Educational Epiphany ™

Districtwide PLC Protocol for **Mathematics**

Teacher/Teacher Team:
Grade/Course: Algebra 2
Date: Week of August 29, 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 2.1 – Vertex Form of a Quadratic Function**	**Lesson 2.2 – Standard Form of a Quadratic**
		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. ★ **Foundational Standards:** A1.F.IF.A.1, A1.N.Q.A.1 **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. **Foundational Standards:** A1.F.IF.C.6a, A1.F.IF.C.6b	**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. **Foundational Standards:** A1.F.IF.A.1, A1.N.Q.A.1 **A2.S.ID.B.2** Represent data on two quantitative variables on a scatter plot and describe how the variables are related. **Foundational Standards:** 8.SP.A.3, A1.F.LE.A.1, A1.A.CED.A.2
2	What **mathematical concepts** are embedded in the state standard?	**Understand that:** • All quadratic functions are transformations of the parent function $f(x) = x^2$. • The vertex form of a quadratic function highlights the key features of the function's graph and shows how the graph of the parent function can be transferred. • Students create quadratic functions in vertex form that model graphed relationships between variables. • Students relate quadratic functions to the parent function $f(x) = x^2$. • Students express the vertex, axis of symmetry, domain, and range algebraically. • Students identify whether a quadratic function opens upward or downward. • Students use and interpret key features to graph quadratic functions and interpret these key features.	**Understand that:** • A quadratic function in vertex form can be written in standard form to highlight different features of the function's graph. • The key features are used to interpret values in context. • Students create quadratic functions written in standard form. • Students use the coefficients of the quadratic and linear terms to calculate the coordinates of the vertex and the axis of symmetry. • (why) the constant term in the quadratic function provides the value of the y-intercept. • Students identify key features of quadratic functions and relate them to the graphs of the function.

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3	What teacher **knowledge, reminders, and misconceptions** are assumed in the standard?	**Knowledge:** • This lesson emphasizes a blend of conceptual understanding and application. • Students understand that all quadratic functions are transformations of the parent function. • Students interpret key features of the graph of a quadratic function in terms of the quantities given in real-world problems, such as those describing projectile motion. • Students make sense of problems involving quadratic functions and plan solution pathways based on the information provided. • Students look for relationships between a quadratic function and its graph. • Students use structure of the function in vertex form to rewrite a quadratic function in its equivalent standard form $y = ax^2 + bx + c$. • Students create and graph quadratic functions in vertex form by identifying and interpreting the key features. **Reminders and Misconceptions:** • Students created and graphed linear functions. • Some students may switch the coordinate values when writing the vertex form of the equation of the parabola. Emphasize that h is the x-coordinate of the vertex and k is the y-coordinate of the vertex.	**Knowledge:** • This lesson emphasizes a blend of conceptual understanding and application. • Students understand that the standard form a quadratic function can be used to find the vertex and axis of symmetry for the function's graph. • Students apply the standard form of a quadratic function to solve real-world problems such as projectile motion problems. • Students use the standard form of a quadratic function to represent a real-world situation where height is expressed as a function of time. • Students find relationships involving a, h, and k by converting fro vertex form to standard form and then use it to identify the key features of the function's graph, including the vertex, axis of symmetry, maximum and minimum. • Students rewrite quadratic functions in standard form. • Students graph a quadratic function written in standard form by identifying its key features. **Reminders and Misconceptions:** • Students identified the key features of a quadratic function written in vertex form and used those features to graph the function. • When b is negative, students sometimes forget to include the negative sign when calculating the x-coordinate of the vertex because there is already a negative sign in $h = -\frac{b}{2a}$. Remind students to include the negative sign in the calculation when b is negative.
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 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**: • Create quadradic functions in vertex form to represent relationships between variables as shown in their graphs.	**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 write a function defined by an expression to model a quadratic or an exponential relationship given a real-world context IOT describe a given real-world context. **(A2.F.BF.A.1)** • SWBAT fit a linear function to a given set of data, fit a quadratic function to a given set of data, or fit an exponential function to a given set of data, where exponential functions are limited to domains not in the integers, IOT solve problems in the context of the data. **(A2.S.ID.B.2a)**

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		• Graph functions on coordinates axes using their key features. • Interpret key features of the graph of a quadratic function.	**Lesson objectives**: • Create quadratic functions written in standard form. • Identify key features of quadratic functions and graph a quadratic function written in standard form.
5	What **academic language** must be taught before the teacher models for students? How will the academic language be **taught and assessed**?	**Academic Language:** • **axis of symmetry -** • **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 • **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; $y = ab^x$, $y = a(1+r)^x$, 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. • **identify** – to recognize and name; to make sense of and assign meaning to the data • **interpret** – explain the meaning of (information, words, action) • **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 • **parabola -** the graph of a quadratic function • **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, especially the sum of several terms that contain different powers of the same variable(s) • **problem** – a question that needs a solution • **quadratic function** - $f(x) = ax^2bx + c$, for constants a, b, c with a not equal to zero and for x any real number • **real-world** – related to a concrete setting • **relationship** – the way in which two or more concepts are connected • **solve** – to find an answer • **square root** – one of two identical factors of a number that is the product of those factors	**Academic Language:** • **context -** situation used to describe the mathematical problem • **cube root** – one of three identical factors of a number that is the product of those factors • **data** – a collection of information or facts • **domain** – the set of input values of a function • **exponential function –** a 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 • **identify** – to recognize and name; to make sense of and assign meaning to the data • **integers** – whole numbers and their opposites • **interpret** – explain the meaning of (information, words, action) • **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. • **linear function** – a function whose graph is a line and is represented by a linear equation • **logarithmic function** – the inverse of an exponential function • **model** – to describe or show mathematically • **polynomial function** – a function 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 • **quadratic expression** – expression written with a squared term • **quadratic function**- $f(x) = ax^2 + bx + c$, for constants a, b, c with a not equal to zero and for x any real number • **real-world** – related to a concrete setting • **relationship** – the way in which two or more concepts are connected • **solve -** to apply an operation(s) in order to find a value; to find an answer • **square root** – one of two identical factors of a number that is the product of those factors

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		• **turning point** - of the graph of a function is a point where the graph changes direction from upwards to downwards or from downwards to upwards • **vertex** - the point at which the graph of a parabola changes directions; the highest or lowest point on the graph of a parabola. • **vertex form of a quadratic function** - the equation for a parabola in the form $y = (a-h)^2 + k$ where the point (h, k) is the vertex. **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)	• **standard form of a quadratic function -** $ax^2 + bx + c = 0$; where a, b, c, are real numbers and a is not equal to zero • **vertex form of a quadratic function -** the equation for a parabola in the form $y = (a-h)^2 + k$ where the point (h, k) is the vertex • **write** – to create using words, symbols, equations, expressions, etc. **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. 73, pg. 75, pg. 76 • 2-1 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. • 2-1: Virtual Nerd™: How do You Vertically Translate a Quadratic Function? • 2-1: Virtual Nerd™: What is Vertex Form of a Quadratic 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. 79 • 2-1 Additional Practice • 2-1 Mathematical Literacy and Vocabulary • 2-1 Enrichment	**Station Rotation Model Suggestions** **Teacher-Led Station:** Teachers can work with students on additional We Do problems. • Additional Examples – TE pg. 80, pg. 81, pg. 83 • 2-2 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. • 2-2: Virtual Nerd™: How Do You Convert a Quadratic Equation form Vertex Form to Standard Form? • 2-2: Virtual Nerd™: How Do You Write an Equation for a Quadratic if You Have Three Points? **Offline Station:** Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #31 – Pg. 87 • 2-2 Additional Practice • 2-2 Mathematical Literacy and Vocabulary • 2-2 Enrichment

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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' conceptual understanding of the process outlined by the performance-based objective(s)?	**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers • Teacher Vision	**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers • Teacher Vision

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