Grade Level/Course: Algebra 1
Lesson/Unit Plan Name: Matching Quadratic Functions
Rationale/Lesson Abstract: This lesson will help you assess how well students are able to understand what the different algebraic forms of a quadratic function reveal about the properties of its graphical representation. Specifically, intercept form to identify roots, vertex form to identify the vertex, and standard form to identify the y-intercept.
Timeframe: 15-minute warm-up, 1-hour lesson/activities.
Common Core Standard(s): **A-SSE:** Write expressions in equivalent forms to solve problems. **F-IF:** Analyze functions using different representations. **Related Standards: Mathematical Practice Standards.** **1)** Make sense of problems and persevere in solving them. **7)** Look for and make use of structure **8)** Look for and express regularity in repeated reasoning.

Instructional Resources/Materials:

Prep: *Students must be familiar with vertex form, standard form, and intercept form of quadratics and their related graphs. They need to have factored quadratics and practiced completing the square.*

Supplies:

- *1 warm-up per pair of students, pre-cut to save time.*
- *1 graphic organizer per student.*
- *Equation and graph cutouts, pre-cut to save time.*
- *Blank sheet of paper to glue cut-outs*
- *Glue stick.*

Activity/Lesson:

Activity 1-Warm-up

Put students into groups of 2 to 4. Give students first matching activity. Have them sort the pieces in any groupings. Encourage them to be creative in their sorting and work toward having more than 2 groups. Give only about 3 minutes for them to decide before you ask each group to debrief their sorting and explain the reasons for such. Ask each group to explain using academic vocabulary and complete sentences. There are many correct answers for this part of the activity. Next, have the students divide the pieces into graphs and equations. They are now going to match each graph to an equation. Upon completion, randomly ask groups for one answer and reason until all equations have been match. We want students to see that each form gives us some information about a quadratic. (To keep lesson within an hour it is helpful to have everything cut out and ready to sort/match.)

Solutions for matching activity 1 (1-B, 2-D, 3-F, 4-E, 5-C, 6-A)

Graphic Organizer

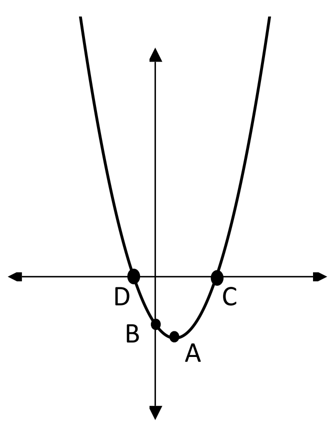
At this time, hand out the blank graphic organizer and lead students through the benefits of each form. Then go through the example that leads to graphing a quadratic.

Activity 2
Hand out matching activity 2. In this activity, students will match a graph to all three forms of a quadratic equation. Have students either glue or tape matched pieces on a piece of paper or poster paper. Collect or have student post on wall for a gallery walk. (To keep lesson within an hour it is helpful to have everything cut out and ready to sort/match.)

Questions to ask groups during matching activity to guide them:

- What is the same and what is different between graphs?
- Which equations will give you the coordinates of the minimum or maximum values?
- What are the x- or y-intercepts
- How many roots does your graph have?
- How many roots can a quadratic have?
- What are the common features of the graph?
- Which graphs don't have roots?

Assessment:
Exit Ticket:



Using the three given functions, identify the coordinates of the points on the graph.

$$y = (x-1)^2 - 4$$

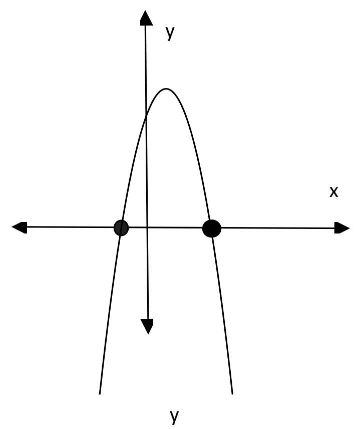
$$y = (x+1)(x-3)$$

$$y = x^2 - 2x - 3$$

KEY:
A (1, –4)
B ((0, –3)
C (3, 0)
D (–1, 0)

Matching Activity 1

A



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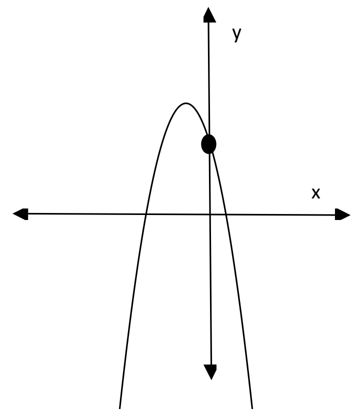

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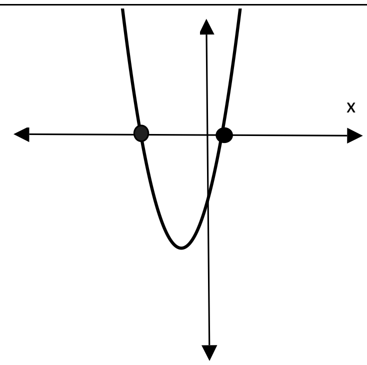

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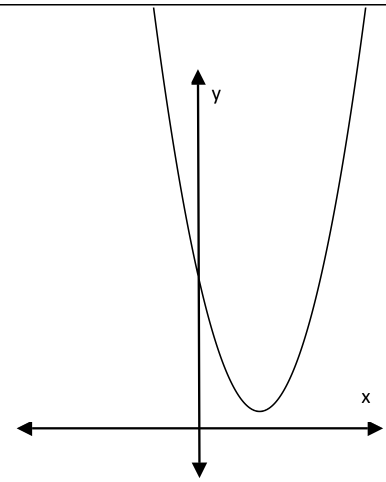

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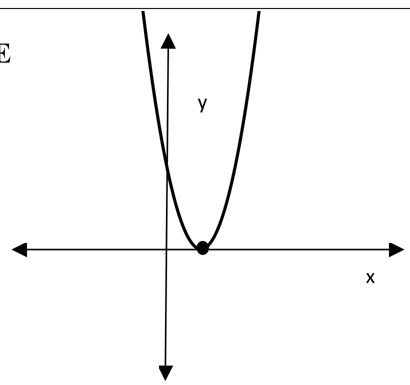
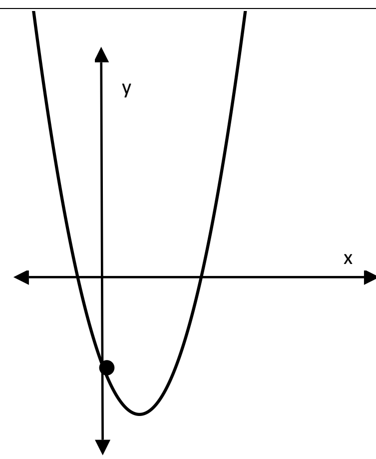


F



1) $y = -x^2 - 2x + 5$

2) $y = (x-3)^2 + 1$

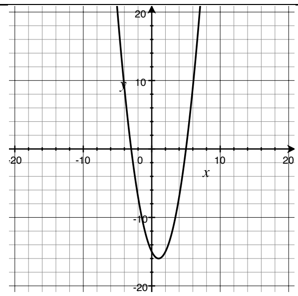
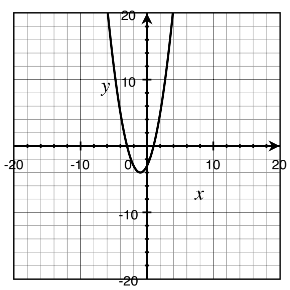
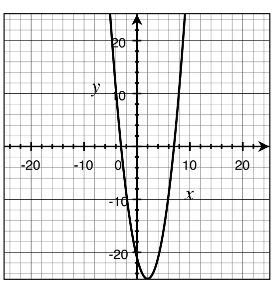
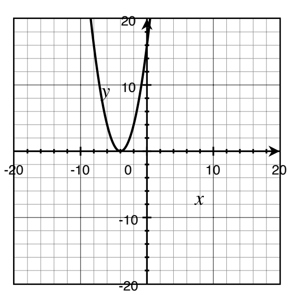
3) $y = x^2 - 2x - 3$

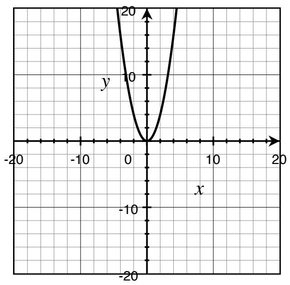
4) $y = (x-3)^2$

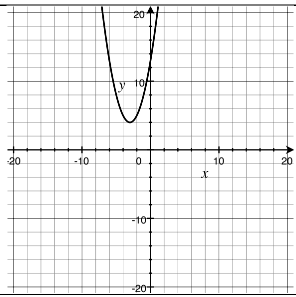
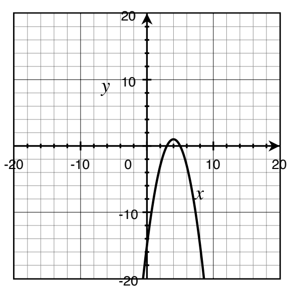
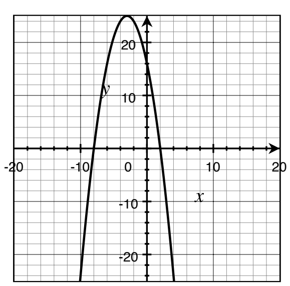
5) $y = (x+5)(x-2)$

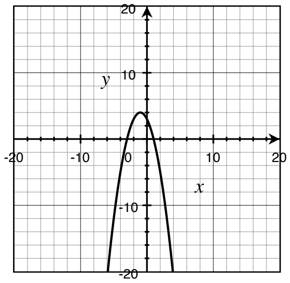
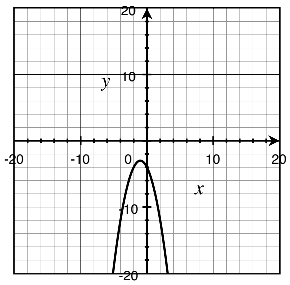
6) $y = -(x+2)(x-5)$

Matching Activity 2

Graph	Vertex Form	Standard Form	Intercept Form
	$y = (x-1)^2 - 16$	$y = x^2 - 2x - 15$	$y = (x+3)(x-5)$
	$y = (x+1)^2 - 4$	$y = x^2 + 2x - 3$	$y = (x-1)(x+3)$
	$y = (x-2)^2 - 25$	$y = x^2 - 4x - 21$	$y = (x-7)(x+3)$
	$y = (x+4)^2$	$y = x^2 + 8x + 16$	$y = (x+4)(x+4)$

	$y = (x+0)^2 + 0$	$y = x^2$	$y = x \cdot x$

Graph	Vertex Form	Standard Form	Intercept Form
	$y = (x+3)^2 + 4$	$y = x^2 + 6x + 13$	No Intercepts
	$y = -(x-4)^2 + 1$	$y = -x^2 + 8x - 15$	$y = -(x-5)(x-3)$
	$y = -(x+3)^2 + 25$	$y = -x^2 - 6x + 16$	$y = -(x+8)(x-2)$

	$y = -(x+1)^2 + 4$	$y = -x^2 - 2x + 3$	$y = -(x-1)(x+3)$
	$y = -(x+1)^2 - 3$	$y = -x^2 - 2x - 4$	No Intercepts

<table>
<tr>
<td><u>Vertex Form: $f(x) = a(x-h)^2 + k$</u>
Benefits:</td>
<td><u>Standard Form: $f(x) = ax^2 + bx + c$</u>
Benefits:</td>
<td><u>Intercept Form: $f(x) = a(x-p)(x-q)$</u>
Benefits:</td>
</tr>
<tr>
<td colspan="3">Use all three forms to graph the function:
$f(x) = x^2 - 4x - 5$</td>
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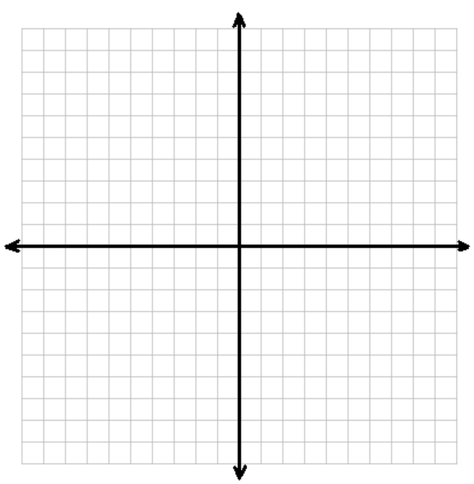
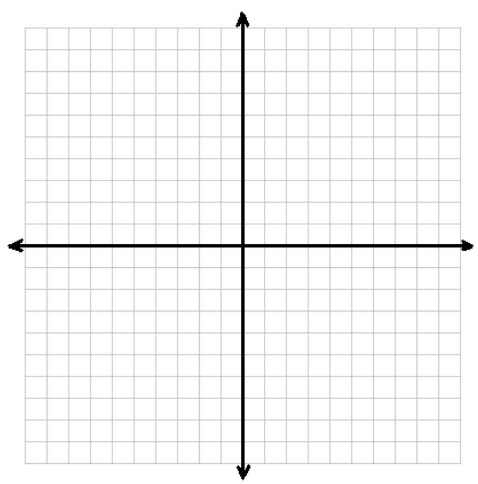
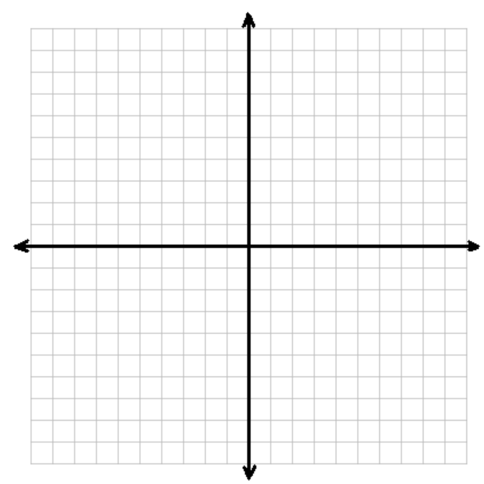
<td></td>
<td></td>
<td></td>
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<tr>
<td>Vertex Form: $f(x) = a(x-h)^2 + k$
Benefits:
This form will give concavity and the vertex (h, k)</td>
<td>Standard Form: $f(x) = ax^2 + bx + c$
Benefits:
This form will give concavity and the y-intercept $(0, c)$</td>
<td>Intercept Form: $f(x) = a(x-p)(x-q)$
Benefits:
This form will give concavity and the x-intercepts $(p, 0)$ and $(q, 0)$</td>
</tr>
<tr>
<td colspan="3">Use all three forms to graph the function:
$f(x) = x^2 - 4x - 5$</td>
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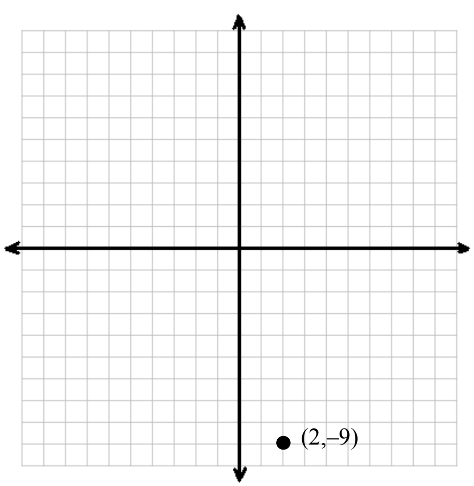
Complete the square to find the vertex.

$$f(x) = x^2 - 4x - 5$$
$$f(x) + 5 = x^2 - 4x$$
$$f(x) + 5 + 4 = x^2 - 4x + 4$$
$$f(x) + 9 = (x-2)^2$$
$$f(x) = (x-2)^2 - 9$$

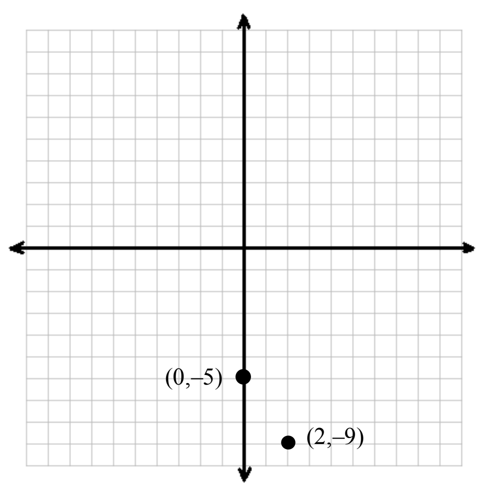
This parabola will be concave up with a vertex at (2, –9)



Let x=0 to find the y-intercept.

$$f(x) = x^2 - 4x - 5$$
$$f(0) = 0^2 - 4(0) - 5$$
$$f(0) = -5$$

The y-intercept is (0, –5)



Factor and set $f(x)$=0 to find the x-intercepts.

$$f(x) = x^2 - 4x - 5$$
$$0 = x^2 - 4x - 5$$
$$0 = (x-5)(x+1)$$
$$x - 5 = 0 \text{ and } x + 1 = 0$$
$$x = 5, -1$$

$\therefore$ the x-intercepts are

(5,0) and (–1,0)