

Educational Epiphany™

Districtwide PLC Protocol for Mathematics

Teacher/Teacher Team:
Grade/Course: Algebra 2
Date: Week of October 3, 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 3.3 – Polynomial Identities	Lesson 3.4 – Dividing Polynomials
		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.B.3 Know and use polynomial identities to describe numerical relationships. Foundational Standards: None	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.A.1 Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$. Foundational Standard: A1.A.SSE.B.3a A2.A.APR.C.4 Rewrite simple rational expressions in different forms Foundational Standard: 7.NS.A.2b
2	What mathematical concepts are embedded in the state standard?	Understand that: - Polynomial identities and the Binomial Theorem are helpful tools for efficiently rewriting expressions and describing mathematical relationships. - Students use the proven polynomial identities Difference of Cubes or Squares, Square of a Sum, and Sum of Cubes to multiply and factor polynomials. - Students use the Binomial Theorem to expand the powers of a binomial expression. They also use Pascal’s Triangle to determine the coefficients of the terms in the binomial expansion.	Understand that: - Polynomial expressions can be divided by linear factors using long division or synthetic division. The Remainder Theorem is used to determine the remainder of a polynomial division problem. - Students divide polynomial expressions using long division. when the divisor is linear and the leading coefficient is 1, students may use synthetic division instead. - Students find the remainder of a division problem using the Remainder Theorem and factor polynomials using the Factor Theorem.
3	What teacher knowledge, reminders, and misconceptions are assumed in the standard?	Knowledge: - This lesson emphasizes a blend of conceptual understanding and procedural skill and fluency. - Students understand that polynomial identities are useful tools for multiplying and factoring polynomials. - Students use numbers from Pascal’s Triangle and the Binomial Theorem to expand binomials. - Students make sense of quantities and their relationships when they use Pascal’s Triangle to find the value of n in polynomial expressions, given the sum of coefficients in the expansion.	Knowledge: - This lesson emphasizes a blend of conceptual understanding and procedural skill and fluency. - Students use the Remainder Theorem to understand the relationship between the divisor and the remainder in polynomial division. - Students use flexibility when choosing between the two methods for dividing polynomial expressions. - Students conceptualize the results of dividing a polynomial within the context of a real-world problem about the relationship between the volume and possible dimensions of an object.

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		- Students see polynomial expressions as a sum or difference of squares or cubes that can be multiplied or expanded to rewrite the expression. - Students know and apply the Binomial Theorem to expand powers of binomial expressions using Pascal's Triangle. - Students use polynomial identities to efficiently multiply and factor polynomials. Reminders and Misconceptions: - Students added, subtracted, and multiplied polynomial expressions.	- Students use clear mathematical language when explaining how they know that a specific binomial is a factor of a polynomial. - Students divide polynomials using long division and synthetic division. - Students use the Remainder Theorem to evaluate polynomials. - Students use the Factor Theorem to identify factors of a polynomial. Reminders and Misconceptions: - Students used identities and theorems to rewrite polynomial expressions in different forms.
4	What objective(s) must be taught? In what order? Why?	PBO: - SWBAT rewrite expressions IOT represent the expressions in different forms. (A2.A.SSE.A.1) - SWBAT identify and use appropriate polynomial identities IOT use them to describe given numerical relationships. (A2.A.APR.B.3) Lesson objectives: - Prove polynomial identities and use them to multiply and factor polynomials. - Expand binomials using the Binomial Theorem and coefficients determined by Pascal's Triangle.	PBO: - SWBAT rewrite expressions IOT represent the expressions in different forms. (A2.A.SSE.A.1) - SWBAT know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$, IOT find all factors for a polynomial $p(x)$. (A2.A.APR.A.1) - SWBAT rewrite rational expressions involving addition, subtraction, multiplication and/or division IOT represent the expressions in different forms. (A2.A.APR.C.4) Lesson objectives: - Divide polynomial expression using long division. - Use synthetic division to rewrite 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: appropriate – suitable or proper in the circumstances binomial - a polynomial of two terms Binomial Theorem - A rule for writing out the expansion of $(a + b)^n$ without performing all the multiplication involved, in which a and b are any real numbers and n is an integer describe – give an account in words of (someone or something) that includes all the relevant characteristics expression – a group of mathematical numbers and/or symbols representing a number or quantity form – the visible shape or configuration of something identify – to recognize and name; to make sense of and assign meaning to the data numeric - of, related to or expressed as a number or numbers Pascal's Triangle - a triangular array of numbers in which the first and last number is 1	Academic Language: apply – put to use; do division - repeated subtraction expression - a group of mathematical numbers and/or symbols representing a number or quantity Factor Theorem - the expression $x - a$ is a linear factor of a polynomial if and only if the value of a is a root of the related polynomial function factor – numbers or variables that are multiplied to obtain a product or new expression find – to determine and make a statement about form – the visible shape or configuration of something know - be aware of through observation, inquiry, or information polynomial – an expression of more than two algebraic terms, especially the sum of several terms that contain different powers of the same variable(s) rational – a real number that can be written as a ratio

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		• polynomial – an expression of more than two algebraic terms, especially the sum of several terms that contain different powers of the same variable(s) • relationship – the way in which two or more concepts are connected • represent – state or point something out • rewrite -to revise words, symbols, equations, expressions, etc. in a different way • use – take or hold; apply; deploy (something) as a means of accomplishing a purpose or achieving a result 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)	• Remainder Theorem - If you divide a polynomial $P(x)$ of degree $n > 1$ by $x - a$, then the remainder is $P(a)$. • represent – state or point something out • rewrite -to revise words, symbols, equations, expressions, etc. in a different way • synthetic division - process for dividing a polynomial by a linear expression $x - a$. 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. 146, pg. 148, pg. 150 • 3-3 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. • 3-3: Virtual Nerd™: How Do You Expand a Power of a Binomial Sum Using the Binomial Theorem? • 3-3: Virtual Nerd™: What is the Formula for Factoring the Sum of Cubes? Offline Station: Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #69 – Pg. 153 • 3-3 Additional Practice • 3-3 Mathematical Literacy and Vocabulary • 3-3 Enrichment	Station Rotation Model Suggestions Teacher-Led Station: Teachers can work with students on additional We Do problems. • Additional Examples – TE pg. 154, pg. 156, pg. 157 • 3-4 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. • 3-4: Virtual Nerd™: How Do You Divide a Polynomial by a Binomial Using Synthetic Division When You Have a Remainder? • 3-4: Virtual Nerd™: How Do You Determine Whether a Binomial is a Factor of Polynomial Using the Factor Theorem? Offline Station: Students would complete problems and exercises selected for the You Do in Pairs part of the lesson. • Lesson Performance Task #37 – Pg. 161 • 3-4 Additional Practice • 3-4 Mathematical Literacy and Vocabulary • 3-4 Enrichment
7	What manipulatives might be integrated into the	Reference: Interactive Manipulatives • Didax Virtual Manipulatives	Reference: Interactive Manipulatives • Didax Virtual Manipulatives

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	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?	• Savvas Math Tools • Realize Desmos (Graphing Calculator) • Realize Desmos (Scientific Calculator)	• 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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