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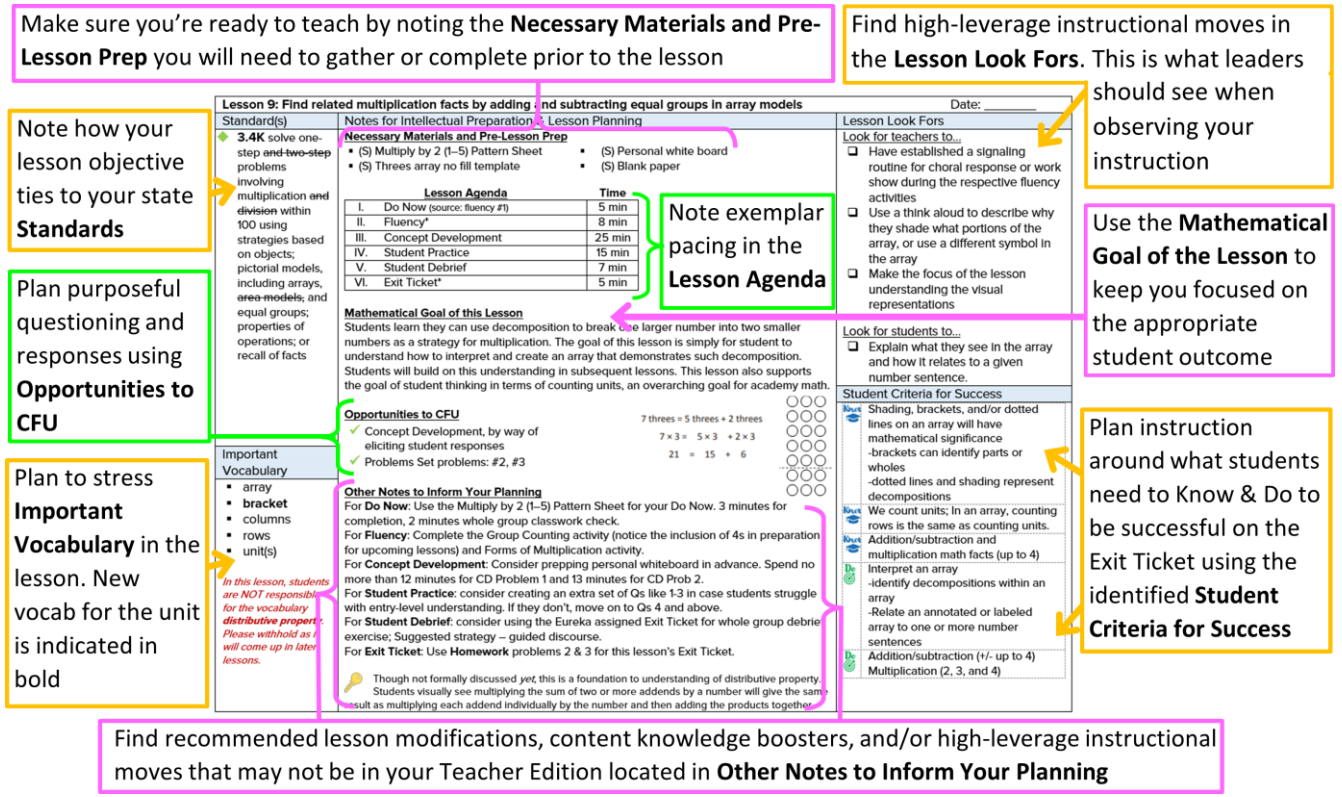
How to Use This Addendum



UNIT SYNOPSIS

Students begin this unit by exploring graphs of quadratic functions to see what shape they take when graphed (parabola!) and noticing properties the parent function $y = x^2$ (namely, that the domain is all real numbers, the range is $y \geq 0$, the vertex is at $(0, 0)$, and the axis of symmetry is at $x = 0$). With this basic understanding, students then explore transformations of quadratic functions and build on transformations to understand vertex form of a quadratic function. Students then learn about other forms (standard and intercept) before more deeply exploring the "why" behind intercept form (revisiting the zero property of multiplication from elementary). Students then learn how to solve quadratics using symmetry before they apply their learning to work with quadratic models of real-world situations. Last, students learn how to use the calculator to calculate a quadratic line of best fit AND how to use it to find zeros, the y-intercept, and the vertex.

CONTENT STANDARDS

Below are the standards addressed in this unit.

Readiness Standards	Supporting Standards
A.6(A) determine the domain and range of quadratic functions and represent the domain and range using inequalities	**A.6(B)** write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form ($f(x) = a(x - h)^2 + k$), and rewrite the equation from vertex form to standard form ($f(x) = ax^2 + bx + c$)
A.7(A) graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including *x*-intercept, *y*-intercept, zeros, maximum value, minimum values, vertex, and the equation of the axis of symmetry.	**A.6(C)** write quadratic functions when given real solutions and graphs of their related equations
A.7(C) determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d	**A.7(B)** describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions
A.8(A) solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula	**A.8(B)** write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems

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 → Math Supports	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14
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, or models, or color-coding	Visual Aids	✓	✓	✓	✓	✓			✓	✓	✓		✓		✓
includes definitions, examples vs. nonexamples, cognates, etc.	Vocabulary Supports	✓	✓	✓		✓	✓								
includes strategies that support language development	Language Supports														
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	Different Modalities														
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

Experience First, Formalize Later (EFFL) Model

Opening

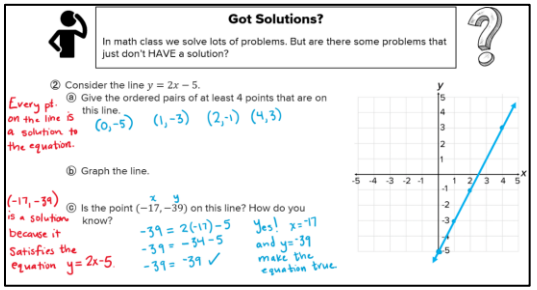
For every new lesson, the teacher begins by making the goals of the lesson crystal clear. The teacher does more than simply read the objective to the class. They make connections to previous learning, share how this learning fits into a bigger picture, or explain why this learning is important for future learning.

Activity / Interaction With New Material (INM)

For this part of the lesson, students work in pairs or groups of four to experience new content through an activity. Students might be discussing a proposed scenario, working with other groups, or doing a simulation. The student activity is designed for students to be able to do without the help of the teacher. Of course, the teacher is watching and listening in to conversations in order to formatively assess student understanding. The teacher provides questions, cues, and prompts (not answers!) to help push groups forward when they are stuck or have made a mistake. As students begin to finish the activity, the teacher identifies students to write their work on the board. Most often, the teacher selects student work that will easily allow them to connect the experience to formal learning. Students write their work on the whiteboard in a single-color marker.

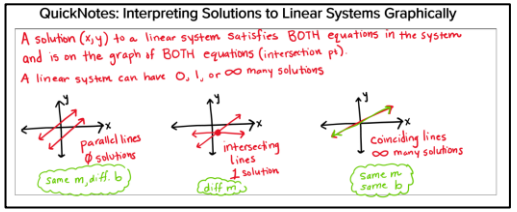
Debrief Activity

Once students have recorded their responses in their workbook (see blue writing to the right), the teacher calls the whole group back together for a debrief. It is in this discussion that the teacher will help students formalize the learning. The teacher connects the student activity experience to new vocabulary, definitions, formulas, and algorithms. The formal learning is attached specifically to the experiences of the activity so that students can enhance their constructed understanding of the new content. The teacher writes all of the formal learning in a different color in the margins of the activity **(see red writing to the right).** The students add these ideas in the margins on their activity page and often think of this as the formal "notes" of the lesson. In all of the answer keys we provide on Math Medic, the teacher formal learning points are provided in the margins in a **different color.**



QuickNotes

In this part of the lesson, the teacher uses the whole experience of the activity and the formalization in the debrief to summarize the learning from the lesson. Notice that we use the box to constrain the amount of formal "notes" that the teacher can provide.



Student Practice

Now that students have arrived at some new learning, they need to be able to apply it in new contexts. Most often we have students complete these questions in pairs and occasionally we select one question to use as an exit ticket. If we have time, we have students write solutions on the whiteboard.

Extra Practice

We typically give students around 3-5 "Extra Practice" problems for each lesson. We choose problems that are closely aligned with the Learning Objectives of the lesson. It is our belief that "less is more" here. We would rather students spend their Extra Practice time thinking deeply about just a few problems, rather than surface level thinking on many problems. When possible, we provide the answers at the bottom of the page, so they can immediately assess their understanding.

Slightly modified version of: https://www.calc-medic.com/post/experience-first-formalize-later#:~:text=%E2%80%9CExperience%20First%2C%20Formalize%20Later%E2%80%9D,at%20formal%20definitions%20and%20formulas.

Before You EFFL!

Here are helpful resources that you guide you in the right direction before your first 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 calculus 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 9 – Quadratic Functions and Equations			
Day	Date	Lesson	Lesson Title
There are 3 flexible Success Days that you can use anywhere in the unit. • Consider using 1 day between Lessons 7 and 8 to administer optional Topic Quiz 9A and/or use the provided Mid-Unit Review activity (Around the World). • Consider using 1 day between Lessons 10 and 11 to administer optional Topic Quiz 9B and/or use the provided Mid-Unit Review activity (Bingo). • Consider using 1 day to provide your own cumulative review or administer the optional Unit 9 Exam.			
1		1	Introduction to Quadratic Functions
2		2	The Quadratic Parent Function
3		3	Transformations of Quadratic Functions (Day 1)
4		4	Transformations of Quadratic Functions (Day 2)
5		5	Features of Quadratic Functions
6		6	Forms of Quadratic Functions
7		7	Success Day | Mid-Unit Review – Around the World *and/or* Optional **Unit 9 Topic Quiz A**
8		8	Writing Quadratic Functions in Factored Form
9		9	Solving Quadratics: The Zero Product Property
10		10	Solving Quadratics Using Symmetry
11		11	Success Day | Mid-Unit Review – BINGO! *and/or* Optional **Unit 9 Topic Quiz B**
12		12	Write Quadratic Functions
13		13	Quadratic Models
14		14	Quadratic Regression
15		15	Optional **Unit 9 Exam** (distributed on Edcite for your use, but not included in weekly data reports)

Lesson 1: Introduction to Quadratic Functions | Date: _____

Standard(s)

◆ **A.7(A)** graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including ~~*x*-intercept, *y*-intercept, zeros,~~ maximum value, minimum values, vertex, and the equation of the axis of symmetry.

Important Vocabulary

- **axis of symmetry**
- **constant second difference**
- **parabola**
- **quadratic function**
- **vertex (of a parabola)**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.1 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (15 min)
- Debrief (8 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to identify and describe basic features of a graphed quadratic function, including its vertex, line of symmetry, and parabolic shape. In this foundational, introductory lesson, students are simply plotting points for a variety of quadratic functions and exploring what they have in common (vertex, line of symmetry, parabolic shape) and their specific differences (some point up, some point down, some are wide, some are narrow, their vertices and lines of symmetry are in different places, etc.)

Opportunities to CFU

✓ INM: 3c, 4c, 5c ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now should not be skipped; it exists to activate students' prior knowledge of linear functions so that they may contrast linear functions with quadratic functions, highlighting the idea of the "constant second difference" that makes a quadratic a quadratic.

For the **INM**: The INM spirals in students' graphing skills and the notice/wonder sections make this lesson intentionally low-stakes. The big idea is for students to see different examples of quadratic functions look like (on a graph and a table) so that they can identify some of the most basic characteristics of a quadratic function.

Focus on Disciplinary Literacy

INM 3c, 4c, 5c

Lesson Look Fors

Look for teachers to…

- ❑ encourage and respond to the difference noticings/wonderings students share at 3c/4c/5c.
- ❑ during QuickNotes, juxtapose properties of linear functions with quadratic functions (i.e. linear functions have a constant diff., quadratic functions have a constant **second** diff; linear functions look like a "straight line" when graphed, quadratic functions have a parabolic shape, etc.)

Look for students to…

- ❑ identify a parabola's axis of symmetry and use it to identify other points on a parabola that is only partially graphed.
- ❑ explain how you can determine if a function is linear, quadratic, or neither given a table of values.

Student Know/Do Chart

Do	Students can identify the vertex and axis of symmetry of a partially graphed quadratic function.
Do	Students can use symmetry to identify a "missing" point on a parabola that is only partially graphed.
Know	The vertex of a parabola is the point at which the function changes from increasing to decreasing or vice versa.
Know	The axis of symmetry of a parabola the line that runs through the vertex of a parabola.
Know	Because parabolas are symmetrical, if you are given a partial graph of a parabola, you can identify points on the part that isn't already graphed.

Lesson 2: The Quadratic Parent Function | Date: _____

Standard(s)

- **A.7(A)** graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including ~~*x*-intercept, *y*-intercept, zeros,~~ maximum value, minimum values, vertex, and the equation of the axis of symmetry.
- **A.6(A)** determine the domain and range of quadratic functions and represent the domain and range using inequalities

Important Vocabulary

- axis of symmetry
- parabola
- **parent function**
- quadratic function
- vertex (of a parabola)

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.2 Student Workbook pages
- Class set of red pens
- Two different-colored highlighters or colored pencils

Lesson Structure:

- Do Now (7 min)
- INM (10 min)
- Debrief (10 min)
- Student Practice (18 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to graph the parent function $f(x) = x^2$ and identify its domain, range, vertex, and intercepts. Students should also be able to describe the quadratic parent function's rate of change.

Opportunities to CFU

✓ INM: 6, 7

✓ Student Practice: 2, 5

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now cannot be skipped or replaced; it sets up the INM.

For the **Debrief**: Use different colored highlighters or colored pencils to indicate where the graph is increasing and where it is decreasing. See TE p24 for an example.

Focus on Disciplinary Literacy

INM 6

On **Scaffolding:** Some students, especially our beginner EBs, struggle to know how to begin their answer. As you circulate, when students get stuck, consider using a sentence stem to help them get started. Here are examples of some that could work:

- For Q3: *The lowest point on the graph is….*
- For Q4: *The domain of f is …..*
- For Q5: *The graph of f is decreasing when……*

You could provide these on the whiteboard and allow students to use them if they need them, but your higher-performing students should be free to choose not to use them.

Lesson Look Fors

Look for teachers to…

- ❑ release students to work on INM #s 2-7 with their partner
- ❑ use the monitoring questions provided in the green box on TE p17 while circulating as students work on the INM.
- ❑ share the cognates for EBs (see yellow box on TE p18). The QuickNotes is a great time to do that.

Look for students to…

- ❑ accurately plot points during the Do Now and use the graph to reason through the INM with a partner.
- ❑ be able to tell you the domain, range, vertex, and line of symmetry of any parabola from the lesson.

Student Know/Do Chart

Do	Students can determine if a vertex is a maximum or minimum and explain why.
Do	Students can identify the equation for a parabola's axis of symmetry.
Do	Students can identify the domain and range of a quadratic function given its graph.
Know	A vertex is a minimum when it is the "lowest point," because that is where the function changes from decreasing to increasing from left to right.
Know	The domain of a function is all possible x-values of a function; the range of a function is all possible y-values of a function.

Lesson 3: Transformations of Quadratic Functions Date: _____

Standard(s)

- **A.7(A)** graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including ~~*x*-intercept, *y*-intercept, zeros,~~ maximum value, minimum values, vertex, and the equation of the axis of symmetry.
- **A.7(C)** determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d

Important Vocabulary

- axis of symmetry
- **horizontal translation**
- parabola
- parent function
- quadratic function
- vertex (of a parabola)
- **vertical shrink**
- **vertical stretch**
- **vertical translation**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.3 Student Workbook pages
- Class set of red pens
- Access to Desmos

Lesson Structure:

- Do Now (7 min)
- INM (15 min)
- Debrief (8 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to identify the effects of specific transformations (vertical shifts, horizontal shifts, vertical stretches) on the graph of the parent function $f(x) = x^2$. In this lesson, students explore how changing values changes the graph of a parabola. By the end of this lesson, students should be able to understand what equations like $y = (x - h)^2 + k$ mean (i.e. that the parent function is shifted h units horizontally and k units vertically). The bulk of Lesson 4 is more practice with transformations, so students will get more opportunities to apply what they have learned.

Opportunities to CFU

- ✓ INM: 3, 4c, 5
- ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now cannot be skipped/replaced; it sets up the INM.

For the **INM**: In this lesson, we don't just TELL students "when you add a value to x^2 it makes the parabola shift up by that many units." Rather, students create tables and graph ordered pairs to see what effect changing the equation in a certain way has on the graph. This is incredibly important and will decrease the likelihood that students confuse or swap horizontal shifts, vertical shifts, and/or stretches/shrinks.

Focus on Disciplinary Literacy

DEBRIEF

Lesson Look Fors

Look for teachers to…

- ❑ use the monitoring questions provided in the green box on TE p25 while circulating.
- ❑ either supply students with electronic devices to graph #s 5-7, or use the projector to show each graph (AFTER students have gotten the chance to do parts a/b of each question).

Look for students to…

- ❑ recall the parent function $y = x^2$ and be able to explain how including an *h* or *k* changes the graph (e.g. "shifts it by *h* units to the right")

Student Know/Do Chart

Students can interpret the meanings of h and k in the vertex form of a quadratic function.

Students can either graph, or visualize the graph, of a parabola given its equation in vertex form.

The vertex form of a parabola is $f(x) = (x - h)^2 + k$. h indicates a horizontal shift, and k indicates a vertical shift.

Lesson 4: Transformations of Quadratic Functions (Day 2) Date: _____

Standard(s)

- **A.7(A)** graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including ~~*x*-intercept, *y*-intercept, zeros,~~ maximum value, minimum values, vertex, and the equation of the axis of symmetry.
- **A.7(C)** determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d

Important Vocabulary

- axis of symmetry
- horizontal translation
- parabola
- parent function
- quadratic function
- vertex (of a parabola)
- vertical shrink
- vertical stretch
- vertical translation

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.4 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (3 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to identify the effects of specific transformations (vertical shifts, horizontal shifts, vertical stretches) on the graph of the parent function $f(x) = x^2$. This lesson is essentially an extended practice opportunity – no new information is delivered.

Opportunities to CFU

- ✓ STINKY FEET: a, b, g (and any other Q that sticks out to you as a potential trouble area based on yesterday's Exit Ticket)
- ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now could be skipped or replaced. It is included as a very brief recap of the previous day's lesson, and it's something students can refer to as they play STINKY FEET.

For the **STINKY FEET**: Carefully read the directions in the pink box on TE p47 on how to set up and play the game. Know that the student workbook pages have work space for each problem.

About the **Debrief:** Between the game and the exit ticket, consider going over 1 or 2 questions that you saw several groups struggle with.

Focus on Disciplinary Literacy

STINKY FEET

Lesson Look Fors

Look for teachers to…

- ❑ set clear expectations and give clear directions on how to play STINKY FEET.

Look for students to…

- ❑ work with their team to solve STINKY FEET problems.
- ❑ capture their work in the right place in their Student Workbook
- ❑ have discussions with each other, especially when they disagree with each other's work/solutions
- ❑ work together to leave no team member behind.

Student Know/Do Chart

Students can describe what transformation(s) occurred when given a quadratic equation in vertex form.

Changing the value of h translates the function horizontally. A positive h value shifts the function right; a negative h value shifts the function left.

Multiplying the parent function by a negative value reflects the function over the x-axis.

Lesson 5: Features of Quadratic Functions Date: _____

Standard(s)

◆ **A.7(A)** graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including *x*-intercept, *y*-intercept, zeros, maximum value, minimum values, vertex, and the equation of the axis of symmetry.

Important Vocabulary

- axis of symmetry
- maximum
- minimum
- quadratic function
- vertex (of a parabola)

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.5 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (12 min)
- Debrief (10 min)
- Student Practice (16 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to identify a relationship between the vertex and *x*-intercepts of a quadratic function using symmetry. Students should also be able to use graphs, tables, and equations to identify the vertex, intercepts, and other values of a quadratic function. Additionally, students should be able to determine if a parabola points up or down. This lesson focuses on **symmetry** because it allows students to make sense of solutions visually (as opposed to relying on algebraic procedures).

Opportunities to CFU

✓ INM: 3, 4

✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The provided Do Now cannot be skipped; it sets up the INM.

On **Sentence Starters:** Some students, especially our beginner EBs, need sentence starters to communicate their ideas. Here are a few examples you can consider using:

- For 3: *The other x-value must be …. because….*
- For 4a: *The parabola opens ….. because……*

Focus on Disciplinary Literacy

DEBRIEF

Lesson Look Fors

Look for teachers to…

- ❑ use the Monitoring Questions in the green box on TE p45 when monitoring students as they work through the INM.

Look for students to…

- ❑ notice that a parabola's x-intercepts are equidistant from the axis of symmetry.
- ❑ determine if a parabola points up or down given only the vertex and the x-intercept.
- ❑ apply their understanding of symmetry to find a missing x-intercept given the vertex and the other x-intercept.

Student Know/Do Chart

Do	Students can identify the vertex, axis of symmetry, and x-intercepts given the graph of a quadratic function.
Do	Students can apply their understanding of symmetry to find a requested x-value.
Do	Students can interpret function notation.
Know	The vertex is the point at which the function changes from increasing to decreasing.
Know	The axis of symmetry is the line that runs through the vertex of a parabola.
Know	The x-intercept of a quadratic function is where the graph crosses the x-axis.
Know	Points equidistant from the axis of symmetry have the same y-value.

Lesson 6: Forms of Quadratic Functions Date: _____

Standard(s)

- **A.6(B)** write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form ($f(x) = a(x - h)^2 + k$), and rewrite the equation from vertex form to standard form ($f(x) = ax^2 + bx + c$)

Important Vocabulary

- **Standard Form (of a quadratic)**
- **Vertex Form (of a quadratic)**
- **Intercept Form (of a quadratic)**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.6 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (12 min)
- Debrief (10 min)
- Student Practice (16 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to calculate the vertex of a quadratic function given its equation in standard form using the formula $x = -\frac{b}{2a}$. Students should also be able to determine if two different forms of a quadratic equation are equivalent. We do not yet expect students to fully understand the relationship between the factored form of a quadratic and its zero or x-intercepts, as this will be explored in greater depth in lesson 9.

Opportunities to CFU

✓ INM: 3, 4, 8, 9 ✓ Student Practice: 1, 2, 7

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now sets up the INM and cannot be skipped or replaced. Students might not be able to articulate their answer to #1, or they might not see how it connects to the previous unit on polynomials, but they should be able to evaluate the function in #2. Before moving onto the INM, ensure students understand both Do Now questions.

In **General:** In the previous unit, students learned how to factor and multiply polynomials. While students are working through the INM, they may realize that they can algebraically prove two equations are equivalent by expanding vertex or intercept form into standard form.

Anchor Chart: The three forms of quadratic equations, with their key features highlighted, definitely belong on a very visible anchor chart. Use bright colors to make the key features pop. See the QuickNotes on TE p55 as a basic example.

Focus on Disciplinary Literacy

INM 8

Lesson Look Fors

Look for teachers to…

- ❑ use the monitoring questions on TE p53 while checking in with students as they work through the INM.
- ❑ emphasize that a quadratic function can be written in three different but equivalent forms

Look for students to…

- ❑ find the y-intercept of a quadratic function
- ❑ be able to rewrite a quadratic equation originally given in vertex form so that it is in standard form

Student Know/Do Chart

Do Students can identify the equation of a quadratic function in all three forms given the function's vertex and one x-intercept.

Know If you are given the vertex and one x-intercept of a quadratic function, you can apply your knowledge of the axis of symmetry to find the other x-intercept and use this to generate an equation in intercept form.

Know The vertex form of a parabola is $f(x) = (x - h)^2 + k$. h indicates a horizontal shift, and k indicates a vertical shift.

Know If you are given an equation in vertex or intercept form, you can rewrite it in standard form by simplifying the expression that is set equal to y.

Lesson 7: Mid-Unit Review: Around the World	Date: _____	
Standard(s)	**Notes for Intellectual Preparation & Lesson Planning**	**Lesson Look Fors**

A.6(B) write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form ($f(x) = a(x - h)^2 + k$), and rewrite the equation from vertex form to standard form ($f(x) = ax^2 + bx + c$)

A.7(A) graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including *x*-intercept, *y*-intercept, zeros, maximum value, minimum values, vertex, and the equation of the axis of symmetry.

A.6(A) determine the domain and range of quadratic functions and represent the domain and range using inequalities

Important Vocabulary

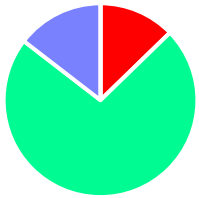
- All terms from Lessons 1 - 6

Necessary Materials and Pre-Lesson Prep

- Unit 9.7 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (0 min)
- Around the World (40 min)
- Debrief (8 min)
- Exit Ticket (0 min)



Mathematical Goal of this Lesson

This is an optional review lesson that can be used on a flexible Success Day. It includes questions from concepts and skills students encountered in Lessons 1 – 6. Please read the pink box on TE p93 for details on how to prepare for and facilitate this review activity.

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now can be skipped or replaced, but it is included to activate students' prior knowledge.

About the **Debrief:** There are no QuickNotes and no new material since today is a review day. However, you can use this time to debrief questions you saw many students struggle with.

Focus on Disciplinary Literacy

AROUND THE WORLD

Exit Ticket: There is no exit ticket provided for this optional review lesson, which precedes a topic quiz. If you plan to give an exit ticket, use previous exit ticket data from Lessons 1-6 to help you determine what is most useful for you to assess right now.

Look for teachers to…

- ❑ provide clear directions for AROUND THE WORLD and set expectations.
- ❑ as students engage in the activity, circulate and monitor, listening in to see which problems you might wish to go over before class ends.

Look for students to…

- ❑ work together to answer review questions
- ❑ ensure they do not leave their partner behind, or if they feel lost, communicating with their partner so they aren't left behind.

Student Know/Do Chart

Do — Students can apply any/all Dos from lessons 1 – 6.

Know — Students know any/all Knows from lessons 1 – 6.

Lesson 8: Writing Quadratic Functions in Factored Form Date: _____

Standard(s)

(in preparation for)

- **A.8(A)** solve quadratic equations having real solutions by factoring, ~~taking square roots, completing the square, and applying the quadratic formula~~

Important Vocabulary

- factor(s) (noun)
- factor (verb)
- factoring
- Standard Form (of a quadratic)

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.8 Student Workbook pages
- Class set of red pens
- Highlighters or colored pencils in two different colors per student

Lesson Structure:

- Do Now (7 min)
- INM (14 min)
- Debrief (9 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

The first part of the unit focused on key features of quadratic functions and their graphs. We now turn to solving quadratics! By the end of this lesson, students should be able to factor a quadratic function given in standard form when $a = 1$ AND factor quadratic functions that have a GCF.

Opportunities to CFU

- ✓ INM: 4, 5, 6
- ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

In **General**: Students learned how to factor trinomials in the previous unit. This lesson revisits factoring trinomials in a slightly different way. If you feel that students were very successful with the previous unit, you might choose to skip this lesson. If you feel that students struggled with factoring trinomials, this is another way to teach it that may help students that were not successful the first time. This method relies heavily on trial and error.

For the **Do Now**: The Do Now cannot be skipped or replaced; it sets up the INM.

Focus on Disciplinary Literacy

Debrief

Lesson Look Fors

Look for teachers to…

- ❑ recall their data from Unit 8. If students did very well on factoring trinomials, they may want to skip this lesson. If students struggled with factoring trinomials, figure out why and see what parts of this lesson may address the issue.
- ❑ use the monitoring questions provided in the green box on TE p70 while students work on the INM.

Look for students to…

- ❑ use trial and error to factor trinomials instead of the "ac" method.
- ❑ check their work by multiplying the two binomials that resulted from their factoring.

Student Know/Do Chart

Students can factor a quadratic equation given in standard form.

Lesson 9: Solving Quadratics: The Zero Product Property Date: _____

Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors

Standard(s)

- **A.7(B)** describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions

Important Vocabulary

- Standard Form (of a quadratic)
- *x*-intercept
- zero of a quadratic function

Necessary Materials and Pre-Lesson Prep

- Unit 9.9 Student Workbook pages
- Class set of red pens
- Class set of laptops for Desmos access*

Lesson Structure:

- Do Now (7 min)
- INM (15 min)
- Debrief (8 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to identify *x*-intercepts or zeros of a quadratic function in standard form using factoring. This lesson focuses on the WHY behind factoring and gives students additional opportunities to build fluency in this skill. Going into this lesson, students know what factored form is and can identify x-intercepts when given the equation in this form. However, most students at this point do not know WHY the numbers appearing in the factors are the solutions to the equation $f(x) = 0$

Opportunities to CFU

✓ INM: 6, 7, 8

✓ Student Practice: 1, 4

Other Notes to Inform Your Planning

For the **Do Now**: This Do Now spirals in the previous lesson and can be skipped or replaced if necessary.

*on **Desmos**: If you do not have a class set of laptops, use your projector to graph the quadratic in #1 before releasing students to work on #1. (They'll need to be able to use it to complete #1.) Bring students back to discuss their responses and release them to work on INM#2. Bring students back to discuss their ideas for #s 2a-c and then show them the graph using Desmos during part 2d.

Focus on Disciplinary Literacy

DEBRIEF

Lesson Look Fors

Look for teachers to…

- ❑ use the Monitoring Questions in the green box on TE p77 while students are working on INM#1 and the questions in the green box on TE p78 when students are working on #s 4-8.
- ❑ during the QuickNotes, emphasize that if a product is 0, then one of the factors must be 0.

Look for students to…

- ❑ be able to explain why we factor quadratics and set each factor equal to zero to identify the zeros.

Student Know/Do Chart

Students can factor a quadratic function.

Students can identify the zeros of a quadratic function given its equation in standard form and explain why.

The zeros/solutions of a quadratic function are the x-intercepts of the function, where the output (y-value) is 0.

To solve a quadratic in standard form, factor if possible, then determine when each factor is zero.

Lesson 10: Solving Quadratics Using Symmetry Date: _____

Standard(s)

- **A.7(B)** describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions
- **A.8(A)** solve quadratic equations having real solutions ~~by factoring, taking square roots, completing the square, and applying the quadratic formula~~

Important Vocabulary

- Standard Form (of a quadratic)
- *x*-intercept
- zero of a quadratic function

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.10 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (3 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to find the zeroes of a quadratic equation (given in standard form) by identifying the axis of symmetry and calculating the horizontal distance between the vertex and an x-intercept. Like lesson 5, this lesson focuses on symmetry as an intuitive, visual way to solve. In the previous lesson, students worked only with equations that were easy to factor. In reality, not all equations are so easy to factor, but using symmetry is one way to factor more challenging equations.

Opportunities to CFU

- ✓ INM: 4
- ✓ Student Practice: 1, 4, 5

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now is connected to the INM and should not be skipped. (A note on *scaffolding*: If you feel some students will struggle to sketch the scenario described in #1, consider providing them with graph paper. For the most critical cases, consider providing the sketch so they can use it to answer part B.) Ensure you debrief the Do Now before moving on, stamping that the x-intercepts are equidistant from the AoS.

For the **INM**: In INM 3b students might struggle with remembering how to find the x-coordinate of the vertex. That is okay! Give them 1-2 minutes to try to remember, and if they can't, give it to them so they can move on. Finding the x-value isn't the crux of this lesson, and they need it to move on.

Focus on Disciplinary Literacy

DEBRIEF

The Quadratic Formula: This lesson replaces last year's lesson on the Quadratic Formula. If you would rather use last year's lesson on the quadratic formula, you can find it here: TE | SE.

Lesson Look Fors

Look for teachers to…

- ❑ use the monitoring questions on TE p85 to provide scaffolds for struggling students and/or probe all students' thinking while they're working on Q2.
- ❑ use the monitoring questions on TE p86 during Q3 (and TE p87 during Q4) for the same reasons mentioned above.

Look for students to…

- ❑ apply their understanding of symmetry to find a missing x-intercept given the vertex and the other x-intercept.
- ❑ be able to use $\sqrt{h^2 - \frac{c}{a}}$ to find the horizontal distance between the vertex and each x-intercept given the equation of a quadratic function.

Student Know/Do Chart

Do: Students can solve a quadratic equation that is not easily factored.

Know: The solutions to a quadratic equation are its zeros, and the zeros of a quadratic equation are equidistant from that quadratic's axis of symmetry.

Know: One way to solve a quadratic equation is to identify its axis of symmetry using $-\frac{b}{2a} = h$, calculate the distance between the AoS and zeroes using $\sqrt{h^2 - \frac{c}{a}}$, and finding the location of each vertex by adding the distance to h.

Lesson 11: Mid-Unit Review: BINGO!	Date: _____	
Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors

A.7(B) describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions

A.8(A) solve quadratic equations having real solutions by factoring, taking square roots, ~~completing the square, and applying the quadratic formula~~

Important Vocabulary

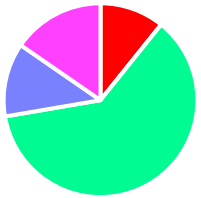
- All terms from Lessons 8 – 10.

Necessary Materials and Pre-Lesson Prep

- Unit 9.11 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (0 min)
- Debrief (40 min)
- Student Practice (8 min)
- Exit Ticket (10 min)



Mathematical Goal of this Lesson

This is an optional review lesson that can be used on a flexible Success Day. It includes questions from concepts and skills students encountered in Lessons 8 – 10. Please read the pink box on TE p93 for details on how to prepare for and facilitate this review activity.

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now can be skipped or replaced, but it is included to activate students' prior knowledge.

About the **Debrief:** There are no QuickNotes and no new material since today is a review day. However, you can use this time to debrief questions you saw many students struggle with.

Focus on Disciplinary Literacy

BINGO!

Exit Ticket: There is no exit ticket provided for this optional review lesson, which precedes a topic quiz. If you plan to give an exit ticket, use previous exit ticket data from Lessons 8-10 to help you determine what is most useful for you to assess right now.

Look for teachers to…

- ❑ provide clear directions for BINGO and set expectations.
- ❑ as students engage in the activity, circulate and monitor, listening in to see which problems you might wish to go over before class ends.

Look for students to…

- ❑ work together to answer review questions
- ❑ ensure they do not leave their partner behind, or if they feel lost, communicating with their partner so they aren't left behind.

Student Know/Do Chart

Do — Students can apply any/all Dos from lessons 8-10.

Know — Students know any/all Knows from lessons 8-10.

Lesson 12: Write Quadratic Functions Date: _____

Standard(s)

◆ **A.6(C)** write quadratic functions when given real solutions and graphs of their related equations

Important Vocabulary

- Intercept Form (of a quadratic)
- Standard Form (of a quadratic)
- Vertex Form (of a quadratic)

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.12 Student Workbook pages
- Class set of scissors and glue/tape

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (3 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to write quadratic functions in any form given either real solutions of the function or a graph.

Opportunities to CFU

✓ INM: 1 and 2 ✓ Student Practice: 1, 2, 5, 6

Other Notes to Inform Your Planning

For the **Do Now**: This Do Now can be skipped or replaced; however, it is included here to prime students for the INM. You can use your discussion of INM#2 to review how to generate quadratic functions given a graph if necessary.

One way to **scaffold**: if you would like the matching activity to take less time, or if you would like to give particular students a reduced number of equations to match, remove some of the problems. For example, you could remove all equations having to do with #s 6/7/8 by telling students to cross out equations E, H, I, Q, T, K, P, N, and R.

In **General:** This lesson does not introduce any new ideas, but it does bring previous ideas together in a very STAAR-like way. Questions 5-8 from Student Practice are nearly identical to released STAAR multiple-choice items.

Focus on Disciplinary Literacy

Matching!

Lesson Look Fors

Look for teachers to…

- ❑ Use the monitoring questions provided on TE p115 to scaffold for struggling students
- ❑ Set clear expectations for scissors and trash cleanup

Look for students to…

- ❑ annotate graphs when provided to identify key features (like x-intercepts) that will help them identify a matching equation
- ❑ expand factored forms of equations to identify equivalent forms of the equation
- ❑ physically manipulate/move cut out equations to group equivalent equations together.

Student Criteria for Success

Do: Students can generate an equation in standard form of a quadratic function given its graph.

Know: When given the graph of a quadratic function, you can identify its x-intercepts to write the equation in intercept form. Then you can multiply the factors to get the equation in standard form.

Lesson 13: Quadratic Models Date: _____

Standard(s)

- **A.6(A)** determine the domain and range of quadratic functions and represent the domain and range using inequalities
- **A.8(A)** solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula

Important Vocabulary

- maximum
- minimum
- Standard Form (of a quadratic)
- *x*-intercept
- zero of a quadratic function

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.13 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (12 min)
- Debrief (8 min)
- Student Practice (18 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to interpret zeros and relative extrema of a quadratic in a real-world context. This lesson gives students the opportunity to apply everything they have learned about quadratics to a real-world situation. Students are expected to interpret key features of a quadratic function in context.

Opportunities to CFU

- ✓ INM: 2, 3, 5
- ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now cannot be skipped or replaced; it sets up the INM. It also gives you the opportunity to ensure students know what "revenue" is before moving into the INM.

On **scaffolding**: Please see the green box on TE p123 for helpful questions. Additionally, consider putting a table on the board and filling it in as students move through the INM. The x-column would be "ticket price;" the y-column would be "revenue." You can even show the quadratic function on a graph, plotting the points as you add them to the table.

Focus on Disciplinary Literacy

DEBRIEF

Lesson Look Fors

Look for teachers to…

- ❑ ensure students understand the term "revenue" to access the INM. (See pink box on TE p122 for a quick way to do this.)
- ❑ use the questions provided in the green box on TE p123 to see what students are thinking and to provide scaffolds for students that need them.

Look for students to…

- ❑ be able to interpret a situation and determine if it is asking for the max/min and/or zeros of a quadratic.

Student Know/Do Chart

Do	Students can sketch the graph of a quadratic function.
Do	Students can interpret zeros and relative extrema of a quadratic in a real=world context.
Know	If you're asked for a maximum or minimum value, find the vertex!
Know	x- and y-intercepts have special meanings depending on the context.

Lesson 14: Quadratic Regression Date: _____

Standard(s)

A.8(B) write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems

Important Vocabulary

- coefficient of determination
- curve of best fit
- quadratic regression

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 9.13 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (2 min)
- Student Practice (16 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to use their calculator to generate a line of best fit for data that can be modeled by a quadratic function. This lesson also shows students how to identify the zeros using the calculator.

Opportunities to CFU

✓ INM: 3 ✓ Student Practice: 1

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now spirals in previous concept and can be skipped or replaced.

For the **INM**: Be aware that INM #s 4-5 is an extension activity. It is unlikely students will be asked to generate or interpret R^2. You can deprioritize this question OR leave it as a challenge question for high-performing students. While #s 1-3 help students find the line of best fit, #s 6-10 guide students to find key features of a quadratic function.

In **General:** Students saw a lesson like this one when they learned how to generate a line of best fit modeled by a **linear** function. The steps are very similar; still, you need to decide if you want to model under the doc cam and have students follow along, or if you want to release them to walk through the steps with their partner.

Focus on Disciplinary Literacy

INM 7 & 10

Lesson Look Fors

Look for teachers to…

- ❑ model how to use the calculator to find the line of best fit, step by step.
- ❑ maintain the expectation that students coach their partners when they're stuck (as opposed to pressing the buttons for them).

Look for students to…

- ❑ follow along in their workbook (SW pp 152-153) as their teacher models the steps.
- ❑ take advantage of the four problems in the SP to further internalize these steps, which they'll need for STAAR.

Student Know/Do Chart

Do: Students can use their graphing calculator to generate a line of best fit given a data set and given that it is quadratic.

Know: Students know the steps to generating a line of best fit on their calculator (see TE pp 131-132).

Recommended Success Day Materials and Resources

A.6(A): domain and range of quadratic functions

- ☐ Sirius: Domain and Range of Quadratics

A.7(A): graph quadratic functions and identify key attributes

- ☐ Imagine Math: Learn About Quadratics TE | SW
- ☐ quadratic equations question bank (contains questions that apply to the unit in general)
- ☐ Sirius: Graph Quadratic Functions

A.7(C): transformations

- ☐ A Wolfram applet that models transformations
- ☐ Sirius: Transformations of Quadratics
- ☐ Carnegie: Transformations of Quadratics

A.6(B) & A.6(C): write equations given various info

- ☐ Imagine Math: Standard Form of a Quadratic: TE | SW
- ☐ Imagine Math: Vertex Form of a Quadratic: TE | SW
- ☐ Carnegie: Write a Quadratic Equation

A.8(A): solve quadratics

- ☐ Desmos activity: Factoring Quadratics Check
- ☐ A video on how to solve quadratic equations by factoring
- ☐ Carnegie: Applications of Quadratic Equations

A.7(B): relationship between linear factors and zeros

- ☐ Imagine Math: Solving Quadratics and the Zero Property (SE | TE)
- ☐ Online flashcards for finding zeros

Unit 9 Tech Enhanced Question Practice

Here are four brief assignments, one per readiness TEKS. None contain multiple-choice items, as the point of these is to offer students opportunities to practice the tech-enhanced question types that could appear on the STAAR EOC

- Tech-Enhanced Question Practice: A.6(A)
- Tech-Enhanced Question Practice: A.7(A)
- Tech-Enhanced Question Practice: A.7(C)
- Tech-Enhanced Question Practice: A.8(A)

If student data indicates a pause point is not necessary, you can opt to move forward and reserve a Success Day to use at a later date.

Unit 9 Exam	Date: _____
Standard(s)	Notes for Intellectual Preparation & Lesson Planning
◆ **A.6(A)** determine the domain and range of quadratic functions and represent the domain and range using inequalities ◆ **A.7(A)** graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including *x*-intercept, *y*-intercept, zeros, maximum value, minimum values, vertex, and the equation of the axis of symmetry. ◆ **A.7(C)** determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d ◆ **A.8(A)** solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula ◆ **A.6(B)** write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form ($f(x) = a(x - h)^2 + k$), and rewrite the equation from vertex form to standard form ($f(x) = ax^2 + bx + c$) ◆ **A.6(C)** write quadratic functions when given real solutions and graphs of their related equations ◆ **A.7(B)** describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions ◆ **A.8(B)** write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems	**Necessary Materials and Pre-Lesson Prep** ▪ Ensure you can access UE9 on EdCite. **Notes to Inform Your Planning** Review the Unit 9 Exam on Curriculum Corner. Internalize and create an exemplar for the assessment prior to teaching the unit as part of unpacking the unit. Use your exemplar to spar with the solutions provided in the Assessment Companion on Curriculum Corner. **There is no scanning deadline for this optional exam.** For any test items that are not multiple choice, verify that student responses marked incorrect by Edcite truly are incorrect. (Edcite occasionally does not recognize all possible equivalent correct responses.)

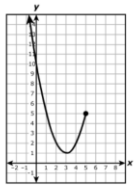
UNPACKED STANDARDS

Focus standards for this unit.

<table>
<tr><th colspan="3">Standard Breakdown</th></tr>
<tr><th>Standard</th><th>Specificity</th><th>STAAR Alignment</th></tr>
<tr>
<td>A.6A determine the domain and range of quadratic functions and represent the domain and range using inequalities</td>
<td>Concepts (Know)
- Domain
- Range
- Quadratic Functions
- Inequalities

Skills (Do)
- Determine
- Represent

<u>Clarifications Including, but not limited to:</u>
- Inequalities used to represent domain and range when applicable
- Students need to be able to calculate domain and range from a graph, table, equation, or real-world scenario
- The domain is all inputs (x-values) and the range is all outputs (y-values).
- In real-world situations, the domain of a quadratic is all real numbers and the range will not exceed the minimum/maximum value.
- Equations may be expressed in standard form or vertex form</td>
<td><u>2025 – Q5</u>
Which function has a range that is the set of all real numbers greater than or equal to -1?
Ⓐ $f(x) = -x^2 - 1$
Ⓑ $f(x) = x^2 + 4x + 3$
Ⓒ $f(x) = (x+3)^2 + 1$
Ⓓ $f(x) = (x+4)^2 - 17$

<u>2025 – Q32</u>
Part of a quadratic function is shown on the grid.
 
Which statement best represents the domain of the part of the function shown?
Ⓐ All real numbers less than or equal to 5
Ⓑ All real numbers greater than or equal to 3
Ⓒ All real numbers greater than or equal to 1
Ⓓ All real numbers

<u>2023 – Q11</u>
Which statement about the function $n(x) = 5x^2 - 20x + 12$ is true?
Ⓐ The domain of the function is $x \geq 2$.
Ⓑ The range of the function is $n(x) \geq -8$.
Ⓒ The domain of the function is $x \geq 0$.
Ⓓ The range of the function is $n(x) \leq 12$.</td>
</tr>
</table>

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 value, minimum value, vertex, and the equation of the axis of symmetry

Concepts (Know)
- Quadratic Functions
- Coordinate Plane
- Key Attributes
- x-intercept
- y-intercept
- zeros
- maximum value
- vertex
- equation of the axis of symmetry

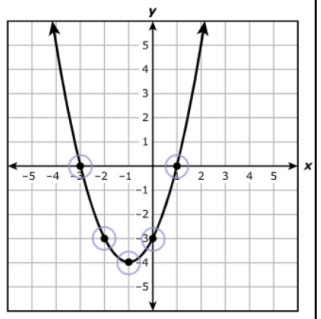
Skills (Do)
- Graph
- Identify

Clarifications Including, but not limited to:
- The point where the parabola changes from increasing/decreasing to decreasing/increasing is called the vertex.
- The vertex is either the maximum or minimum of the function
- The axis of symmetry runs through the vertex and cuts the parabola in half. It is a vertical line, and is represented by its linear equation.
- The domain is all inputs (x-values) and the range is all outputs (y-values).
- In real-world situations, the domain of a quadratic is all real numbers and the range will not exceed the minimum/maximum value.
- The x-intercept/zero is the point where the parabola intersects the x-axis. There may be zero, one or two x-intercepts.

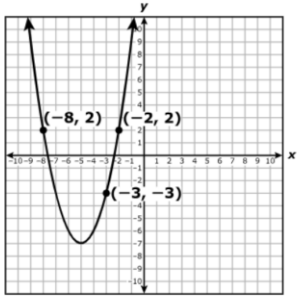
2025 – Q15 & Q21

A graph of a quadratic function is shown. Which location best represents the *y*-intercept of the function?

Select **ONE** correct answer.



The graph of quadratic function *f* is shown on the grid.



Which equation represents the axis of symmetry of the graph of *f* ?

Ⓐ $x = -5$

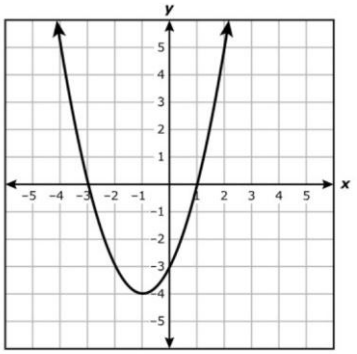
Ⓑ $x = -3$

Ⓒ $y = -7$

Ⓓ $y = 2$

2025 – Q25

A graph of a quadratic function is shown on the grid.



Complete the statement about the quadratic function.

Move the correct answer to each box. Not all answers will be used.

minimum | maximum | −4 | −3 | −1 | 0 | 1

The function has a [ ] value of [ ].

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 specific values of a, b, c, and d

Concepts (Know)
- Effects
- Graph
- Parent Function
- $f(x) = x^2$
- $af(x)$, $f(x) + d$
- $f(x - c)$
- $f(bx)$
- Specific Values of a, b, c and d

Skills (Do)
- Determine
- Replaced

Clarifications Including, but not limited to:
- Effects include stretches and compressions
- The quadratic parent function is $f(x) = x^2$, which can also be written as $f(x) = (x - h)^2 + k$.
- Multiplying the function by a factor of a stretches or compresses the function vertically.
- When a is greater than 1 the function compresses and when a is between 0 and 1 the function stretches.
- Multiplying the argument (term within the parentheses) by a factor of b stretches or compresses the function horizontally. When b is greater than 1 the function compresses and when b is between 0 and 1 the function stretches.
- Stretching and compressing the function will not change the domain, range, vertex, axis of symmetry or number of x-intercepts.
- Vertical stretches may have the same impact graphically as a horizontal compression. Vertical compressions may have the same impact graphically as a horizontal stretch.
- Multiplying the parent function by a negative factor will reflect the function over the x-axis. This will have an impact on the range.
- Multiplying the input by a negative factor will reflect the function over the y-axis. This does not change any key attributes.

2025 – Q12 & Q39

The quadratic function $f(x) = x^2$ with vertex $(0, 0)$ has been transformed to create $g(x) = f(x + 8.7)$. What is the vertex of g?

Ⓐ $(0, 8.7)$

Ⓑ $(0, -8.7)$

Ⓒ $(8.7, 0)$

Ⓓ $(-8.7, 0)$

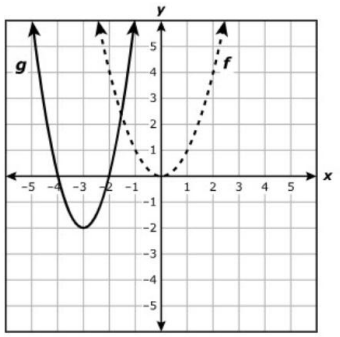
The quadratic function $f(x) = x^2$ is transformed to create the function $g(x) = f(x - 6) + 2$.

Choose the correct answer from each drop-down menu to complete the sentence.

The graph of f is translated 6 units [ ] and 2 units [ ] to create the graph of function g.

2024 – Q21

The quadratic function $f(x) = x^2$ is transformed to create g as shown in the graph.



What is the equation for g?

Ⓐ $g(x) = f(x + 3) - 2$

Ⓑ $g(x) = 2f(x + 3) - 2$

Ⓒ $g(x) = f(x - 3) + 2$

Ⓓ $g(x) = 2f(x - 3) + 2$

A.8A solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula

Concepts (Know)
- Quadratic Equations
- Real Solutions
- Square Roots
- Completing the Square
- Quadratic Formula

Skills (Do)
- Solve
- Factor
- Apply

Clarifications Including, but not limited to:
- Students need to be able to describe the appropriate method to solve a quadratic
- When a quadratic equation can be factored, the equation should be solved by graphing or factoring
- When a quadratic equation has no x term the equation should be solved by taking the square root.
- If "a" is 1 and the equation cannot be factored, the equation should be solved by completing the square.
- If none of the above methods work for solving a quadratic, the quadratic formula should be used to solve a quadratic equation.
- Although the quadratic formula can be used to solve all quadratic equations, it may not be the most efficient way.

2025 – Q26 & Q36

The equation $x(x+3)=108$ can be used to find the width, x, of a rectangular deck that has an area of 108 square feet. What is the width of the deck in feet?

Ⓐ 6 ft

Ⓑ 4 ft

Ⓒ 9 ft

Ⓓ 3 ft

What are the solutions to the equation $(2x+1)^2 = 25$?

Move the correct answer to each box. Not all answers will be used.

−5 −3 −2 2 3 5

$x =$ ☐

$x =$ ☐

2024 – Q18 & Q31

Function g is defined by $g(x) = 3x^2 - 2x - 5$. What are the solutions to $g(x) = 0$?

Ⓐ $x = -1$ and $x = \frac{3}{5}$

Ⓑ $x = -1$ and $x = \frac{5}{3}$

Ⓒ $x = 1$ and $x = -\frac{3}{5}$

Ⓓ $x = 1$ and $x = -\frac{5}{3}$

What are the solutions to the equation $5(x+3)^2 = 75$?

Ⓐ $-\frac{3}{5} \pm \sqrt{15}$

Ⓑ $-\frac{3}{5} \pm \sqrt{3}$

Ⓒ $-3 \pm \sqrt{3}$

Ⓓ $-3 \pm \sqrt{15}$

VERTICAL STANDARDS

This section details the **progression** of key student expectations/standards** 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.

6th / 7th Grade	Algebra I	Algebra II
6.7A generate equivalent numerical expressions using order of operations, including whole number exponents and prime factorization 6.11A graph points in all four quadrants using ordered pairs of rational numbers 6.6A identify independent and dependent quantities from tables and graphs 6.7C determine if two expressions are equivalent using concrete models, pictorial models, and algebraic representations 7.4A represent constant rates of change in mathematical and real-world problems given pictorial, tabular, verbal, numeric, graphical, and algebraic representations, including $d = rt$ 7.7A represent linear relationships using verbal descriptions, tables, graphs, and equations that simplify to the form $y = mx + b$	A.6(A) determine the domain and range of quadratic functions and represent the domain and range using inequalities A.7(A) graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possibly, including *x*-intercept, *y*-intercept, zeros, maximum value, minimum values, vertex, and the equation of the axis of symmetry. A.7(C) determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d A.8(A) solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula A.6(B) write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form ($f(x) = a(x - h)^2 + k$), and rewrite the equation from vertex form to standard form ($f(x) = ax^2 + bx + c$) A.6(C) write quadratic functions when given real solutions and graphs of their related equations A.7(B) describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions	A2.3(C) solve, algebraically, systems of two equations in two variables consisting of a linear equation and a quadratic equation A2.4(A) write the quadratic function given three specified points in the plane A2.4(B) write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening A2.4(C) 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 A2.4(D) 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 $f(x)$ A2.4(F) solve quadratic and square root equations A2.4(H) solve quadratic inequalities A2.7(A) add, subtract, and multiply complex numbers A2.8(B) use regression methods available through technology to write a quadratic function from a given set of data