# *Unit 2 Polynomial Equations and Functions Copied from: Algebra 2 CP, Copied on: 07/06/22

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| Content Area: | **Mathematics** |
| Course(s): | **Algebra 2 CP** |
| Time Period: | **November** |
| 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**

Factoring polynomials is a major concept in this unit and should be connected to graphs of polynomials.

## 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

**Defintions of Polynomials**

Define polynomials and identify expressions as polynomials.

Express polynomials in standard form.

Classify polynomial functions based on degree, number of terms.

Perform arithmetic operations on polynomials.

**Solving Polynomials**

Use the structure of an expression to identify ways to rewrite it in a case where two or more rewriting steps are required. (Ex 1: Factor completely: 6cx - 3cy - 2dx + dy Ex, 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 $(x^2 - y^2)(x^2 + y^2)$.

Factor and solve polynomials using sums/differences of cubes.

Factor and solve polynomials by grouping.This will require basic grouping, and grouping where a second factoring step is required.

**Division of Polynomials**

Use synthetic division to divide polynomials.

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).

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.

**Graphing Polynomials**

Create a basic graph of a polynomial and identify zeros and multiplicity and show end behavior.

Create an equation of a polynomial with given zeros or from a graph.

Identify the effect on the graph of a polynomial by 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.

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; relative maximums and minimums; symmetries; end behavior; and periodicity.

Estimate the rate of change from a graph, table, or polynomial function over a given interval.

## Resources

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**PARCC Practice Test for EOY**

www.parcconline.org/practice-tests

**NJDOE Model Curriculum**

www.state.nj.us/education/modelcurriculum/math/

**Teacher Resources by Standard**

www.illustrativemathematics.org

katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf

illuminations.nctm.org/

www.pbslearningmedia.org/

**Online Teaching Websites**

www.khanacademy.org

www.youtube.com/user/bullcleo1

**Algebra 2 Common Core Textbook**

Chapter 5 pg. 277

## 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. Understnad the relationship between zeros and factors of polynomials**

2. Know and apply the Remainder Theorem: For polynomial p(x) and a number a, ther remainder on divisio 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 behaior.

**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.

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| MA.F-BF | Building Functions |
| MA.F-BF.B.3 | Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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. |
| 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. |

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| 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.

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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.