Educational Epiphany ™

Districtwide PLC Protocol for **Mathematics**

Teacher/Teacher Team:
Grade/Course: Algebra 2
Date: Week of August 15, 2022

#	Planning Question	Teacher/Teacher Team Response	
	Algebra 2 Coherence Tool: Access the foundational standards to make connections to previously taught skills during the lesson introduction.		
1	Which **state standard** is your lesson progression addressing?	**Lesson: 1.1 Measuring Segments and Angles**	**Lesson 1.2 – Transformation of Functions**
		• **A2.F.IF.A.1** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.★ **Embedded with A2.F.IF.A.1 is A2.N.Q.A.1** Scope and Clarification Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. i) Tasks have a real-world context. ii) Tasks may involve square root, cube root, polynomial, exponential, and logarithmic functions. **Foundational Standards**: A1.F.IF.A.1, A1.N.Q.A.1 • **A2.F.IF.A.2** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★ **Embedded with A2.F.IF.A.2 is A2.N.Q.A.1** Scope and Clarification i) Tasks have a real-world context. ii) Tasks may involve polynomial, exponential, and logarithmic functions. **Foundational Standard:** A1.F.IF.A.2 • **A2.F.IF.B.3** Graph functions expressed symbolically and show key features of the graph, by hand and using technology.★ **Embedded with A2.F.BF.B.3 is A2.N.Q.A.1** A2.F.IF.B.3a Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.	• **A2.F.IF.B.3** Graph functions expressed symbolically and show key features of the graph, by hand and using technology.★ **Embedded with A2.F.BF.B.3 is A2.N.Q.A.1** **Foundational Standards:** A1.F.IF.A.1, A1.F.IF.C.7a, A1.A.APR.B.2, and A1.F.LE.A.1c • **A2.F.IF.B.3a** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Scope and Clarification A2.F.IF.B.3a: Tasks are limited to square root and cube root functions. The other functions are assessed in Algebra 1. **Foundational Standards:** None • **A2.F.BF.B.3** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, 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. Scope and Clarification i. Tasks may involve polynomial, exponential, and logarithmic functions. **ii.** Tasks may involve recognizing even and odd functions. **Foundational Standards:** A1.F.IF.C.6a, A1.F.IF.C.6b

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		Scope and Clarification A2.F.IF.B.3a: Tasks are limited to square root and cube root functions. The other functions are assessed in Algebra 1. **Foundational Standards:** None	
2	What **mathematical concepts** are embedded in the state standard?	**Understand that:** • The key features of a graph – including the domain, range, and intercepts – reveal the relationship between two quantities. • Students find and interpret key features of linear, quadratic, absolute value, and constant functions, including the x- and y-intercepts, the positive and negative internals, and intervals where the function is increasing and decreasing. • Students use the x-intercepts of a function to determine the zeros of a function, and they use set-builder and interval notation to state the domain and range.	**Understand that:** • A function of the form $f(x) = a \cdot f[b(x-h)] + k$ is transformed by changing the values of a, b, h, or k. Changing the value of h or k results in a horizontal or vertical translation, changing the sign of a or b results in a reflection across one of the axes, and changing the value of a or b results in a horizontal or vertical stretch or compression. • Students interpret, graph, and write equations of transformations of functions. Functions in the form $y = f(x-h)$ represent horizontal translations, functions in the form $y = f(x) + k$ represents reflections across the x-axis, functions in the form $y = f(-x)$ represent reflections across the y-axis, functions in the form $y = f(bx)$ represent horizontal stretches or compressions, and functions in the form $y = af(x)$ represent vertical stretches or compressions.
3	What teacher **knowledge, reminders, and misconceptions** are assumed in the standard?	**Knowledge:** • The lesson emphasizes a blend of conceptual understanding and application. • Identify and interpret the key features of the graph of a function, including the domain, range, intercepts, and areas where the graph is increasing or decreasing. • Identify intercepts of a function and interpret them in the context of a real-world problem, such as finding the distance that a car can travel before it runs out of gas. • Students use stated mathematical assumptions about the minimum value of a function to construct an argument explaining why the function has no maximum value. • Students demonstrate understanding of the meanings of mathematical symbols when they use information about the volume of a container and the rate at which it is being filled to describe the key features of the graph that models the situation. **Reminders and Misconceptions:** • Students created, graphed, and identified key features of functions. • While working problems involving square roots, students may only find one x-intercept. Have students check their work by substituting 0 for y and solving for x. • Students may forget when to use a bracket and when to use a parenthesis in interval notation. Have students make flashcards to review. One side should have interval notation, the other side	**Knowledge:** • The lesson emphasizes a blend of conceptual understanding and application. • Students apply their understanding of transformations either to graph a translation of a linear , quadratic, or absolute value function or to write an equation given a graph. • Students write equations for linear and quadratic functions by understanding how changing the values of a, b, h, and k affect the key features of the graph of a function. • Students use appropriate tools strategically to determine why the transformation $g(x) = f(-x)$ affects the x-coordinate of each point. **Reminders and Misconceptions:** • Students created, graphed, and identified the key features of graphs of linear, quadratic, and absolute value functions.

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		should represent the same interval on a number line. Students should focus on recognizing that a parenthesis in the interval notation corresponds to an open circle on the number line (or positive/negative infinity), and a bracket represents a closed circle.	
4	What **objective(s)** must be taught? In what order? Why?	**PBO:** • SWBAT graph the following functions, identify key features of the graph, and interpret the meaning of the key features in relationship to the context of the problem IOT solve a real-world problem. (square root function, cube root function, exponential function, polynomial function, logarithmic function) **(A2.F.IF.A.1)** • SWBAT calculate and interpret the average rate of change when given an equation or table of a polynomial, exponential, or logarithmic function IOT understand the meaning in a contextual problem. **(A2.F.IF.A.2)** • SWBAT estimate the average rate of change over a specified interval of a polynomial, exponential, or logarithmic function when given a graph IOT understand the meaning in a contextual problem. **(A2.F.IF.A.2)** • SWBAT graph a square root, cube root, polynomial with degree greater than two, exponential, and logarithmic function by hand and using technology IOT explain the relationship that exists between a contextual problem and the key features of a graph. **(A2.F.IF.B.3a)** **Lesson objectives**: • Identify key features of a graph of a function, including the intercepts, positive and negative intervals, and areas where the function is increasing or decreasing. • Calculate and interpret the average rate of change of a function over a specified interval. • Write the domain and range of function using set-builder and interval notations.	**PBO:** • SWBAT graph a square root, cube root, polynomial with degree greater than two, exponential, and logarithmic function by hand and using technology IOT explain the relationship that exists between a contextual problem and the key features of a graph. **(A2.F.IF.B.3a)** • SWBAT describe the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative) IOT understand and explain the differences of the transformations to f(x). **(A2.F.BF.B.3)** • SWBAT determine if the function is an odd function, even function, or neither, given a function defined by an expression IOT determine the graph the function. **(A2.F.BF.B.3)** • SWBAT experiment with cases and illustrate an explanation of the effects on the graph using technology IOT understand the differences of the transformations. **(A2.F.BF.B.3)** **Lesson objectives**: • Graph a transformed function by identifying the effect on the graph of replacing $f(x)$ by $f(x)+k, kf(x), f(kx)$ and $f(x+k)$ for specific values of k. • Write an equation of a transformed function. • Relate the domain of a function to its graph and the real-world situation it describes.
5	What **academic language** must be taught before the teacher models for students? How will the academic language be **taught and assessed**?	**Academic Language:** • **average rate of change** – the slope of a line or curve on a given range • **calculate** - to determine the amount or number of something mathematically • **context** – a situation used to describe a mathematical problem • **cube root** – one of three identical factors of a number that is the product of those factors • **degree** – the amount, level, or extent to which something happens or is present • **equation** – a mathematical statement containing an equal sign to show that two expressions are equal	**Academic Language:** • **compression -** a transformation that decreases the distance between corresponding points of a graph • **context** – a situation used to describe a mathematical problem • **cube root** – one of three identical factors of a number that is the product of those factors • **degree** – the amount, level, or extent to which something happens or is present • **describe** – give an account in words of (someone or something) that includes all the relevant characteristics • **determine** – to find out something using mathematical processes; to conclude after reasoning; to figure out

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		• **estimate** – an approximate calculation; judgment of the value, number, quantity, or extent of something • **explain** – make clear by describing • **exponential function** – nonlinear function in which the independent value is an exponent in the equation, and can be written in the following forms; y = abx, y = a(1+r)x, or y = a(1 – r)x • **function** – a relation in which every domain(input) value is paired with exactly one range(output) value. • **graph** – to plot; a pictorial diagram used to show a numerical relationship using distinctive plots. lines, bars, etc. • **interpret** – explain the meaning of (information, words, action) • **interval notation** - • **key features** – intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; domain; as determined by the function or by context. • **logarithmic function** – the inverse of an exponential function • **maximum –** • **minimum** - • **polynomial -** an expression of more than two algebraic terms, especially the sum of several terms that contain different powers of the same variable(s) • **polynomial function** - a function of more than two algebraic terms that for each real number x in the domain, f(x) is the value found by substituting and evaluating the number x • **problem** – a question that needs a solution • **relationship** – the way in which two or more concepts are connected • **set – builder notation -** • **square root** – one of two identical factors of a number that is the product of those factors. • **table** – numbers or quantities arranged in rows and columns • **understand** – comprehend; grasp the intended meaning of; infer something from information received • **zero of the function** - **Instructional Practice 2:** Strategies used to teach unfamiliar words will include: • 30 – 30 – 30 (common math-related word parts in the text, problem, or objective) • Point of Use Annotation of the Performance-Based Objective • Universal Language of Literacy • Word and Definition Walls • Word Parts	• **effect** – a change which is a result or consequence of an action or other cause • **even function** – is symmetric to the y-axis, and whose domain values are opposite and range values are the same; f-x) = f(x) • **experiment** - to make a discovery or demonstrate a known fact • **explain -** make clear by describing • **explanation** – a statement making something clear by describing it in more detail or by revealing relevant facts or ideas • **exponential function –** nonlinear function in which the independent value is an exponent in the equation, and can be written in the following forms; $y = ab^x$, $y = a(1 + r)x, or\ y = a(1 - r)x$ • **expression -** a group of mathematical numbers and/or symbols representing a number or quantity • **function** – a relation in which every domain(input) value is paired with exactly one range(output) value. • **graph** – to plot; a pictorial diagram used to show a numerical relationship using distinctive plots. lines, bars, etc. • **illustrate** – to explain; make clear by giving examples, pictures, charts, etc. • **key features** – intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; domain; as determined by the function or by context. • **logarithmic function** – the inverse of an exponential function • **odd function** – is symmetric to the origin, and the input and output values are both opposites; f(-x) = -f(x) • **polynomial -** an expression of more than two algebraic terms, especially the sum of several terms that contain different powers of the same variable(s) • **problem** – a question that needs a solution • **reflection** - a transformation of a figure that creates a mirror image or "flips" over a line • **relationship** – the way in which two or more concepts are connected • **square root** – one of two identical factors of a number that is the product of those factors. • **stretch** - a transformation that increases the distance between corresponding points of a graph • **transformation** – the mapping, or movement, of all points of a figure in a plane according to a common operation • **translation -** a transformation that slides each point of a figure the same distance in the same direction • **understand** – comprehend; grasp the intended meaning of; infer something from information received

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		• Context Clues • Point of Use Annotation of the Text (in Real-Time)	**Instructional Practice 2:** Strategies used to teach unfamiliar words will include: • 30 – 30 – 30 (common math-related word parts in the text, problem, or objective) • Point of Use Annotation of the Performance-Based Objective • Universal Language of Literacy • Word and Definition Walls • Word Parts • Context Clues • Point of Use Annotation of the Text (in Real-Time)
6	What **practice problems** are you planning to use for the I Do, We Do, You Do in Pairs, and You Do Without Assistance? What did you learn from working the problems **in advance** of using them in class with students?	**Station Rotation Model Suggestions** **Teacher-Led Station:** Teachers can work with students on additional We Do problems. • Additional Examples – TE pg. 5, pg. 7, pg. 8 • 1-1 Reteach to Build Understanding **Online Station**: Students can watch and engage with Virtual Nerd Video lessons. Students will initially tell what they think the answer to the question is or their opinion regarding an issue, and/or their thoughts based on a prompt. Then the students will watch the video to decide as to whether their original assertion was accurate, justified, etc. • 1-1: Virtual Nerd™: How Do You Write a Set in Interval Notation? **Offline Station:** Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #33 – Pg. 12 • 1-1 Additional Practice • 1-1 Mathematical Literacy and Vocabulary 1-1 Enrichment	**Station Rotation Model Suggestions** **Teacher-Led Station:** Teachers can work with students on additional We Do problems. • Additional Examples – TE pg. 13, pg. 16, pg. 19 • 1-2 Reteach to Build Understanding **Online Station**: Students can watch and engage with Virtual Nerd Video lessons. Students will initially tell what they think the answer to the question is or their opinion regarding an issue, and/or their thoughts based on a prompt. Then the students will watch the video to decide as to whether their original assertion was accurate, justified, etc. • 1-2: Virtual Nerd™: How Do You Reflect a Function? • 1-2: Virtual Nerd™: How do You Graph a Translation of a Function? **Offline Station:** Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #38 – Pg. 22 • 1-2 Additional Practice • 1-2 Mathematical Literacy and Vocabulary • 1-2 Enrichment
7	What **manipulatives** might be integrated into the gradual release of responsibility (I Do, We Do, You Do in Pairs, You Do Without Assistance)? What did you learn from using the manipulatives **in advance** of using them in class with students?	**Reference:** Interactive Manipulatives • Didax Virtual Manipulatives • Savvas Math Tools • Realize Desmos (Graphing Calculator) Realize Desmos (Scientific Calculator)	**Reference:** Interactive Manipulatives • Didax Virtual Manipulatives • Savvas Math Tools • Realize Desmos (Graphing Calculator) • Realize Desmos (Scientific Calculator)
8	What **graphic organizer(s)** might support students'	**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers	**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers

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	conceptual understanding of the process outlined by the performance-based objective(s)?	• Teacher Vision	• Teacher Vision

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