Orange Public Schools

Office of Curriculum & Instruction

2020-2021 Mathematics Curriculum Guide

Applying Functions & Modelling

Unit 2: Quadratic Relationships and Solving Quadratic Equations

November 14, 2020 –January 30, 2021

Board Approved: 1.14.2020

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Contents

Curriculum Map

A STORY OF UNITS (Yearlong Pacing Guide)				
Marking Period	MP 1 (9/9/20 – 11/13/20)	MP 2 (11/14/20- 1/30/21)	MP 3 (1/31/21-4/9/21)	MP 4 (4/10/21-6/22/21)
Unit Topic	Number systems & Linear Equation	Quadratic Relationships and solving quadratic equations	Exponential functions	Polynomial and functions
Description	Create linear equations & inequalities to model situations given and solve related problems *Create systems of equations/inequalities to model real-life situations and solve problems; Identify types of functions with tables and graphs*	Identify quadratic functions; find key features for the graphs. Solve quadratic equations by using tables, and graphing and solving algebraically Interpret, write, and solve quadratic equations	Understand properties of exponents, create exponential functions, solve exponential functions	Solve polynomial functions, work on the operations of complex numbers, compare growth rates of different of functions

Unit Overview

Unit 2: Quadratic Relationships & Solving Quadratic Equations

Overview

This course uses Mathematic Visions Project (MVP) as its primary resource. Unit 2 will focus on Modules 1 and 2 from Secondary Mathematics II which can be accessed in our Dropbox or at the following URL:

- https://www.mathematicsvisionproject.org/secondary-mathematics-i.html

This course is designed to provide seniors with a problem-based math course that utilizes skills and concepts that will prepare them for college and/or careers. This unit will address the following topics that are part of the Essex County College MTH 100 Introductory College Mathematics course:

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- Solve literal equations
- Solve linear inequalities
- Solve systems of linear equations

All dates (pacing calendar, assessments, due dates) are general recommendations based on this course meeting during an A-day. Dates and pacing may be adjusted slightly using teacher discretion, however all standards must be covered and all assessments must be given within the marking period.

The unit authentic assessment is a key component to this course. It applies skills and concepts taught in this unit to real world problems. Students will be expected to conduct their own research, do the majority of the work outside of class, put forth substantial effort, and submit each phase by the due date. Prior to introducing the project, teachers are required to complete the project themselves in order to gain a better understanding of the requirements and provide an exemplar for students when necessary.

Essential Questions

- What does a quadratic pattern look like?
- How can we differentiate between different types of functions based off of given patterns?
- How can we use multiple representations when exploring quadratic functions?
- What does rate of change look like in quadratic functions?
- What are the key features of a quadratic function?
- What are the different forms of a quadratic function?
- How do we factor a quadratic function?
- How can we use completing the square to solve and/or change the form of a quadratic function?

Enduring Understandings

- Patterns can be used to represent functions, most commonly linear, quadratic, and exponential functions. Each function creates a different type of pattern that can be used to identify the type of function.
- Perimeter can be used to represent linear functions while area can be used to represent quadratic functions in a real world context.
- Quadratic functions can be used to represent a variety of real world situations such as area, speed, and falling or flying objects.
- It is possible to change to any form of a quadratic function given any type of quadratic equation, graph, or table.
- Factoring is essentially the opposite of multiplying binomials; it helps you find the factors given a trinomial.

New Jersey Student Learning Standards

Algebra – Creating Equations

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

Algebra – Seeing Structure in Expressions

2) A.SSE.1: Interpret expressions that represent a quantity in terms of its context.
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.

Functions – Interpreting Functions

4) 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.
5) F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

Functions – Building Functions

6) F.BF.1: Write a function that describes a relationship between two quantities.
7) 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.

Functions – Linear, Quadratic, and Exponential Models

8) F.LE.1: Distinguish between situations that and be modeled with linear functions and with exponential functions.
9) F.LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
10) F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Modifications

Special Education/ 504:	English Language Learners:
-Adhere to all modifications and health concerns stated in each IEP. -Give students a MENU options, allowing students to pick assignments from different levels based on difficulty. -Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time -Allow students to demonstrate understanding of a problem by drawing the picture of the answer and then explaining the reasoning orally and/or writing , such as Read-Draw-Write -Provide breaks between tasks, use positive reinforcement, use proximity -Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum by using manipulatives -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 17-18) -Strategies for Students with 504 Plans	- Use manipulatives to promote conceptual understanding and enhance vocabulary usage - Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction - During ALEKS lessons, click on “Español” to hear specific words in Spanish - Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information - Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve word problems - Utilize program translations (if available) for L1/ L2 students - Reword questions in simpler language - Make use of the ELL Mathematical Language Routines (click here for additional information) -Scaffolding instruction for ELL Learners -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 16-17)
Gifted and Talented:	**Students at Risk for Failure:**
- Elevated contextual complexity - Inquiry based or open ended assignments and projects - More time to study concepts with greater depth - Promote the synthesis of concepts and making real world connections - Provide students with enrichment practice that are	- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum - Modify Instructional Strategies, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Field Trips, Google Expeditions, Peer Support, one on one instruction

imbedded in the curriculum such as: ● Application / Conceptual Development ● Are you ready for more? - Common Core Approach to Differentiate Instruction: Students with Disabilities (pg. 20) - Provide opportunities for math competitions - Alternative instruction pathways available	- Assure constant parental/ guardian contact throughout the year with successes/ challenges - Provide academic contracts to students and guardians - Create an interactive notebook with samples, key vocabulary words, student goals/ objectives. - Always plan to address students at risk in your learning tasks, instructions, and directions. Try to anticipate where the needs will be and then address them prior to lessons. -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 19)

21st Century Life and Career Skills:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

https://www.state.nj.us/education/cccs/2014/career/9.pdf

- **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.

Students are given an opportunity to communicate with peers effectively, clearly, and with the use of technical language. They are encouraged to reason through experiences that promote critical thinking and emphasize the importance of perseverance. Students are exposed to various mediums of technology, such as digital learning, calculators, and educational websites.

Technology Standards:

All students will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information, and ideas.

https://www.state.nj.us/education/cccs/2014/tech/

8.1 Educational Technology:

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. **Technology Operations and Concepts:** Students demonstrate a sound understanding of technology concepts, systems and operations.
B. **Creativity and Innovation:** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
C. **Communication and Collaboration:** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
D. **Digital Citizenship:** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
E. **Research and Information Fluency:** Students apply digital tools to gather, evaluate, and use of information.
F. **Critical thinking, problem solving, and decision making:** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:

All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

A. **The Nature of Technology: Creativity and Innovation-** Technology systems impact every aspect of the world in which we live.
B. **Technology and Society:** Knowledge and understanding of human, cultural, and societal values are fundamental when designing technological systems and products in the global society.
C. **Design:** The design process is a systematic approach to solving problems.
D. **Abilities in a Technological World:** The designed world in a product of a design process that provides the means to convert resources into products and systems.
E. **Computational Thinking: Programming-** Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

Interdisciplinary Connections:	
English Language Arts:	
ELA.LITERACY.RI-9-10.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).
NJSLS..ELA-LITERACY.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
NJSLS..ELA-LITERACY.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

Pacing Guide

Overview			
Lesson	Topic	NJSLS	Suggesting Pacing
1	Understanding Quadratic Patterns	A.CED.2, A.SSE.1	2 days
2	Quadratic Patterns vs. Linear Patterns	A.CED.2, A.SSE.1, F.BF.1	2 days
3	Identifying Quadratic Functions	F.BF.1, F.LE.1,	2 days
4	Understanding Quadratic Functions	A.CED.2, A.SSE.1, F.BF.1	2 days
5	Rate of Change in Quadratic Functions	A.CED.2, A.SSE.1, F.BF.1	2 day
6	Comparing Rate of Change in Different Types of Functions	A.CED.2, A.SSE.1, F.BF.1	2 days
7	Multiple Representations of Quadratic Functions	F.LE.1, F.LE.2, F.LE.3	2 days
8	Transformations of Quadratic Functions	F.IF.7, F.BF.3,	2 days
9	Vertex form of a Quadratic Function	F.IF.7, F.BF.3	2 days
10	Completing the Square	F.IF.B	2 days
11	Graphing Parabolas Using Completing the Square	F.IF.8	2 days
12	Factoring Quadratic Functions	F.IF.8, F.BF.1, A.SSE.3	4 days
13	Connecting Different Forms of a Quadratic	F.IF.8, F.BF.1	2 days

Summary:

28 days on new content (14 lessons/topics)
2 task days
1 review day
1 test day
1 flex day
1 Benchmark day

34 days in Unit 1

Calendar

Please complete the pacing calendar based on the suggested pacing.

November 2020						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**

December 2020						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**

January 2021						
Sun	Mon	Tue	Wed	Thu	Fri	Sat

Assessment Framework

Assessment	Assignment Type	Grading	Source	Estimated in-class time	When?
Diagnostic Assessment *Unit 1 Diagnostic*	Summative Assessment	Traditional	Curriculum created – see Dropbox	1 Period	Beginning of unit
Performance Tasks (Authentic Assessments)	Authentic	Rubric	NJ state portfolio task	1 period each task	
Check Point 1	Formative Assessment	Traditional	Teacher Created	½ - 1 period	As needed
End of Unit Assessment *Unit 1 Assessment*	Summative Assessment	Traditional	Curriculum created – distributed at end of unit	2 Periods	After Module 2
Quizzes	Formative Assessment	Rubric or Traditional	Teacher created	< ½ block	Varies (at least 3 quizzes throughout the Unit)
Exit Ticket	Formative Assessment	Vary	Teacher created	3-5 minutes	Daily

MP2 Benchmark Assessment Window: 1/19/2021- 1/29/2021

Lesson 1: Understanding Quadratic Patterns

Objectives

- Using given points SWBAT work _____ to identify the pattern and write a recursive and explicit equation to represent the pattern for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 7: Look for and make use of structure
- MP 8: Look for and express regularity in repeated reasoning

Vocabulary

- Explicit Equation, Recursive Equation, distributive property, linear equations, exponential equations

Common Misconceptions/struggles

- Correctly identifying the given pattern
- Identifying a rule by determining how move between each f(x) value rather than how to move from x to f(x) each time
- Creating a correct scale on a set of axes for a given set of points

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.SSE.1: Interpret expressions that represent a quantity in terms of its context. F.BF.1: Write a function that describes a relationship between two quantities	***Review*** • The *structure* of patterns and quantities can be used to create variable expressions ***New*** • The *structure* of patterns and quantities can be used to create equations for different types of functions including linear, exponential, and quadratic	***Review*** • Using distributive property to simplify expressions ***New*** • Write explicit and recursive equations to represent a pattern • Identify the type of equation (linear, exponential, or a new type: quadratic) from a given pattern	MVP 2 1.1	2 Periods	1.1 Set #5 and 9f

Lesson Analysis

Lesson 2: Quadratic Patterns vs. Linear Patterns

Objectives

- Using multiple representations SWBAT work _____ to identify and understand the difference between quadratic and linear relationships for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reasoning abstractly and quantitatively
- MP 7: Look for and make use of structure

Vocabulary

- Binomial, perimeter, area, GCF

Common Misconceptions/struggles

- Using correct area and perimeter formulas
- Correctly identifying patterns from a given word problem

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.SSE.1: Interpret expressions that represent a quantity in terms of its context. F.BF.1: Write a function that describes a relationship between two quantities	***Review*** • The *structure* of patterns and quantities can be used to create variable expressions for different types of functions ***New*** • Comparing the relationships in linear and quadratic functions given through multiple representations	***Review*** • adding and subtracting binomials • combing like terms • finding area and perimeter ***New*** • multiplying binomials • Identifying the difference between linear and quadratic patterns	MVP 2 1.2	2 Periods	1.2 Set #14 and 15

Lesson 3: Identifying Quadratic Functions

Objectives

- Using the first and second differences of given patterns SWBAT work _____ to identify the type of pattern and write a recursive equation to represent the pattern for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reasoning abstractly and quantitatively
- MP 7: Look for and make use of structure
- MP 9: Look for and express regularity in repeated reasoning

Vocabulary

- Explicit equation, recursive equation, prime factorizations, quadratic equations, first and second difference

Common Misconceptions/struggles

- Using first and second difference to determine the type of function a pattern is
- Prime factorization

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.BF.1: Write a function that describes a relationship between two quantities F.LE.1: Distinguish between situations that and be modeled with linear functions and with exponential functions.	***Review*** • The *structure* of patterns and quantities can be used to create variable expressions for different types of functions ***New*** • Comparing patterns and recursive equations of linear and quadratic functions	***Review*** • Using distributive property to multiply binomials • Writing a recursive equation from a given pattern ***New*** • Writing a quadratic expression from a given prime factorization • Identify a pattern as either linear or quadratic using first and second differences	MVP 2 1.3	2 Periods	1.3 set #9 and 15

Lesson 4: Understanding Quadratic Functions

Objectives

- Using the area formula SWBAT work _____ to write quadratic equations and understand what a quadratic equation represents in terms of area for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reasoning abstractly and quantitatively
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary

- Quadratic function, area, perimeter, slope, rates of change

Common Misconceptions/struggles

- Using area and perimeter formulas
- Understanding the relationship between area and perimeter
- Graphing a parabola on a set of axes

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.SSE.1: Interpret expressions that represent a quantity in terms of its context. F.BF.1: Write a function that describes a relationship between two quantities	***Review*** • The *structure* of patterns and quantities can be used to create variable expressions for different types of functions ***New*** • Understanding how quadratic functions can be represented using area • Understanding the relationship between area and perimeter	***Review*** • Finding slope • Finding area and perimeter • Graphing from a table ***New*** • Creating a quadratic equation using area	MVP 2 1.4	2 Periods	1.7 Set #5-9

Lesson 5: Rate of Change in Quadratic Functions

Objectives

- Using the slope formula SWBAT work _____ to find rates of change in given quadratic functions for at least _____ out of _____ correct on the 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

Vocabulary

- Slope, slope formula, rate of change, evaluating functions

Common Misconceptions/struggles

- Correctly setting up slope formula

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.SSE.1: Interpret expressions that represent a quantity in terms of its context. F.BF.1: Write a function that describes a relationship between two quantities	***Review*** • Rate of change is the same as slope ***New*** • Understanding how rate of change is applied to real life situations • Understanding how rate of change can help you determine the type of function you have	***Review*** • Finding slope using the slope formula • Evaluating functions ***New*** • Using the distance formula • Finding average rate of change in a quadratic function	MVP 2 1.5	2 Periods	1.5 Set #10

Lesson 6: Comparing Rates of Change in Different Types of Functions

Objectives

- Using slope SWBAT work _____ to identify and compare the rates of change of different types of functions for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP 4: Model with Mathematics
- MP 6: Attend to precision

Vocabulary

- Distance formula, slope, rate of change, function, domain and range

Common Misconceptions/struggles

- Understanding the connection between rate of change and speed
- Recalling functions vs. relations

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.SSE.1: Interpret expressions that represent a quantity in terms of its context. F.BF.1: Write a function that describes a relationship between two quantities	***Review*** • Function vs. just a relation ***New*** • Speed can be represented as rate of change • Understanding how to determine speed from a graphical representation of a function	***Review*** • Finding the rate of change of a function • Finding domain and range ***New*** • Comparing the rates of change of different types of functions • Finding the speed of different functions representing real life situations	MVP 2 1.6	1 block	1.6 Set #11 and 12

Lesson 7:Multiple Representations of Quadratic Functions

Objectives

- Using multiple representations of quadratic functions SWBAT work _____ to identify types of functions and create another representation of the same function for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 8: Look for and express regularity in repeated reasoning

Vocabulary

- Relation, function, multiple representations

Common Misconceptions/struggles

- Creating multiple representations of the same function

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.LE.1: Distinguish between situations that and be modeled with linear functions and with exponential functions. F.LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	***Review*** • Function vs. just a relation ***New*** • Understanding that functions can be represented by multiple representations	***Review*** • Identifying types of functions ***New*** • Creating multiple representations of the same function • Identifying changes in functions that have been transformed	MVP 2 1.6	2 Periods	1.6 Set #14

Lesson 8: Transformations of Quadratic Functions

Objectives

- Using a parent function SWBAT work _____ to identify the changes that happen to a quadratic function during transformations at least _____ out of _____ correct on the daily exit slip.

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
- MP 7: Look for and make use of structure

Vocabulary

- Transformations, Parent Function, Vertex, Axis of Symmetry, X-intercepts, Y-intercept, Standard form

Common Misconceptions/struggles

- Difficulty identifying the patterns that occur in transformations
- Difficulty writing the equations
- Switching the x and y axis when identifying transformations

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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. 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.	***Review*** • Quadratic functions can be used to represent the area of a figure ***New*** • The simplest form of any type of function is called a parent function • Functions can be transformed or changed from their parent function by changing parts of the given equation	***Review*** • Identifying Key features of an quadratic from a graph and standard form of an equation; intercepts, vertex, max or min, and axis of symmetry ***New*** • Identifying the changes placed on a quadratic parent function by looking at the graph • Identifying the changes placed on a quadratic parent function by looking at the equation • Finding and identifying patterns in the equations of transformed quadratic functions • Writing equations of transformed functions in standard form	MVP 2: 2.1	2 Periods	2.1 Set #17 and 18

Lesson 9: Vertex form of a Quadratic Function

Objectives

- Using given quadratic functions SWBAT work _____ to identify the vertex from an equation in vertex form and write an equation in vertex form when given the vertex for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 7: Look for and make use of structure

Vocabulary

- Vertex Form, Vertex, AoS, Intercepts

Common Misconceptions/struggles

- Mistakes made while plotting points
- Difficulty identifying key points of a quadratic
- Mistakes while using the distributive property

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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. 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.	***Review*** • Standard form of a quadratic equation helps you to identify or can be written from knowing values for a, b, and c and the y –intercept ***New*** • Vertex form of a quadratic helps you to identify r can be written from knowing the vertex of a quadratic	***Review*** • Identifying Key features of an quadratic from a graph and standard form of an equation; intercepts, vertex, max or min, and axis of symmetry • Writing equations of transformed functions in standard form ***New*** • Writing equations of transformed functions in Vertex form • Identifying key features of a quadratic from a given table	MVP 2: 2.2	2 Periods	2.2 Set #24 and 29

Lesson 10: Completing the Square

Objectives

- Using completing the square SWBAT work _____ to write complete equations in standard form and factor perfect square trinomials at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

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

Vocabulary

- Complete the Square, intercepts, trinomial, factors, perfect square

Common Misconceptions/struggles

- Difficulty with distributive property
- Difficulty seeing the reverse action of distributive property when determining the factors of a trinomial
- Difficulty understanding the visual representation of a quadratic function using a square

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	***Review*** • Quadratic functions can be used to find the area of a figure • Multiplying binomials creates a quadratic trinomial in standard form ***New*** • Completing the square is a method used to solve quadratic equations • Perfect squares can be writing as the product of two factors	***Review*** • Identifying intercepts from a quadratic given in standard form • Identifying intercepts from a given graph ***New*** • Writing a complete equation in standard form using completing the square • Identifying the two factors that would produce the given trinomial when multiplied	MVP 2: 2.3 & 2.4	1 block	Set 2.3 #23 and set 2.4 #13

Lesson 11: Graphing Parabolas Using Completing the Square

Objectives

- Using completing the square SWBAT work _____ to write the vertex form of a quadratic equation and graph the parabola for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

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

Vocabulary

- Vertex form, completing the square, vertex, intercepts

Common Misconceptions/struggles

- Difficulty with distributive property
- Difficulty seeing the reverse action of distributive property when determining the factors of a trinomial
- Difficulty understanding the visual representation of a quadratic function using a square

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	***Review*** • Quadratic functions can be used to find the area of a figure • Multiplying binomials creates a quadratic trinomial in standard form ***New*** • Completing the square is a method used to solve quadratic equations • Completing the square can also be used to change forms of an equation from standard form to vertex form	***Review*** • Writing a complete equation in standard form using completing the square • Identifying the two factors that would produce the given trinomial when multiplied ***New*** • Writing a complete equation in vertex form using completing the square • Graphing a parabola from vertex form	MVP 2: 2.5	1 block	Set 2.5 #9, 10, & 11

Lesson 12: Factoring Quadratic Functions

Objectives

- Using the idea of area representing a quadratic equations SWBAT work _____ to factor given quadratic equations into two linear factors for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

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

Vocabulary

- Trinomial, binomial, linear factors, factoring

Common Misconceptions/struggles

- Difficulty with distributive property
- Difficulty seeing the reverse action of distributive property when determining the factors of a trinomial
- Difficulty understanding the visual representation of a quadratic function using a square

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check
F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. F.BF.1: Write a function that describes a relationship between two quantities. 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*** • Multiplying two binomials creates a trinomial • Area of a quadratic function is found by multiplying the two side lengths of a square together ***New*** • The process of working distributive property backwards and finding the factors that would multiply to a given trinomial is called factoring • The factors of a given quadratic represent the side lengths of the square represented by the function	***Review*** • Using distributive property to multiply two binomials • Combining like terms ***New*** • Use the idea of distributive property to work backwards and determine the two factors that would be multiplied together to create a given trinomial • Factor a given trinomial into two linear factors	MVP 2: 2.6 & 2.7	2 blocks	Set 2.6 #25 & Set 2.7 #14 g and #14

Lesson 13: Connecting Different Forms of Quadratic Functions

Objectives

- Using multiple representations of quadratic functions SWBAT work _____ to identify the key parts of each function and rewrite the given equation in a different form for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

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

Vocabulary

- Vertex, Intercepts, Vertex Form, Factored form, Standard Form, factorization

Common Misconceptions/struggles

- Difficulties graphing
- Difficulty with distributive property
- Confusion between the different forms of a quadratic function

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. F.BF.1: Write a function that describes a relationship between two quantities. 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*** • Multiple representations can be used to represent the same function (i.e table, graph, equation) • A quadratic equation can be written 3 main ways (vertex form, standard form, and factored form)_ ***New*** • Any form of a quadratic function can be changed to any other desired form • Each form of a quadratic equation gives provides you with key points of a quadratic function	***Review*** • Using distributive property to multiply two binomials • Identifying key points of a quadratic function from multiple representations of the function ***New*** • Change forms of a given quadratic function	MVP2: 2.8 & 2.9	1 block	Set 2.8 #25 & Set 2.9 #8

5 Practices for Orchestrating Productive Mathematics Discussions	
Practice	Description/ Questions
1. Anticipating	What strategies are students likely to use to approach or solve a challenging high-level mathematical task? How do you respond to the work that students are likely to produce? Which strategies from student work will be most useful in addressing the mathematical goals?
2. Monitoring	Paying attention to what and how students are thinking during the lesson. Students working in pairs or groups Listening to and making note of what students are discussing and the strategies they are using Asking students questions that will help them stay on track or help them think more deeply about the task. (Promote productive struggle)
3. Selecting	This is the process of deciding the *what* and the *who* to focus on during the discussion.
4. Sequencing	What order will the solutions be shared with the class?
5. Connecting	Asking the questions that will make the mathematics explicit and understandable. Focus must be on mathematical meaning and relationships; making links between mathematical ideas and representations.

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 (5-10 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 /Task(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) Guided Practice (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 ticket

Ideal Math Block with Intervention Stations

Whole Group Instruction	50 min	INSTRUCTION (Grades 9 – 12) Daily Routine: Mathematical Content or Language Routine Anchor Task: Anticipate, Monitor, Select, Sequence, Connect Collaborative Work* Guided Practice Independent Work (Demonstration of Student Thinking)		TOOLS Manipulatives RESOURCES Agile Mind
Rotation Stations (Student Notebooks & Chromebooks Needed)	1-2X 35 min	STATION 1: Focus on current Grade Level Content STUDENT EXPLORATION* Independent or groups of 2-3 Emphasis on MP's 3, 6 (Reasoning and Precision) And MP's 1 & 4 (Problem Solving and Application) TOOLS/RESOURCES Agile Mind Math Journals	STATION 2: Focus on Student Needs TECH STATION Independent TOOLS/ RESOURCES Khan Academy Approved Digital Provider Fluency Practice	TEACHER STATION: Focus on Grade Level Content; heavily scaffolded to connect deficiencies TARGETED INSTRUCTION 4 – 5 Students TOOLS/ RESOURCES Agile Homework Manipulatives
	5 min	INSTRUCTION Exit Ticket (Demonstration of Student Thinking) TOOLS/RESOURCES Notebooks or Exit Ticket Slips		

Extended Constructed Response (ECR)

Math Department ECR Protocol

ECR Protocol

(Extended Constructed Response)

Issuing

- Moving forward ECR'S will be disseminated by the first of each month and collected by the end of each month
- Method of Issuing: email and post on the website

Dissemination

- Teachers can elect to print copies for each student or use the Smartboard to project the ECR. (Note: Student work will be included in Student Portfolios)
- Students should be given up to 30 minutes depending on the complexity of the ECR
- Assure appropriate testing environment
- ECR should be completed independently

Scoring

- Conversion tables are available in the *Assessment & Data in Mathematics Bulletin* for genesis inputting purposes
- ECR's will count as Authentic Assessments
- Naming Protocol "Course Month ECR" (ex: Grade 6 October ECR)

Collection

- ECR's will be collected & kept in student portfolios
- Student work will be reviewed during CPT's

Link of Unit 1 ECRs
https://www.dropbox.com/sh/q03j0a1vmoaq3ce/AACOv1vpS3-p7G7V7_xpTBcla?dl=0

ECR Conversion Chart

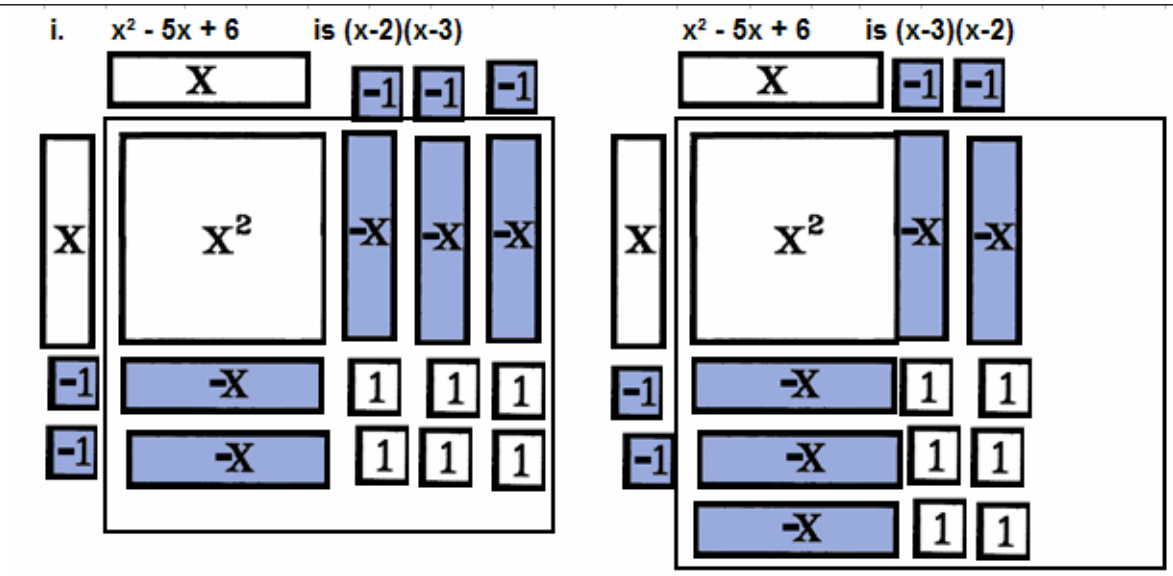
Points	Genesis Conversion	Points	Genesis Conversion	Points	Genesis Conversion
0	55	0	55	0	55
1	59	1	69	1	69
2	69	2	79	2	89
3	79	3	89	3	100
4	89	4	100		
5	100				

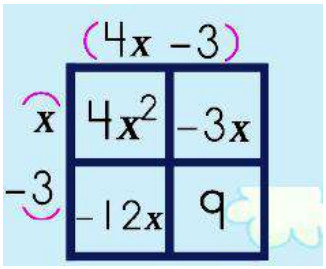
Sample of ECR Scoring Rubric

Part A	
Score	Description
3	Student response includes the following 3 elements. Modeling component: 2 pts * Valid equation * Logical work to find the price per ticket Computation: 1 pt * Correct computation for finding the price of per ticket Sample Student Response The total cost of the prizes is 349 + 42 + 25 + 18 + 16 = 450. For 75 tickets to make $450, they must each cost 450 ÷ 75 = $6. Equation: n= 6x – 450
2	Student response includes 2 of the 3 elements
1	Student response includes 1 of the 3 elements
0	Student response is incorrect or irrelevant.
Part B	
Score	Description
2	Student response includes the following elements: * Logical progression toward problem solving * Correct computation to find the number of tickets and determine the reasonable solution Sample of student work: 6x-450 >= 850 6x >= 1300 x >= 216.6666 Answer: the minimum number of tickets is 217
1	Student response includes 1 of 2 elements
0	Student response is incorrect or irrelevant

Multiple Representations

Concrete and/or pictorial

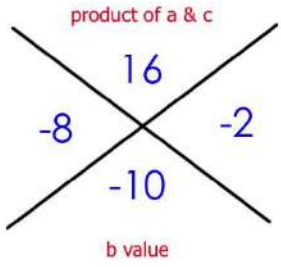




Abstract

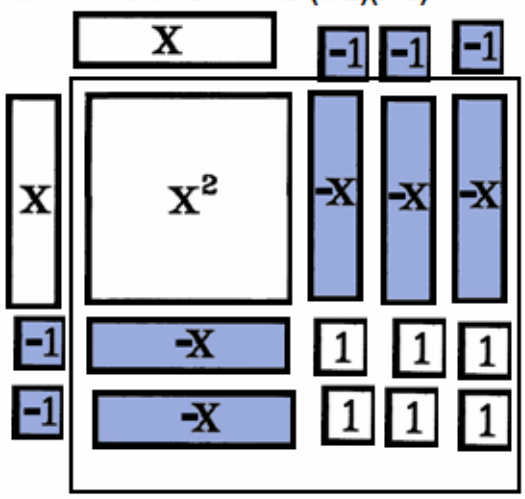
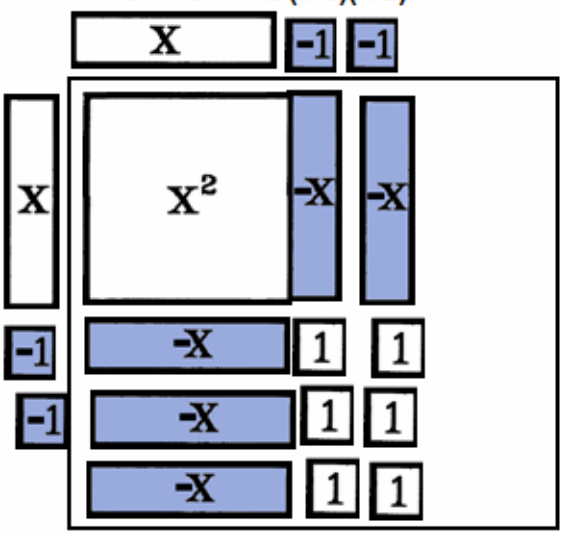
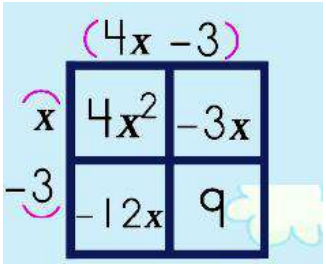
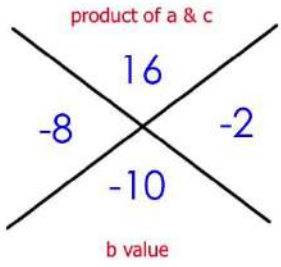
Factor. $n^2 - 10n + 16$

Diamond Method



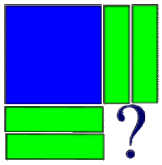
=(n - 8)(n - 2)

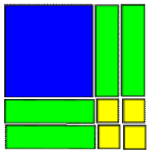
$$x^2 - x - 30 = \underbrace{x^2 - 6x}_{group} + \underbrace{5x - 30}_{group}$$
$$= x(x-6) + 5(x-6)$$
$$= (x-6)(x+5)$$

Polynomial Operations	
Concrete and/or pictorial	i. $x^2 - 5x + 6$ is $(x-2)(x-3)$  $x^2 - 5x + 6$ is $(x-3)(x-2)$  
Abstract	**Factor. $n^2 - 10n + 16$** **Diamond Method**  **=(n - 8)(n - 2)** $x^2 - x - 30 = \underbrace{x^2 - 6x}_{group} + \underbrace{5x - 30}_{group}$ $= x(x-6) + 5(x-6)$ $= (x-6)(x+5)$

Completing the Square

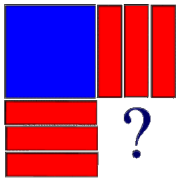
What is needed to create a perfect square trinomials for :

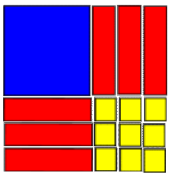




$x^2 + 4x + ?$ → $x^2 + 4x + 4$

Use the algebra tiles to create a **square**.
What tiles will be needed to complete the square?





$X^2-6x +?$ → $X^2 -6x + 9$

Use the algebra tiles to create a **square**.
Red tiles represent negative values.
What tiles will be needed to complete the square

* After viewing several examples, help students to see the pattern for finding the needed constant term. ***"Take half of the coefficient of the x-term and square it.***

Transfer concrete model to symbolic expression

Example:

"Take half of the coefficient of the x-term and square it.

$X^2 + 10x + ?$ → $x^2 + 10x +25$

Half of 10 = 5 then 5 square = 25