Unit 4 Polynomials

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **5-6 weeks**
Status: **Published**

Brief Summary of Unit

The beginning of this chapter focuses on vocabulary, concepts, and skills related to polynomials. Prior work with factoring is extended to polynomials with degree greater than 2. Synthetic division is used to efficiently test possible solutions before rewriting polynomials in factored form to solve polynomial equations. Then, the last part of the chapter details graphing polynomials and modeling polynomial functions.

Revision Date: July 2024

Standards

MATH.9-12.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.
MATH.9-12.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.
MATH.9-12.A.APR.C.4	Prove polynomial identities and use them to describe numerical relationships.
ELA.L.KL.9–10.2.A	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.
MATH.9-12.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.
MATH.9-12.A.APR.D.6	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
MATH.9-12.A.CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MATH.9-12.N.CN.C.8	Extend polynomial identities to the complex numbers.
MATH.9-12.N.CN.C.9	Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
MATH.9-12.F.IF.B.4	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.
MATH.9-12.F.IF.C.7.c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

MATH.9-12.A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
ELA.SL.PE.11–12.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.

Essential Questions

- How can polynomial functions be used to model real-world problems?
- How can the properties of the real number system be useful when working with polynomials?
- How do the characteristics of quadratics apply to polynomials?
- How do we factor a polynomial?
- How do we use the factors of a polynomial to solve a division problem?
- What could you learn by classifying polynomials?
- Why can two algebraic expressions that appear to be different be equivalent?

Enduring Understandings

- Add, subtract, and multiply polynomials.
- Analyze graphs of polynomial functions.
- Describe and graph transformations of polynomial functions.
- Divide polynomials by other polynomials.
- Factor polynomials using a variety of methods.
- Graph and describe polynomial functions.
- Solve polynomial equations and find zeros of polynomial functions.
- Use the Fundamental Theorem of Algebra to find all complex roots of polynomial equations.
- Write polynomial functions using various forms.

Students Will Know

- How to add, subtract, multiply divide, and factor polynomials.
- How to graph polynomial functions.
- How to model with and analyze graphs if polynomial functions.
- How to solve polynomial equations.

Students Will Be Skilled At

- Adding and subtracting polynomials.

- Describing and graphing transformations of polynomial functions.
- Describing end behavior of polynomial functions.
- Dividing polynomials by binomials in the form x-k using synthetic division.
- Explaining how solutions of equations and zeros of functions are related.
- Explaining the relationship among the degree of a polynomial function, real zeros, and turning points.
- Factoring polynomials.
- Finding common monomial factors of polynomials.
- Graphing polynomial functions.
- Identifying and evaluating polynomial functions.
- Identifying characteristics of polynomials from the function as well as the graph.
- Identifying the degree of a polynomial and explaining the Fundamental Theorem of Algebra.
- Multiplying polynomials and using special product patterns.
- Solving polynomials.
- Using technology to find a polynomial model for a set of data.
- Writing a polynomial function when given information about its zeros.
- Writing functions that represent transformations of polynomial functions.

Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions
- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations

Learning Plan

The following list is meant to create a day-to-day plan. Teachers are encouraged to slow down or condense days as appropriate to the student population in the class. Assessment(s) should be given when appropriate. (This unit may need to be broken into two parts due to the timing of midterm exams. Plan appropriately and talk with other teachers of this course to determine what must be covered before the exams.)

- Have students recall as many classifications for functions based on its highest degree, and fill in the missing gaps of knowledge (when stuck, try leading questions such as "what is x^3 also called?"). Based on their prior knowledge of functions, students will discover end behavior patterns. Reinforce this knowledge by creating a list of points for a given equation to determine its end behavior.
- Students should recall how to combine like terms when adding and subtracting polynomials, but be sure to show them how to do this both vertically and horizontally. You can also show how to multiply polynomials vertically, but most students prefer horizontally. When multiplying with trinomial, show how the "box method" can be used to better organize all the terms.
- Students will likely need additional time to practice finding end behavior and simplifying polynomials with the above three operations.
- Introduce synthetic division as the last operation for polynomials. Carefully emphasize that a binomial should be solved for its x-value before setting up the division. Also, reinforce that any missing terms in a polynomial should have the placeholder of zero in the set up of coefficients. Be specific when writing the quotient, noting that all the terms have dropped one degree and the remainder is written in a fraction with the binomial.
- Take time to refresh student prior knowledge of factoring techniques. This should include: GCF, trinomial with a<1, trinomial with a>1, and difference of squares.
- Introduce how to use the trinomial factoring methods when there is a quartic trinomial. Introduce how to use the difference of squares factoring method when it is a quartic. Introduce factor by grouping for a cubic polynomial. Point out there may be additional factoring needed to completely factor all these methods.
- Students will likely need additional time to practice all the newly introduced factoring methods.
- Now that the factoring skills should be solid, take it one step further and have students solve polynomials after factoring completely. Remind students that there are many ways to solve, including quadratic formula if needed. Mention at this point that the Fundamental Theorem of Algebra requires the same number of solutions as the highest degree of the given polynomial. This will lead to a conversation about multiplicities.
- Using the zeros and end behavior, have students accurately graph polynomials. Make a distinct "call back" to the beginning of the chapter when they guessed at the look of a polynomial graph based on random points found. Take this time to illustrate how multiplicities effect the graph.
- Students will likely need additional time to practice solving for zeros and graphing a polynomial based on a given equation.
- Begin working "backwards" by giving the roots of a polynomial and finding the polynomial equation. Introduce the Irrational/Complex Conjugates Theorem, focusing on monomial complex numbers. (If time allows, you can introduce binomial conjugates. But consult with other teachers of this class to determine if this should be covered.)
- To build on the previous lesson, incorporate multiplicities as given roots. Multiplicities can apply to both simple and complex roots.
- From here, take another step "backwards" by giving the students a graph with decided zeros and end behavior for the students to find the equation of. Remind students how multiplicities play into the equation.
- Students will likely need additional time to practice working "backwards" to find a polynomial equation based on given roots, both complex and simple, and/or a given graph.
- Remind students that when graphing polynomials, they can also have transformations applied to them.

Take this time to point out local maxima and minima, multiples of them if necessary.

- Discuss how to graphically point out an even or odd function. Then introduce how to algebraically prove that a function is even, odd, or neither.

Materials

Core instructional materials:Core Book List including Big Ideas Math Algebra 2 2022

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes

Suggested Strategies for Modifications

Possible accommodations/modification for Algebra 2