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How to Use This Addenda

Make sure you're ready to teach by noting the **Necessary Materials and Pre-Lesson Prep** you will need to gather or complete prior to the lesson

Find high-leverage instructional moves in the **Lesson Look Fors**. This is what leaders should see when observing your instruction

Note how your lesson objective ties to your state **Standards**

Plan purposeful questioning and responses using **Opportunities to CFU**

Note exemplar pacing in the **Lesson Agenda**

Use the **Mathematical Goal of the Lesson** to keep you focused on the appropriate student outcome

Plan instruction around what students need to Know & Do to be successful on the Exit Ticket using the identified **Student Know/Do Chart**

Plan to stress **Important Vocabulary** in the lesson. New vocab for the unit is indicated in bold

Find recommended lesson modifications, content knowledge boosters, and/or high-leverage instructional moves that may not be in your Teacher Edition located in **Other Notes to Inform Your Planning**

Lesson 9: Find related multiplication facts by adding and subtracting equal groups in array models		Date: _____														
Standard(s) 3.4K solve one-step and two-step problems involving multiplication and division within 100 using strategies based on objects, pictorial models, including arrays, area models, and equal groups, properties of operations; or recall of facts	Notes for Intellectual Preparation & Lesson Planning Necessary Materials and Pre-Lesson Prep <ul style="list-style-type: none"> • (S) Multiply by 2 (1–5) Pattern Sheet • (S) Personal white board • (S) Threes array no fill template • (S) Blank paper <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="text-align: left;">Lesson Agenda</th> <th style="text-align: left;">Time</th> </tr> </thead> <tbody> <tr> <td>I. Do Now (source: fluency #1)</td> <td>5 min</td> </tr> <tr> <td>II. Fluency*</td> <td>8 min</td> </tr> <tr> <td>III. Concept Development</td> <td>25 min</td> </tr> <tr> <td>IV. Student Practice</td> <td>15 min</td> </tr> <tr> <td>V. Student Debrief</td> <td>7 min</td> </tr> <tr> <td>VI. Exit Ticket*</td> <td>5 min</td> </tr> </tbody> </table> <p>Mathematical Goal of this Lesson Students learn they can use decomposition to break a larger number into two smaller numbers as a strategy for multiplication. The goal of this lesson is simply for student to understand how to interpret and create an array that demonstrates such decomposition. Students will build on this understanding in subsequent lessons. This lesson also supports the goal of student thinking in terms of counting units, an overarching goal for academy math.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ Concept Development, by way of eliciting student responses ✓ Problems Set problems: #2, #3 <p>Other Notes to Inform Your Planning For Do Now: Use the Multiply by 2 (1–5) Pattern Sheet for your Do Now. 3 minutes for completion, 2 minutes whole group classwork check. For Fluency: Complete the Group Counting activity (notice the inclusion of 4s in preparation for upcoming lessons) and Forms of Multiplication activity. For Concept Development: Consider prepping personal whiteboard in advance. Spend no more than 12 minutes for CD Problem 1 and 13 minutes for CD Prob 2. For Student Practice: consider creating an extra set of Qs like 1-3 in case students struggle with entry-level understanding. If they don't, move on to Qs 4 and above. For Student Debrief: consider using the Eureka assigned Exit Ticket for whole group debrief exercise; Suggested strategy – guided discourse. For Exit Ticket: Use Homework problems 2 & 3 for this lesson's Exit Ticket.</p> <p><small>Though not formally discussed yet, this is a foundation to understanding of distributive property. Students visually see multiplying the sum of two or more addends by a number will give the same result as multiplying each addend individually by the number and then adding the products together.</small></p>	Lesson Agenda	Time	I. Do Now (source: fluency #1)	5 min	II. Fluency*	8 min	III. Concept Development	25 min	IV. Student Practice	15 min	V. Student Debrief	7 min	VI. Exit Ticket*	5 min	Lesson Look Fors Look for teachers to... <ul style="list-style-type: none"> <input type="checkbox"/> Have established a signaling routine for choral response or work show during the respective fluency activities <input type="checkbox"/> Use a think aloud to describe why they shade what portions of the array, or use a different symbol in the array <input type="checkbox"/> Make the focus of the lesson understanding the visual representations Look for students to... <ul style="list-style-type: none"> <input type="checkbox"/> Explain what they see in the array and how it relates to a given number sentence. Student Criteria for Success <ul style="list-style-type: none"> <input type="checkbox"/> Shading, brackets, and/or dotted lines on an array will have mathematical significance <input type="checkbox"/> Brackets can identify parts or wholes <input type="checkbox"/> Dotted lines and shading represent decompositions <input type="checkbox"/> We count units; In an array, counting rows is the same as counting units. <input type="checkbox"/> Addition/subtraction and multiplication math facts (up to 4) <input type="checkbox"/> Interpret an array <input type="checkbox"/> Identify decompositions within an array <input type="checkbox"/> Relate an annotated or labeled array to one or more number sentences <input type="checkbox"/> Addition/subtraction (+/-, up to 4) <input type="checkbox"/> Multiplication (2, 3, and 4)
Lesson Agenda	Time															
I. Do Now (source: fluency #1)	5 min															
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VI. Exit Ticket*	5 min															

UNIT SYNOPSIS

This unit expands on students' understanding of quadratic functions and equations from Algebra 1 and extends to inequalities. In this unit, students will solve quadratic equations and inequalities algebraically by factoring, completing the square, and using the quadratic formula. Many of these methods are initially taught in Algebra 1 but students may have had limited practice with them. This unit introduces the imaginary number i and students will solve quadratic equations for complex solutions where in prior courses they exclusively solved for real solutions. The unit focuses on both the standard form of quadratic functions as well as the standard form of parabolas, also known as vertex form. In addition to solving quadratics functions, the unit also includes graphing and transforming parabolas and solving a system including a linear function and quadratic function. After this unit, in unit 5, students will continue to explore parabolas as they graph square root functions.

Solving Equations and Inequalities: Solving an equation is the process of rewriting the equation to make what it says about its variable(s) as simple as possible. Properties of numbers and equality can be used to transform an equation (or inequality) into equivalent, simpler equations (or inequalities) in order to find solutions. Useful information about equations and inequalities (including solutions) can be found by analyzing graphs or tables. The numbers and types of solutions vary predictably, based on the type of equation.

- o You can factor many quadratic trinomials $ax^2 + bx + c$ into products of two binomials.
- o To find the zeros of a quadratic function $y = ax^2 + bx + c$, solve the related quadratic equation $0 = ax^2 + bx + c$.
- o Completing a perfect square trinomial allows you to factor the completed trinomial as the square of a binomial.
- o You can solve a quadratic equation $ax^2 + bx + c = 0$ in more than one way. In general, you can find a formula that gives values of x in terms of a , b , and c .
- o You can solve systems involving quadratic equations using methods similar to the ones used to solve systems of linear equations.

Functions: A function is a relationship between variables in which each value of the input variable is associated with a unique value of the output variable. Functions can be represented in a variety of ways, such as graphs, tables, equations, or words. Each representation is particularly useful in certain situations. Some important families of functions are developed through transformations of the simplest form of the function.

- o The graph of any quadratic function is a transformation of the graph of the parent quadratic function, $y = x^2$.
- o Three non-colinear points, no two of which are in line vertically, are on the graph of exactly one quadratic function.

Equivalence: A single quantity may be represented by many different expressions. The facts about a quantity may be expressed by many different equations (or inequalities).

- o The graph of any quadratic function is a transformation of the graph of the parent quadratic function, $y = x^2$.
- o For any quadratic function, $f(x) = ax^2 + bx + c$, the values of a , b , and c provide key information about its graph.

Misconceptions:

- Some students may think that the terms zeros, x-intercepts, roots, and solutions are all the same and can be used interchangeably rather than understanding that when an equation is set equal to zero, these will be equivalent, but not at other times. Roots and solutions pertain to equations, while x-intercepts and zeros pertain to functions.
- Some students may think that in order to be a complex number, the number must contain an imaginary part rather than that all numbers can be written in complex form, e.g., 25 can be written as $25 + 0i$, and its conjugate is $25 - 0i$.
- Some students may think that the x- and y-values in the solution to a system of two linear equations in two variables can never be equal in value.

Underdeveloped Concepts:

- Some students may not visualize how a system containing a linear and a quadratic function can have zero, one, or two solutions.

Key Questions:

- What kinds of mathematical and real-world situations can quadratic functions model?
- What graphs, key attributes, and characteristics are unique to quadratic functions?
- What are the real-world meanings of the key attributes of a quadratic function model?
- How can the key attributes of a quadratic function be used to make predictions and critical judgments?
- How does knowing more than one solution strategy build mathematical flexibility?

CONTENT STANDARDS

Below are the standards addressed in this unit.

Readiness Standards	Supporting Standards
2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.	2A.3C Solve, algebraically, systems of two equations in two variables consisting of a linear equation and a quadratic equation.
2A.4C Determine the effects on the graph of $f(x) = \sqrt{x}$ $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(bx)$, and $f(x - c)$ for specific positive and negative values of a , b , c , and d . *Due to prerequisite needs.	2A.4A Write the quadratic function given three specified points in the plane.
2A.4F Solve quadratic and square root equations.	2A.4D Transform a quadratic function $f(x) = ax^2 + bx + c$ into the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$.
	2A.4H Solve quadratic inequalities.
	2A.7A Add, subtract, and multiply (and divide) complex numbers.

Focus on Disciplinary Literacy 	Mathematical Process Standard (F) – Analyze mathematical relationships to connect and communicate mathematical ideas.
	Mathematical Process Standard (G) – Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

LEARNING SUPPORTS BY LESSON

There is a checkmark for the math support if the lesson	Lessons →	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13
	Math Supports													
makes a connection to prior content or from a previous unit or academic year	Access Prior Knowledge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
uses familiar contexts or experiences to make the learning relevant to students	Real-World Connections										✓			✓
makes use of graphic organizers	Graphic Organizers	✓	✓	✓			✓	✓	✓	✓	✓			✓
includes tools like rulers, protractors, patty paper, algebra tiles, etc.	Tools or Manipulatives	✓					✓							
incorporates tables, reference charts, displays, pictures, models, or color-coding	Visual Aids			✓			✓	✓	✓	✓		✓	✓	
includes definitions, examples vs. nonexamples, cognates, etc.	Vocabulary Supports	✓	✓		✓	✓	✓		✓			✓	✓	
includes strategies that support language development														
asks students to discuss with their partner to prepare for whole class discussion	- Turn and Talk	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
teacher facilitates a whole class discussion to debrief key learnings	- Guided Discussion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
asks students to think independently, test their idea with a partner, and share whole group	- Think, Pair, Share										✓			
includes sentence stems to support students with explanations	- Sentence Stems													
provides opportunities for students to work with a partner or a group	Peer Collaboration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
uses mnemonics such as SohCahToa	Mnemonics													
includes websites or equipment that enhances the lesson	Technological Support	✓	✓		✓	✓	✓	✓		✓				
content can be presented in different forms														
uses hands-on tools or manipulatives to represent the math	- Concrete													
uses drawings to represent the math	- Pictorial	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
uses numbers and number sentences to represent the math	- Abstract	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The EFFL Model

Before You EFFL!

Here are helpful resources that you guide you in the right direction before your EFFL lesson!

Why Should We EFFL?

The article advocates for the Experience First, Formalize Later (EFFL) teaching model, emphasizing its effectiveness in fostering deep understanding and flexible thinking in students. The author compares traditional teaching to a game of "Simon Says," where students merely mimic instructions without grasping underlying concepts. In contrast, EFFL encourages students to engage actively with problems, enhancing their ability to understand and apply math concepts creatively.

Tips for Lesson Planning

The article offers practical advice for effective lesson planning beyond the exhaustive and overly detailed approaches often emphasized during teacher training. It underscores the importance of thoughtful preparation but rejects the notion that teachers need to script every minute or detail of a class session.

Making the Most of Your EFFL Lesson Debrief

The article discusses the significance of the debriefing phase in the Experience First, Formalize Later (EFFL) lesson model, emphasizing its role in reinforcing learning and highlighting student contributions. The debrief session is seen as crucial for integrating academic vocabulary, emphasizing key lesson understandings, and valuing students' mathematical insights.

While You EFFL!

While each lesson may be unique in context and skills, all lessons benefit from the following practices:

Teacher Look Fors:

- Utilizing the Do Now to spark students' interest in the Activity.
- Use questioning to promote small group discussion and exploration, guided by monitoring questions.
- Connects Experience First to formal concepts using a **colored pencil/pen** to take notes along the margin during the Debrief.
- Facilitates whole-class discussions for students to reflect, share insights, and provides feedback that reinforces key concepts.
- Tracks time to adapt lesson pacing and support based on student response and engagement.

Students Look Fors:

- In the Activity, students engage in group work and discourse.
- Exploring the activity, testing hypotheses and approaches (trial & error).
- Take notes on key ideas and concepts using different **colored pencil/pen** to take notes along the margin.
- Share thoughts and ideas that demonstrate their approach to their work.

Other considerations

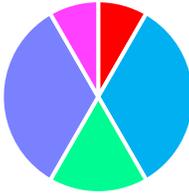
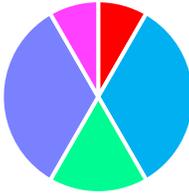
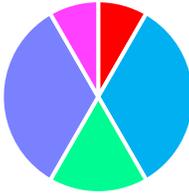
- During the **Experience First** phase, if most of your students seem stuck or disengaged, take a moment to pause, reset, and provide clear instructions. Some problems of the Activity are more suitable to do a whole-class discussion as a means to save some instructional time for Student Practice or the Exit Ticket. You are encouraged to adapt the EFFL (Experience First, Formalize Later) process to meet your students' needs while maintaining a focus on student-centered instruction.

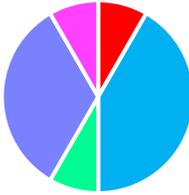
ROADMAP

AT A GLANCE: Unit 4 – Quadratic Functions and Equations			
Day	Date	Lesson	Lesson Title
1		1	Quadratic Functions and Translations
2		2	Forms of Quadratic Equations
3		3	Writing Equations for Quadratic Functions
4		4	Factoring Quadratics
5		5	Solving Using the Zero Product Property
6		6	Completing the Square
7			<i>Unit 4 Success Day 1 – Review and Reteach topics from 4.1 - 4.6</i>
8		7	Quadratic Formula
9		8	Complex Numbers
10		9	The Discriminant and Types of Solutions
11		10	Key Features of Quadratic Functions
12		11	Graphing Quadratic Functions in Standard Form
13		12	Graphing Quadratic Inequalities
14		13	Systems of Linear and Quadratic Equations
15			<i>Unit 4 Success Day 2 – Unit Assessment Review</i>
16			End of Unit 4 Assessment

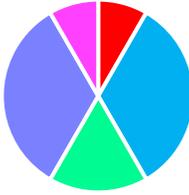
Date: _____		
Lesson 1: Quadratic Functions and Translations		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.</p> <p>◆ 2A.4C Determine the effects on the graph of $f(x) = \sqrt{x}$ when $f(x) = x^2$ is replaced by $af(x)$, $f(x) + d$, $f(bx)$, and $f(x - c)$ for specific positive and negative values of a, b, c, and d.</p> <p>*Prerequisite needs.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook Graphing calculator or Desmos <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> ■ Do Now (5 min) ■ INM (20 min) ■ Debrief (10 min) ■ Student Practice (20 min) ■ Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson</p> <p>In this lesson, students will be able to understand how the shape of a quadratic graph determines the domain, range, vertex, axis of symmetry, and number of solutions. Students will also graph and write equations of transformed quadratic functions.</p>	<p>Look for teachers to...</p> <ul style="list-style-type: none"> <input type="checkbox"/> Use the guiding questions from the TE while students work in groups. <input type="checkbox"/> Build on students' prior knowledge of translating functions from unit 1. <p>Look for students to...</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identify the key features of quadratics given, like the vertex, axis of symmetry, direction of opening, domain, and range. <input type="checkbox"/> Use the graphs of quadratics to solve.
Important Vocabulary	<p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ After INM #5 ✓ Debrief <p style="text-align: right;">✓ Student Practice #1-4</p> <p>Other Notes to Inform Your Planning</p> <p>Students already learned about translating functions in Lesson 1.04 which is going to allow us to focus more on the important parts of a quadratic graph, like the vertex and axis of symmetry. Have students work in groups on questions #1-5. Ideally, they will do their graphing in Desmos but a graphing calculator would work also. Ask groups to put their work on the board. What's important here is for students to recognize that the symmetry of the graph means that we will sometimes get two solutions to equations.</p>	<p>Student Know/Do Chart</p> <p>Students can</p> <ul style="list-style-type: none">  Graph quadratic functions based on specified transformations.  Write the equation for quadratic functions that have been transformed.  Know how to translate a quadratic function horizontally and vertically based on the changes of h and k in the form $y = (x - h)^2 + k$.  Quadratic functions graph as vertical parabolas and have a vertex, axis of symmetry, and either open up or down.
	<p>Focus on Disciplinary Literacy</p> <div style="border: 1px solid black; padding: 5px; text-align: center;">  <p>Student Practice 6-8</p> </div>	

Date: _____		
Lesson 2: Forms of Quadratic Equations		
<p>Standard(s)</p> <p>◆ 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.</p> <p>◆ 2A.4C Determine the effects on the graph of $f(x) = \sqrt{x}$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(bx)$, and $f(x - c)$ for specific positive and negative values of a, b, c, and d.</p> <p>*Prerequisite needs.</p>	<p>Notes for Intellectual Preparation & Lesson Planning</p> <p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook Graphing calculator or Desmos <div data-bbox="499 347 1251 621" style="border: 1px solid black; padding: 5px;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> ■ Do Now (5 min) ■ INM (20 min) ■ Debrief (10 min) ■ Student Practice (10 min) ■ Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson</p> <p>In this lesson, students will be able to write and graph quadratic functions in vertex, intercept, and general forms. Students will also find the vertex and axis of symmetry from the equation of a quadratic.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM #1-4 ✓ Debrief <div data-bbox="1123 878 1423 1040" style="border: 1px solid black; padding: 5px; text-align: center;"> <p>Focus on Disciplinary Literacy</p>  <p>INM #3-4 & Debrief</p> </div> <p>Other Notes to Inform Your Planning</p> <p>Today we will start with a quick refresh of vertex form from the previous lesson and then will shift into investigating intercept form. Using Desmos is recommended for this lesson, but graphing calculators would be fine also. Groups should work through the entire activity together. We want students to notice how the equations relate to the graphs of the functions. What is most important is that students recognize that different forms tell us different things about the function.</p>	<p>Lesson Look Fors</p> <p>Look for teachers to...</p> <ul style="list-style-type: none"> <input type="checkbox"/> Use the guiding questions from the TE while students work in groups. <input type="checkbox"/> Support students as they discover the different benefits of each form of quadratics we discuss today: standard, vertex, and intercepts. <p>Look for students to...</p> <ul style="list-style-type: none"> <input type="checkbox"/> Use the vertex or the x-intercepts to graph and write the equations of given quadratics. <input type="checkbox"/> Use symmetry to find the vertex of a quadratic when they know the x-intercepts for the curve.
<p>Important Vocabulary</p> <ul style="list-style-type: none"> standard form of a quadratic vertex form intercept form of a quadratic 		<p>Student Know/Do Chart</p> <p>Students can</p> <ul style="list-style-type: none">  Write the equation of a given quadratic function from its vertex or x-intercepts.  Find the vertex and axis of symmetry for a quadratic function from the equation.  Know that there are benefits to each form of the equation of a quadratic function that we learned. The vertex form allows for easy translation. The intercept form allows to find zeros and find the vertex in the middle of the intercepts. The standard form is best for factoring and can give the axis of symmetry by finding $x = \frac{-b}{2a}$.

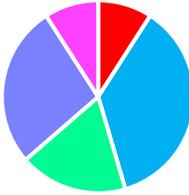
Date: _____													
Lesson 3: Writing Equations for Quadratic Functions													
Standard(s) ◆ 2A.4A Write the quadratic function given three specified points in the plane. ◆ 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.	Notes for Intellectual Preparation & Lesson Planning Necessary Materials and Pre-Lesson Prep <ul style="list-style-type: none"> SE workbook <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> Lesson Structure: <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20px;"></td> <td>Do Now (5 min)</td> <td rowspan="5" style="text-align: center; vertical-align: middle;"></td> </tr> <tr> <td></td> <td>INM (20 min)</td> </tr> <tr> <td></td> <td>Debrief (10 min)</td> </tr> <tr> <td></td> <td>Student Practice (20 min)</td> </tr> <tr> <td></td> <td>Exit Ticket (5 min)</td> </tr> </table> </div> Mathematical Goal of this Lesson In this lesson, students will be able to write an equation for a quadratic from a graph, table, or description. Students will also use the symmetry of a quadratic to find values of the function. Opportunities to CFU <ul style="list-style-type: none"> ✓ INM problems #1-3 ✓ Student Practice #1-3 ✓ Debrief 		Do Now (5 min)			INM (20 min)		Debrief (10 min)		Student Practice (20 min)		Exit Ticket (5 min)	Lesson Look Fors <u>Look for teachers to...</u> <ul style="list-style-type: none"> <input type="checkbox"/> Use the guiding questions from the TE while students work in groups. <input type="checkbox"/> Remind students of the different forms for equations of quadratic functions from the previous lesson and what each specializes in. <u>Look for students to...</u> <ul style="list-style-type: none"> <input type="checkbox"/> Use tables of points and graphs to identify key points for the quadratic to write an equation in one of the forms discussed. <input type="checkbox"/> Plug in values given, ideally the y-intercept, to make sure the equation they have written has the correct stretch or shrink.
	Do Now (5 min)												
	INM (20 min)												
	Debrief (10 min)												
	Student Practice (20 min)												
	Exit Ticket (5 min)												
Important Vocabulary <ul style="list-style-type: none"> standard form of a quadratic vertex form intercept form of a quadratic constant first differences constant second differences 	Other Notes to Inform Your Planning Today students will be getting practice in writing equations in different forms of a quadratic equation. We want students to decide which form is best based on the information that is given to them. That being said, students can choose any of the forms to use. We don't like to tell them which form they have to use because all of the forms are equally valid. <div style="text-align: right; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Focus on Disciplinary Literacy  INM #2 & 3 </div> </div>	Student Know/Do Chart Students can <ul style="list-style-type: none">  Use the symmetry of a parabola to find missing values or locate the vertex from given points.  Write an equation for a quadratic from a graph, table, or description.  Know that the vertex, intercepts, and axis of symmetry can be used to write the equation of the given quadratic function. 											

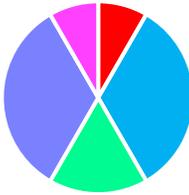
Date: _____		
Lesson 4: Factoring Quadratics		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
2A.4F Solve quadratic and square-root equations.	Necessary Materials and Pre-Lesson Prep <ul style="list-style-type: none"> SE workbook 	Look for teachers to... <ul style="list-style-type: none"> Use the guiding questions from the TE while students work in groups. Build on students' prior experiences with factoring and with array models (rectangle diagrams) for distribution. Look for students to... <ul style="list-style-type: none"> Perform a variety of distributions to see how to "undo" distribution and find quadratic factors. Identify special cases like difference of squares and how a GCF affects factoring.
	<div style="border: 1px solid black; padding: 5px;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (25 min) Debrief (5 min) Student Practice (20 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson In this lesson, students will be able to multiply polynomial factors using distribution or rectangle diagrams. Students will also factor quadratic equations in the form $ax^2 + b + c$.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problems #3-5, 7-10 ✓ Student Practice #11 ✓ Debrief 	
Important Vocabulary <ul style="list-style-type: none"> quadratic expression factor factoring binomial trinomial greatest common factor (GCF) difference of squares distribute 	<p>Other Notes to Inform Your Planning</p> <p>Today is a big day. We're going to take on FACTORING! And we're going to do it without telling the students HOW to factor before they start factoring. It's a tall order. To accomplish this, we've created a sequence of problems that have slight variations from one to the next to help students notice how the factors must change in order to get a certain product. The level of difficulty will increase slightly between each problem so that students can get from the simplest problem to the most challenging without any jumps that are too large.</p> <p>This activity at first glance may look like a Drill and Kill lesson, but it's not. We've made specific equations, each with different pieces missing. Each question was intentionally written to help students notice how changing the value of b or c affects the factors or how where you put a negative makes a difference. Students should work in their groups to find all of the missing pieces to the equations.</p>	Student Know/Do Chart <p>Students can</p> <ul style="list-style-type: none">  Use rectangle diagrams to distribute polynomial factors.  Factor quadratic equations in the form $ax^2 + b + c$.  To factor quadratic equations in the form $ax^2 + b + c$, first look for factors of a and c that can combine to equal b.

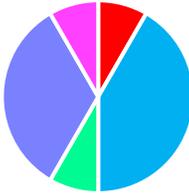
Date: _____		
Lesson 5: Solving Using the Zero Product Property		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.4F Solve quadratic and square-root equations.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbooks Graphing calculator or Desmos <div data-bbox="495 345 1270 618" style="border: 1px solid black; padding: 5px;"> <p>Lesson Structure:</p> <ul style="list-style-type: none">  Do Now (5 min)  INM (20 min)  Debrief (10 min)  Student Practice (20 min)  Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson In this lesson, students will be able to solve quadratic equations using the Zero Product Property. Students will also connect solving quadratics in factored form with graphing a quadratic and finding the x-intercepts.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problems #3-5 ✓ Student Practice ✓ Debrief <p>Other Notes to Inform Your Planning The path for this lesson is to get students thinking about the Zero Product Property first by using simple examples and then transitioning into examples with binomial factors. We want students to recognize that if a product equals zero, one of the factors MUST be zero. So, what makes each factor equal to zero? Those are your solutions! Students will discover this in questions #1-3c.</p> <div data-bbox="1142 1101 1451 1268" style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Focus on Disciplinary Literacy</p> <div style="display: flex; align-items: center;">  <p>INM #5c & Student Practice #1d</p> </div> </div> <p>We want students to make a connection between solving using factoring and the Zero Product Property with graphing and finding the x-intercepts. Remember, in Lesson 4.02 we learned that quadratics written in intercept form give us the x-intercepts. The y-coordinate for any x-intercept is zero, so when an equation equals zero, the solution is the x-intercept, and the factors give us the x-intercepts (which we already knew).</p>	<p>Look for teachers to...</p> <ul style="list-style-type: none"> <input type="checkbox"/> Use the guiding questions from the TE while students work in groups. <input type="checkbox"/> Build on students' use of different forms of quadratic equations studied in lesson 4.02. <p>Look for students to...</p> <ul style="list-style-type: none"> <input type="checkbox"/> Rewrite equations to equal zero and factor and solve. <input type="checkbox"/> Connect the x-intercepts of functions from a graph with the zeros and how to write a function from the factors.
Important Vocabulary	Student Know/Do Chart	
<ul style="list-style-type: none"> quadratic equation zero product property factoring solution root double root solution set, { } 	<p>Students can</p> <ul style="list-style-type: none">  Solve quadratic equations using the Zero Product Property.  Connect solving quadratics in factored form with graphing a quadratic and finding the x-intercepts.  Zero Product Property states that if a product of factors equals zero, then one or both of the factors must be 0. 	

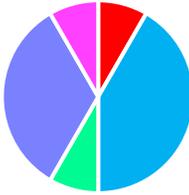
Date: _____		
Lesson 6: Completing the Square		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.4F Solve quadratic and square root equations.</p> <p>◆ 2A.4D Transform a quadratic function $f(x) = ax^2 + bx + c$ into the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbooks Graphing calculator or Desmos <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (20 min) Debrief (10 min) Student Practice (20 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson In this lesson, students will be able to rewrite quadratic equations as perfect squares. Additionally, students will solve quadratic equations by completing the square.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problems #2-4 ✓ Student Practice #1-3 ✓ Debrief 	<p><u>Look for teachers to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Remind students of a perfect square trinomial and how they are factored. <input type="checkbox"/> Keep students focused on the square root principal and when using the square root to solve it yields \pm solutions. <p><u>Look for students to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Solve quadratic equations by taking the square root of each side. <input type="checkbox"/> Solve quadratic equations using completing the square.
	Important Vocabulary	<p>Other Notes to Inform Your Planning</p> <p>In this lesson we're working to get students to understand why we would want an equation to be written as a perfect square (so we can square root) and if it's not a perfect square, how do we turn it into one (add something so that it is).</p> <p>Since we will be using Completing the Square to solve, we will work mostly with equations. This means students need to remember to keep their equations balanced by adding equal values to each side of the equation.</p>
<ul style="list-style-type: none"> ▪ rationalize the denominator ▪ completing the square ▪ perfect square trinomial 	<div style="border: 1px solid black; padding: 5px; margin: 10px 0; background-color: #fff9c4;"> <p style="text-align: center;">Focus on Disciplinary Literacy</p> <div style="display: flex; align-items: center; justify-content: center;">  <div style="margin-left: 10px;">Debrief</div> </div> </div>	<p>Students can</p> <p>Do Solve quadratic equations by using the square root principal and by first completing the square when necessary.</p> <p>Know Know that the square root of a variable yields \pm solutions.</p>

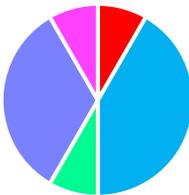
Date: _____		
Lesson 7: Quadratic Formula		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.4F Solve quadratic and square root equations.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook <div data-bbox="499 310 1251 583" style="border: 1px solid black; padding: 5px;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (20 min) Debrief (5 min) Student Practice (20 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson In this lesson students will solve quadratic equations with real solutions using the quadratic formula.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problem #2 ✓ Debrief 	<p><u>Look for teachers to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Create an anchor chart or similar tool to make the quadratic formula clear for the students and demonstrate how to properly evaluate it. <p><u>Look for students to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Solve quadratic equations using completing the square, factoring, and the quadratic formula. <input type="checkbox"/> Learn to inspect a quadratic equation and determine which method would be the easiest to solve.
Important Vocabulary	Other Notes to Inform Your Planning	
<ul style="list-style-type: none"> quadratic formula real rational irrational double root 	<p>In this lesson we are talking about one last way to solve quadratic equations, the Quadratic Formula. Instead of discovering the Quadratic Formula, we wanted to focus on which method of solving you should use and when. To get at this idea, students will solve three different quadratic equations three times each. It's kind of a lot, we know. But it's great practice, and it allows students to see that sometimes factoring is nice, sometimes completing the square is nice and sometimes the Quadratic Formula is nice. Also, the students may have been introduced to the Quadratic Formula in Algebra 1.</p>	
Student Know/Do Chart		
<p>Students can</p> <ul style="list-style-type: none">  Use the quadratic formula to solve quadratic equations.  Know that there are a variety of appropriate methods to solve quadratic functions with real solutions, but the quadratic formula always will work. 		

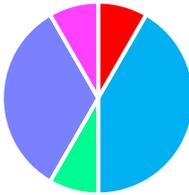
Date: _____		
Lesson 8: Complex Numbers		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.7A Add, subtract, and multiply complex numbers.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook 	<p><u>Look for teachers to...</u></p> <ul style="list-style-type: none"> Support students as they develop an understanding of the complex plane. Connect for students that the normal x-axis or number line relates to the real axis. <p><u>Look for students to...</u></p> <ul style="list-style-type: none"> Evaluate i as $\sqrt{-1}$ to establish what the powers of i represent. Simplify complex numbers using adding, subtracting, and multiplication.
	<div style="border: 1px solid black; padding: 5px;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (20 min) Debrief (10 min) Student Practice (15 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson</p> <p>In this lesson, students will be able to understand what the imaginary number is, why it is needed, and how to simplify expressions using it. They will simplify square roots of negative numbers using i. Students will also solve quadratic equations with imaginary solutions and identify conjugate pairs.</p>	
Important Vocabulary	<p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problems #1-3 ✓ Debrief ✓ Student Practice #1-4 <p>Other Notes to Inform Your Planning</p> <p>This lesson is different than most and include some Math History for you to narrate and to guide you as you sketch some notes for the class in the “Story Time” section of the INM.</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>Focus on Disciplinary Literacy</p>  <p>Debrief</p> </div> <p>One additional vocabulary term is a conjugate pair. This will be covered in the Debrief and the Student Practice. It's not important that students memorize what a conjugate pair is. What we want to point out is that the solutions come in pairs because of the +/- . This will become more evident in the next lesson when we use the Quadratic Formula to solve for imaginary solutions. (#5-6 on the Student Practice gives students a chance to challenge themselves to skip ahead to using imaginary numbers in the Quadratic Formula.)</p>	<p>Student Know/Do Chart</p> <p>Students can</p> <ul style="list-style-type: none">  Simplify complex numbers using addition, subtraction, and multiplication.  Simplify i^n to an equivalent value of i, -1, $-i$, or 1.  The if $a + bi$ is the solution to a quadratic equation, then it's conjugate pair $a - bi$ must also be a solution.

Date: _____		
Lesson 9: The Discriminant and Types of Solutions		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
2A.4F Solve quadratic and square-root equations.	Necessary Materials and Pre-Lesson Prep <ul style="list-style-type: none"> SE workbooks Graphing calculator or Desmos 	Look for teachers to... <ul style="list-style-type: none"> Stamp the connections between the graph of a parabola and the discriminant. Connect for students the representation of real versus imaginary zeros on the coordinate plane. Look for students to... <ul style="list-style-type: none"> Simplify discriminants and use them to categorize the number and types of roots for a given quadratic equation. Use the quadratic formula to find imaginary solutions for given quadratic equations.
	<div style="border: 1px solid black; padding: 5px;"> Lesson Structure: <ul style="list-style-type: none"> Do Now (5 min) INM (20 min) Debrief (10 min) Student Practice (20 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson In this lesson students will solve quadratic equations with nonreal solutions using the quadratic formula. They will use the discriminant to determine the type and number of solutions an equation will have. Students will also use the graph of a quadratic to determine the number and type of solutions.</p>	
Important Vocabulary	Opportunities to CFU <ul style="list-style-type: none"> ✓ INM problems #1-2 ✓ Debrief 	Student Know/Do Chart Students can <ul style="list-style-type: none">  Solve quadratic equations with nonreal solutions using the quadratic formula.  Use the discriminant or the graph of a quadratic to determine the number and types of roots it has.  If the discriminant is negative, then the quadratic equation has two imaginary solutions. If the discriminant is zero, then it has one real double root. If the discriminant is positive, it will have two real roots and they will be rational if it is a perfect square, otherwise they are irrational roots.
<ul style="list-style-type: none"> quadratic formula discriminant real imaginary rational root irrational root double root complex conjugate 	Other Notes to Inform Your Planning In Lesson 4.07, we learned how to solve quadratic equations using the Quadratic Formula. All the problems we did in that lesson had real solutions. In Lesson 4.08, we were introduced to imaginary solutions. So today, we'll be putting that together to see how we can find imaginary solutions with the Quadratic Formula. What we'd like students to notice here is that the square root portion of the Quadratic Formula is what determines if we will have imaginary solutions or not. Which makes total sense because the imaginary number is a square root. We also want to connect the type and number of solutions to the x-intercepts of the graphs.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> Focus on Disciplinary Literacy  INM </div>

Date: _____		
Lesson 10: Key Features of Quadratic Functions		
<p>Standard(s)</p> <p>◆ 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.</p> <p>◆ 2A.4D Transform a quadratic function $f(x) = ax^2 + bx + c$ into the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$.</p>	<p>Notes for Intellectual Preparation & Lesson Planning</p> <p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (25 min) Debrief (5 min) Student Practice (20 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson</p> <p>In this lesson, students will be able to write a quadratic function from real-world scenarios and identify and interpret its key features.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ After the INM ✓ Student Practice #1 <p>Other Notes to Inform Your Planning</p> <p>This lesson builds off of lesson 4.9 and the prior lesson. Students will use an understanding of the attributes of a quadratic graph and quadratic equations to solve the real-world situations. Students will match values from scenarios to use as key features of quadratic functions that they will write. The next lesson builds on this standard as well.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0; text-align: center;"> <p>Focus on Disciplinary Literacy</p>  <p>INM</p> </div>	<p>Lesson Look Fors</p> <p><u>Look for teachers to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Help the students create the functions they will be using then you will let them work with their table groups to complete the questions that follow. <input type="checkbox"/> Monitor and support students as they go through the real-world scenarios and work on problems in groups. <p><u>Look for students to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Use the forms of parabolas they have used throughout the unit to set up a function to model the scenario or data. <input type="checkbox"/> Analyze the key features of their quadratic functions to answer questions in the context of the given scenarios.
<p>Important Vocabulary</p> <ul style="list-style-type: none"> standard form increases decreases maximum minimum vertex axis of symmetry x/y intercepts domain/range set notation interval notation inequality notation 		<p>Student Know/Do Chart</p> <p>Students can</p> <ul style="list-style-type: none">  Write a quadratic function based on a real-world or mathematical contextual problem and answer the problem.  Know the vertex and zeros of a quadratic function can often be used to answer contextual problems involving quadratic relationships.

Date: _____		
Lesson 11: Graphing Quadratic Functions in Standard Form		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook 	<p><u>Look for teachers to...</u></p> <ul style="list-style-type: none"> Focus students on what they already know about graphing parabolas from quadratic functions and analyzing the key features. Demonstrate how to find the axis of symmetry and then vertex from the standard form of a quadratic function. <p><u>Look for students to...</u></p> <ul style="list-style-type: none"> Identify key attributes of the quadratic function when it is in standard form. Graph quadratic functions when they are in standard form.
	<p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (25 min) Debrief (5min) Student Practice (20 min) Exit Ticket (5 min)  <p>Mathematical Goal of this Lesson In this lesson, students will be able to graph and identify key features of quadratic functions in standard form.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problems #1 & 2 ✓ Student Practice #1 & 2 ✓ Debrief <p>Other Notes to Inform Your Planning This lesson continues the standard from the prior lesson. In this lesson, students will use standard form to determine the key features of the quadratic function and then graph it. The next lesson will build off of this one for graphing inequalities.</p> <p>Students will use an understanding of finding the attributes of a quadratic from standard form to graph quadratic functions. Students will use formulas to find specific attributes and key features from the equation, then plot those on a coordinate plane to create the graph of the function.</p>	
<p>Important Vocabulary</p> <ul style="list-style-type: none"> standard form increases decreases maximum minimum vertex axis of symmetry x/y intercepts 	<p>Focus on Disciplinary Literacy</p>  <p>INM, Student Practice & Debrief</p>	<p>Student Know/Do Chart</p> <p>Students can</p> <ul style="list-style-type: none"> Do Graph quadratic functions in standard form $y = ax^2 + bx + c$ by using $x = -\frac{b}{2a}$ to find the axis of symmetry and then the vertex. Know To graph a quadratic in standard form, find the vertex using the axis of symmetry and minimum/maximum and the intercepts, plot the points, then sketch the graph.

Date: _____		
Lesson 12: Graphing Quadratic Inequalities		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.4H Solve quadratic inequalities.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> ▪ SE workbook ▪ TI-Nspire Calculators or Desmos for differentiation if needed 	<p>Look for teachers to...</p> <ul style="list-style-type: none"> ☐ Connect students to their prior experiences with graphing inequalities in two variables and shading the proper regions.
	<div style="border: 1px solid #0070c0; padding: 5px;"> <p>Lesson Structure:</p> <ul style="list-style-type: none"> Do Now (5 min) INM (25 min) Debrief (5 min) Student Practice (20 min) Exit Ticket (5 min)  </div> <p>Mathematical Goal of this Lesson In this lesson, students will be able to determine the solutions to a quadratic inequality by graphing.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ INM problems #1-4 ✓ Debrief ✓ Student Practice #1 & 2 	<p>Look for students to...</p> <ul style="list-style-type: none"> ☐ Graph quadratic inequalities curves. Make them solid (\leq, \geq) or dotted ($<, >$), and shade the side of the curve where the test point makes the original inequality true.
Important Vocabulary		Student Know/Do Chart
<ul style="list-style-type: none"> ▪ quadratic inequality ▪ solution region ▪ dotted curve ▪ solid curve ▪ test point 	<p>Other Notes to Inform Your Planning In this lesson students will use an understanding of graphing linear inequalities and quadratic equations to graph quadratic inequalities. Students will graph the quadratic then create a solid or dotted curve, then shade the solution region, checking the work with a test point. Similar to linear inequalities, the shading will appear on one side of the curve or the other.</p>	<p>Students can</p> <ul style="list-style-type: none">  Graph quadratic inequalities and shade the proper region for the solution set.  Know to graph quadratic inequalities in two variables you need to graph the curve, decide if it is solid or dotted, and test a point on one side of the curve.
	<div style="border: 1px solid black; padding: 5px; background-color: #fff9c4;"> <p style="text-align: center;">Focus on Disciplinary Literacy</p>  <p style="text-align: center;">INM & Debrief</p> </div>	

Date: _____		
Lesson 13: Systems of Linear and Quadratic Equations		
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
<p>◆ 2A.3C Solve, algebraically, systems of two equations in two variables consisting of a linear equation and a quadratic equation.</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none"> SE workbook 	<p><u>Look for teachers to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Connect students to their prior experiences with solving two variable systems of equations in Unit 3. <p><u>Look for students to...</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Solve the given system by substitution or graphing. <input type="checkbox"/> Identify if the given line and parabola will have zero, one, or two solutions.
	<p>Lesson Structure:</p> <ul style="list-style-type: none">  Do Now (5 min)  INM (25 min)  Debrief (5 min)  Student Practice (20 min)  Exit Ticket (5 min)  <p>Mathematical Goal of this Lesson In this lesson, students will be able to solve systems of linear and quadratic equations.</p> <p>Opportunities to CFU</p> <ul style="list-style-type: none"> ✓ After the INM ✓ Debrief ✓ Student Practice #1-3 	
Important Vocabulary	<p>Other Notes to Inform Your Planning</p> <p>This lesson builds on Unit 3, in which students solved systems of linear equations. This lesson focuses on systems of equations with one line and one parabola. Students will apply an understanding of solving systems of linear equations to solve systems of linear and quadratic equations. Students will use the substitution method and graphing to solve, understanding that the solutions represent where the x- and y-values are the same for both functions. Students also use the knowledge that there can be zero, one, or two solutions.</p>	<p>Student Know/Do Chart</p> <p>Students can</p> <ul style="list-style-type: none">  Solve a system of equations with one linear equation and one quadratic equation.  Know a system of a line and a parabola will have zero, one, or two real solutions.  Know that if you were to solve a system of a line and a parabola graphically, you may need to adjust the scale to see where they intersect.
<ul style="list-style-type: none"> system of linear and quadratic equations ordered pairs (x, y) solutions substitution 	<p>Focus on Disciplinary Literacy</p>  <p>INM #1-5, Student Practice #1-5 & Debrief</p>	

Recommended Unit 4 Success Days Material and Resources

Date: _____

To review **topics taught up to 4.6**, use the following resources. Your exit ticket data should be used to determine individualized needs. The resources can be used in small groups, whole groups, or independent groups and be integrated with other classroom routines, like computer aligned practice and teacher-led groups.

To review or practice factoring quadratic expressions or solving quadratic equations by factoring, use...

GeoGebra Interactive Applets:

- Area Model for Factoring Quadratics

Desmos Interactive Applets:

- Solving Quadratic Equations by Factoring

Sample Activities & Tasks:

- Area Models
- Area Model Practice
- Factoring Skills Practice
- Solving Quadratic Equations by Factoring Guided Examples and Additional Practice

Content Video Lessons:

- Factoring Trinomials
- Factoring Trinomials ($a \neq 1$) Using Area Models
- Finding Zeros by Factoring
- Solving Quadratics by Factoring
- Solving Quadratics by Factoring Where Leading Coefficient Not 1

To review or practice completing the square and taking square roots, use...

GeoGebra Interactive Applets:

- Completing the Square Visualization

Sample Activities & Tasks:

- Completing the Square TI-Nspire Activity
- Completing the Square Algebraically TI-Nspire Activity

Content Video Lessons:

- Solving Quadratic Equations by Taking Square Roots
- Solving Quadratics by Completing the Square
- Solving Quadratics by Completing the Square: Another Example

To review or practice the imaginary unit i , use...

Sample Activities & Tasks:

- Simplifying Radicals/Imaginary Numbers Skills Practice

Content Video Lessons:

- Introducing Complex Numbers
- Introduction to Imaginary Numbers
- Introduction to Complex Numbers
- Simplifying Roots of Negative Numbers
- Graphing Complex Numbers

To review or practice the imaginary unit i or factoring with complex numbers, use...

Sample Activities & Tasks:

- Complex Numbers TI-Nspire Activity

Content Video Lessons:

- Adding and Subtracting Complex Numbers
- Multiplying Complex Numbers
- Dividing Complex Numbers
- Finding Complex Conjugate
- Factor with Complex Numbers
- Solving Quadratic Equations with Complex Solutions
- Solving Quadratics by Extracting Complex Roots

Date: _____

Unit 4 Exam

Standard(s)	Notes for Intellectual Preparation & Lesson Planning
<p>◆ 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening. Problems # 5</p> <p>◆ 2A.4C Determine the effects on the graph of $f(x) = \sqrt{x}$ $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(bx)$, and $f(x - c)$ for specific positive and negative values of a, b, c, and d Due to prerequisite needs. Problem #7, 9d</p> <p>◆ 2A.4F Solve quadratic and square-root equations. Problems # 1, 6, 9ab</p> <p>◆ 2A.3C Solve, algebraically, systems of two equations in two variables consisting of a linear equation and a quadratic equation. Problem # 4</p> <p>◆ 2A.4D Transform a quadratic function $f(x) = ax^2 + bx + c$ into the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$. Problem # 8, 9c</p> <p>◆ 2A.4H Solve quadratic inequalities. Problems # 3</p> <p>◆ 2A.7A Add, subtract, and multiply (and divide) complex numbers. Problems # 2</p>	<p>Necessary Materials and Pre-Lesson Prep</p> <ul style="list-style-type: none">▪ Algebra 2 Unit 4 Exam▪ Assessment Companion for Algebra 2 Unit 4 Exam found on Curriculum Corner <p>Notes to Inform Your Planning</p> <p>Review the Unit 4 Exam on Curriculum Corner. Internalize & create an exemplar for the assessment prior to teaching the unit as part of unpacking the unit. Use the exemplar to spar with the answer key provided on Curriculum Corner.</p> <p>Administer the Unit 4 Exam following guidance on the Scope & Sequence to ensure the scoring deadline is met.</p>

UNPACKED STANDARDS

Focus standards for this unit.

Standards Clarification		
Standards	Specificity	Notes/Explanations/Examples
<p>2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening.</p>	<p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Parabola – the locus of points, P, such that the distance from P to a point F (the focus) is equal to the distance from P to a line q (the directrix) • Quadratic equation representations <ul style="list-style-type: none"> ○ Standard form ○ Vertex form ○ Parabola (conic form) ○ Connection between a and p in the vertex form and parabola (conic form) • Attributes of a parabola <ul style="list-style-type: none"> ○ Vertex: (h, k) ○ Axis of symmetry ○ Positive value of a or p, the parabola opens up or to the right ○ Negative value of a or p, the parabola opens down or to the left ○ p – distance from vertex to directrix or distance from vertex to focus ○ Directrix – horizontal or vertical line not passing through the focus whose distance from the vertex is p and is perpendicular to the axis of symmetry ○ Focus – point not on the directrix whose distance from the vertex is p and lies on the axis of symmetry 	<ul style="list-style-type: none"> • Grade Level(s): <ul style="list-style-type: none"> ○ Algebra I wrote quadratic equations in vertex form ($f(x) = a(x - h)^2 + k$), and rewrote from vertex form to standard form $f(x) = ax^2 + bx + c$. ○ Precalculus will address parabolas as conic sections. ○ Various mathematical process standards will be applied to this student expectation as appropriate.
<p>2A.4F Solve quadratic and square root equations.</p>	<p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Methods for solving quadratic equations with and without technology <ul style="list-style-type: none"> ○ Tables ○ Graphs ○ Algebraic methods <p>Connections between solutions and roots of quadratic equations to the zeros and x-intercepts of the related function</p> <p>Complex number system</p> <ul style="list-style-type: none"> ○ Complex number – sum of a real number and an imaginary number, usually written in the form $a + bi$ ○ Operations with complex numbers, with and without technology <p>Complex solutions for quadratic equations</p> <ul style="list-style-type: none"> ○ One real solution ○ Two real solutions ○ Two complex solutions <p>Reasonableness of solutions</p>	<ul style="list-style-type: none"> • Grade Level(s): <ul style="list-style-type: none"> ○ Algebra I solved quadratic equations having real solutions using tables, graphs, factoring, completing the square, and the quadratic formula. ○ Various mathematical process standards will be applied to this student expectation as appropriate.

Standards Clarification

Standards	Specificity	Notes/Explanations/Examples
2A.4A Write the quadratic function given three specified points in the plane.	Including, but not limited to: <ul style="list-style-type: none"> • 3 x 3 system of three linear equations in three variables <ul style="list-style-type: none"> ○ Determination of a linear system of three equations in three variables using the three points and the standard form of the quadratic function, $ax^2 + bx + c = y$ ○ Methods for solving the linear system of three equations in three variables • Quadratic regression using the graphing calculator <ul style="list-style-type: none"> ○ Three points required ○ Correlation of determination, or r^2 value, closer to ± 1, the better the fit of the regression equation 	<ul style="list-style-type: none"> • Grade Level(s): <ul style="list-style-type: none"> ○ Algebra I wrote quadratic functions given real solutions and graphs of their related equations. ○ Algebra I formulated a quadratic function using technology. ○ Algebra II solves systems of three linear equations in three variables using various methods. ○ Various mathematical process standards will be applied to this student expectation as appropriate.
2A.4D Transform a quadratic function $f(x) = ax^2 + bx + c$ into the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$.	Transform: Including, but not limited to: <ul style="list-style-type: none"> • Forms of quadratic functions <ul style="list-style-type: none"> ○ Standard form: $f(x) = ax^2 + bx + c$ ○ Vertex form: $f(x) = a(x - h)^2 + k$ • Completing the square to transform from the standard form $f(x) = ax^2 + bx + c$ to vertex form $f(x) = a(x - h)^2 + k$ Identify: Including, but not limited to: <ul style="list-style-type: none"> • Attributes from the vertex form $f(x) = a(x - h)^2 + k$ <ul style="list-style-type: none"> ○ Vertex of the function, (h, k) ○ y-intercept, $ah^2 + k$ ○ Axis of symmetry, $x = h$ • Attributes from the standard form, $f(x) = ax^2 + bx + c$ <ul style="list-style-type: none"> ○ Vertex of the function, $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$ ○ y-intercept, c ○ Axis of symmetry, $x = \frac{-b}{2a}$ 	<ul style="list-style-type: none"> • Grade Level(s): <ul style="list-style-type: none"> ○ Algebra I wrote quadratic equations in vertex form ($f(x) = a(x - h)^2 + k$), and rewrote from vertex form to standard form $f(x) = ax^2 + bx + c$. ○ Algebra I solved quadratic equations having real solutions by completing the square. ○ Various mathematical process standards will be applied to this student expectation as appropriate.
2A.4H Solve quadratic inequalities.	Including, but not limited to: <ul style="list-style-type: none"> • Methods for solving quadratic inequalities with and without technology <ul style="list-style-type: none"> ○ Graphs ○ Tables ○ Algebraic methods Graphical analysis of solution sets for quadratic inequalities <ul style="list-style-type: none"> ○ One-dimensional on a number line ○ Two-dimensional on a coordinate plane Comparison of solution sets of equations and inequalities Comparison of one-dimensional solutions and two-dimensional solutions, e.g. intervals versus points Reasonableness of solutions	<ul style="list-style-type: none"> • Grade Level(s): <ul style="list-style-type: none"> ○ Algebra I solved quadratic equations. ○ Algebra II introduces quadratic inequalities. ○ Various mathematical process standards will be applied to this student expectation as appropriate.

VERTICAL STANDARDS

This section details the **progression** of key student expectations in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

Algebra 1	Algebra 2	Pre-Calculus
<ul style="list-style-type: none"> • A.6A Determine the domain and range of quadratic functions and represent domain and range using inequalities. • A.6B Write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form $f(x) = (x - h)^2 + k$, and rewrite the equation from vertex form to standard form $f(x) = ax^2 + bx + c$. • A.6C Write quadratic functions when given real solutions and graphs of their related equations. • A.7A Graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possible, including x-intercept, y-intercept, zeros, maximum values, minimum values, vertex, and the equation of the axis of symmetry. • A.7B Describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions. • A.7C Determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, and $f(bx)$ for values of a, b, c, d. • A.8A Solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula. • A.8B Write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems. • A.10E Factor, if possible, trinomials with real factors in the form $ax^2 + bx + c$, including perfect square trinomials of degree two. • A.10F Decide if a binomial can be written as the difference of two squares and, if possible, use the structure of a difference of two squares to rewrite the binomial. 	<ul style="list-style-type: none"> • 2A.3C Solve, algebraically, systems of two equations in two variables consisting of a linear equation and a quadratic equation. • 2A.4A Write the quadratic function given three specified points in the plane. • 2A.4B Write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening. • 2A.4C Determine the effects on the graph of $f(x) = \sqrt{x}$ $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(bx)$, and $f(x - c)$ for specific positive and negative values of a, b, c, and d. Due to prerequisite needs. • 2A.4D Transform a quadratic function $f(x) = ax^2 + bx + c$ into the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$. • 2A.4F Solve quadratic and square root equations • 2A.4H Solve quadratic inequalities. • 2A.7A Add, subtract, multiply, (and divide) complex numbers. • 2A.8B Use regression methods available through technology to write a linear function, a quadratic function, and an exponential function from a given set of data. 	<ul style="list-style-type: none"> • (2.G) Graph functions, including exponential, logarithmic, sine, cosine, rational, polynomial, and power functions and their transformations, including $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d in mathematical and real-world problems. • (2.I) Determine and analyze the key features of exponential, logarithmic, rational, polynomial, power, trigonometric, inverse trigonometric, and piecewise defined functions, including step functions such as domain, range, symmetry, relative maximum, relative minimum, zeros, asymptotes, and intervals over which the function is increasing or decreasing. • (3.C) Use parametric equations to model and solve mathematical and real-world problems. • (5.J) Solve polynomial equations with real coefficients by applying a variety of techniques in mathematical and real-world problems. • (5.K) Solve polynomial inequalities with real coefficients by applying a variety of techniques and write the solution set of the rational inequality in interval notation in mathematical and real-world problems.