Unit 03: Polynomial Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **1-2 weeks**
Status: **Published**

Brief Summary of Unit

Students will examine functions with degree greater than two. Through exploration on the graphing calculators, students will find roots and discuss the distinguishable characteristics of cubics and quartics including end behavior, root multiplicities and local extrema. Without graphing calculators, students will utilize the rational root theorem and synthetic division to find roots and graph the related function.

Revised Date: July 2025

Standards

Math Focus:

- Graphing and interpreting **polynomial models** (e.g., income curves)

Connected Social Studies Standards:

6.1.12.EconNE.14.a

Use economic indicators to evaluate the effectiveness of economic policies.

6.3.12.EconET.4

Analyze and propose solutions to current economic disparities, both local and global.

6.3.12.CivicsPR.7

Evaluate the effectiveness of public policy in addressing social and economic issues facing diverse populations in New Jersey and the United States.

L.SS.11–12.1	Demonstrate command of the system and structure of the English language when writing or speaking.
9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
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.
9.4.2.CT.2	Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3).
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.

L.VL.11–12.3	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, including technical meanings, choosing flexibly from a range of strategies.
A.APR.D.6	Rewrite simple rational expressions in different forms; write □(□)/□(□) in the form □(□) + □(□)/□(□), where □(□), □(□), □(□), and □(□) are polynomials with the degree of □(□) less than the degree of □(□), using inspection, long division, or, for the more complicated examples, a computer algebra system.
N.CN.A.3	Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
N.CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.
N.CN.C.8	Extend polynomial identities to the complex numbers.
N.CN.C.9	Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
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.
F.IF.C.7.c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Essential Questions

- How are higher-order functions graphed and what strategies can be used to solve higher-order equations?
- What are the distinguishable characteristics of functions with degree greater than two?

Enduring Understandings

- A polynomial function can be determined if the zeros of the function are known. The equation of the polynomial can be determined if a sketch of the graph is given, noting the zeros and whether the leftmost portion of the graph is positive or negative.
- An equation with odd degree has at least one real root.
- Evaluating a function at a given value can be accomplished by direct substitution or synthetic substitution.
- Graphing calculators can be used to find roots of a polynomial. Once a root is found, the polynomial can be factored by synthetic division.
- Knowing that f(a) is positive and f(b) is negative is enough to show that there must be a root somewhere on the interval [a, b] for any polynomial function.
- Synthetic division is a simplified version of long division.
- The multiplicity of a root determines if the graph is tangent at that point or if the graph has a horizontal tangent.
- The Rational Root Theorem and synthetic division can be used to factor a polynomial of degree 3 or higher.
- The Remainder Theorem and the Factor Theorem used in conjunction with synthetic substitution/division can help one determine if ‘a’ is a zero or ‘x-a’ is a factor.
- The sum and product of roots can be used to find the equation of any quadratic. This can be further

extended to find the equation of polynomials of degree 3 or higher.

Students Will Know

- How to graph a polynomial given its roots and/or equation.
- How to perform long and synthetic division of polynomials.
- The effect of the degree on the number of roots that a polynomial can have.
- The Fundamental Theorem of Algebra and Complex Conjugates Theorem.
- The Remainder Theorem, Factor Theorem and Rational Root Theorem.

Students Will Be Skilled At

- Describing the execution and uses of the Complex Conjugates Theorem.
- Describing the execution and uses of the Factor Theorem.
- Describing the execution and uses of the Fundamental Theorem of Algebra.
- Describing the execution and uses of the Rational Root Theorem.
- Describing the execution and uses of the Remainder Theorem.
- Graphing roots for a polynomial equation.
- Identifying how the degree of a polynomial's roots effect the graph.
- Performing any kind of division on polynomials.

Assessment

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
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students

- 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.

- Introduce long division for polynomials divided by a binomial. Include cases of various binomial types (linear, quadratic, cubic, leading coefficient as one, leading coefficient not as one, etc).
- Define synthetic division and its quotient after a root is given for a polynomial equation. Discuss how to use the Fundamental Theorem of Algebra to identify the number of solutions.
- Emphasize that the given root is a binomial that divides into the polynomial and can be written alongside the quotient as part of the answer. Describe the difference between this binomial in synthetic division and long division.
- Introduce Remainder Theorem and Factor Theorem. Use these theorems as an extension of synthetic division or instead of it.
- Use Rational Root Theorem when a root is not given. Continue to discuss the Remainder and Factor Theorems.
- Use synthetic division with a given root or Rational Root Theorem in cases with multiplicities.
- When give all roots of a polynomial, determine the equation. Include cases of multiplicity. Also include complex solutions.
- Introduce the Complex Conjugate Theorem when given roots and solving for polynomial equations.
- Graph polynomials when given roots. Include cases of multiplicity.
- Graph polynomials when roots are found through synthetic division or Rational Root Theorem. Include cases of multiplicity.
- Given a graph, determine how to write the equation of the polynomial. Include cases of multiplicity.
- Identify max/min values of a graph. Discuss notation for increasing, decreasing, and constant intervals.

Graphing calculators are encouraged to be used as an extension of these topics.

Materials

Core instructional materials: Core Book List including PreCalculus Enhanced with Graphing Utilities, Sullivan, Savvas

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy

- Teacher created activiites
- Teacher created notes
- Whiteboard tables

Integrated Accommodation & Modifications

Possible accommodations/modification for CP PreCalc & Trig