*Unit 2 Polynomial Equations and Functions

Content Area: **Mathematics**
Course(s): **Algebra 2 CP**
Time Period: **Marking Period 1**
Length: **10 blocks**
Status: **Published**

Transfer Skills

In this unit, students will extend upon factoring to include higher order polynomials. Students will make connections between zeros and factors and graphs of polynomials.

Instructional Notes

- The "Definitions of Polynomials" Skills are review from Algebra 1 and should be reviewed using retention strategies and Warm-Ups.
- Factoring polynomials is a major concept in this unit and should be connected to graphs of polynomials.
- The use of a graphing calculator is encouraged for students to check their work when graphing polynomials and solving polynomial equations.

BLUE* = 9/10 Only**

RED = 9/10 & 11/12

Enduring Understandings

Defining and solving the problem begins by selecting the appropriate procedural tool.

The characteristics of polynomial functions and their representations are useful in solving real-world problems.

The domain and range of polynomial functions can be extended to include the set of complex numbers.

Essential Questions

How can I use the remainder and factor theorems to solve polynomials?

How do we use polynomial patterns to make real world predictions?

Content

Vocabulary:

- Polynomial
- Factors
- Rational Zeros
- Degree of polynomials
- Synthetic Substitution
- Synthetic Division
- Even Function*
- Odd Function*

Skills

Definitions of Polynomials

- Recognize characteristics of a polynomial expression and use proper vocabulary to classify polynomial expressions.
- Express polynomials in standard form.
- Perform arithmetic operations on polynomial expressions: add, subtract & multiply

Solving Polynomials

- Understand the relationship between zeros and factors of polynomials.
- Factor and solve polynomials using the zero product property for all solutions (real and complex) above degree 2, including:
    - Quartic Polynomials
    - Greatest Common Factor
    - Embedded Difference of Squares
    - Using Sums/Differences of Cubes
    - By Grouping (4 terms)

Division of Polynomials

- Use the Remainder Theorem to evaluate polynomials. (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))
- Use synthetic division to divide polynomials given one possible factor or zero.
- Use synthetic division to solve polynomial equations given one factor or zero.
- Use synthetic division to solve polynomial equations using the graphing calculator to determine a zero.*

Graphing Polynomials

- Create a basic graph of a polynomial: Identify zeros, multiplicity, and show end behavior.
- Identify zeros of polynomials by factoring by grouping or using synthetic division (given one zero or factor), and use the zeros to construct a rough graph of the function defined by the polynomial.
- Identify zeros of polynomials by using synthetic division and the graphing calculator to determine a zero, and use the zeros to construct a rough graph of the function defined by the polynomial.*
- Create an equation of a polynomial given zeros or from a graph.
- Recognize and identify even and odd functions from their graphs and algebraic expressions for them.*
- 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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; end behavior; and multiplicities.
- Determine relative maximums and minimums.*
- Estimate the rate of change from a graph, table, or polynomial function over a given interval.

Resources

NJGPA Practice Test

https://nj.mypearsonsupport.com/practice-tests/njgpa-math/

NJSLA Practice Test*

https://nj.mypearsonsupport.com/practice-tests/math/

Teacher Resources by Standard

www.illustrativemathematics.org

illuminations.nctm.org/

www.pbslearningmedia.org/

Online Teaching Websites

www.khanacademy.org

www.ixl.com

Algebra 2 Common Core Textbook

Chapter 5 pg. 277

Assessments

Quiz
Formative: Other Evidence: Other: Quiz

Polynomial Operations and Terminology, Factoring Polynomial Equations, Solving Polynomial Equations by Factoring

Quiz
Formative: Other Evidence: Other: Quiz

Evaluating, Dividing Polynomial Expressions and Solving Polynomial Equations using Synthetic Division

Quiz
Formative: Other Evidence: Other: Quiz

Polynomial Graph Sketches

Unit Test
Summative: Transfer Tasks: Test: Common

Polynomial Equations and Functions

Standards

NJSLS 2016

Algebra

Arithmetic operations on polynomials

A- APR A. Perform arithmetic operations on polynomials

1. Understand that polynomials form a system analogous to the intergers, namely, they are closed under the operations of addition, subtratction, and multiplicatino; add, subtract, multiply polynomials.

B. Understand the relationship between zeros and factors of polynomials

2. Know and apply the Remainder Theorem: For 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).

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.

C. Use polynomial identities to solve problems

4. Prove polynomial identies and use them to describe the numerical relationships. For example, the difference of two squares, the sum and difference of two cubes.

Creating Equations

A -CED A. Create equations that describe numbers or relationships

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Functions

Interpreting Functions

F-IF B. Interpret functions that arise in applications in terms of the context

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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums*; symmetries; end behavior; and periodicity.

5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph

C. Analyze functions using different representations

7. Graph functions expressed symbollically and show key features of a the graph, by hand in simply cases and using technology for more complicated cases.

c. Graph polynomial functions, identifying zeros when suitable factprizations are available and showing end behavior.

Building Functions

F-BF B. Build new functions from existing functions

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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

Mathematical Practices

2 Reason abstractly and quantitatively.

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.

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

7 Look for and make use of structure.

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 x2 + 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	Interpreting Functions
MA.F-IF.B	Interpret functions that arise in applications in terms of the context
MA.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.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.F-IF.B.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
MA.F-IF.C	Analyze functions using different representations
MA.F-IF.C.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.
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.A-APR.B.2	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 $p(x)$.
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.A-APR.C	Use polynomial identities to solve problems
MA.A-APR.C.4	Prove polynomial identities and use them to describe numerical relationships.
MA.A-CED	Creating Equations
MA.A-CED.A	Create equations that describe numbers or relationships
MA.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.
	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.
	For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.
	Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a

student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.