Unit #04: Polynomials

Content Area: **Mathematics**
Course(s): **English I, Algebra II**
Time Period: **November**
Length: **6 weeks**
Status: **Published**

Unit Overview

This unit is broken into groups of lessons: working with polynomials, factors of polynomials, and applications of factoring. In the first three lessons, the terms associated with polynomials are reviewed and the laws of exponents are used to develop the concepts used to find the products of polynomials. Greatest common factor and least commmon multiple are used to develop the methods of factoring polynomials in the next three lessons. In the last lesson the methods developed in the unit are used to solve polynomial equations.

Enduring Understandings

Students will understand that performing operations on polynomials helps you solve and graph them.

There are different approaches to solving polynomial functions.

Essential Questions

- How can we classify equations?
- What must you know in order to solve an equation?
- Why is it necessary to have rules?

Lesson Titles/Objectives

- Add and subtract polynomials.
- Factor polynomials by using GCF.
- Factor polynomials by grouping terms.
- Factor quadratic polynomials.
- Find GCF and LCM of integers and monomials.
- Multiply and divide polynomials.
- Recognize special cases of factoring polynomials.
- Simplify polynomials.

- Solve polynomial equations.
- Solve polynomial inequalities.
- Solve problems using polynomial equations.
- Use laws of exponents.

Standards

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.N-RN.A.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.
MA.A-SSE.B	Write expressions in equivalent forms to solve problems
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
MA.K-12.7	Look for and make use of structure.
MA.F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.A-APR	Arithmetic with Polynomials and Rational Expressions
MA.A-APR.A	Perform arithmetic operations on polynomials
MA.A-APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
MA.A-APR.B	Understand the relationship between zeros and factors of polynomials
MA.F-IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
MA.A-APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
MA.F-LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.

Indicators

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress

	and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
	Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.
MA.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
MA.A-SSE.A.1b	Interpret complicated expressions by viewing one or more of their parts as a single entity.
	Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.
MA.A-SSE.B.3a	Factor a quadratic expression to reveal the zeros of the function it defines.
MA.A-SSE.B.3b	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
MA.A-SSE.B.3c	Use the properties of exponents to transform expressions for exponential functions.
	Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.
MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.

MA.F-IF.C.7b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.
MA.F-IF.C.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
MA.F-IF.C.8a	Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
MA.F-IF.C.8b	Use the properties of exponents to interpret expressions for exponential functions.

21st Century Skills and Career Ready Practices

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Inter-Disciplinary Connections

LA.W.11-12.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
LA.SL.11-12.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
LA.SL.11-12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.L.11-12.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
12.9.3.ST-ET.3	Apply processes and concepts for the use of technological tools in STEM.
12.9.3.ST-ET.5	Apply the knowledge learned in STEM to solve problems.
12.9.3.ST-SM.1	Apply science and mathematics to provide results, answers and algorithms for engineering

	and technological activities.
12.9.3.ST-SM.2	Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
12.9.3.ST-SM.3	Analyze the impact that science and mathematics has on society.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

Warm-Up

- Kahoot!
- Long division Problems without a calculator
- Sample PARCC item
- Sample SAT question
- Socrative

Anticipatory Set

- Difference between GCF and LCM
- How does multiplying and dividing polynomials relate to each other
- Review parts of polynomials and special vocabulary

Instructional Strategies/Learning Activities

- Intro lesson on adding and subtracting polynomials
- Intro lesson on dividing a polynomial by a first degree polynomial using synthetic division
- Intro lesson on dividing monomials subtract exponents
- Intro lesson on dividing polynomial by polynomial using long division
- Intro lesson on factoring by grouping terms
- Intro lesson on factoring difference of 2 squares and perfect square trinomials
- Intro lesson on factoring sum and difference of two cubes
- Intro lesson on factoring trinomial with leading coefficient of 1
- Intro lesson on factoring trinomials with leading coefficient greater than 1
- Intro lesson on finding the GCF and LCM
- Intro lesson on multiplying binomial by binomial, and binomial by trinomial
- Intro lesson on multiplying same base add exponents
- Intro lesson on power to a power
- Intro lesson on solving polynomial equations by factoring
- Intro lesson on vocab terms needed for the Polynomial Unit
- Intro lesson on zero and negative exponent rules

- Notes will be taken using Power Point
- Review homework
- Review warm up
- Students will present solutions on the board
- Students will work independently on examples
- Students will work together on a worksheet

Closure

- Discussion on today's lesson
- Exit ticket
- Journal Entry
- Kahoot!
- Oral Questioning
- Poll the class to self-analyze their comfort level of the lesson
- Socrative
- Vocab Review
- What did you learn today?

Modifications-G&T, LES, Special Education

- Collaborate with after-school programs or clubs to extend learning opportunities.
- Engage students with a variety of Mathematical Practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Provide ELL students with multiple literacy strategies.
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Structure the learning around explaining or solving a social or community-based issue.
- Use project-based math learning to connect math with observable phenomena.

Formative Assessment

- Factoring Quadratics Quiz
- Group Work
- Guided Practice
- Individual Practice
- Kahoot!
- Multiplying Polynomials Quiz
- Observation
- Oral Responses
- Smart Response
- Socrative
- Solving by Factoring Quiz
- Teacher Observation

Summative Assessment

- Unit Test on Factoring

Resources & Technology

- chromebook
- Desmos online graphing calculator
- Graphing Calculator
- Kahoot!
- mathxlforschool.com
- PowerPoint
- Smart Board
- Socrative.com
- Teacher generated worksheets
- Textbook: Algebra and Trigonometry Structure and Method Book 2 (McDougal Littell)
- Video to introduce or demonstrate concepts