Algebra 2

[Implement Start Year (2013-2014)]

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Unit #3, Polynomial Functions

Stage 1 – Desired Results

Established Goals

2009 NJCCC Standard(s), Strand(s)/CPI #
(http://www.nj.gov/education/cccs/2009/final.htm)

Common Core Curriculum Standards for Math and English
(http://www.corestandards.org/)

The Complex Number System N-CN: 3, 8, 9
- Perform arithmetic operations with complex numbers.
- Use complex numbers in polynomial identities and equations.

Seeing Structure in Expressions A-SSE: 1, 1a, 1b
- Interpret the structure of expressions.

Creating Equations A-CED: 2
- Create equations that describe numbers or relationships.

Arithmetic with Polynomials and Rational Expressions A-APR: 1, 2, 3
- Perform arithmetic operations on polynomials.
- Understand the relationship between zeros and factors of polynomials.

Interpreting Functions F-IF: 4, 5, 6, 7, 7c
- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

21st Century Themes
(www.21stcenturyskills.org)

_x_ Global Awareness
_x_Financial, Economic, Business and Entrepreneurial Literacy
_x_Civic Literacy
_x_Health Literacy
_x_Environmental Literacy

21st Century Skills

Learning and Innovation Skills:
_x_Creativity and Innovation
_x_Critical Thinking and Problem Solving
_x_Communication and Collaboration

Information, Media and Technology Skills:
_x_Information Literacy
_x_Media Literacy
_x_ICT (Information, Communications and Technology) Literacy

Life and Career Skills:
_x_Flexibility and Adaptability
_x_Initiative and Self-Direction
_x_Social and Cross-Cultural Skills
_x_Productivity and Accountability
_x_Leadership and Responsibility

Enduring Understandings: *Students will understand that . . .*	**Essential Questions:**
EU1 • graphs can be examined in detail or in their entirety depending on what information is sought. • graphs provide a means of correlation. EU2 • operations can be performed over the complex number system. EU3 • Symbolic statements can be manipulated to produce other statements of the same relationship. EU4 • the characteristics of polynomial functions and their representations are useful when solving real world problems.	EU1 • What is the correlation between the graphical and algebraic representations of a polynomial function? EU2 • How is arithmetic properties used to simplify expressions involving complex numbers? EU3 • How are factors, solutions, and zeros of a polynomial function related? EU4 • What real world phenomena can be represented with mathematical functions? • How can you determine and use the relationships between models to investigate future situations? • What do the solutions to polynomial functions provide?
Knowledge: *Students will know . . .* EU1 • the leading coefficient dictates the end behavior of a polynomial function • the maximum number of real zeros of a function coincide with its degree and are the x-intercepts of its graph • imaginary zeros are not indicated on the graph of a polynomial function EU2 • polynomial expressions should be simplified using order of operations • the meaning of a complex number • complex numbers should be simplified using order of operations • complex zeros come in conjugate pairs EU3 • polynomial equations can be translated from standard form to factored form and factored form to standard form in a polynomial equation • how to solve various polynomial equations by factoring • how to recognize the relationship between a zero and a factor	**Skills:** *Students will be able to . . .* EU1 • sketch a function's end behavior using the leading coefficient test • give a precise graph using zeros and end behavior • identify the number of real and imaginary zeros based off the degree and the graph of a polynomial function EU2 • add, subtract, multiply, evaluate, simplify, and compose polynomial functions • add, subtract, multiply, and simplify complex numbers • utilize the conjugate of a complex number in simplifying polynomial expressions EU3 • factor a polynomial function (include grouping and sum/diff cubes) • solve a polynomial function to find the zeroes (include: factor theorem, remainder theorem, synthetic division) • write a polynomial function of least degree given the zeros • use the quadratic formula to find all solutions for the polynomial equation • transform polynomial equations to expedite graphing and/or solving the polynomial equation

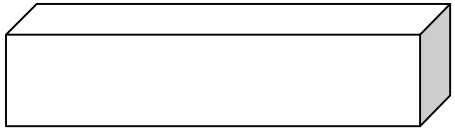
EU4 • the solutions to a polynomial function represent the x-intercept • verbal models can be translated into an algebraic model	EU4 • recognize the relationship between the zeros of a function and the x-intercepts of a graph • algebraic functions can model real life situations(differentiate between significant and extraneous information in a given situation and distinguish between linear, quadratic, and polynomial models for a given situation)

Stage 2 – Assessment Evidence

Recommended Performance Tasks: EU1, EU3, EU4

Performance Task for Polynomials

The Burly Bag Company manufactures trash bags in three different sizes. The bags are rolled together and then packaged in a rectangular box (right rectangular prism). The diagram below represents the length, width, and height of the box, respectively. To cut down on packaging costs, the company has decided to put fewer bags in each package therefore making the boxes smaller. For the new boxes, the height must be 1 inch larger than the width, and the length must be 8 inches longer than it is wide. Recommend a shipping vendor. The options and costs are listed below in a table.



1. What formula would be used to find the volume of the box? Show your work. Write the expression in standard form.

2. The box volume requirements for a tall kitchen bag is listed below. Determine a reasonable volume for small and large bags. Complete the chart.

Type of Bag	Box Volume (in^3)
small	
tall kitchen	240
large	

3. Using the information above and the volume formula, represent the volume of the box for each type of bag as an equation.

Type of Bag	Volume Equation
small	
tall kitchen	
large	

4. Find the length, width, and height for each of the box types. Are your answers reasonable?

5. Recommend a shipping vendor. The options and costs are listed below in a table. Write a proposal recommending the vendor that is the most cost effective for the Burly Bag Company. Include the following in your report:

a. All calculations and graphs utilized

b. Reasons supporting your decision

Company	Cost/box
US Postal Service	$39.95 Flat Rate
FedEx	$36.58 Standard Overnight
UPS	$36.58 Next Day Air Saver

Type of Bag	# of boxes needing to be shipped
small	10
tall kitchen	60
large	20

Other Recommended Evidence:

- Quiz on Polynomial Operations
- Quiz on End Behavior & Operations on Complex Numbers
- Quiz on Factoring, Solving, Zeros, Graphing
- Test on Polynomials Unit
- Benchmark after MP1

Stage 3 – Learning Plan

Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: *Consider the WHERETO elements. Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

- Activity #1 – End Behavior Simon Says, Partner Worksheet w/ Sketching the graph using end behavior and degree (including maximum number of solutions as zeros - only real solutions), check on the graphing calculator to confirm graphs (A)
- Activity #2 – Repeat Activity #1 with imaginary solutions (M)
- Activity #3 - TI-Nspire Activity – Watch your p's and q's (Rational Zero Thm) (M) http://education.ti.com/calculators/timath/US/Activities/Detail?sa=1010&id=8517
- Activity #4 – I have/who has game. Give ½ the class graphs, ½ the class equations & they have to find each other. (T)

The following is the suggested sequence of learning activities and number of days for the Algebra 2 L2 class. Adjustments should be made accordingly for other levels.

Approximately 24 days for completion of unit

YWBAT perform operations on polynomials (+, -, x, evaluate) (A)

YWBAT perform composition on functions (A)

YWBAT perform long division (A)

YWBAT perform synthetic division (A)

YWBAT sketch graphs of polynomial functions using end behavior (only real solutions) (A)

- Activity #1 – End Behavior Simon Says, Partner Worksheet w/ Sketching the graph using end behavior and degree (including maximum number of solutions as zeros - only real solutions), check on the graphing calculator to confirm graphs

YWBAT sketch graphs of polynomial functions using end behavior (real and imaginary solutions) (M)

- Activity #2 – Repeat activity with imaginary solutions, graphing calculator check will prompt "What does that tell you about the other solutions? Revisit quadratics and discriminant, imaginary solutions

YWBAT perform operations with Complex Numbers (+, -, x, powers of i) (A)

YWBAT factor and solve quadratic and cubic (sum/diff cubes, grouping) polynomials (A)

YWBAT apply the factor and remainder theorems to polynomials to find the zeros and/or factors (A)

YWBAT use the rational root theorem to find all rational zeros of a polynomial (M)

- TI-Nspire Activity #3 – Watch your p's and q's (Rational Zero Theorem) http://education.ti.com/calculators/timath/US/Activities/Detail?sa=1010&id=8517

YWBAT find ALL zeros (real and imaginary) of a polynomial function (A)

YWBAT write a polynomial function of least degree given all zeros of the polynomial (M)

YWBAT sketch the graph of a polynomial function using end behavior and zeros (T)

- Activity #4 – I have/who has game. Give ½ the class graphs, ½ the class equations & they have to find each other.

Critical Vocabulary:

Binomial	Complex	Composition of Functions
Degree	Discriminant	Domain
End Behavior	Extraneous	Factor
Factored Form	Imaginary	Irrational
Leading Coefficient	Maximum	Minimum
Monomial	Multiplicity	Polynomial
Quadratic Formula	Range	Rational
Real	Root	Simplify
Solution	Standard Form	Substitution
Synthetic Division	Trinomial	X-Intercept
Y-Intercept	Zero	