CONNECTIONS: Michigan Academic Standards for Mathematics - Algebra I

EXAMPLE CONTEXT FOR LANGUAGE USAGE: Students, given an equation of a quadratic parent function (i.e., y = x^2), will listen to a description of one or more transformations to be made to the graph, sketch a graph that appropriately displays those transformations, and write the appropriate equation for their graph in vertex form, y = a(x - h)^2 + k. Depending on the lesson goals, it may be appropriate for students to choose correct answers rather than creating them. Note that selecting an answer reduces the cognitive demand of the task.

The goal is to create the vertex form, y = a(x - h)^2 + k. Note that this form does not have a coefficient on x, so there will be no reflection over the y-axis or horizontal stretch/shrink. This listening task is a good opportunity for students to notice that order matters by changing the order of transformations (i.e., the vertical shift) on two examples. For example, (1) reflect over x-axis, (2) stretch vertically by 2, (3) shift horizontally by 3, and (4) shift vertically by 7 yields y = -2(x - 3)^2 + 7. But, (1) shift vertically by 7, (2) reflect over x-axis, (3) stretch vertically by 2, (4) shift horizontally by 3 yields y = -2 [(x - 3)^2 + 7].

COGNITIVE FUNCTION: Students at all levels of language proficiency **INFER** how various transformations (translating, reflecting, stretching, or shrinking) affect the appearance of the graph (including the vertex, width, and orientation) and the equation in vertex form, y = a(x - h)^2 + k to **PRODUCE** an appropriate graph and equation.

	Level 1 Entering	Level 2 Emerging	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
Listening	Listen to a description read aloud multiple times with purposeful pauses, pointing, and clarifying language, of one or more transformations made to the graph of a quadratic function, sketch the appropriate graph and write the appropriate equation in vertex form, y = a(x - h)^2 + k, to represent the graph, while referring to an anchor chart, working with a level 1 or 2 partner, and viewing a properly completed similar task with different transformations. E.g., "Sketch [say: or draw] a graph of the transformed function [pause and say: the new function] and write an equation in vertex form [pause and point to anchor chart] to represent the graph. Sketch and write the steps of each transformation. Circle your final graph and equation. The graph of the parent function [pause and point to the anchor chart or student example] y equals x	Listen to a description read aloud multiple times with purposeful pauses, pointing, and clarifying language, of one or more transformations made to the graph of a quadratic function, sketch the appropriate graph and write the appropriate equation in vertex form, y = a(x - h)^2 + k, to represent the graph, while referring to an anchor chart, working with a level 1 or 2 partner, and viewing a completed similar task with different transformations. E.g., "Sketch [say: or draw] a graph of the transformed function [pause and say: the new function] and write an equation in vertex form [pause and point to anchor chart] to represent the graph. Sketch and write the steps of each transformation. Circle your final graph and equation. The graph of the parent function [pause and point to the anchor chart or	Listen to a description read aloud multiple times (with purposeful pauses) of one or more transformations made to the graph of a quadratic function, sketch the appropriate graph and write the appropriate equation in vertex form, y = a(x - h)^2 + k, to represent the graph, while referring to an anchor chart and working with a partner at a higher level of language proficiency. E.g., "Sketch a graph of the transformed function [pause] and write an equation in vertex form [pause] to represent the graph. Sketch and write the steps of each transformation. Circle your final graph and equation. The graph of the parent function y equals x squared [pause] is transformed by a horizontal shift [pause] two units to the right [pause], and a vertical stretch [pause] by a factor of three [pause]."	Listen to a description read aloud (with purposeful pauses) of one or more transformations made to the graph of a quadratic function, sketch the appropriate graph and write the appropriate equation in vertex form, y = a(x - h)^2 + k, to represent the graph, while referring to an anchor chart while working with a partner. E.g., "Sketch a graph of the transformed function [pause] and write an equation in vertex form [pause] to represent the graph. Sketch and write the steps of each transformation. Circle your final graph and equation. The graph of the parent function y equals x squared [pause] is transformed by a horizontal shift [pause] two units to the right [pause], and a vertical stretch [pause] by a factor of three [pause]."	Listen to a description read aloud (with purposeful pauses) of one or more transformations made to the graph of a quadratic function, sketch the appropriate graph and write the appropriate equation in vertex form, y = a(x - h)^2 + k, to represent the graph, while referring to an anchor chart before checking work with a partner. E.g., "Sketch a graph of the transformed function [pause] and write an equation in vertex form [pause] to represent the graph. Sketch and write the steps of each transformation. Circle your final graph and equation. The graph of the parent function y equals x squared [pause] is transformed by a horizontal shift [pause] two units to the right [pause], and a vertical stretch [pause] by a factor of three [pause]."	

	Level 1 Entering	Level 2 Emerging	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
Listening Continued	squared [pause] is transformed by a horizontal shift [pause and point to the anchor chart] two units to the right [pause and point to the right], and a vertical stretch [pause and point to the anchor chart] by a factor of three [pause and hold up three fingers]."	student example] y equals x squared [pause] is transformed by a horizontal shift [pause and point to the anchor chart] two units to the right [pause and point to the right], and a vertical stretch [pause and point to the anchor chart] by a factor of three [pause and hold up three fingers]."				

ELD STANDARD 3: The Language of Mathematics — **MAISA Unit Algebra I, Unit 4: Quadratic Functions**

EXAMPLE CONTEXT FOR LANGUAGE USAGE: Students explain what different algebraic forms of quadratic equations reveal about their graphical features. Students should work in groups of mixed abilities, but Level 5 students' language usage may be too far ahead of Level 1 students. We recommend grouping students in similar language levels. For example, groups with overlapping levels such as: students in Levels 1, 2, & 3; students in levels 2, 3, & 4; or students in levels 3, 4, & 5.

COGNITIVE FUNCTION: Students at all levels of English language proficiency **JUSTIFY** what graphical information is identified from each form of a quadratic equation.

Problem taken from: https://tasks.illustrativemathematics.org/content-standards/tasks/388 (only part b of the task)
These three equations all describe the same function: y1 = (x – 3)(x + 1); y2 = x^2 – 2x – 3; y3 = (x–1)^2 – 4. What are the coordinates of the following points on the graph of the function? vertex: __; y--intercept: ___; x--intercept(s): __. From which equation is each point (or points) most easily determined? Explain.

	Level 1 Entering	Level 2 Emerging	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
Speaking	Justify using multiple simple sentences the graphical information given from each form of a quadratic equation using sentence frames with choices, pointing, a quadratic forms reference sheet (labeling the different forms of quadratic equations and terms including constant, factors, vertex, x-intercepts, and y-intercepts) while working in a small group with mixed abilities, mathematically and linguistically, where students with higher levels of English language proficiency model appropriate responses. The vertex is [students may say or point to the coordinates] (__,__). It is from [students may say or point to the equation] y___(1/2/3) in ___________(vertex/standard/ factored) form. The y-intercept is [students may say or point to the coordinates] (__,__). It is from [students may say or point to the equation] y___(1/2/3). It is from the _________(constant/factors) from ___________(vertex/standard/ factored) form.	Justify using multiple simple sentences the graphical information given from each form of a quadratic equation using sentence frames with choices, a quadratic forms reference sheet (labeling the different forms of quadratic equations and terms including constant, factors, vertex, x-intercepts, and y-intercepts) while working in a small group with mixed abilities, mathematically and linguistically, where students with higher levels of English language proficiency model appropriate responses. The vertex is (__,__). It is easiest to get from y___(1/2/3) because it comes from the ___ (constants/factors) [student points to h and k]. The equation is in ___________(vertex/standard/factored) form. The y-intercept is (__,__). It is easiest to get from y___(1/2/3) because it comes from the ______constant/factors) [student points to constant].The equation is in _________ (constant/ factors).	Justify using multiple sentences the graphical information given from each form of a quadratic equation using sentence frames, a suggested word bank (factored form, expanded/standard form, vertex form, constant, factors, y1, y2, y3,), a quadratic forms reference sheet (labeling the different forms of quadratic equations and terms including constant, factors, vertex, x-intercepts, and y-intercepts) while working in a small group with mixed abilities, mathematically and linguistically, where students with higher levels of English language proficiency model appropriate responses. The vertex is ________. It is easiest to get it from equation_______ because it comes from ______. This equation is in ________ form. The y-intercept is______. It is easiest to get it from equation______ because it comes from ______. This equation is in ________ form.	Justify using compound and/or complex sentences the graphical information given from each form of a quadratic equation using a suggested word bank (factored form, expanded form or standard form, constant, factors, vertex form, y-intercept, x-intercept(s), vertex, opposite) while working in a small group with mixed abilities, mathematically and linguistically, where students with higher levels of English language proficiency model appropriate responses. E.g. The vertex is (1, -4). It is easiest to see in equation y3 because it comes from the opposite values of these constants [points to h and k]. The equation y3 is in vertex form. The y-intercept is (0, -3). It is easiest to see in y2 because it is the constant. The equation y2 is in standard form. The x-intercepts are (3,0) and (-1,0). They are easiest to see in y1 because they are the opposite values of theconstants in the factors. The equation y1 is in factored form.	Justify using compound and/or complex sentences the graphical information given from each form of a quadratic equation using a required word list (i.e., factored form, expanded form or standard form, constant, factors, vertex form, y-intercept, x-intercept(s), vertex, opposite) while working in a small group with mixed abilities, mathematically and linguistically, where students with higher levels of English language proficiency model appropriate responses. E.g., The vertex is (1, -4) and is easily determined from y3 (vertex form) a(x-h)^2+k, where (h, k) is the vertex (the opposite values of the constants shown in this form). The y-intercept (0,-3) can be easily determined from y2 (standard/expanded form) because it is the constant. The x-intercepts (3, 0) and (-1, 0) can be easily determined from y1 (factored form) since the x-intercepts are found by setting both factors equal to zero.	

	Level 1 Entering	Level 2 Emerging	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
Speaking Continued	The x-intercepts are [students may say or point to the coordinates] (__,__) and (__,__). They are from [students may say or point to the coordinates] y___ (1/2/3). They are from the ___________(constant/factors) from ___________(vertex/standard/factored) form.	The x-intercepts are (__,__) and (__,__). It is easiest to get from y___ (1/2/3) because the come from the (constant/factors) [student points to constants in each factor]. The equation is in ___________(vertex/standard/factored) form.	The x-intercepts are _______ and ________. They are easiest to get from equation _____ because they come from ______. This equation is in ________ form.			

ELD STANDARD 3: The Language of Mathematics	MAISA Unit Algebra I, Unit 4: Quadratic Functions

EXAMPLE CONTEXT FOR LANGUAGE USAGE: The strand below is written for the "Egg Launch Contest" from NCTM Illuminations archived at https://tinyurl.com/y7zund6v . It is a two page activity with multiple tasks. The strand below was written to support the linguistic demands of the first page. Additional strands would be required to support the linguistic demands of the additional tasks on the second page. This is a combined reading and writing activity. A writing strand should be written to scaffold the supports necessary for students to perform the writing tasks. The following YouTube video shows students performing an egg launch. As an introduction to the context, all students would benefit from seeing a video in which an egg is launched. (https://www.youtube.com/watch?v=2VcghDq1qI8) Due to the lengthy nature of the reading required to do the tasks for this activity, the examples related to this strand can be found in the supports for this unit.

Teachers can use this opportunity to talk to students about precision and accuracy of real-world data: that the table, equation, and graph are all approximations of real-world data. Note that if students use the table to create an equation, using different rows would yield different equations. As indicated in the sample responses, students could have multiple supports available to them to encourage multiple strategies (e.g., graph paper to generate graphs from equations or tables, graphing calculators). The task intentionally leaves open the goal, so students may want to find the vertex (highest egg wins) or the length from start to end (max distance - min distance). Rich discussion may emerge from comparing strategies, noting that different representations have advantages and disadvantages when it comes to the accuracy and precision of estimates of vertices or intercepts.

COGNITIVE FUNCTION: Students at all levels of language proficiency **ANALYZE** mathematical descriptions and mathematical representations in order to **DRAW CONCLUSIONS.**

	Level 1 **Entering**	**Level 2** **Emerging**	**Level 3** **Developing**	**Level 4** **Expanding**	**Level 5** **Bridging**	**Level 6** **Reaching**
Reading	Analyze glossed and illustrated mathematical descriptions co-created with the teacher and student(s) to compare multiple representations of multiple (three) data sets, after viewing a video depicting the context, and using an illustrated word bank for contextual words, in order to draw conclusions about the data while working with a partner. For detailed examples, see the supports for this unit.	Analyze glossed and illustrated mathematical descriptions co-created with the teacher and student(s) to compare multiple representations of multiple (three) data sets, after viewing a video depicting the context, and using an illustrated word bank for contextual words, in order to draw conclusions about the data while working with a partner. For detailed examples, see the supports for this unit.	Analyze a glossed version of mathematical descriptions to compare multiple representations of multiple (three) data sets, after viewing a video depicting the context, and using an illustrated word bank for contextual words, in order to draw conclusions about the data while working with a partner. For detailed examples, see the supports for this unit.	Analyze a glossed version of mathematical descriptions to compare multiple representations of multiple (three) data sets, after viewing a video depicting the context, in order to draw conclusions about the data while working with a partner. For detailed examples, see the supports for this unit.	Analyze mathematical descriptions to compare multiple representations of multiple (three) data sets, after viewing a video depicting the context, in order to draw conclusions about the data while working with a partner. For detailed examples, see the supports for this unit.	

ELD STANDARD 3: The Language of Mathematics | **MAISA Unit Algebra I, Unit 4: Quadratic Functions**

EXAMPLE CONTEXT FOR LANGUAGE USAGE: The strand below is written for the "Egg Launch Contest" from NCTM Illuminations archived at https://tinyurl.com/y7zund6v. It is a two page activity with multiple tasks. The strand below was written to support the linguistic demands of the first page ("Which team won the contest?") and the first question of the second page ("Using the data from Team A, determine an equation that describes the path of the egg. Describe how you found your equation."). The task on page 1 is open to multiple answers and approaches, while the questions on page 2 direct students in one strategy. The goals of the first page are focused more on students making sense of the situation through their analysis and using creativity to make and justify claims. On the second page, the goals focus on guiding students to practice skills and concept understanding from previous lessons in this unit. Additional strands would be required to support the linguistic demands of the additional tasks on the second page.

This is a combined reading and writing activity. The strand below is written to scaffold the supports necessary for students to perform the writing tasks. As an introduction to the context, all students would benefit from viewing a video in which the students launch eggs. Teachers can use this opportunity to talk to students about precision and accuracy of real-world data: that the table, equation, and graph are all approximations of real-world data. Note that if students use the table to create an equation, using different rows would yield different equations. As indicated in the sample responses, students could have multiple supports available to them to encourage multiple strategies (e.g., graph paper to generate graphs from equations or tables, graphing calculators). The task intentionally leaves open the goal, so students may want to find the vertex (highest egg wins) or the length from start to end (max distance - min distance). Rich discussion may emerge from comparing strategies, noting that different representations have advantages and disadvantages when it comes to the accuracy and precision of estimates of vertices or intercepts.

Time to problem solve and work with the mathematics scaffolds students into using language to justify their reasoning in writing. In order to support language without undermining the cognitive demand of the mathematics, sentence starters/prompts should be given after significant time for problem solving. While students problem solve, asking them to label their work with short phrases prepares them to write more detailed sentences.

COGNITIVE FUNCTION: Students at all levels of language proficiency **ANALYZE** mathematical descriptions and mathematical representations in order to **DRAW CONCLUSIONS.**

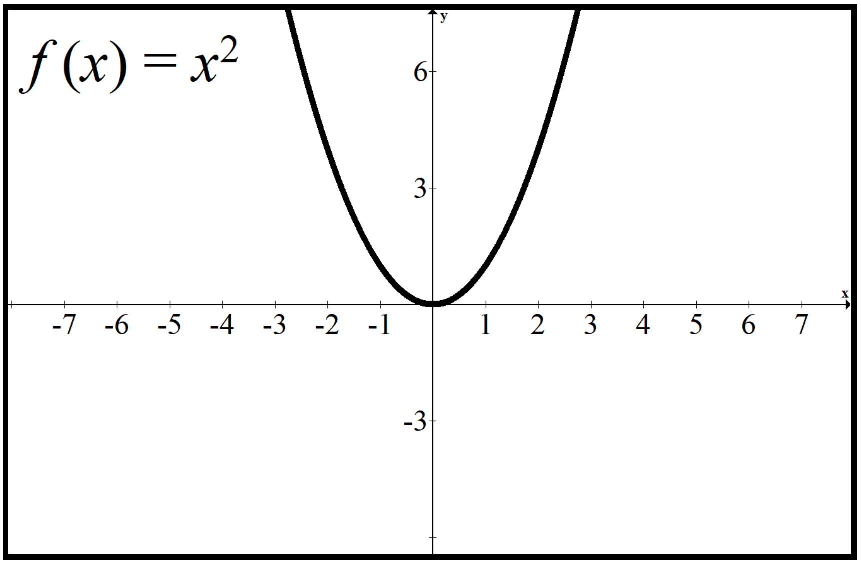
	Level 1 Entering	Level 2 Emerging	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
Writing	Justify by labeling with words or short phrases a conclusion drawn from comparing different representations of quadratic functions to reveal and explain different properties of the function followed by a few simple sentences using provided data, a suggested word list (i.e., quadratic, parabola, equation, function, variables, x-axis, y-axis, maximum, height, distance, regression, intercept, vertex, vertex form, standard form, factored form) and pictures drawn by the student, the quadratic forms reference sheet, and working with a partner. E.g., drawing an arrow to the point (6,0) and labeling it "intercept" and writing "factor is (x-6)". "The x-intercept is (6,0). (x-6) is a factor."	Justify by labeling with words or short phrases a conclusion drawn from comparing different representations of quadratic functions to reveal and explain different properties of the function followed by a few simple sentences using provided data, a suggested word list (i.e., quadratic, parabola, equation, function, variables, x-axis, y-axis, maximum, height, distance, regression, intercept, vertex, vertex form, standard form, factored form) and pictures drawn by the student, the quadratic forms reference sheet, and working with a partner. E.g., drawing an arrow to the point (6,0) and labeling it "intercept" and writing "factor is (x-6)". "The x-intercept is (6,0). (x-6) is a factor."	Justify in complete sentences a conclusion drawn from comparing different representations of quadratic functions to reveal and explain different properties of the function using provided data, a suggested word list (i.e., quadratic, parabola, equation, function, variables, x-axis, y-axis, maximum, height, distance, regression, intercept, vertex, vertex form, standard form, factored form) and pictures drawn by the student, a sentence prompt/starter organizer, the quadratic forms reference sheet, and working with a partner. The form of the equation I used is .... [Using a table to find an equation in factored form, the student answers the following questions:] How did you find p and q? How did you find a? The equation is... OR	Justify in compound or complex sentences a conclusion drawn from comparing different representations of quadratic functions to reveal and explain different properties of the function using provided data, a suggested word list (i.e., quadratic, parabola, equation, function, variables, x-axis, y-axis, maximum, height, distance, regression, intercept, vertex, vertex form, standard form, factored form) and pictures drawn by the student, working with a partner. E.g., [Using a table to find an equation in factored form] "I know that one of the factors is (x-24) because of the point (24,0) on the table. I used a graph to estimate the other x-intercept at (6,0), so the other factor is (x-6). Then, I used the point (12,90) and the equation y=a(x-6)(x-24) to find the value of a which is -5/4. So, the equation is y=-5/4(x-6)(x-24)."	Justify in compound and/or complete sentences with transition words a conclusion drawn from comparing different representations of quadratic functions to reveal and explain different properties of the function using provided data, a suggested word list (i.e., quadratic, parabola, equation, function, variables, x-axis, y-axis, maximum, height, distance, regression, intercept, vertex, vertex form, standard form, factored form, first, then, so, therefore) and pictures drawn by the student, working with a partner. E.g., [Using a table to find an equation in factored form] "First, I know one factor is (x-24) because of the point (24,0) on the table. I used a graph to estimate the other x-intercept at (6,0), so the other factor is (x-6). Then, I used the point (12,90) and the equation y=a(x-6)(x-24) to find the value of a which is -5/4. So, the equation is y=-5/4(x-6)(x-24)."	

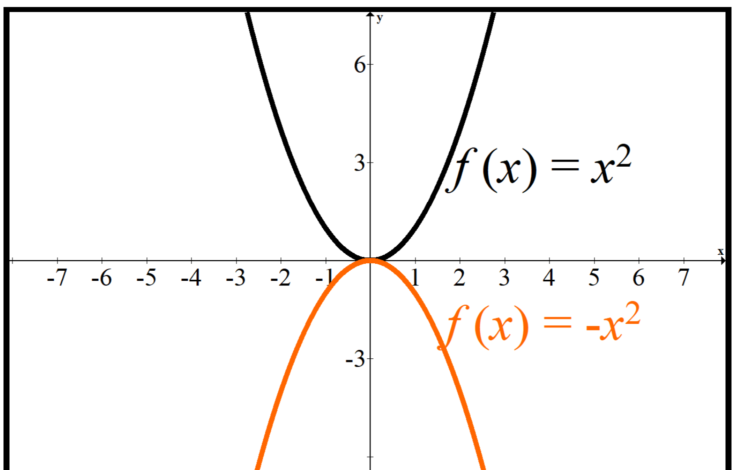
	Level 1 Entering	Level 2 Emerging	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
Writing Continued			[Using a table to find an equation in vertex form, the student answers the following questions:] How did you find h and k? How did you find a? The equation is... OR [Using a table to find an equation in standard form, the student answers the following questions:] How did you find a, b, and c?The equation is…	[Using a table to find an equation in vertex form] "I graphed the points from the table to estimate the vertex. I know the x value of the vertex is 15.5 because it is halfway between (12,90) and (19,90). I used the graph to estimate that the vertex is (15.5, 105). Then I used the point (12,90) and the equation y=a(x-15.5)^2+105 to find a which is -1.22. So, the equation is y =-1.22(x-15.5)^2+105." [Using a table to find an equation in standard form] "I entered the data into a calculator and used regression to find the equation. The equation is y = –1.3x^2 + 39.6x – 195.1."	[Using a table to find an equation in vertex form] "First, I graphed the points from the table to estimate the vertex. I know the x value of the vertex is 15.5 because it is halfway between (12,90) and (19,90). I used the graph to estimate that the vertex is (15.5, 105). Then I used the point (12,90) and the equation y=a(x-15.5)^2+105 to find a which is -1.22. So, the equation is y =-1.22(x-15.5)^2+105." [Using a table to find an equation in standard form] "First, I entered the data into a calculator and then used regression to find the equation. The equation is y = –1.3x^2 + 39.6x – 195.1."	

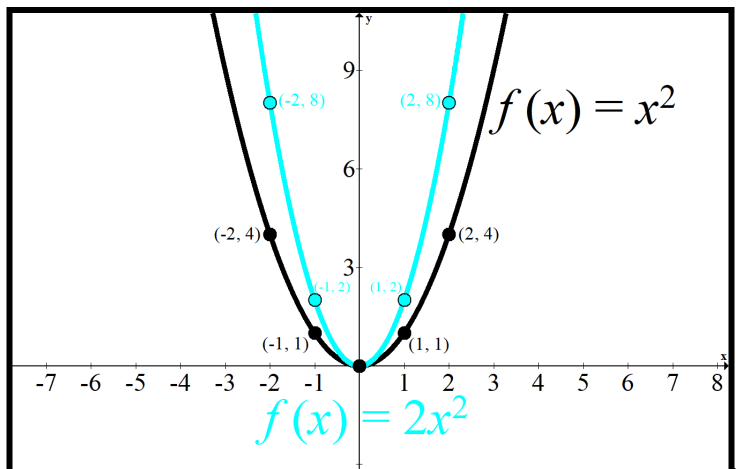
Algebra 1 Unit 4 Anchor Chart Part 1: Graphs of Quadratic Functions

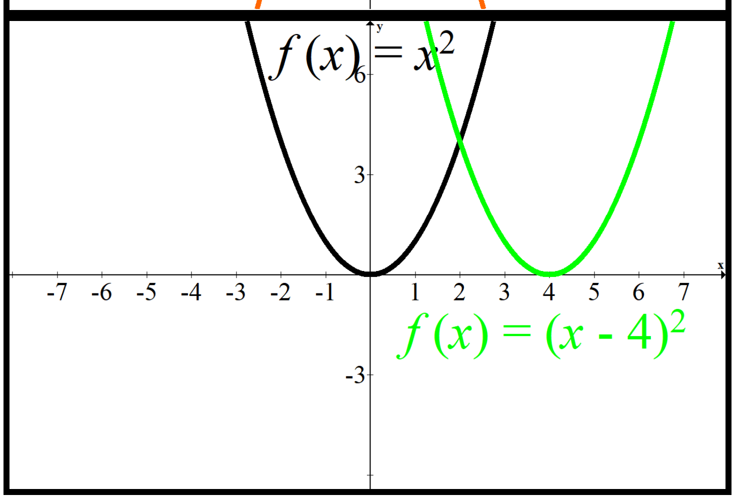
Transformations of Quadratic Functions

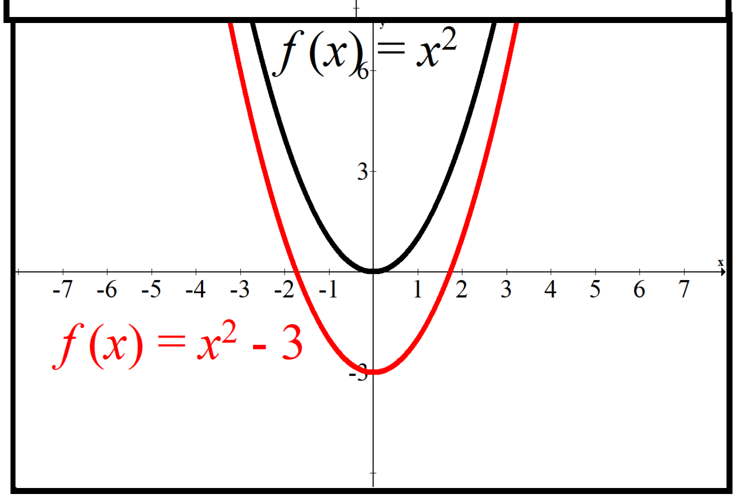
$$f(x) = \pm a(x - h)^2 + k$$







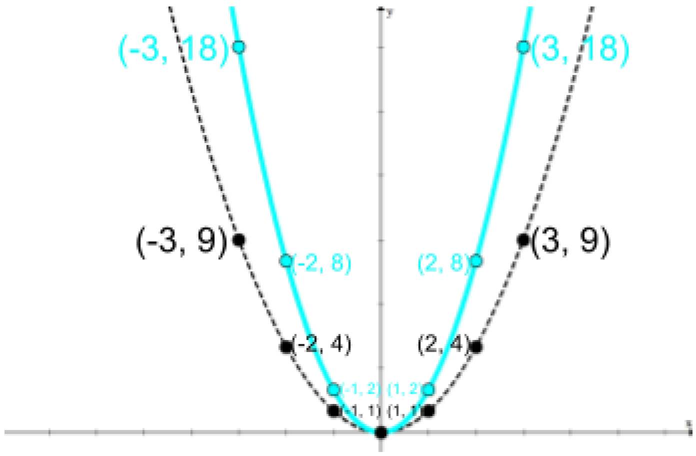




Algebra 1 Unit 4 Anchor Chart Part 2:
Transformations of Quadratic Functions

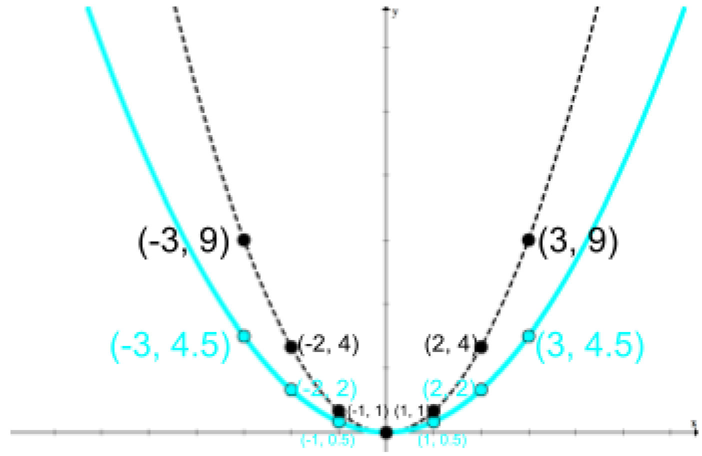
$$f(x) = \pm a(x - h)^2 + k$$

Vertical Stretch



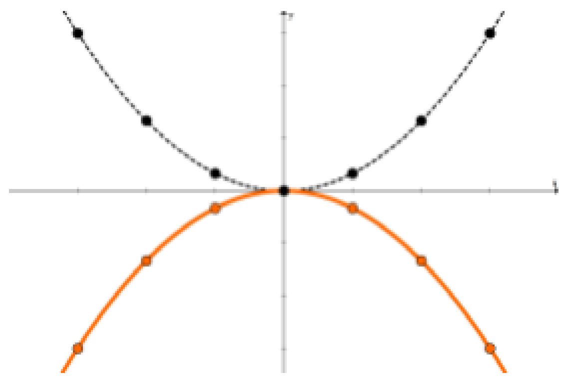
multiply by 2

Vertical Shrink



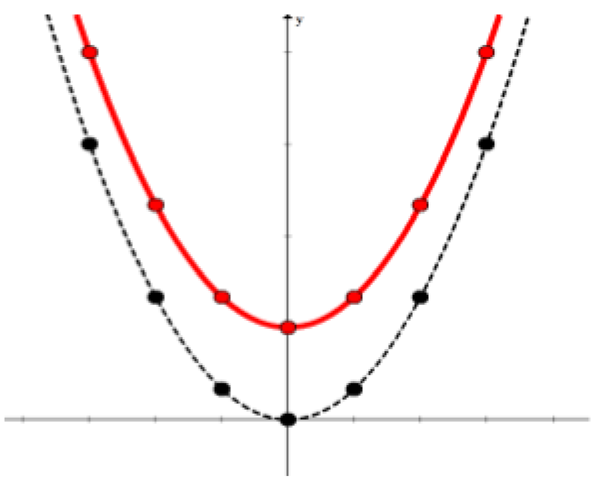
divide by 2

Reflection in the *x*-axis

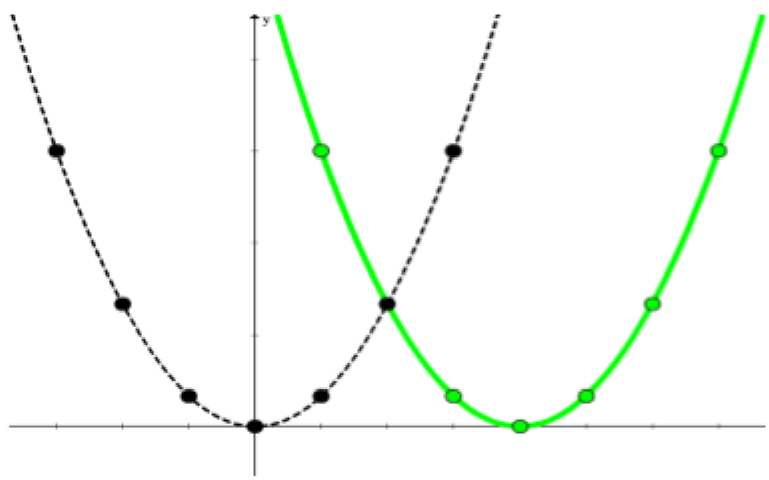


Translation (shift)

Vertical



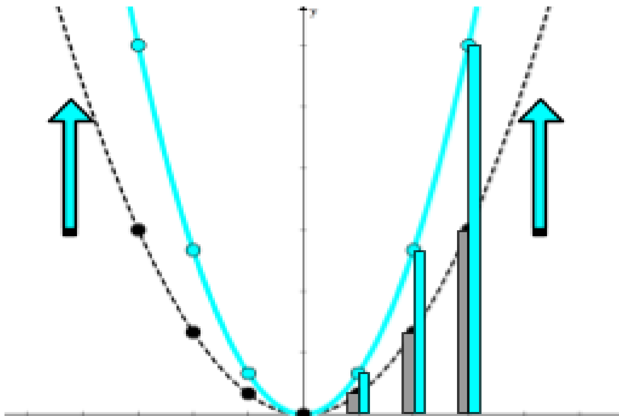
Horizontal



Algebra 1 Unit 4 Anchor Chart Part 2:
Transformations of Quadratic Functions

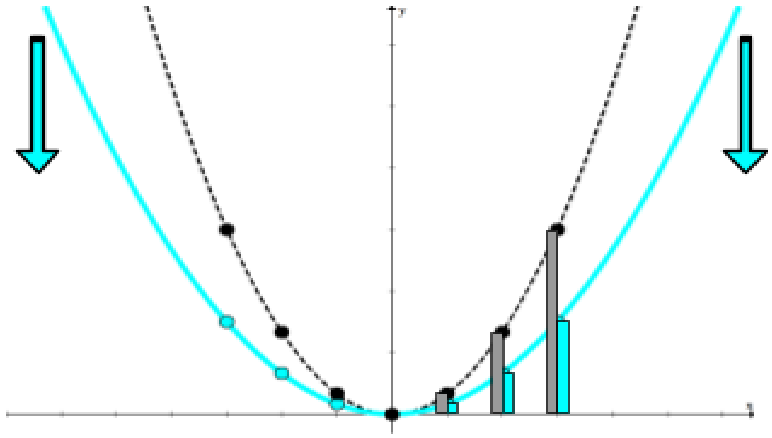
$$f(x) = \pm a(x - h)^2 + k$$

Vertical Stretch



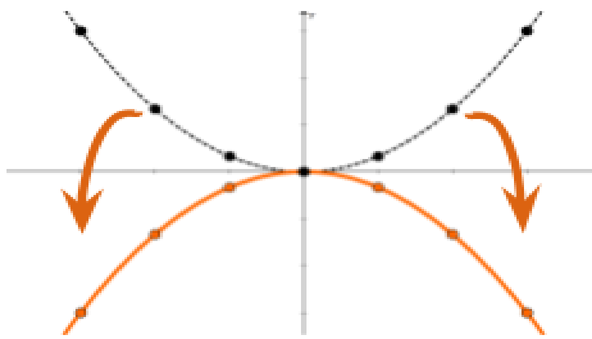
multiply by 2
(double height)

Vertical Shrink



divide by 2
(half height)

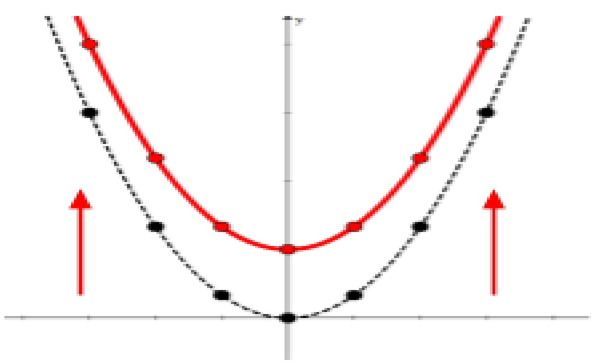
Reflection in the *x*-axis



$y \rightarrow -y$

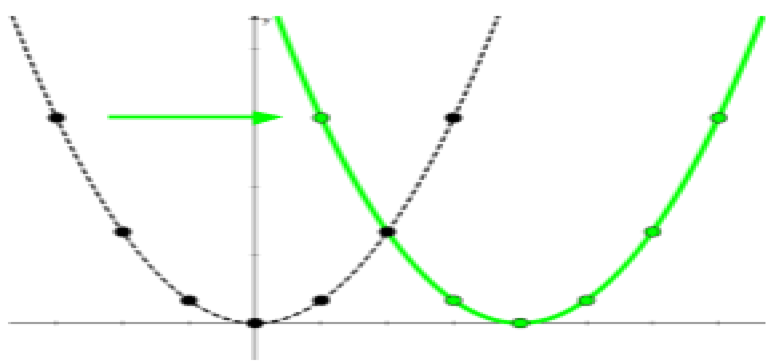
Translation (shift)

Vertical



$y \rightarrow y + k$

Horizontal



$x \rightarrow x + h$

Algebra 1 Unit 4 Listening Task Example

Example of a similar task for students to reference:

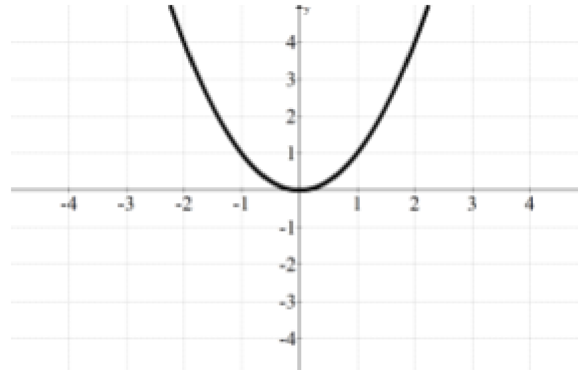
$$f(x) = \pm a(x - h)^2 + k$$

The graph of the parent function is y equals x squared.

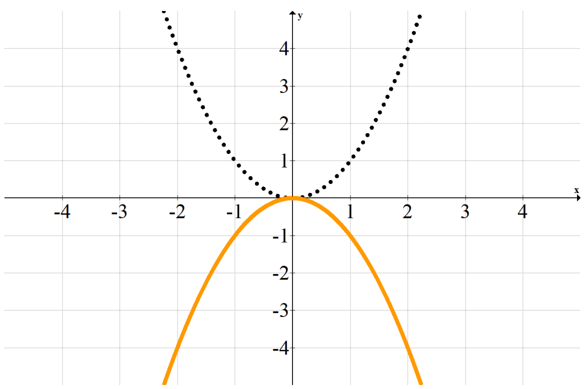
- The original graph is first transformed by a reflection over the x-axis.
- Then by a vertical translation three units up.

Sketch a graph and write the equation of the transformed function."

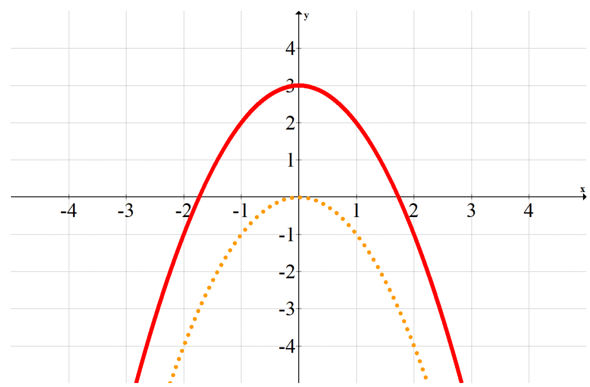
Parent Function: $y = x^2$



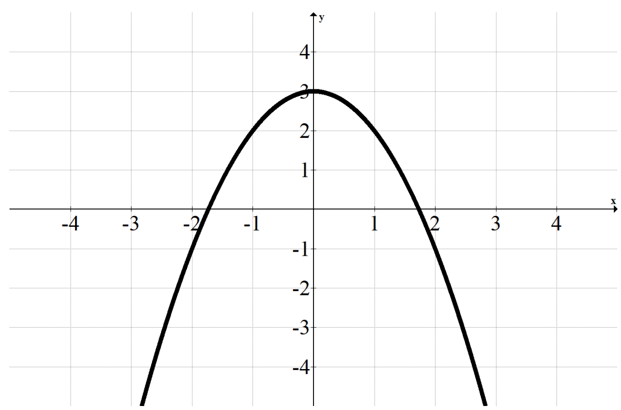
reflection over x-axis: $y = -x^2$



vertical translation 3 units up: $y = -x^2 + 3$



Transformed Function: $y = -x^2 + 3$



Algebra 1 Unit 4 Listening Task Example

Part 1: Order matters

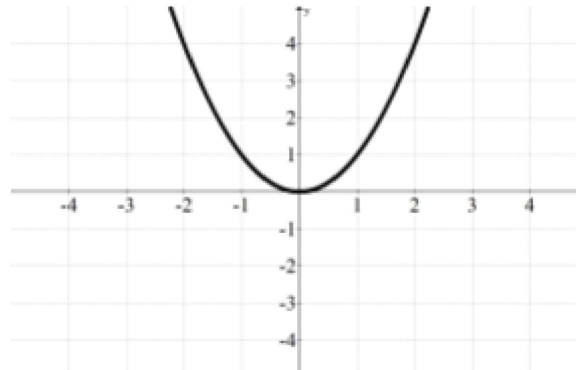
$$f(x) = \pm a(x - h)^2 + k$$

The graph of the parent function is y equals x squared.

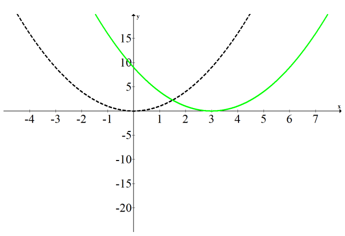
- shift horizontally by 3
- shift vertically by 7
- stretch vertically by 2
- reflect over x-axis

Sketch a graph and write the equation of the transformed function."

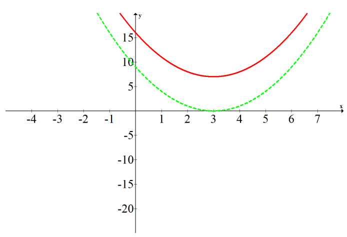
Parent Function: $y = x^2$



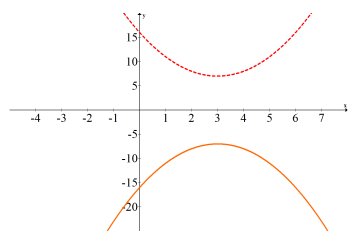
shift horiz. by 3



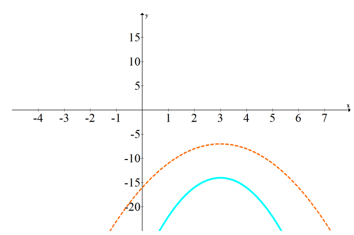
shift vert. by 7



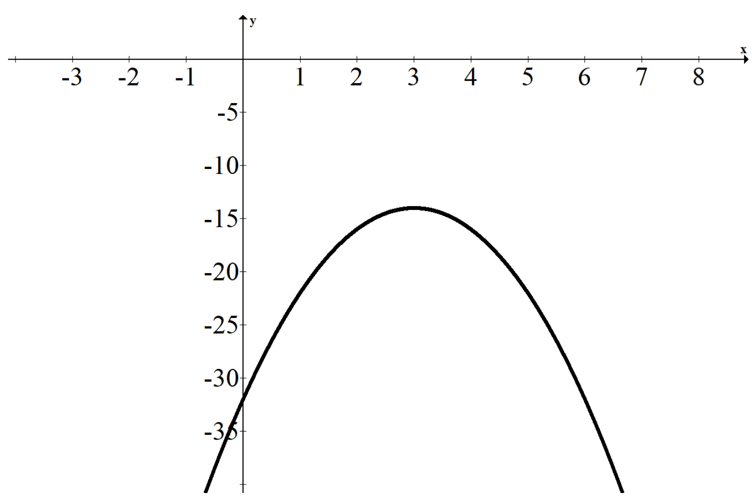
reflect over x-axis



stretch vert. by 2



Transformed Function: $y = -2[(x - 3)^2 + 7]$



Algebra 1 Unit 4 Listening Task Example

Example of a similar task for students to reference:

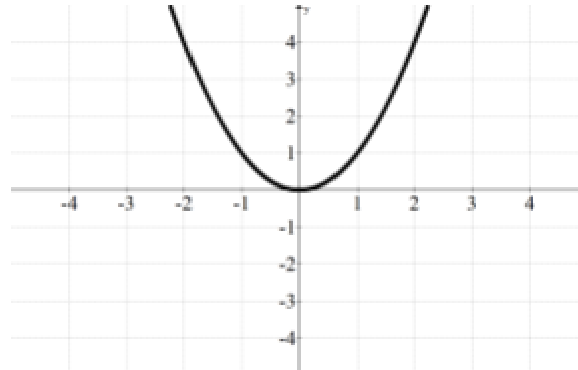
$$f(x) = \pm a(x - h)^2 + k$$

The graph of the parent function is y equals x squared.

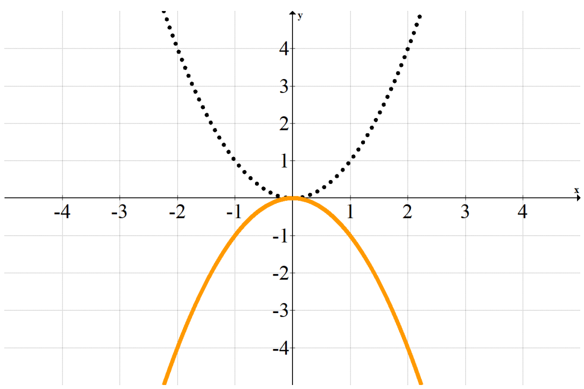
- The original graph is first transformed by a reflection over the x-axis.
- Then by a vertical translation three units up.

Sketch a graph and write the equation of the transformed function."

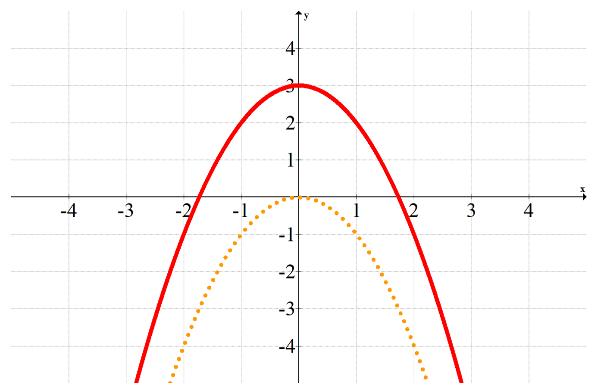
Parent Function: $y = x^2$



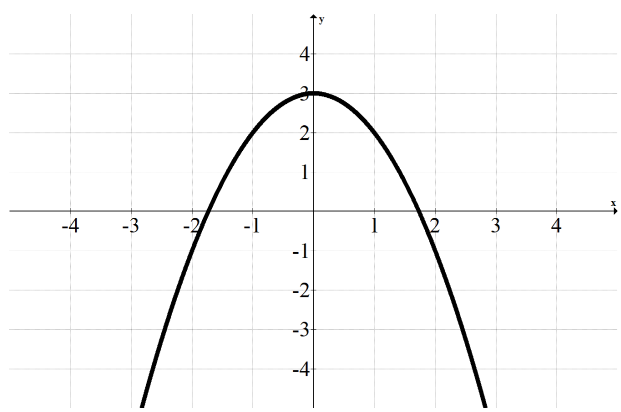
reflection over x-axis: $y = -x^2$



vertical translation 3 units up: $y = -x^2 + 3$



Transformed Function: $y = -x^2 + 3$



Quadratic Forms Reference Sheet

Standard form: $y = ax^2 + bx + c$

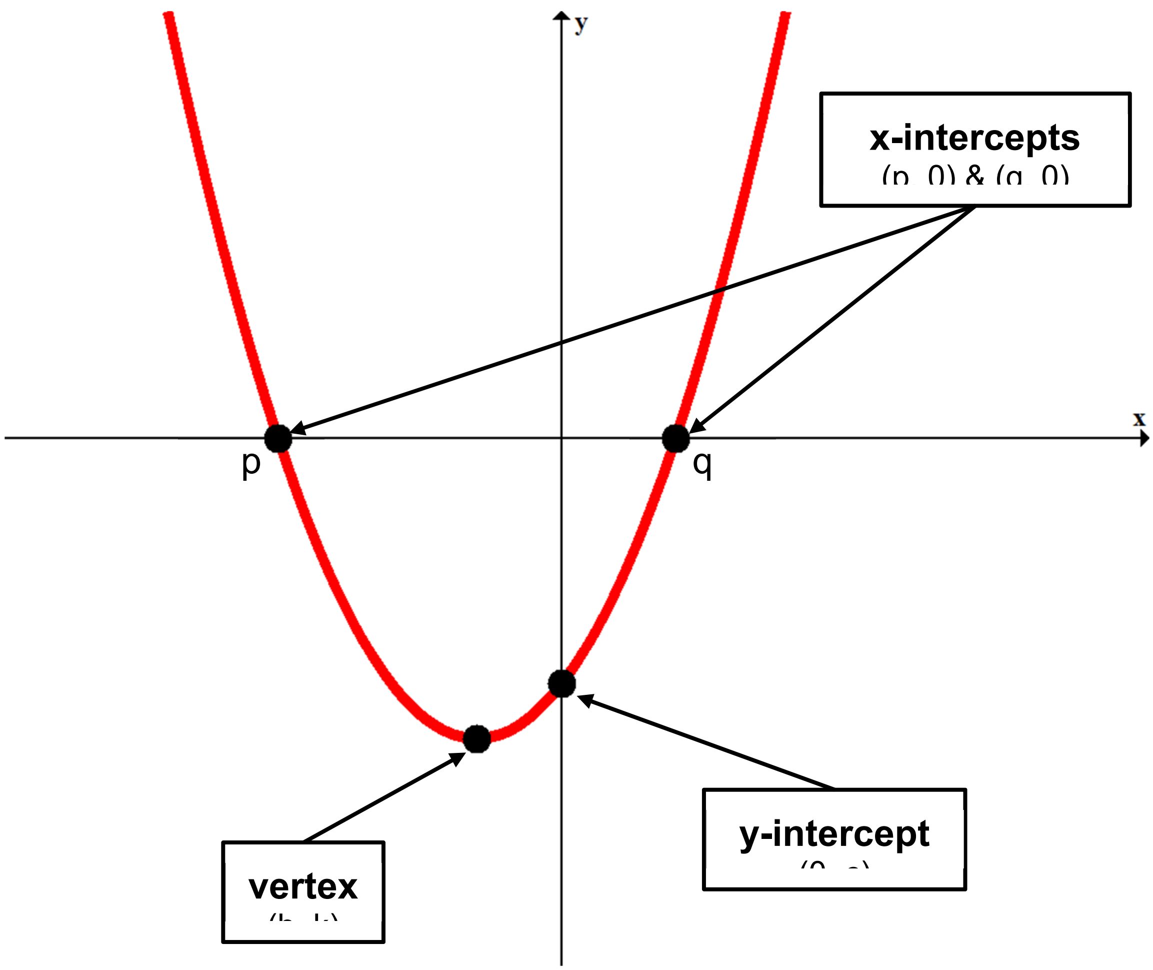
Constant:

Factored form: $y = a(x - p)(x - q)$

Factors: (x-p) & (x-q)

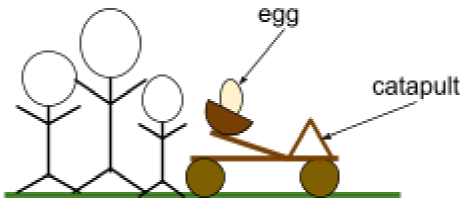
Vertex form: $y = a(x - h)^2 + k$

Vertex:

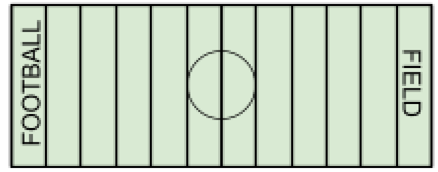


Egg Launch Game

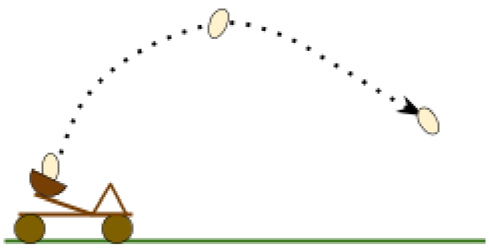
Adapted from https://tinyurl.com/y7zund6v



Mr. Rhodes' class holds an egg launching game on the football field.



Student teams built [made] catapults [machines to throw things] to hurl [throw] an egg down the football field.

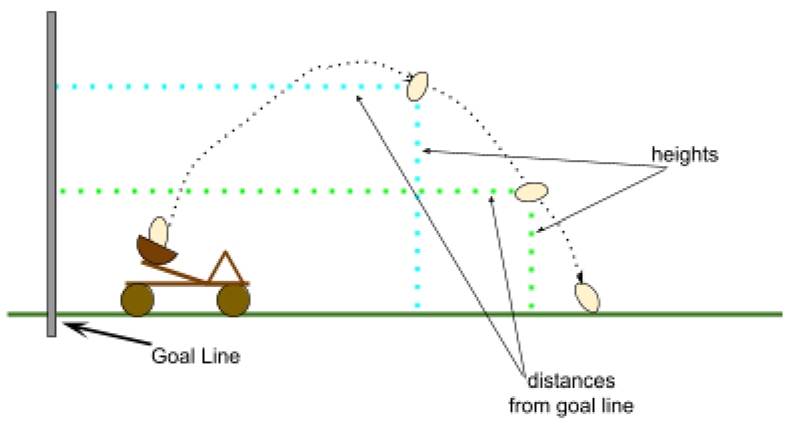


Teams use their catapult [machine to throw things] to hurl [throw] an egg down the football field. Teams do not start at the field goal line.

Teams use a motion detector [tool to measure speed and distance] to capture data [measurements]. Distances are measured from the field goal line. Heights are measured from the ground.

Team A wrote the table below to represent the path of their egg.

DISTANCE FROM GOAL LINE (IN FEET)	HEIGHT (IN FEET)
7	19
12	90
14	101
19	90
21	55
24	0

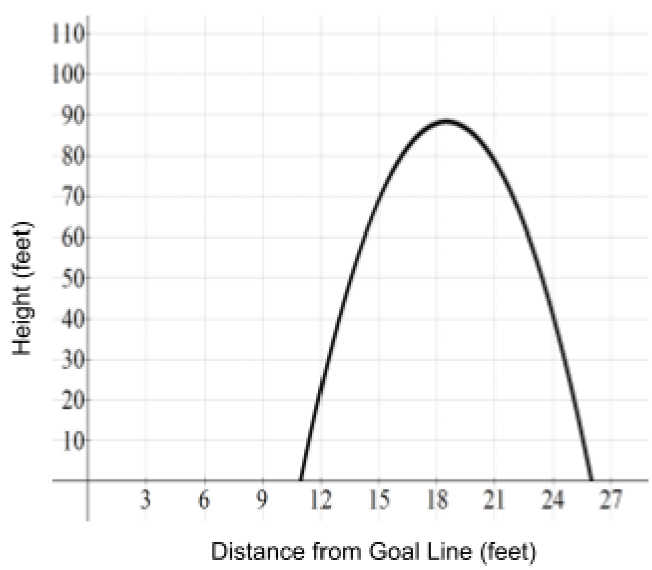


Team B wrote an equation to represent the path of their egg:

$$y = -0.8x^2 + 19x - 40,$$

where x is distance from the goal line and y is height from ground.

Team C drew a graph to represent the path of their egg.



Which team do you think won the game? Why?

Egg Launch Game

Adapted from https://tinyurl.com/y7zund6v

Mr. Rhodes' class holds an egg launching game on the football field.

Student teams built [made] catapults [machines to throw things] to hurl [throw] an egg down the football field.

Teams use their catapult [machine to throw things] to hurl [throw] an egg down the football field. Teams do not start at the field goal line.

Teams use a motion detector [tool to measure speed and distance] to capture data [measurements]. Distances are measured from the field goal line. Heights are measured from the ground.

Team A wrote the table below to represent the path of their egg.

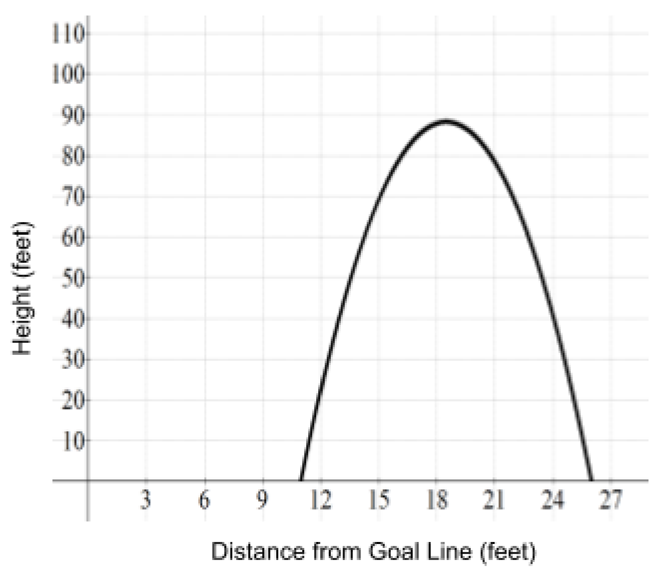
DISTANCE FROM GOAL LINE (IN FEET)	HEIGHT (IN FEET)
7	19
12	90
14	101
19	90
21	55
24	0

Team B wrote an equation to represent the path of their egg:

$$y = -0.8x^2 + 19x - 40,$$

where x is distance from the goal line and y is height from ground.

Team C drew a graph to represent the path of their egg.



Which team do you think won the game? Why?

Unit 4 Egg Launch Illustrated Word Bank

Figure 1: Mr. Rhodes

Figure 2: Ms Monroe

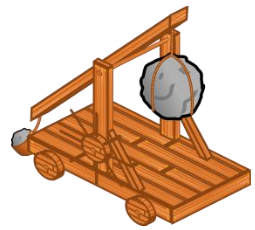


Figure 1 Catapult

Figure 4: Hurl

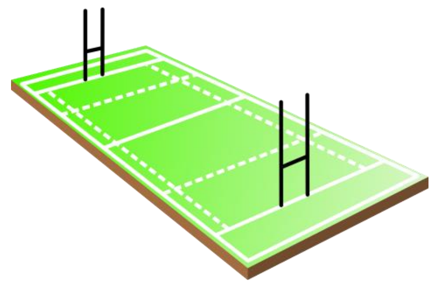


Figure 2: Football Field

Figure 3: Measure, Measuring, Measured

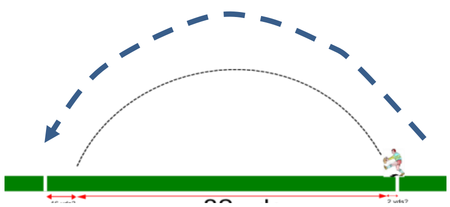


Figure 5: Path

Team A

1. Using the data from Team A, determine an equation that describes the path of the egg. Describe how you found your equation.

12. Find a method of ~~determining~~ finding a winner so that the team that **did not win** in Question 10 or Question 11 **would win** using your method.

- Height is a method.
- Distance is a method.
- Another method could be...

Which form of the equation did you use?(circle your answer below)		
Factored Form $y = a(x - p)(x - q)$	***Vertex Form*** $y = a(x - h)^2 + k$	***Standard Form*** $y = ax^2 + bx + c$
How did you find *p* and *q*?	How did you find *h* and *k*?	How did you find *a*, *b*, and *c*?
How did you find *a*?	How did you find *a*?	
The equation is…	The equation is...	The equation is...