Educational Epiphany ™

Districtwide PLC Protocol for **Mathematics**

Teacher/Teacher Team:
Grade/Course: Algebra II
Date: Week of October 31, 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 4.2 – Graphing Rational Functions** • **A2.F.BF.B.3** Identify the effect on the graph of replacing $f(x)$ with $f(x)+k$, $kf(x)$, $f(kx)$, 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 Standard:** A1.F.IF.C.6a • **A2.A.APR.C.4** Rewrite rational expressions in different forms. **Foundational Standard:** 7.NS.A.2b	**Lesson 4.3 – Multiplying and Dividing Rational Expressions** • **A2.A.SSE.A.1** Use the structure of an expression to identify ways to rewrite it. **Foundational Standard:** A1.A.SSE.A.1 • **A2.A.APR.C.4** Rewrite rational expressions in different forms. **Foundational Standard:** 7.NS.A.2b
2	What **mathematical concepts** are embedded in the state standard?	**Understand that:** • A rational function is any function $R(x)=\frac{p(x)}{q(x)}$ where $p(x)$ and $q(x)$ are polynomial functions. The domain of a rational function is all real numbers except any x-values for which $q(x)$ equals to zero. The graph of a rational function has one or more asymptotes, which guide the end behavior of the graph. • Students graph rational functions by finding the function's asymptotes. A vertical asymptote exists where the value of x causes the denominator of the function to be zero. Horizontal asymptotes are determined by the relationship between the degrees of the numerator and denominator. • In some cases, students use long division to rewrite rational expressions as transformations of the reciprocal function and then find the asymptotes by identifying the transformation.	**Understand that:** • Rational expressions form a system similar to the system of rational numbers and can be multiplied and divided by applying the properties of operations as they apply to rational expressions. • Students multiply or divide a rational expression by another rational expression. They also multiply a rational expression by polynomial by first writing the polynomial as a rational expression with a denominator of 1. • Students write all products and quotients in the simplified form of a rational expression by dividing out all common factors other than one
3	What teacher **knowledge, reminders, and misconceptions** are assumed in the standard?	**Knowledge:** • Use long division to relate the quotient of a reciprocal function to the parent function and use it to sketch the graph. • Students should understand how to find both horizontal and vertical asymptotes and represent them graphically.	**Knowledge:** • Provide students with problems that make connections to work with division of polynomials and with the Remainder Theorem. • Students should be about to identify the quotient by name and as q(x) and to identify the remainder as a fraction with the divisor as the denominator.

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		• Students should be able to take a rational expression and graph it completely. • Students should be able to use rational functions in real-world situations. **Reminders:** • Make connections between symmetry and transformations represented both graphically and algebraically. **Misconceptions:** • Students frequently see $f(x+k)$ as a horizontal shift to the right k units.	• Provide students with procedural fluency in rewriting rational expressions as quotients and remainders. **Reminders:** • Students should understand operations with fractions and how those apply to multiplying and dividing rational expressions. **Misconceptions:** • Misconceptions may occur when determining the correct order of operations. • Students may want to cancel common variables from the numerator and denominator that have different degrees. • Students may forget to or struggle with completely factoring to simplify. • Students may struggle with writing the remainder as fraction.
4	What **objective(s)** must be taught? In what order? Why?	**PBO:** • **SWBAT** describe the effect on the graph of replacing $f(x)$ with $f(x)+k$, $kf(x)$, $f(kx)$, and $f(x+k)$ for specific values of k (both positive and negative) IOT understand and explain the differences of the transformations to $f(x)$. • **SWBAT** rewrite expressions IOT represent the expressions in different forms. **Lesson objectives**: • Graph rational functions by identifying asymptotes and end behavior. • Rewrite simple rational expressions in different forms using long division.	**PBO:** • **SWBAT** rewrite expressions IOT represent the expressions in different forms. • **SWBAT** rewrite rational expressions involving addition, subtraction, multiplication and/or division IOT represent the expressions in different forms. **Lesson objectives**: • Use the structure of rational expressions to rewrite simple rational expressions in different forms. • Understand that rational expressions form a system analogous to the system of rational numbers and use that understanding to multiply and divide rational expressions.
5	What **academic language** must be taught before the teacher models for students? How will the academic language be **taught and assessed**?	**Academic Language:** • **Expression** – a group of mathematical numbers and/or symbols representing a number or quantity • **Form** – the visible shape or configuration of something • **Represent** – state or point something out • **Rewrite** – to revise words, symbols, equations, expressions, etc. in a different way • **Describe** – give an account in words of (someone or something) that includes all the relevant characteristics • **Explain** – make clear by describing • **Graph** – a pictorial diagram used to show a numerical relationship using distinctive plots. lines, bars, etc. • **Transformation –** the mapping, or movement, of all points of a figure in a plane according to a common operation • **Understand –** comprehend; grasp the intended meaning of; infer something from information received • **Rational Expression** – An expression that can be expressed as the ratio of two polynomials, such as $\frac{p(x)}{q(x)}$, where $q(x) \neq 0$	**Academic Language:** • **Describe** – give an account in words of (someone or something) that includes all the relevant characteristics • **Explain** – make clear by describing • **Graph** – a pictorial diagram used to show a numerical relationship using distinctive plots. lines, bars, etc. • **Transformation** – the mapping, or movement, of all points of a figure in a plane according to a common operation • **Understand** – comprehend; grasp the intended meaning of; infer something from information received • **Expression** – a group of mathematical numbers and/or symbols representing a number or quantity • **Form** – the visible shape or configuration of something • **Rational** – a real number that can be written as a ratio • **Represent** – state or point something out • **Rewrite** – to revise words, symbols, equations, expressions, etc. in a different way

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		• **Rational Function** – Any function defined by a rational expression, such as $R(x) = \frac{p(x)}{q(x)}$, where $q(x) \neq 0$ **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)	• **Simplified Form of a Rational Expression** – A rational expression that has no common factors, other than 1, in the numerator and the denominator. **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. • 4-2 Reteach to Build Understanding **Online Station**: Students can engage with the Savvas Realize Explore & Reason, engage with MathXL for School: Additional Practice, or watch and engage with a Virtual Nerd Video • 4-2 Explore & Reason • 4-2: Math XL for School: Additional Practice • Virtual Nerd: How Do You Find the Horizontal Asymptotes of a Rational Function? • Virtual Nerd: How Do You Find the Vertical Asymptotes of a Rational Function? **Offline Station:** Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #35 – Pg. 209 • 4-2 Additional Practice	**Station Rotation Model Suggestions** **Teacher-Led Station:** Teachers can work with students on additional We Do problems. • 4-3 Reteach to Build Understanding **Online Station**: Students can engage with the Savvas Realize Explore & Reason, engage with MathXL for School: Additional Practice, or watch and engage with a Virtual Nerd Video • 4-3 Explore & Reason • 4-3: Math XL for School: Additional Practice • Virtual Nerd: How Do You Multiply Two Rational Expressions? • Virtual Nerd: How Do You Divide Two Rational Expressions? **Offline Station:** Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #37 – Pg. 216 • 4-3 Additional Practice
7	What **manipulatives** might be integrated into the gradual release of responsibility (I Do, We Do, You Do in Pairs, You Do	**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)

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	Without Assistance)? What did you learn from using the manipulatives **in advance** of using them in class with students?		
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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