231 – 245) **F-BF 1**	**Focus Question** How are domains affected when functions are combined arithmetically or composed? **Inquiry Question** Describe the values of x that must be excluded from the domain of **(f ◦ g)(x)**	• Operations of functions are performed same are for real numbers. One difference is that the domain of each functions must be considered • If a function does not model a verbal condition, its domain is the largest set of real numbers for which the value of f(x) is a real number, excluding real numbers that cause division by zero and real numbers that result in an event root of a negative numbers.	**Vocabulary:** inequality symbols and related operations, solid and dashed lines, region of solutions **Concepts:** • The composition of two functions involves replacing the variable of one function with the expression equal to the other function.	• Perform operations that apply to all types of functions and build new functions from existing functions. • Consider the domain of functions as the largest set of real numbers, excluding real numbers that cause division by zero and real numbers that result in an event root of a negative numbers.	**Common Core Problems:** **1.7:** #97-107, 110-119 **Test Prep:** **1.7:** p. 234-235 #a-d, p. 242-243 #8-12, 25-26, 51-66, 67-82
1 day (Sept. 1st)	**Lesson 1.8: Inverse Functions** (p. 245 – 256) **F-BF 4**	**Focus Question** How can a function's inverse be determined, verify, and graphed? **Inquiry Question** Pg. 255 #67	• The inverse of a may be or not be a function. • The range of the relation is the domain of the inverse and domain of the relation is the range of the inverse. • If f and f^{-1} are functions and if either maps a to b, then the other maps b to a.	**Vocabulary:** inverse relation, inverse function, one-to-one function, horizontal line test, **Concepts:** • The inverse of a function will only be a function if the function is a one-to-one.	• Find the inverse functions by restricting the domain using algebraic method, using tables, and using graphs. • Verify inverse functions by composing the functions in both orders.	**Common Core Problems:** **1.8:** #65-75, 87-99 **Test Prep:** **1.8:** #1-10, 11-28, 39-48
1 day (Sept. 5th)	**Lesson 1.10: Modeling with Functions** (p. 266 – 281) **A-CED 1,2**	**Focus Question** How can you construct functions from verbal descriptions and from formulas? **Inquiry Question** Pg. 281 # 68	• Data can be modeled from real-world situations with equations, formulas, or graphs. These tools can be used to draw conclusions about the situations. • Real-world situations can be analyzed and solved by functions..	**Vocabulary:** verbal models **Concepts:** • When developing functions that model situations, it is helpful to draw a diagram	• Identify appropriate basic functions with which to model real-world problems and be able to produce specific functions to model data, formulas, graphs, and verbal descriptions.	**Common Core Problems:** This whole lesson has cc problems. **Test Prep:** **1.10:** #21-22, 31-32
1 day (Sept. 8th)	**Topic 1 Performance Task** (See the attached activity)					
1 day (Sept. 11th)	**Review Topic 1 Concepts & Skills** Use Textbook Resources and/or Teacher Created Items					
2 days (Sept. 12-13)	**Topic 1 Assessment** (Created and provided by PUSD)					

Common Core Practices

- ☐ Instruction in the Standards for Mathematical Practices
- ☐ Use of Talk Moves
- ☐ Note-taking
- ☐ Use of Manipulatives
- ☐ Use of Technology
- ☐ Use of Real-world Scenarios
- ☐ Project-based Learning
- ☐ Thinking Maps

Performance Task Activity: Chapter 1

A) Kind of Numbers:

The first numbers people used were whole numbers. It took many centuries to discover more and more types of numbers. The discovery of new kinds of numbers is related to the attempt to solve more and more equations. The following equations are examples:

a. $x + 2 = 9$ **b. $x + 9 = 2$** **c. $2x = 6$** **d. $6x = 2$** **e. $x^2 = 9$** **f. $x^2 = 10$** **g. $x^2 = -9$**

1) Pretend you only know about the **natural numbers**. (These are the positive whole numbers.) List the equations above that can be solved with natural numbers answers only.

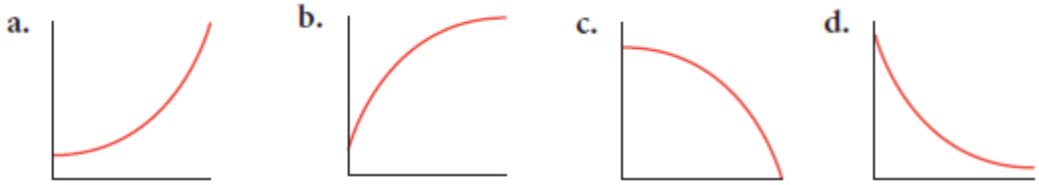
2) Pretend you only know about the **integers**. (These are positive and negative whole numbers, and zero.) List the equations above that can be solved. Find one that has two solutions.

3) Pretend you only know about the **rational numbers**. (These are all fractions, positive, negative, and zero. Of course, integers are included, since for example 3 = 6/2.) List the equations above that can be solved.

4) The **real numbers** include all rational and irrational numbers (numbers like π or $\sqrt{2}$). Which equations can be solved if you know about all the real numbers?

B) Practice Your Skills:

1) Match a description to each graph.



A. increasing more and more rapidly

B. decreasing more and more slowly

C. increasing more and more slowly

D. decreasing more and more rapidly

2) Sketch a graph to match each description.

a. increasing throughout, first slowly and then at a faster rate

b. decreasing slowly, then more and more rapidly, then suddenly becomes constant

c. alternately increasing and decreasing without any sudden changes in rate

a) b) c)

C) Hair Cuts:

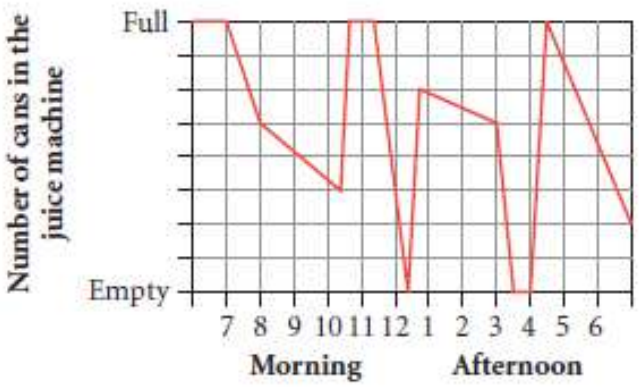
a) What is the real-world meaning of the graph on top?

b) What do you think the **slope** of this graph indicates?

c) What do you think the **x-intercept** of this graph represents?

d) What do you think the **y-intercept** of this represents?

D) Vending Machines:



Students at Paramount High School are complaining that the juice vending machines is frequently empty. Several ASB members decide to study this problem. They record the number of cans in the machine at various times during a typical school day and make a graph.

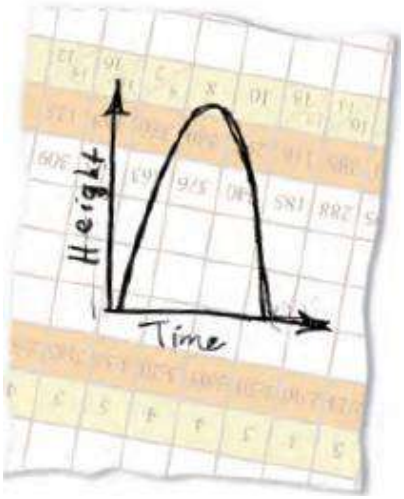
a. Based on the graph, at what times is juice consumed most rapidly?

b. When is the machine refilled? How can you tell?

c. When is the machine empty? How can you tell?

d. What do you think the student council will recommend to solve the problem?

E) DOODLES



Jose's concentration often wanders from soccer to the mathematics involved in his game. He frequently jots down mathematical doodles and graphs in his notes.

a. What is the real-world meaning for the graph found on one? of his recent doodles?

b. What units might he be using?

c. Describe a realistic domain and range for this graph.

d. Does this graph show how far the ball traveled? Explain.