Algebra 2 Unit Plan

Tier 1

Unit 3: Polynomials and Polynomial Functions

ORANGE PUBLIC SCHOOLS 2015 - 2016

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Contents

Unit Overview

Unit 3: Polynomials and Polynomial Functions

Essential Questions

- What does the degree of a polynomial tell you about its related polynomial function?
- For a polynomial function, how are factors, zeros, and x-intercepts related?
- For a polynomial equation, how are factors and roots related?

Enduring Understandings

- A polynomial function has distinguishing "behaviors." You can look at its algebraic form and know something about its graph. You can look at its graph and know something about its algebraic form.
- Knowing the zeros of a polynomial function can help you understand the behavior of its graph.
- If (x – a) is a factor of a polynomial, then the polynomial has value 0 when x = a. If a is a real number, then the graph of the polynomial has (a, 0) as an x-intercept.
- You can divide polynomials using steps that are similar to the long-division steps that you use to divide whole numbers.
- The degree of a polynomial equation tells you how many roots the equation has.

Common Core State Standards

- **N.CN.7:** Solve quadratic equations with real coefficients that have complex solutions.
- **A.SSE.1a:** Interpret parts of an expression such as terms, factors, and coefficients.
- **A.SSE.2:** Use the structure of an expression to identify ways to rewrite it. *For example, 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 $(x^2 – y^2)(x^2 + y^2)$.*
- A.SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- **A.APR.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).
- **A.APR.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.
- **A.APR.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.
- **A.REI.11:** Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x)
- **F.IF.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
- **F.IF.5:** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes
- **F.IF.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
- **F.IF.7.c:** Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior.
- **F.**IF.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
- **F.**BF.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 th 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.

- **A.APR.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.
- .

M : Major Content S: Supporting Content A : Additional Content

Calendar (Honors)

December 2015						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
12/13	12/14	12/15	12/16	12/17	12/18	12/19
12/20	12/21	12/22	12/23	12/24	12/25	12/26
December/January 2015						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
12/27	12/28	12/29	12/30	12/31	1/1	1/2
1/3	1/4	1/5	1/6	1/7	1/8	1/9
1/10	1/11	1/12	1/13	1/14	1/15	1/16
1/17	1/18	1/19	1/20	1/21	1/22	1/23
1/24	1/25	1/26	1/27	1/28	1/29	1/30

Scope and Sequence

Overview		
Lesson	Topic	Suggesting Pacing and Dates
1	Polynomial Functions (5-1)	2 days
2	Polynomials, Linear Factors, and Zeros (5-2)	3 days
3	Solving Polynomial Equations (5 -3)	2days
4	Transforming Polynomial Function (5 – 9)	2 days
5	Even and Odd Functions	
6.	Application for Polynomial Function (parts of 5-8)	1 day
7.	Dividing Polynomial (5-4)	2 days
8.	Rational Expression (8 -4)	2 days
9.	Solving Rational Equations (simply equations without adding and subtracting expressions) (8-6)	2 days

Assessment Framework

Assessment	CCSS	Estimated Time	Format	Graded
Diagnostic/Readiness Assessment (Beginning of Unit)	A.CED.2, F.IF.5, A.CED.1, A.APR.3, A.REI.4.b	½ Block	Individual	No
Assessment Check Up 1 (After lesson 5.3)	F.IF.7.c, A.SSE.1.a, A.APR.3, A.REI.11, A.SSE.2, A.APR.2, A.APR.1, A.APR.6	½ Block	Individual	Yes
Performance (Critical Area) Task Graphing from Roots	A.APR2, A.APR3	½ Block	Individual	Yes
Check up 2 Pearson Algebra II Chapter 5 quiz *p 311*	F.IF.7.c, A.SSE.1.a, A.APR.3, A.REI.11, A.SSE.2, A.APR.2, A.APR.1, A.APR.6	½ Block	Individual	Yes
Unit 3 Assessment	F.IF.7.c, A.REI.11, A.APR.2, N.CN.7, N.CN.8, F.IF.5, A.SSE.1a, A.APR.3, A.SSE.2, A.APR.1, A.APR.6, N.CN.9, F.IF.4, F.IF.6	1 Block	Individual	Yes
Performance (Modeling)Task Introduction to Polynomials: College Fund	A.REI.11, A.CED.1.a	1 Block	Pair/group	Yes
Others				

Lesson Analysis

Lesson 1: Polynomial Functions

Objective

- Using standard form of a polynomial function, students will work individually/in pair/in group to classify polynomial, describe key features and end behavior of polynomial functions, ASB correctly answering ____ exit slip questions.

Focused Mathematical Practices

- MP2: Reason abstractly and quantitatively
- MP 5: Use appropriate tools strategically
- MP 7: Look for and make use of structure

Vocabulary: Monomial, degree of a monomial, polynomial, degree of a polynomial, polynomial function, standard form of a polynomial function, roots, zeros, turning point, end behavior

Common Misconceptions:

- Classifying polynomial by degree – students choose degree based on first term, before putting function in standard form
- Describing end behavior of a polynomial – students may forget the rules of the table, then incorrectly plug values into the polynomial equation (specifically, plugging in a negative number. i.e. incorrectly stating that (-1)^2 = -1)

Most relevant CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.IF.7.c: Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior **F.**BF.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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.	***Review*** • Vocabulary (degree, standard form, monomial, polynomial, leading term, increasing / decreasing, end-behavior) ***New*** • Polynomials can be classified by degree or number of terms • A function is increasing when the y-values increase as x-values increase, and is decreasing when y-values decrease as x-values increase	***Review*** • Create a table for a pattern / write a pattern rule • Identify a pattern using common differences, and find the value of nth term of a pattern • Write a polynomial in standard form in order to more easily classify by degree ***New*** • Determine end behavior of a polynomial from leading term • Use common differences in y-values to determine degree of a polynomial	Lesson 5.1 / online textbook resources	2 days	Lesson Check: pg. 285 (use as exit slip)

Lesson 2: Polynomials, Linear Factors, and Zeros

Objective

- Using factored form of a polynomial, SWBAT analyze and graph the polynomial function showing key features, ASB correctly answering ____ exit slip questions.
- Using zeros of a polynomial, SWBAT create a polynomial function from its zeros, ASB correctly answering ___ exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Use appropriate tools strategically
- MP 3: Construct viable arguments and critique the reasoning of others

Vocabulary: Factor theorem, multiple zero, linear factor, multiplicity, relative maximum, relative minimum

Common Misconceptions:

- Errors with determining zeros from factors (i.e. errors with zero product property: choosing (2,0) as the zero corresponding to a factor of (x + 2), also errors with negatives – ex. factor: -(x + 4), also forgetting the (0,0) zero corresponding to a factor of "x")
- Graphing polynomials: forgetting to plot the y-intercept, incorrectly following curve of the polynomial graph (errors with turning points / even-touch odd-cross)
- Errors with distributive property when writing polynomial from zeros

Most Relevant CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.IF.7.c: Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior **A.APR.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.	***Review*** • Polynomial increasing / decreasing rules learned in Lesson 5.1 • Zero-product property ***New*** • (x – b) is a linear factor of the polynomial P(x), b is a zero of the polynomial function y = P(x), b is a root (or solution) of the polynomial equation P(x) = 0, and b is an x-intercept of the graph of y = P(x) • A relative maximum is the value of the function at an up-to-down droning point • A relative minimum is the value of the function at a down-to-u turning point	***Review*** • Determining end-behavior from the leading term • Factor a polynomial – specifically with GCF ***New*** • Use zero product property to determine zeros of the polynomial • Graph a polynomial using zeros, y-intercept, end-behavior, and test points • Create a polynomial function from its zeros • Finding the multiplicity of a zero • Using relative maximum/minimum to solve real-life problem.	Lesson 5.2	3 days	Lesson check: pg 293; #'s 3, 5, & 6

Lesson 3: Solving Polynomial Equations

Objective

- Using factoring and graphing skills, SWBAT solve a polynomial equation, ASB correctly answering 3 / 3 exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 5: Use appropriate tools
- MP 6: Attend to precision

Vocabulary: Sum of cubes, difference of cubes

Common Misconceptions:

- Forgetting the "0" solution (ex. $x(2x + 1)(x – 3)$)
- Incorrectly writing an x-intercept (ex. (0,4) instead of (4,0))
- Factoring errors (students especially struggle with factoring quadratics with a ≠1, sum / difference of cubes, and remembering to check for GCF first)
- Quadratic formula errors (students often incorrectly plug numbers into the formula) – specifically with imaginary solutions (students will simplify √-9 as 3, instead of 3i)

Most relevant CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.REI.11: Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x) **A.SSE.2** Use the structure of an expression to identify ways to rewrite it. For example, 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 $(x^2 - y^2)(x^2 + y^2)$.	***Review*** • Zero product property ***New*** • The real solutions to a polynomial equation give the x-intercepts of the graph of the polynomial function	***Review*** • Factor methods: factoring out GCF, factoring quadratic trinomials (algebra tiles, x-method, box method, etc.), perfect square trinomials, difference of squares, factor by grouping • Determine zeros from factors • Quadratic formula ***New*** • Factor sum and difference of cubes • Solve polynomial equation by factoring. • Solv polynomial equation by using graphing calculator	*Lesson 5.3, *5.3 Game: Discovering Your Roots (resource online), *Polynomial Factoring BINGO, *"Factor This" game from Lesson 4.4 (resource online), *Factor Stations (see example in Supplemental Materials section), *Solving for Zeros Discovery Activity (see example in Supplemental Material section), *Box Problem Authentic Assessment (see Authentic Assessment section)	3 days Note: the skills for factoring polynomial will be part of focus of this unit fluency practice, do not spend too much time in the class to keep practicing the factoring skills.	Lesson Check pg. 300; #s 1-7, 9 (#8 honors)

Lesson 4: Transforming Polynomial Function

Objective

- Using the concept of function transformation, student will work (individually, in pair, in group) to apply the transformation rule for graphing a polynomial function with __ out of __ accuracy in the exit ticket/class work.

- Focused Mathematical Practices
- MP 1: Make sense of question
- MP 7: Look for and make use of structure

Vocabulary: compress, reflection, translate horizontally, translate vertically, parent function,
Common Difficulty:

- Most students will face the challenge when the transformation combines more than one types of transformation. Looking at rules to figure the effect on the graph will be difficult for most students.

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F. BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), and f(x_k) for specific vlues of k.	***Review:*** * The effect of transformation in a linear or quadratic function ***New*** * The graph of the function y= af(x-h) + k is a vertical stretch or compression by the factor I a I , a horizontal shift of h units, and a vertical shiftof k units of the grah of y = f(x) •	***Review*** Write a linear of quadratic function based on a transformation. ***New*** * Transforming the parent function $y = x^3$ * Create an equation/function based on the description of a or transformation. * Finding zeros of a transformed cubic function.	Lesson 5.9	3 days	Lesson Check pg. Page 342 #1 and page #7,8

Lesson 5: Polynomial Models in the Real World

Algebra 2 Unit 3

Objective

- Using Ti-84 graphing calculator, SWBAT fit data to linear, quadratic, cubic, or quartic models, ASB correctly answering 5 / 6 exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 4: Model with mathematics
- MP 5: Use appropriate tools strategically

Vocabulary: regression, the (n + 1) Point Principle

Common Misconceptions:

- Only one type of model can fit a given data set
- Choosing a model that doesn't *best* fit a data set

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.IF.4: For a function that models a relationship between two quantities, and sketch graphs showing key feature given a verbal description of the relationship. **F.IF.5:** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes **F.IF.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.	***Review*** • Domain of a function is all the possible x-values ***New*** • You can use polynomial functions to model many real-world situations. The behavior of the graphs of polynomial functions of different degrees can suggest what type of polynomial will best fit a particular data set. • For any set of n + 1 points in the coordinate plane that pass the vertical line test, there is a unique polynomial of degree at most n that fits the points perfectly • The best model for a data set often depends on the situation. • When making predictions based on a regression model, stay within domain of the function for greater confidence	***Review*** • Evaluate a function for a given coordinate pair ***New*** • Use LINREG, QUADREG, CUBICREG on Ti-84 to model data set • Use RREF() function on Ti-84 to find coefficient values for polynomial function Supplement Material: Rate of Change (CCSS: F.IF.6) Note: Students have learned this standard in Algebra I Linear Functions, and Quadratic Function units. Use the Material (Dropbox > Curriculum Algebra 2 > Tier 2 > Unit 3 > Curriculum supplement material > Rage of Change	Lesson 5.8 Only do page 333 problem 2, & 3 (Note: (n+1) point principle is NOT in the standard) *Just use the same concept of R^2 from Unit 2 to compare and choose Models.	1 day	

Lesson 6: Dividing Polynomials

Objective

- Using long division and synthetic division, SWBAT rewrite polynomials in factor forms or in the form of q(x) + r(x)/b(x), ASB correctly answering ___ exit slip questions.

Focused Mathematical Practices

- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 7: Look for and make use of structure
- MP 6: Attend to precision

Vocabulary: synthetic division, Remainder theorem, divisor, quotient, remainder, dividend, dimensions

Common Misconceptions:

- Distributing negative sign when subtracting (i.e. $-(4x^2 + 20x) = -4x^2 - 20x$)
- Students stop long division process before the remainder is a polynomial with one degree less than the original polynomial

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.APR.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) **A.APR.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 more complicated examples, a computer algebra system.	***Review:*** * Concepts of long division Algorithm ***New*** * The Division Algorithm for Polynomials is a generalized version of the technique of long division in arithmetic. • (Divisor)(Quotient) + Remainder = Dividend *OR* P(x) = D(x)Q(x) + R(x) • If R(x) = 0, then P(x) = D(x)Q(x) and D(x) and Q(x) are factors of P(x)	***Review*** • Numerical long division • Factoring out GCF ***New*** • Long division – polynomials • Using Remainder Theorem to evaluate a polynomial function • **Use division of polynomial to rewrite expressions in different forms:** **a(x)/b(x) =** **q(x) + r(x)/b(x)**	Lesson 5.4 Divide using algebra tiles: http://www.doe.virginia.gov/testing/solsearch/sol/math/A/m_ess_a-2b_1.pdf Note: skip synthetic Division Note: A.APR.6 indicates "Rewrite simple rational expression", so DO NOT lose focus of the less to spend a lot of instruction time for practicing too complicated long division problems.	3 days	Lesson Check pg. 308 #s 1 – 5 Class discussion on #s 6 & 7 #8 challenge Mid-Chapter Quiz: pg. 311

Lesson 7: Rational Expressions

Objective

- Using the knowledge of multiplying and dividing fractions, SWBAT work in _____ in order to simplify, multiply, and divide rational expressions correctly for 3 out of 4 on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 7: Look for and make use of structure
- MP 2: Reason abstractly and quantitatively

Vocabulary:
Rational expressions
Simplest form of a rational expression

Common Misconceptions:
-using cross multiplication when multiplying rational expressions.
-Incorrect factoring and simplifying parts of terms rather than whole terms.
-Forgetting to identify domain restrictions when the denominator equals 0.

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.SSE.2: Use the structure of an expression to identify ways to rewrite it. *For example, 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 $(x^2 - y^2)(x^2 + y^2)$.*	***Review*** • Simplifying fractions creates equivalent fractions • Reducing fractions still creates equivalent fractions ***New*** • Simplifying rational expression creates equivalent expressions. • Reducing rational expressions by a common factor creates equivalent expressions	***Review*** • Finding a GCF of the numerator and denominator of a fraction • Factoring polynomials ***New*** • Finding a GCF of the numerator and denominator of a rational expression • Factoring the denominator and numerator of a rational expression in order to possibly divide common factors	Text book- 8.4	2 days	Lesson check: pg. 530 #'s 1-4
A.SSE.3: **Choose and produce an equivalent form of an expression** to reveal and explain properties of the quantity represented by the expression.	***Review*** • Fractions cannot have zero as a denominator • Dividing polynomials requires a common term • Multiplying polynomials requires distribution ***New*** • A rational expression cannot have 0 as a denominator; the zero creates a restriction to the domain. • Dividing rational expressions requires a	***Review*** • Multiplication and division of fractions • When multiplying fraction you multiply numerators and multiply denominators ***New*** • Multiplication and division of rational expressions • When multiplying rational expressions you need to multiply numerators and multiply			

	common term • Multiplying rational expressions requires distribution	denominators, using distributive property when necessary			

Lesson 8: Solving Rational Equations

Objectives

- Using operations with rational expressions SWBAT work in _____ to solve equations including rational expressions and use these skills to solve real life problems correctly for 3 out of 4 problems on a daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary:

Rational equations

Common Misconceptions:
-mistakes with combining like terms
- not checking for extraneous solutions
- using cross multiplication incorrectly

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.APR.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. A.SSE.2: Use the structure of an expression to identify ways to rewrite it. *For example, 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 $(x^2 – y^2)(x^2 + y^2)$.*	***Review*** • Creating fractions with common denominators uses equivalent fractions ***New*** • Creating rational expressions with common denominators uses equivalent expressions	***Review*** • Simplifying fractions by dividing common factors from the numerator and the denominator • Factoring polynomials ***New*** • Simplifying rational expression by dividing common factors from the numerator and denominator • Factoring polynomials in rational expressions to simplify the expression	Text book- 8.6 Note: the standard A.REI.2 indicates solve SIMPLE rational equations, do not give students equations that has polynomial in denominator higher than 2 degree	2 days	Exit slip: pg. 545 1-3, and 5
A.REI.2: **Solve simple rational** and radical equations in one	***Review*** • Solving equations means isolating the	***Review*** • Using inverse operations to solve equations,			

variable, and give examples showing how extraneous solutions may arise.	variable that you are trying to solve for • Denominators are cleared by finding a common denominator and multiplying both sides by that denominator or using cross multiplication if possible • Any time you multiply each side of an equation by an algebraic expression, it is possible to produce an extraneous solution. ***New*** • Rational expression contain at least one variable in the denominator so the denominators must be cleared in order to isolate the variable • When denominators are cleared equations are solved using inverse operations	including reciprocal fractions • Checking solutions for extraneous solutions ***New*** • Multiply each side of the equation by the LCD or cross-multiply to eliminate the denominators • Check solutions for extraneous solutions			

Ideal Math Block

The following outline is the department approved ideal math block for grades 9-12.

1) Do Now (7-10 min)
    a. Serves as review from last class' or of prerequisite material
    b. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

2) Starter/Launch (5 min)
    a. Designed to introduce the lesson
    b. Uses concrete or pictorial examples
    c. Attempts to bridge the gap between grade level deficits and rigorous, on grade level content
    d. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

3) Mini-Lesson (15-20 min)
    a. Design varies based on content
    b. May include an investigative approach, direct instruction approach, whole class discussion led approach, etc.
    c. Includes CFU's
    d. Anticipates misconceptions and addresses common mistakes

4) Class Activity (25-30 min)
    a. Design varies based on content
    b. May include partner work, group work/project, experiments, investigations, game based activities, etc.

5) Independent Practice (7-10 min)
    a. Provides students an opportunity to work/think independently

6) Closure (5-10 min)
    a. Connects lesson/activities to big ideas
    b. Allows students to reflect and summarize what they have learned
    c. May occur after the activity or independent practice depending on the content and objective

7) DOL (5 min)
    a. Exit slip

Algebra 2 Unit 3

Sample Lesson Plan

Lesson	2: Polynomials, Linear Factors, and Zeros (Day 2 Lesson)	**Days**	1
Objective	Using factored form of a polynomial, SWBAT analyze and graph the polynomial function, ASB correctly answering 3 / 3 exit slip questions.	**CCSS**	**F.IF.7.c:** Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior
Learning activities/strategies	Lesson Material (see Do Now: (8 minutes) -- using graphing calculator *Sketch the graph of $f(x) = x^2$. What will the graph of $g(x)=x^4$ look like? Sketch it on the same coordinate plane. What will the graph of $h(x) = x^6$ look like? Launch : Discussion: Use the graphs from the Do Now to frame the following discussion about end behavior. * Ask students to compare and describe the behavior of the value f(x) as the absolute value of x increase without bound. Mini Lesson: * Introduce the term "end behavior" (end behavior is way to describe what happens to the function as x approaches positive and negative infinity without having to draw the graph) * use the picture on material page 166 to help students understand the description of end behavior Investigation: (see material example 1) * Tell students that we are now going to look at a new set of functions: Sketch the graph of $f(x) = x^3$. What will the graph of $g(x)= x^5$ look like? Sketch this on the same coordinate plane. What will the graph of $h(x) = x^7$ look like? Sketch this on the same coordinate plane. * Ask students share their finding and take notes about their finding Practice 1: (pair work) * Ask students use the notes that they took from the investigation and work with partners to answer the following questions: (See material page 169) Practice 2: (individual work) * Students will use what they learned today about end behavior to determine whether or not eh polynomial function used to model the data has an even or odd degree. (See material page 170) Closure: * Have students summarize the lesson either with a graphic organizer or a written summary. (see material page 171) Exit Ticket: Without using a graphing utility, match each graph with the function . (see material page 172)		

Differentiation	***Possible differentiation strategies: (please design your own differentiation based on your students learning styles, academic level, strength and weakness,…..)*** * Heterogeneous grouping to allow for peer mentoring throughout investigation activity *Calculators will be provided
Assessment	Formative: *circulating throughout class during lesson, *observe students when they are answering questions, discussing with their partner, working on class work…etc. *exit slip * homework
Common Misconceptions/ Difficulty	

Supplemental Material

CCSS	Dropbox Location and Filename	Link (Original Task)
A-SSE, A-APR, F-IF, F-BF	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1> Unit 3 > Supplemental Material > **Presenting Polynomials**	http://ecsd-fl.schoolloop.com/file/1298972684338/1298972684200/7226566668305715428.pdf
A.SSE2, A.SSE 3, A-APR2, A-APR3, F-IF7	Orange 9-12 Math > Curriculum Algebra 2 >Tier 1> Unit 3 > Supplemental Material > Finding roots when degree is three or higher	http://www.atlanta.k12.ga.us/cms/lib/GA01000924/Centricity/Domain/262/CCGPS_Math_III_Unit_2_WEB_TE_August_2010v1.pdf
A-APR.2, A-APR.6	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1> Unit 3 > Supplemental Material > **Dividing polynomial using alg. tiles**	http://www.doe.virginia.gov/testing/solsearch/sol/math/A/m_ess_a-2b_1.pdf
A-APR.3, A-APR.6	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1> Unit 3 > Supplemental Material > **Graphing Polynomial Functions Activity**	
A-APR.3, A-APR.6	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1> Unit 3 > Supplemental Material > **Polynomials, linear factors, & zero sample lesson**	
A.SSE.2, A.REI.2	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1? Unit 3 > Supplemental Material > Wind Problem	

Unit Authentic Assessments ***:(See OHS Dropbox > Curriculum Algebra 2 > Tier 1 > Unit 3> Performance Task)***

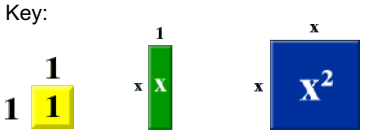
Unit Assessment Question Bank ***:(See OHS Dropbox> Curriculum Algebra 2 > Tier 1 > Unit 3 > Question Bank)***

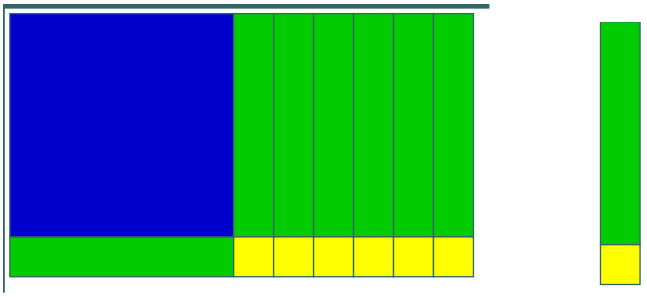
Multiple Representations

Multiple Representation (Dividing Polynomial)

Concreted Model

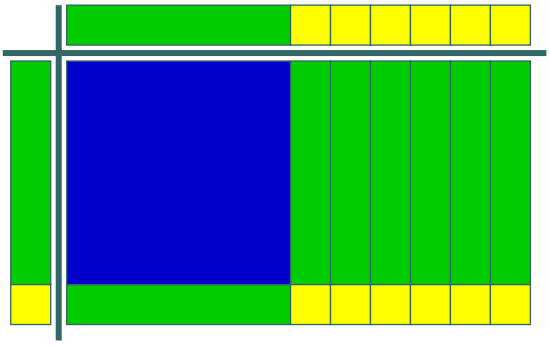
Key:





$(x^2 + 7x + 6) \div (x + 1)$

Quotient Q(x)=(x + 6)



Divisor
D(x)=(x + 1)

Divident P(x)= $(x^2 + 7x + 6)$

Symbolic (Polynomial Long Division)

$$
\begin{array}{r}
x + 6 \\
x + 1 \overline{\big)\, x^2 + 7x + 6} \\
\underline{x^2 + x} \\
6x + 6 \\
\underline{6x + 6} \\
0
\end{array}
$$

Remainder R(x) = 0

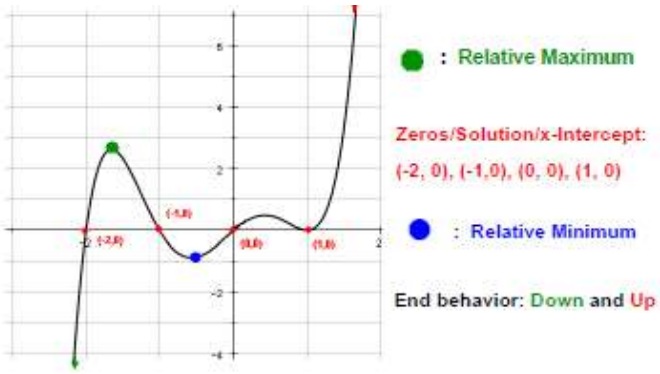
Divident = (Divisor)(quotient) + Remainder

P(x) = D(x)Q(x) + R(x)

Polynomial Graph

Using graph to show vocabulary

Key features of polynomial function graph

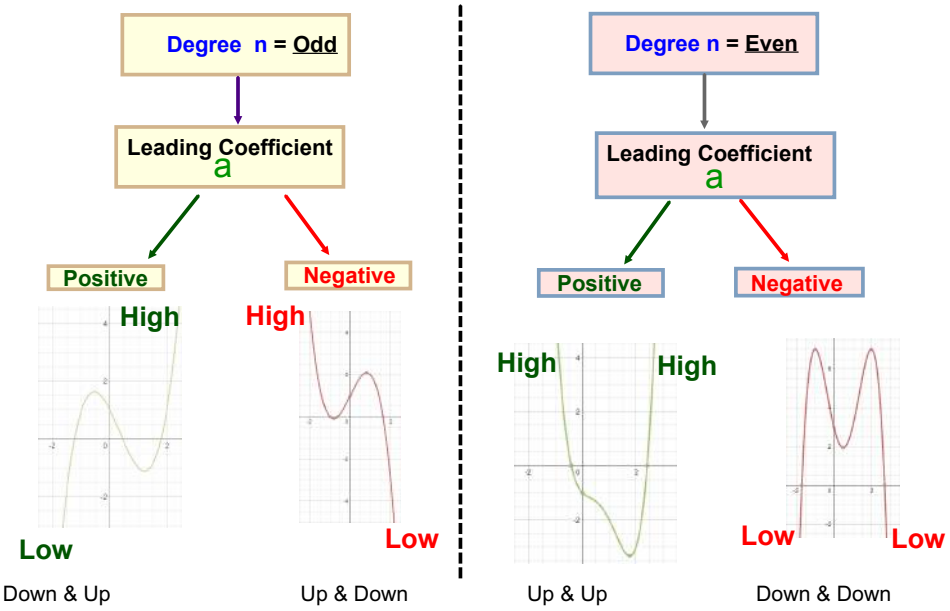


End Behavior of a Polynomial Function With Leading Term ax^n

Using Graphing Organizer

Leading Coefficient Test
(Predicting End Behavior)

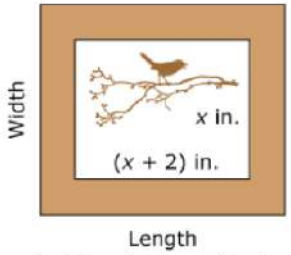
$ax^n + bx^{n-1} + c\,x^{n-2}\ldots$



PARCC Sample Assessment

Partnership for Assessment of Readiness for College and Careers

Sam uses one-inch frames for pictures for which the length is 2 inches (in.) longer than the width, as shown.



The area of the frame for a picture that is x inches wide is given by the expression:

$$(x+4)(x+2)-(x+2)x$$

There are four descriptions shown. Drag the correct expression to the appropriate box below the corresponding description.

x $(x+2)$ $(x+4)$

$(x+2)x$ $(x+4)(x+2)$

the length of the picture alone, in inches	the length of the frame, in inches	the area of the picture alone, in square inches	the area of the picture and frame together, in square inches

Click on a choice and drag it to a box.

HS	Picture Frame
Type	Type I 2 Points
Evidence Statement	**A-SSE.1-2:** Interpret quadratic expressions that represent a quantity in terms of its context. a) Interpret parts of an expression, such as terms, factors, and coefficients. b) Interpret complicated expressions by viewing one or more of their parts as a single entity
Most Relevant Standards for Mathematical Content	**A-SSE.1:** Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.* This standard is major content in the course based on the PARCC Model Content Frameworks.
Most Relevant Standards for Mathematical Practice	This task requires students to make use of the structure provided in the diagram and the formula (MP.7). In addition, students must contextualize that structure to address the descriptions (MP.2).
Item Description and Assessment Qualities	This application task requires students to understand a diagram and formula, and then use expressions within that formula to represent a quantity in terms of its context. The situation allows for possible explanations so students have to carefully attend to the meaning of the variable and the context of the situation. The answer space is technology-enhanced so it can be scored immediately. Unlike traditional multiple choice, it is difficult to guess the correct answer or use a choice elimination strategy.
Scoring Information	The length of the picture alone in inches: $(x + 2)$ The length of the frame in inches: $(x + 4)$ The area of the picture alone in square inches: $(x + 2)x$ The area of the picture and frame together in square inches: $(x + 4)(x + 2)$ The student must get all 4 parts correct to earn 2 points and 3 parts correct to earn 1 point.

Additional Resources

From pearsonsuccessnet.org

- Find the errors
- Enrichment
- Re-teaching
- Activities, games, and puzzles
- Performance tasks
- Chapter project

Pearson Algebra 2 Common Core Teacher's Edition

Student Resources

From pearsonsuccessnet.org;

- Standardized test prep
- Homework tutors
- Think about a plan
- Student companions

Student workbook