A. Lesson Context

BIG PICTURE of this UNIT:	• How & why do we build NEW knowledge in Mathematics? • What NEW IDEAS & NEW CONCEPTS can we now explore with specific references to QUADRATIC FUNCTIONS? • How can we extend our knowledge of FUNCTIONS, given our BASIC understanding of Functions?		
CONTEXT of this LESSON:	Where we've been In Lesson 1, you were introduced to **vertical stretches** & **compressions** of the function y = $\boldsymbol{a}x^2$	Where we are WHY & HOW do we transform parent functions, specifically a quadratic function	Where we are heading How do we extend our knowledge & skills of quadratic functions, given the new ideas & concepts we now know about functions.

B. Lesson Objectives

a. Review KEY IDEAS in our parent function, $y = x^2$
b. Investigate the role of the parameters ***h*** and ***k*** in the equation $y = (x - \boldsymbol{h})^2 + \boldsymbol{k}$ and relate that role to the concept of TRANSFORMATIONS
c. Apply the idea of transforming a parent function to (i) contextual applications & (ii) further functions

C. Fast Five (Skills Review Focus)

Given the quadratic function $f(x) = -\frac{1}{2}(4x + 8)(x - 6)$:

(a) find the zeroes

(b) find the axis of symmetry

(c) find the vertex

(d) find the y-intercept

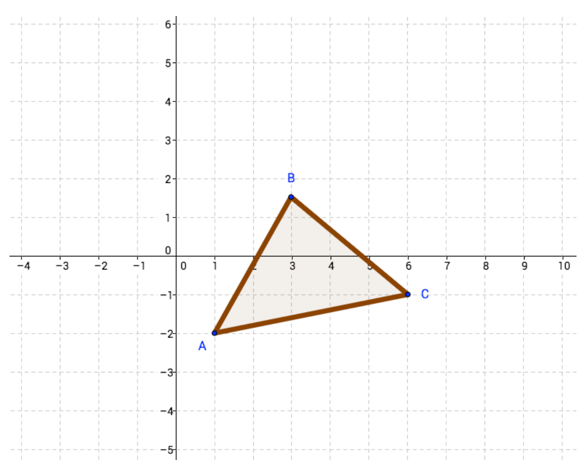
(e) write the equation in standard form

(f) Sketch the parabola, labelling key features

Given the triangle defined below:

(a) Translate the triangle 4 units left and 2 units up

(b) Vertically stretch the triangle by a factor of 3.



D. Observation Table for Exploration

What is the relationship between the value of the **parameters** ***h*** and ***k*** in the equation $y = (x – h)^2 + k$ and the **location** of the graph of the function. How do we DESCRIBE the change in the appearance of the graph?

1. Enter $y = x^2$ into Y1 of the equation editor of your GDC & let your windows ($-9.4 \le x \le 9.4$ and then $-9.4 \le y \le 9.4$)

2. To investigate the effect of ***k***, enter an equation of the form $y = x^2 + k$ into Y2 using ***k*** = -4, -1, 2, 5 , 7. Record your **comparisons** of the new graphs to the graph of your parent function.	2.

3. On the table below, record your findings from your parabolas in Q2.

Value of ***k***	Equation	Distance and direction from $y = x^2$	Vertex
0	$y = x^2$	Not applicable	(0,0)
-4			
-1			
2			
5			
7			

4. To investigate the effect of ***h***, enter an equation of the form $y = (x – h)^2$ into Y2 using ***h*** = -4, -1, 2, 5 , 7. Record your **comparisons** .	4.

5. On the table below, record your findings from your parabolas in Q3

Value of ***k***	Equation	Distance and direction from $y = x^2$	Vertex
0	$y = x^2$	Not applicable	(0,0)
-4			
-1			
2			
5			
7			

6. Identify the type of transformations that have been applied to the parent function to obtain the graphs as recorded in your tables in parts 3 and 5.	6.
7. Make a conjecture about how you could predict the equation of a parabola if you knew the translations that were applied to the graph of $y = x^2$	7.

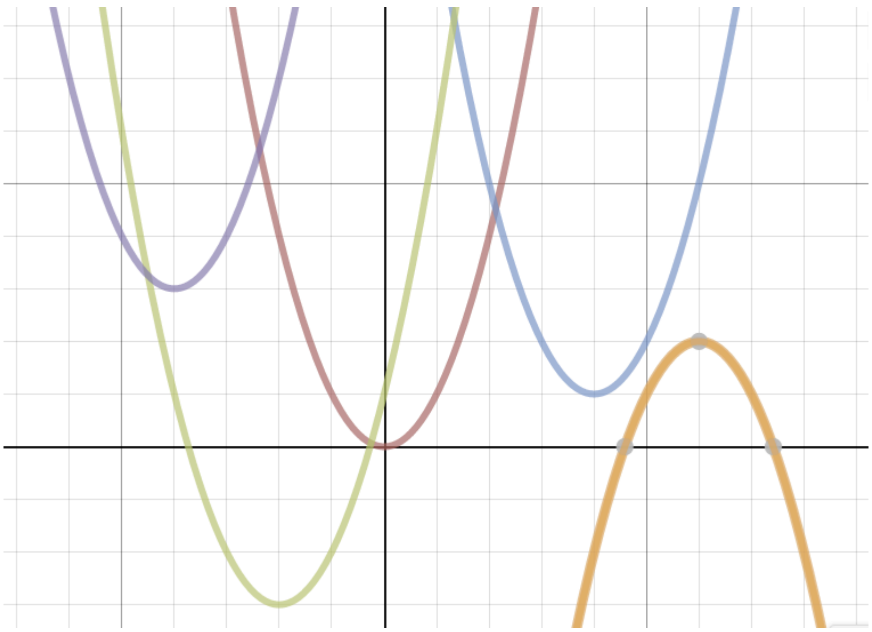
8. Complete this table to investigate and test your conjecture from part 7.

Value of h	Value of k	Equation	Relationship to $y = x^2$		Vertex
			Left/right	Up/down	
0	0	$y = x^2$	N/A	N/A	(0,0)
			Left 3	Down 5	
4	1				
					(-2,6)
		$y = (x + 5)^2 – 3$			

9. CONSOLIDATING: If the equation of a quadratic function is given in the form of $y = (x – M)^2 + N$, what can you conclude about its vertex? About its axis of symmetry?	9.
10. REFLECTING: What happens to the *x* coordinates of all the points on the graph of $y = x^2$ when the parameters ***h*** and ***k*** in $y = (x – \boldsymbol{h})^2 + \boldsymbol{k}$ are changed?	10.
11. REFLECTING: What happens to the *y* coordinates of all the points on the graph of $y = x^2$ when the parameters ***h*** and ***k*** in $y = (x – \boldsymbol{h})^2 + \boldsymbol{k}$ are changed?	11.
12. REFLECTING: State the values of ***h*** and ***k*** that cause the following **TRANSFORMATIONS** of $y = (x – \boldsymbol{h})^2 + \boldsymbol{k}$: (a) ***horizontal translation left*** (b) ***horizontal translation right:*** (c) ***vertical translation up:*** (d) ***vertical translation down:***	12.

E. <u>Practicing with Transforming Quadratics</u>

Example 1 (CI): You are given graphs of parabolas in the form of $y = (x - \boldsymbol{h})^2 + \boldsymbol{k}$. PREDICT the equations of each one & give a reason for your prediction. The parent function, $y = x^2$, is the red curve.



(a)

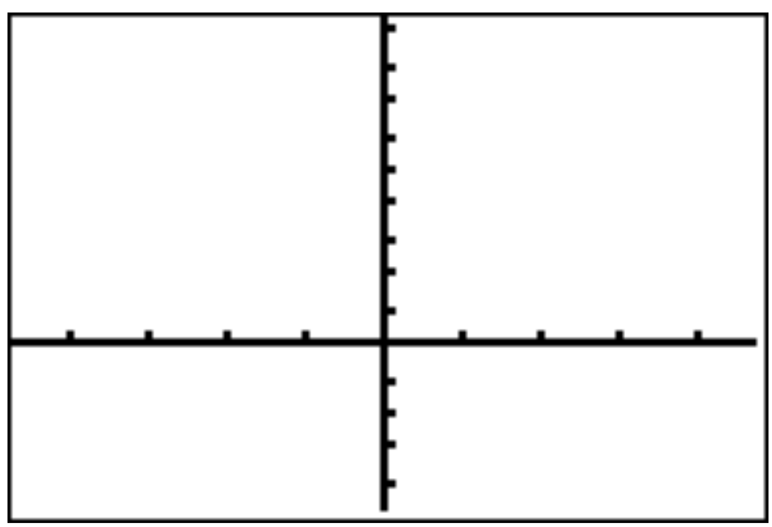
(b)

(c)

(d)

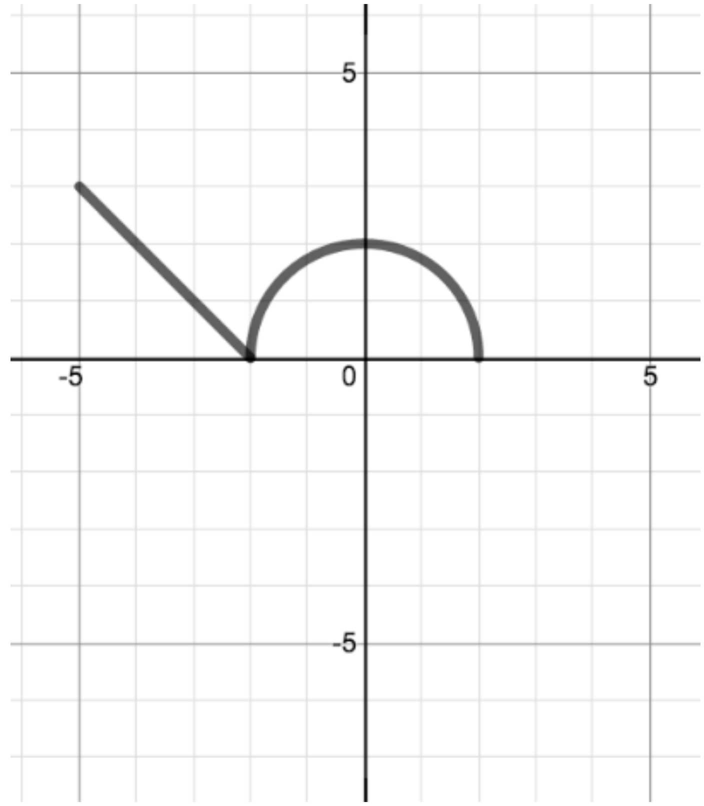
Example 2 (CI): Sketch the graph of $y = (x + 4)^2 - 3$ by transforming the graph of $y = x^2$. Sketch both graphs, label each graph.

Label the points (1,1) and (-1,1) on the parent function. Then label the corresponding, transformed points (i.e. where do these two original points wind up, AFTER the transformation?)



F. Extending the Concepts

Example 4: Working with a Piecewise defined function. A function, y = f(x) is illustrated on the grid.



You are required to produce a graph of a new function, called g(x), which is a TRANSFORMATION of f(x) as defined below:

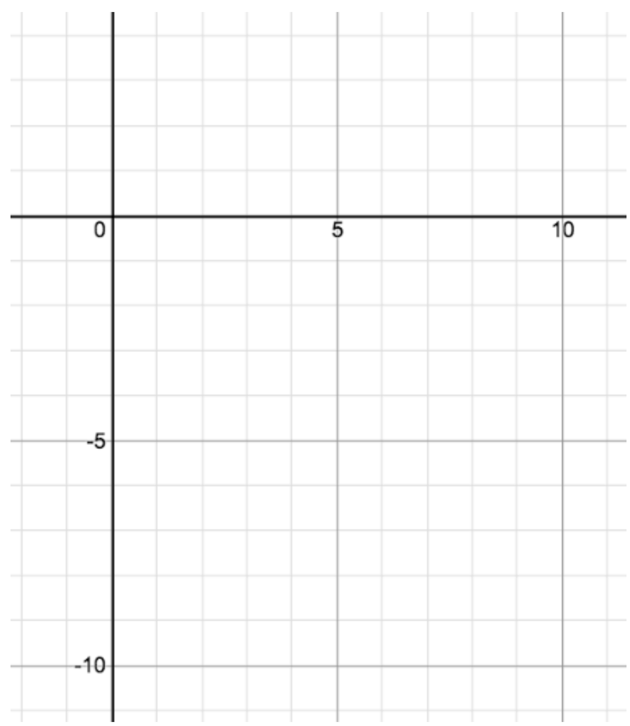
(a) $g(x) = f(x - 2) - 1$

(b) $g(x) = f(x + 1) - 3$

(c) $g(x) = 3 - f(2 + x)$

In each sketch, label KEY points very clearly.

Example 5: Now let f(x) be one of our new parent functions, $f(x) = \sqrt{x}$. On the grid provided, sketch:



(a) the parent function, clearly labelling the key points (0,0) and (4,2) and (9,3)

(b) $y = \sqrt{(x + 1)} - 5$, clearly labelling the new locations for the original key points

(c) $g(x) = -f(x - 3) - 7$, clearly labelling the new locations for the original key points