Algebra II Curriculum Guide
Tier 1 & 2

Unit 2: Polynomial Function and Equations
November 1 – December 23

ORANGE PUBLIC SCHOOLS 2016 - 2017

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Contents

Unit Overview

Unit 2: Polynomial Function and Equations

Overview

This course uses Agile Mind as its primary resource, which can be accessed at the following URL:

- www.orange.agilemind.com

Each unit consists of 1-3 topics. Within each topic, there are "Exploring" lessons with accompanying activity sheets, practice, and assessments. The curriculum guide provides an analysis of teach topic, detailing the standards, objectives, skills, and concepts to be covered. In addition, it will provide suggestions for pacing, sequence, and emphasis of the content provided.

Essential Questions

- What is polynomial function?
- How do you perform arithmetic operation on polynomials?
- How do you interpret key features of graphs and tables in terms of the quantities?
- How do you identify odd and even function based on the symmetry?
- What is a rational expression?
- How do you simplify rational expressions?
- How do you re-write rational expressions?
- How are the degrees of polynomials related to its' zeroes?
- How can you analyze functions using different representation?
- How do you sketch graphs showing key features given a verbal description of the relationship?
- What is the difference between absolute values and relative values?
- What is a short-term behavior?
- What is a long-term behavior?
- How can you analyze functions using different representation?
- What is polynomial equation?
- What is a complex number?
- How do you solve polynomial equation?
- How does discriminant help you make prediction about roots of quadratic equations?
- What is the fundamental theorem of Algebra?
- What is remainder theorem?

Enduring Understandings

- Polynomial functions take the form $f(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0$, where n is a nonnegative integer and $a_n \neq 0$.
- 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.
- Understand the Key features of graphs such as; intercepts, intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries and point of inflections.
- Understand that a function that has line symmetry with respect to y axis is called even function
- Understand that function that has point symmetry with respect to the origin is called odd function
- A rational expression is the quotient of two polynomial expressions, expressed as a ratio.
- Rational expression can be simplified through factoring
- Understand how to use long division to 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).
- Identify zeros of polynomials when suitable factorizations are available.

- Use the zeros of a function, critical points (relative max, min) and intervals for increasing and decreasing function, end behavior, and symmetries to construct a rough graph of the function defined by the polynomial.
- Understand that for any absolute values graph reaches the highest or lowest point then decreases or increases over an interval
- Understand that for any local values graph reaches a high point then a low point and then it keep increasing or decreasing and there is not absolute values
- The behavior of a function over small intervals is called the short-term behavior, or local behavior, of a function
- Long-term behavior is the same as end behavior, of the polynomial. End behavior of the function is defined as the behavior of the values of f(x) as x approaches negative infinity and as x approaches positive infinity.
- Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
- A polynomial equation is any equation that can be written in the form $(a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0 = 0$.
- Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.
- When you know one of the roots you can find other factor by dividing the polynomial by linear expression.
- You can solve polynomial through factoring. If it is quadratic equation then you can also solve by completing the square or by using the quadratic equation
- If the discriminant is positive, there are two distinct real roots. If the discriminant is zero, there is one distinct real root. If the discriminant is negative, there are two distinct non-real complex roots.
- According to the Fundamental Theorem of Algebra, any polynomial with real coefficients of degree n has at least one complex root.
- For a polynomial p(x) and a number a, the remainder on division by x –a is p(a)

NJSLS/CCSS

1) 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.

2) 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 $(x^2 – y^2)(x^2 + y^2)$

3) 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. Factor a quadratic expression to reveal the zeros of the function it defines.

4) 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.

5) 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).

6) 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.

7) A-APR.4: Prove polynomial identities and use them to describe numerical relationships. For

example, the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

8) 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.

9) A-REI.4: Solve quadratic equations in one variable.
b. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real Numbers a and b
d. Represent and solve equations and inequalities graphically

10) 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); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

11) 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.~~

12) F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function

13) F-IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

14) F-IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, ~~and interpret these in terms of a context~~

15) 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

16) F-BF.1: Write a function that describes a relationship between two quantities.
b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

17) F-BF.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.

18) N-CN.1: Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real

19) N-CN-2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

20) N-CN.7: Solve quadratic equations with real coefficients that have complex solutions

21) N-CN.8: +) Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.

22) N-CN.9: (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Major Content
Supporting Content
Additional Content
~~Parts of standard not contained in this unit~~
Algebra I Content

21st Century Career Ready Practice

CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP3. Attend to personal health and financial well-being.
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP9. Model integrity, ethical leadership and effective management.
CRP10. Plan education and career paths aligned to personal goals.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.

Calendar

October 2016						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

November 2016						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22 [1]	23	24	25	26
27	28	29	30			

Assessment Framework

Assessment	Assignment Type	Grading	Source	Estimated in-class time	When?
Diagnostic Assessment *Unit 1 Diagnostic*	Test	Traditional (zero weight)	Curriculum Dept. created – see Dropbox	< ½ block	Beginning of unit
Mid-Unit Assessment	Test	Traditional	Teacher created using "Assessments" in Agile Mind	½ to 1 block	Mid unit (optional, must have 3 tests per MP)
End of Unit Assessment *Unit 1 Assessment*	Test	Traditional	Curriculum Dept. created – distributed at end of unit	1 block	End of unit
Performance Task *Unit 2 Performance Task1*	Authentic Assessment	Rubric	Topic constructed response (also see Dropbox)	½ block	In topic 1
Performance Task *Unit 2 Performance Task2*	Authentic Assessment	Rubric	Topic constructed response (also see Dropbox)	½ block	In topic 3
Quizzes	Quiz	Rubric or Traditional	Teacher created or "Practice" in Agile Minds	< ½ block	Varies (must have 3 quizzes per MP)

Overview			
Topic	Name	Agile Mind "Blocks"*	Suggesting Pacing
4	**Building new functions**	**7**	**5 days**
5	**Polynomial Functions**	**5**	**5 days**
6	**Polynomial Equations**	**8**	**6 days**

Scope and Sequence

Diagnostic Assessment	**½ day**
Transition lesson	**½ - 1 day**
Mid Unit Assessment	**1 day**
End of Unit Assessment	**2 days**
Performance Task 1	**½ day**
Performance Task 2	**½ day**
Review	**2 days**
Total	**21 ½ days**

*1 Agile Mind Block = 45 minutes

Topic 4: Building New functions

Topic Objectives (Note: these are not in 3-part or SMART objective format)

1. Identify polynomial functions from linear and quadratic functions
2. Add, subtract, and multiply polynomial expressions
3. Identify the interval or increasing and decreasing functions from a graph
4. Use interval notation to describe a part of a graph
5. Identify odd and even functions from graphs
6. Define rational expression
7. Simplify rational expression

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 6: Attend to precision
- MP7: Look for and make sense of structure

Vocabulary

Polynomial expression, polynomial function, rational expression, rational function, leading coefficient, increasing function, decreasing function, concavity, inflection point, interval notation, odd function, and even function

Fluency

- Compare and contrast the parent functions
- Simplify Algebraic expressions
- Multiply binomial and trinomial
- Factor trinomials in standard form

Suggested Topic Structure and Pacing

day	Objective(s) covered	Agile Mind "Blocks" (see Professional Support for further lesson details)	MP	Additional Notes
Day 1	1 & 2	*Block 1* *Block 2*	2,4,5	Overview is optional Explore (Building Polynomial) page 1-6
Day 2	1 & 2	*Block 3*	2, 4, 5,	Explore (Building Polynomial) page 7-11
Day 3	3, 4	*Block 4*	4,5, 6	Explore "Quadratic and cubic" page 1,2, 3, 6, and 7 Skip pages 4,5,8 and 9 Introduce interval notation on slide 3
Day 4	5	*Block 4*	4,5,6	Explore "Quadratic and Cubic" page 10 and 11 Department will provide supplements for identifying even and odd functions algebraically and graphically
Day 5	6, 7	*Block 5*	2, 8	Explore "Building rational from polynomial" page 1 and 2 (Students only need to "simplify") Department will provide supplements or the standard A-APR.6

Algebra II Unit 1

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/Resource
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.	***Day 1*** ***Review*** • Algebraic Expressions, binomials, parent function ***New*** • Polynomials • Adding subtracting and multiplying polynomials will result in new polynomials • Structure of polynomial (leading coefficient, constant term, degree..etc)	***Day 1*** ***Review*** • Simplify algebraic expressions by distributive property and combing like terms • Multiply binomials • Compare and contrast the parent functions learned in previous unit ***New*** • Create cubic function for the problem given	***Day 1*** Agile Mind Topic 4 *** Overview** *** Exploring** "Building polynomials" **P 1 – 6** Suggested assignment: SAS 1 Q4a – d More practice 1 – 6 *Overview is optional.
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. A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	***Day 2 (concept)*** ***REVIEW*** • Understand the graph of inequality • Function domain & range ***New*** • Graph of cubic function	***Day 2 (skills)*** ***Review*** • Graphing linear equation or inequality • Solving linear inequality (1 variable) ***New*** • Graph cubic function (graphing calculator) • Find maximum or minimum from a graph given	***Day 2 (Material)*** Agile Mind Topic 4 *** Exploring** **"Building polynomials"** **P 7– 11** **Suggested assignment** **SAS 2 Q9a – c and Q10 a-d** **More Practice** **5-6**

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.~~	**Day 3 (Concept)** ***Review*** • Domain of a function, , linear function, quadratic function ***New*** • Cubic expressions and cubic functions • Increasing and decreasing function • Point of inflection • Interval notation • Rate of change makes a difference in the increasing or decreasing function	***Day 3 (Skills)*** ***Review*** • Multiplying three binomials • Graphing Linear equation ***New*** • Graphing cubic function • Describe behavior of a function for an interval given (in terms of increasing, or decreasing) Use the interval notation to describe for what values of x the graph is increasing or decreasing	**Day 3 (Material)** **Agile Mind** **Topic 4** ***Exploring "quadratic and Cubics"** **P 1,2,3,6, and 7** **Suggested assignment:** **SAS 3 Q14a-c** **GP P1-5** **Moe Practice** **P 7 only** ***skip pages 4,5,8, and 9** **However introduce interval notation on slide 3**

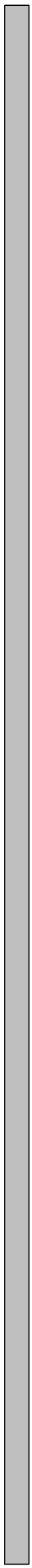
F-BF.3. Identify the effect on the graph of replacing ~~f(x) by f(x) + k, k f(x),~~ f(kx), ~~and f(x + k)~~ for specific values of k (both positive and negative); ~~find the value of k given the graphs.~~ Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.	***Day 4 (Concept)*** ***Review*** • Rotation, Reflection ***New*** • Definition of even and odd functions • Definition of Line symmetry Point symmetry	***Day 4 (Skills)*** ***Review*** • Rotating shapes on a coordinate plane • Reflecting lines over line ***New*** • Sketching graphs given intervals where the function is concave up or down and given the point of inflection • Determining whether a function is even or odd graphically • Determining whether a function is odd or even algebraically	**Day 4 (Material)** Agile Mind Topic 4 *** Exploring** "Quadratic and Cubic" **P10 - 11** SAS 3 Q15a – c GP 7 – 10 MP pg. only 11 Department provide supplements for identifying even and odd functions algebraically, graphically
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. -APR 7: (+) Understand that rational expressions form a system analogous to the rational numbers, ~~closed under addition, subtraction,multiplication~~, and division by a nonzero rational expression; ~~add, subtract, multiply, and~~ divide rational expressions. F-IF.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x)	***Day 5 (Concept)*** ***Review*** Polynomial equation ***New*** • Definition of rational function • Rational expression can be formed by dividing polynomial expressions	***Day 5 (Skills)*** ***Review*** Factor trinomial Factor perfect squares Long division (number_ ***Block 4 : New*** • Use Polynomial division to simplify rational expression (only do long division, NO SYNTHETIC DIVISION) Write rational expressions from the polynomials Factor to simplify rational functions	**Day 5 (Material)** Agile Mind Topic 4 *** Exploring** "Building rational from polynomials" **P 1 – 2 only** **MP 12, 13, 14** * When simplifying rational expressions, the degree in the numerator and denominator is limited to 2

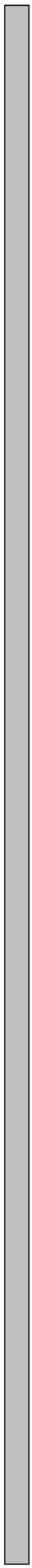
Topic 5: Polynomial function

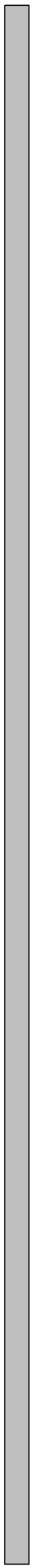
Topic Objective

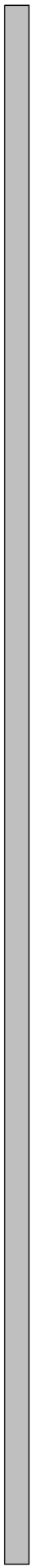
s (Note: these are not in 3-part or SMART objective

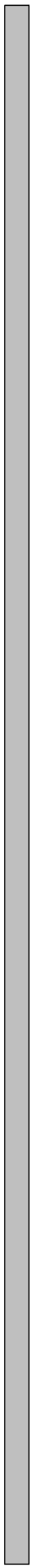
format)

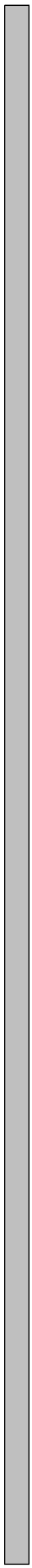


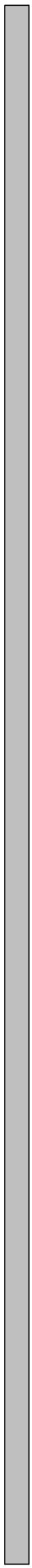


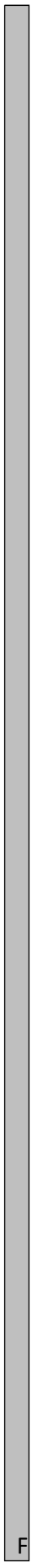








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Vocabulary Fluen

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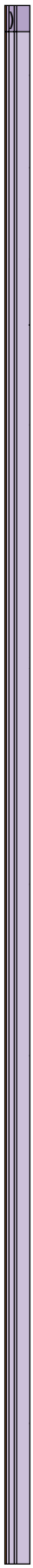
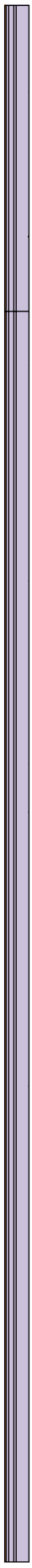
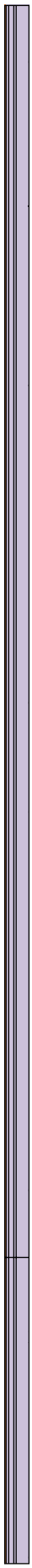
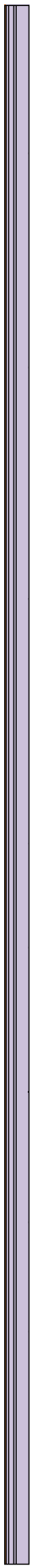
Suggested Topic Structure and Pacing	
Additional	

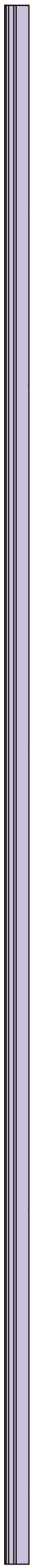
Notes

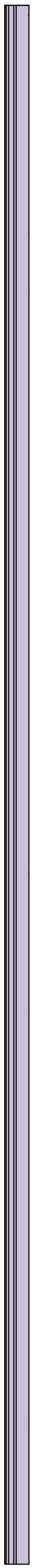


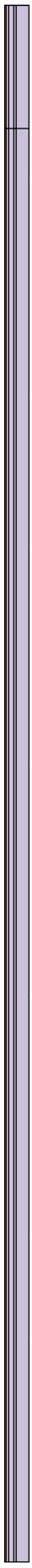


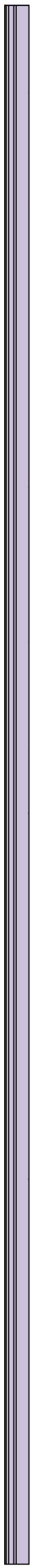


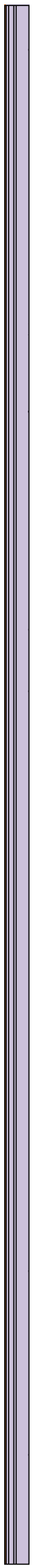


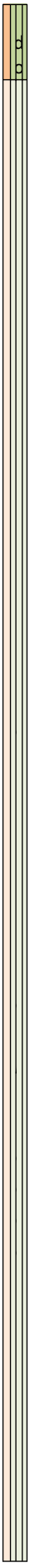








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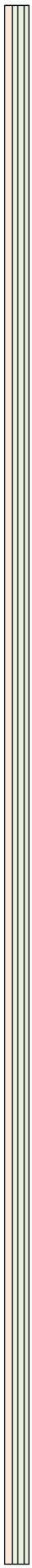
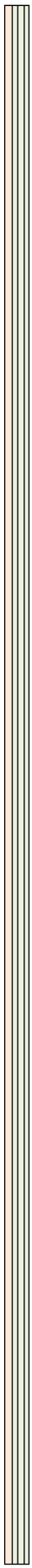
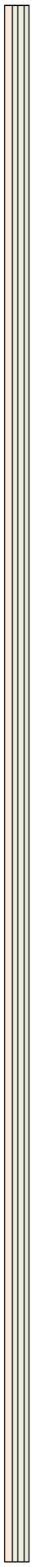
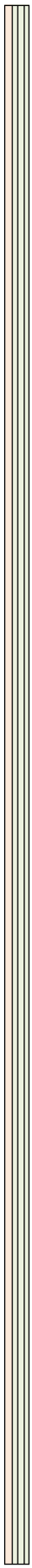
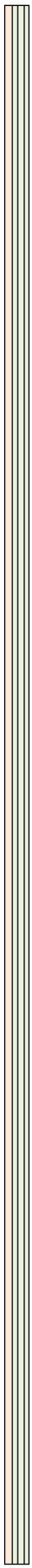
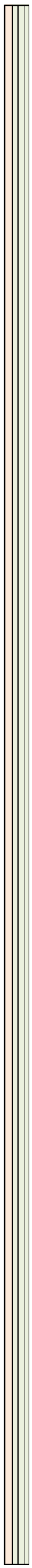


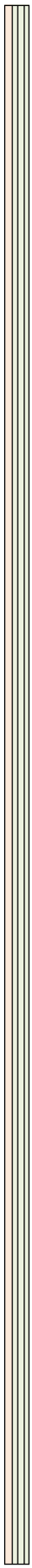


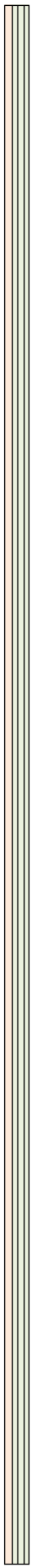


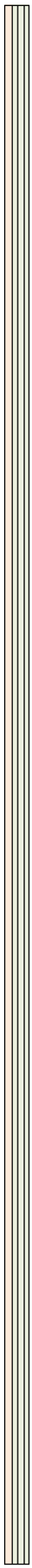


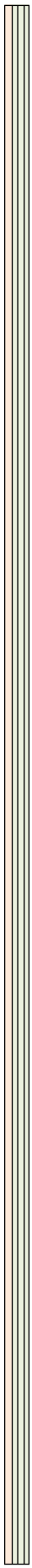


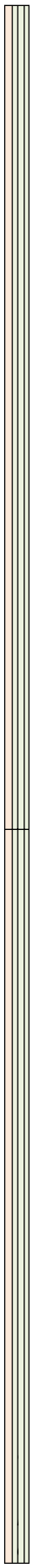


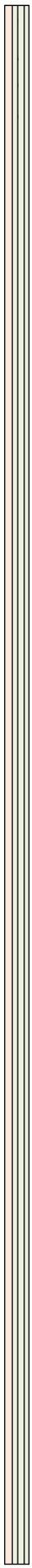


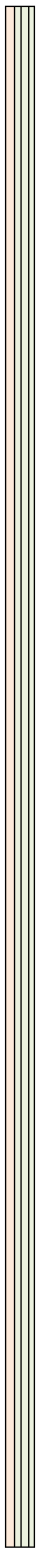


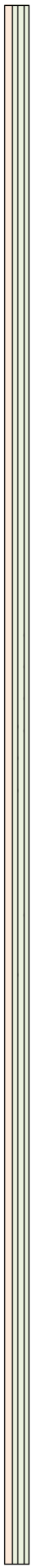


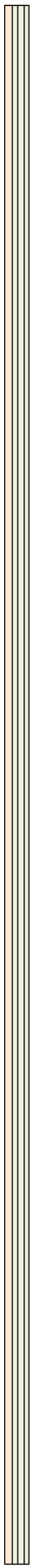


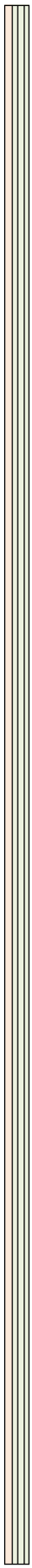


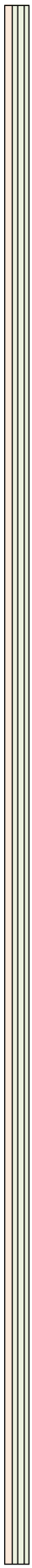


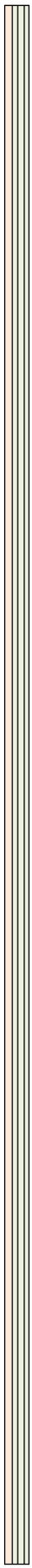


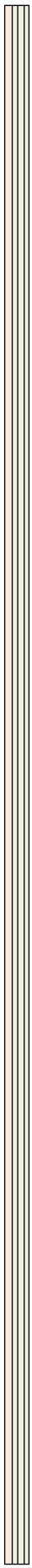


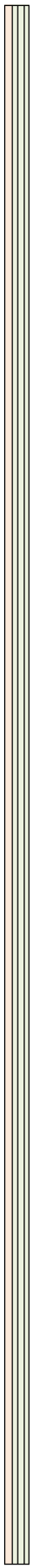


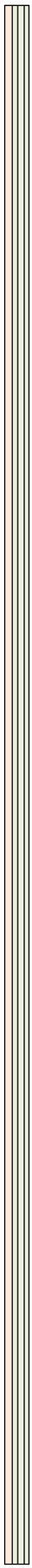


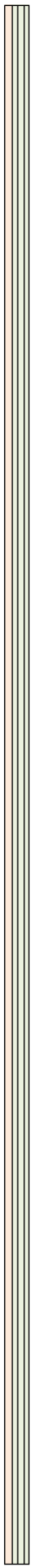


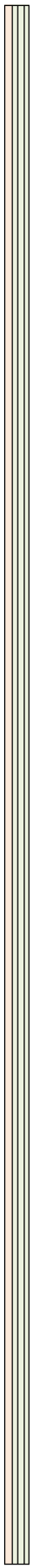


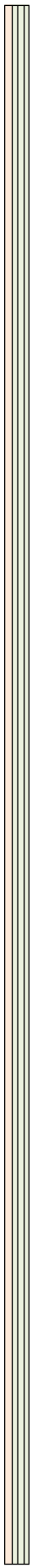


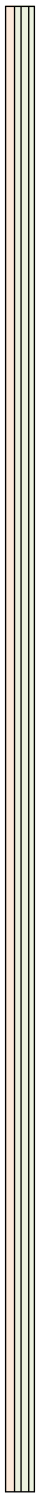


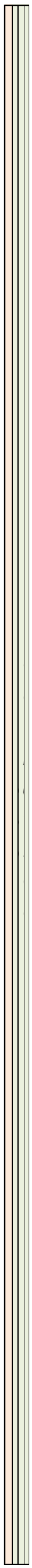


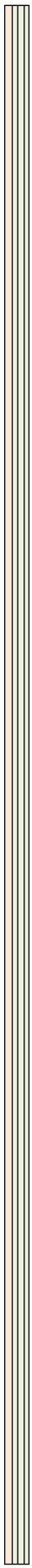


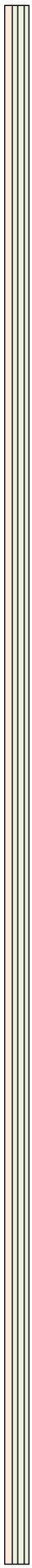


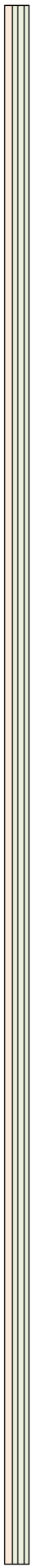


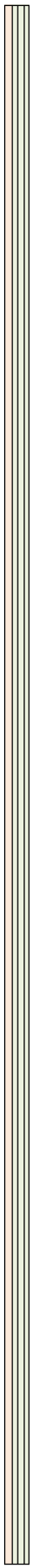


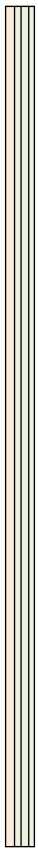












Topic 6: Polynomial Equation

Topic Objectives (Note: these are not in 3-part or SMART objective format)

After completing the topic polynomial equations, students will be able to

1. Define and use imaginary and complex numbers in the solution of quadratic equations
2. Use the discriminant of a quadratic equation to determine the number and type of roots of the equation;
3. Use polynomial long division to solve problems;
4. Factor the sum and difference of two cubes;
5. Factor polynomial expressions by grouping;
6. Solve polynomial equations with real coefficients by applying a variety of techniques in mathematical and real-world problems;
7. Understand the implications of the Fundamental Theorem of Algebra and the Remainder Theorem.

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP 4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary
Quadratic formula, Imaginary numbers, complex numbers, discriminant, real roots and complex roots

Fluency

- Factoring Trinomials
- Using the quadratic formula to solve quadratic equations
- Solving simple quadratic equations
- Graphing quadratic function

Suggested Topic Structure and Pacing

Day	Objective(s) covered	Agile Mind "Blocks" (see Professional Spport for further lesson details)	MP	Additional Notes
1	1	*Block 1* *Block 2*	2,4,5	Over view Exploring " quadratic equation" page 1-5 Note: Students do not to draw the area
2, 3	2 and 3	*Block 3* *Block 4*	2, 4, 5,7	Exploring "quadratic equation" Pages 6- 12. Exploring " complex number" pages 1 – 5 Note: Avoid Synthetic division
4	3,4	*Block 5*	4, 5 7	"Other polynomial equation" page 1- 10 Note: Avoid Synthetic division
5	5-6	*Block 6*	4, 7	"Other polynomial equation" page 11- 18 Note: Avoid Synthetic division
6	7	*Block 7*		"Theorems of algebra" page 1-7

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/Resource

Algebra II Unit 1

1) 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. Factor a quadratic expression to reveal the zeros of the function it defines. 2) 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 3) 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); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.	***Day1 (Concept)*** ***Review*** • Quadratic and cubic function, • Effect on the graph of f(x+k), f(x)+k, kf(x), f(kx) for the parent function f(x) • Definition X intercepts ***New*** • Understanding Real zeros and real roots on the graph • Understanding how transformation can show zeroes of the quadratic function • Definition of point of intersection vs. zero of a function	***Day 1 (Skills)*** ***Review*** • Graphing quadratic and cubic function,(by hand or graphing calculator) • Using quadratic function to model problem situation • Factoring trinomial to solve quadratic equation • Using transformation to find the zeroes of the quadratic equation ***New*** • Identifying Number of real zeroes and number of real roots • Applying transformation to find roots of the polynomials	**Day 1 (Material)** Agile Mind Topic 6 *** Overview** *** Exploring** "Quadratic Equation " P 1-5 SAS 1 and 2 Suggested assignment: SAS 2 Q6 a – d and Q8, 9a-e, 10, and 11 a - b Guided Practice Pg. 1 - 4

4) N-CN.1: Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real 5) N-CN-2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. 6) N-CN.7: Solve quadratic equations with real coefficients that have complex solutions 7) N-CN.8: +) Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$. 8) A-REI.4: Solve quadratic equations in one variable. b. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real Numbers a and b	***Day 2, 3 (Concept)*** ***Review:*** • Quadratic formula and graph • Definition of Whole numbers, integers, real numbers, rational numbers, • Concept of discriminant ***New:*** • Definition of Non-real complex roots of quadratic equations • Connection of non-real root complex solutions to the graph of the associated quadratic function • Definition of complex number	***Day 2, 3 (Skills)*** ***Review*** • Using quadratic formula to solve quadratic equation • Solving simple quadratic equation • Identifying the number system • Multiplying binomials • Simplifying algebraic expressions • Use discriminant to decide number of real roots for quadratic function ***New*** • Use the quadratic formula to determine roots and connect non-real complex solutions to the graph of the associated quadratic function • Perform arithmetic operation with complex numbers	**Day 2, 3 (Material)** Agile Mind Topic 6 *** Exploring** "Quadratic Equation " P 6 – 12 *** Exploring** "Complex number " SAS 2 and 3 Suggested assignment: SAS 2 Q20a-c *More practice* p1-5 SAS 3 SAS 3 Q7a-b, 8a-b, and 9 *More practice* p6-8
~~9)~~ 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~~ 10) A-APR.4: Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. 11) 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 $(x^2 - y^2)(x^2 + y^2)$	***Day 4 (Concepts)*** ***Review:*** • Concept of long division (with whole numbers) • Sum and difference of the squares • Square of the sum and difference • x intercepts from graphs ***New:*** • Definition of polynomial equations • Understand the concept of polynomial division is the same as whole number division • New terms: sum/difference of two cubes	***Day 4 (Skills)*** ***Review:*** • Perform long division with whole numbers • Factor trinomials with a = 1 and a>1 • Expanding sum and difference of the squares • Expanding square of the sum and difference • Determining x intercepts from graphs ***New:*** • Using long division to factor cubic polynomial • Solving cubic polynomials • Expanding/factor sum and difference of the cubic polynomials	**Day 4 (Material)** Agile Mind Topic 6 *** Exploring** "Other Polynomial equation " P 1-10 Suggested assignment: SAS 4 Q10 *More practice* p9-13

~~9)~~ 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~~ 10) A-APR.4: Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. 11) 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 $(x^2 – y^2)(x^2 + y^2)$ ~~12)~~ 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.~~	***Day 5 (Concept)*** ***Review:*** • Long division (with whole numbers) • Factoring • GCF ***New:*** • Understand "factor polynomial" by area model • Understanding factoring by grouping	***Day 5 (Skills)*** ***Review*** • Factoring simple quadratic expressions by factoring Greatest common factor. • Factoring Trinomials using greatest common factor ***New:*** • Factoring Cubic polynomial by: Area model, grouping and using GCF	**Day 5 (Material)** Agile Mind Topic 6 *** Exploring** "Other Polynomial equation " P 11-18 Suggested assignment: SAS 4 Q15 and 16 More practice p14-16 Guided practice
13) 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). 14) 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.	***Day 6 (Concept)*** ***Review:*** • Long division with a remainder • Quotient, divisor, remainder ***New:*** • Concept of Fundamental theorem of Algebra • Concept of Remainder theorem • Understand the implications of the Fundamental Theorem of Algebra and the Remainder Theorem	***Day 56(Skills):*** ***Review*** • Rewrite the solution to long division as the quotient, divisor and remainder • Long division of the polynomial ***New:*** • Use remainder theorem to find the zeros for a function given • Use remainder theorem to decide if the function has a zero "a" if the value of f(a) is given	**Day 6 (Material)** Agile Mind Topic 6 *** Exploring** "Theorems of Algebra " SAS 5 Q8 More practice p17-20

Ideal Math Block

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

1) Fluency Practice (5 min) (see focused fluency skills in each curriculum unit plan)

2) 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

3) 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

4) 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

5) 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.

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

7) 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

8) DOL (5 min)
    a. Exit slip

Algebra II Unit 1

Sample Lesson Plan (Agile Mind)

Lesson	Topic 4 Building polynomials Exploring "Quadratic and cubic"	**Days**	1
Objective	By using the concept of breathing and the definition of increasing, and decreasing functions SWBAT • Visualize and identify cubic polynomial • Identify the interval where the cubic function is increasing and decreasing • Use interval notation to describe where the concavity and point of inflection • Sketch a graph using the given interval And show their mastery completing at least 4-4 independent practice problem and 1/1 problems on the DOL correctly	**CCSS**	A.APR.1
Learning activities/strategies	**Materials needed:** Computer with projection device, transparency to insert the activity sheets, and activity sheet **Fluency Practice:** (5 minutes) Graphing inequality on the number line. Quickly go over the concepts and notations used to include a point on the line or not include a point on the line. **Do Now (5 minutes):** • Provide the breathing cycle graph to students from yesterday's lesson and ask "How is the volume of the air in the lung changes shown by the graph. • During the summary ask guided questions such as "as you breathe in does the volume of air increases or decreases?" "As you breathe out does the volume of air increases or decreases? Discuss the rate of the volume also by asking "when is the rate of air increasing faster" students should see from the graph that it's increasing aster at the beginning as you breath in the air. And it slows down as your lung is filled with air. **Starter/Launch (2 minutes):** • Ask students if they think of any other situation where they might see quadratic or cubic polynomials. Introduce the objective of the day and the importance of polynomial in real life **Mini lesson and practice (20 minutes):** • Display page 2 from "explore" to introduce the definition of increasing and decreasing function. Have students write the definition down in question 1 SAS 3. • Ask students to show using arrows on the graph where the function is increasing and where the function is decreasing then ask them to hold up their transparency sheet with the activity sheet in it check their answer. • Ask students to use inequality to write the interval where the function is increasing and where the function is decreasing • Display page 3 and play animation slide 1 and 2 for students to see the rate of change for a simple linear and cubic function . Students will complete question 3 SAS3 ➢ Guided question: what is happening to rate of change before zero and after zero? ➢ Play animation slide 3 and 4 for students check their answer • Use the animation on page 4 to introduce students to concavity and inflection point on		

	graph as well as the interval notation. Students will complete question 4 from SAS 3 • Use page 6 to illustrate interval notation for students. Point out that often context is the only thing that distinguishes interval notation from ordered pair notation. (Misconception: Students might see the interval notation as ordered pair, which is not the same) **Group work/ Partner work (15 minutes)** Students will complete the puzzle on page 7 and 8 with a partner or in their respective group (SAS 3 questions 5 and 6) Summarize by asking students to come to the smart board and complete the puzzle on Agile mind. **Independent Practice (10 minutes):** • Re-inforce SAS 3: question 14 More practice page 7-10 • Summarize as a class **Closure (2 minutes):** • Ask what is an increasing function, decreasing function, concave up, concave down and point of inflection. **DOL (5 minutes):**

Supplement Materials

Tasks			
CCSS	SMP	Dropbox location and filename	Link (original task and answer key)
F.IF.4, 5, 7, A.APR,3		9-12 Dropbox> curriculum algebra 2>Tier1/2 > Unit 2 > Performance Assessment> Task1	**https://www.dropbox.com/work/Orange%209-12%20Math%202016-17/Curriculum%20Algebra%202/Tier%201/Unit%202/Performance%20Assessment/Task%201?preview=Algebra+2+Unit+2+Performance+task+1+Box+Volume.docx**
HS.C.18.4		9-12 Dropbox> curriculum algebra 2>Tier1/2 > Unit 2 > Performance Assessment> Task2	https://www.dropbox.com/work/Orange%209-12%20Math%202016-17/Curriculum%20Algebra%202/Tier%201/Unit%202/Performance%20Assessment/Task%202?preview=Unit+2+Performance+Task+2.docx

ELL/SWD supplement link

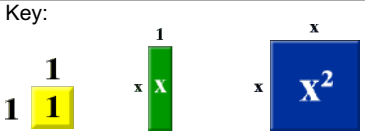
http://nlvm.usu.edu/en/nav/vlibrary.html
http://www.explorelearning.com/index.cfm?method=cResource.dspBrowseCorrelations&v=s&id=USA-000
http://www.thinkingblocks.com/

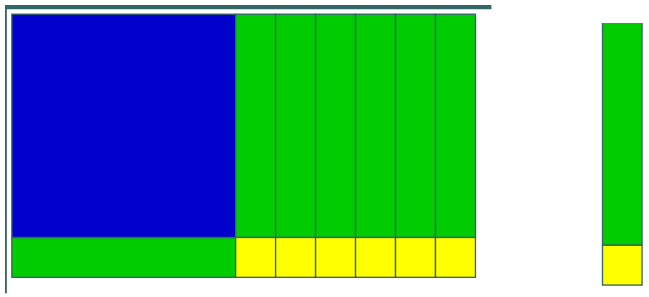
Multiple Representations

Multiple Representation (Dividing Polynomial)

Concreted Model

Key:

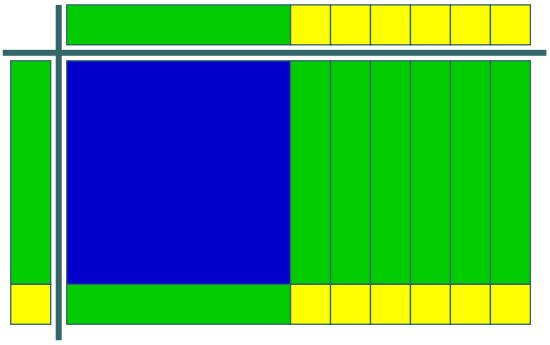




$(x^2 + 7x + 6) \div (x + 1)$

Quotient Q(x)=(x + 6)

Symbolic (Polynomial Long Division)



Divisor
D(x)=(x + 1)

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

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

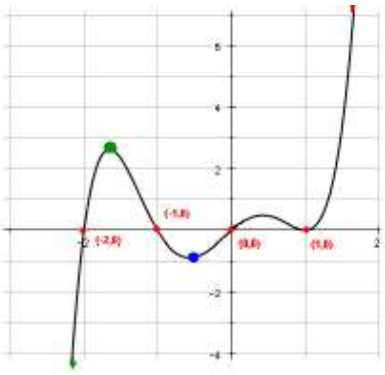
Remainder R(x) = 0

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



: Relative Maximum

Zeros/Solution/x-Intercept:
(-2, 0), (-1,0), (0, 0), (1, 0)

: Relative Minimum

End behavior: Down and Up

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

Using Graphing Organizer

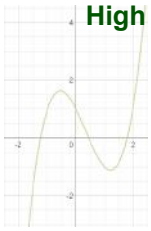
Leading Coefficient Test
(Predicting End Behavior)

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

Degree n = Odd

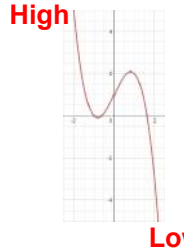
Leading Coefficient a

Positive



Down & Up

Negative

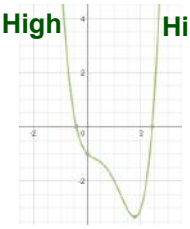


Up & Down

Degree n = Even

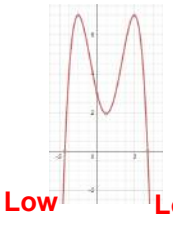
Leading Coefficient a

Positive



Up & Up

Negative

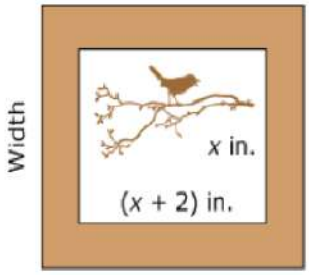


Down & Down

PARCC Sample Item

PARCC
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 $\quad$ $(x+2)$ $\quad$ $(x+4)$

$(x+2)x$ $\quad$ $(x+4)(x+2)$

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.