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 Lessons 5, you worked with quadratic MODELS in word problems in the form of $y = \boldsymbol{a}(x - \boldsymbol{h})^2 + \boldsymbol{k}$	Where we are HOW do we apply the vertex form of quadratic models in contextual problems	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. Apply the equation $y = \boldsymbol{a}(x - \boldsymbol{h})^2 + \boldsymbol{k}$ to geometrical contexts and to modeling contexts as well as data contexts (scatter plots)

C. Fast Five (Skills Review Focus)

Solve the equation $0 = -2(x + 2)^2 + 32$

Find the vertex of the parabola $y = x^2 + 6x - 7$

A parabola with the equation of $y = a(x - h)^2 - 2$ goes through the points (1,2) and (-5,-1). Find the values of *a* and *h*.

D. Modeling with Quadratic Functions (Example #1 – Geometric Context)

A quadratic function is defined by the equation $f(x) = x^2 - 4x - 5$.

(a) Rewrite the equation in vertex form and state the optimal value of the quadratic function.
(b) Find the zeroes of the parabola.
(c) Sketch the parabola, labelling the vertex and the y-intercept.
(d) Solve $f(x) = -5$.
(e) AP/HL ➔ Using your answer from Q(a), isolate x
(f) AP/HL ➔ How would you solve the equation $0 = x^2 - 4x + 5$, given your work in Q(a)

E. Modeling with Quadratic Functions (Example #2 – Free Fall)

The underside of a concrete railway underpass forms a parabolic arch. The arch is 24 m wide at the base and 8.0 high in the center. The upper surface of the underpass is 40 m wide. The concrete is 2 m thick at the center. Can a truck that is 5 m wide and 7.5 tall get through this underpass if the time is 3:30pm?

(a) Visualize the information by drawing a diagram wherein you label the relevant information.

(b) Recall that our general starting point would be a quadratic model and that the vertex form of the equation is $y = a(x – h)^2 + k$

(c) How can you use the quadratic equation to address the problem of the truck passing through the underpass?

F. Modeling with Quadratic Functions (Example #3)

Smoke jumpers are firefighters who parachute into remote locations to suppress forest fires. They are often the first people to arrive at a fire. When smoke jumpers exit an airplane, they are in free fall until their parachutes open.

A quadratic relation can be used to determine the height, H, in metres, of a jumper t seconds after exiting an airplane. In this relation, $a = -0.5g$, where g is the acceleration due to gravity. On Earth, $g = 9.8$ m/s^2.

❓ If a jumper exits an airplane at a height of 554 m, how long will the jumper be in free fall before the parachute opens at 300 m?

AP/HL ➔ If the parachute reduces the acceleration due to gravity by half, how much longer does it take for the smoke jumper to hit the ground?

G. Modeling with Quadratic Functions (Example #4)

The Next Cup coffee shop sells a special blend of coffee for $2.60 per mug. The shop sells about 200 mugs per day at this price. Customer surveys show that for every $0.05 decrease in price, the shop would sell 10 more mugs per day.

(HINT: start with numbers and a data table to see what may be going on)

(a) Determine the REVENUE that the coffee shop makes initially, given the price per mug and the amount of mugs sold.
(b) Since we are making changes in the pricing & revenues of the coffee shop, we need to decide upon an INDEPENDENT variable to use in modeling a change in the revenues ➔ so we need an R(x) equation …..
(c) Determine the MAXIMUM daily revenue from coffee sales and the price per mug in order to earn this revenue.
(d) Write an equation in both standard form and vertex form to model this problem. Then sketch the graph.