(A) Lesson Context

BIG PICTURE of this UNIT:	• How do we analyze and then work with a data set that shows both increase and decrease • What is a parabola and what key features do they have that makes them useful in modeling applications • How can I use graphs and equations of quadratic relations to make predictions from data sets & their models • How do I use graphs, data tables and algebra to analyze quadratic equations?

(B) Lesson Objectives:

a. Preview fundamental algebra skills
b. Look for number patterns that arise in data sets
c. Investigate graphs and the connections between graphs and equations and translations

(C) Algebra of Polynomials:

Expand the following expressions

7. (2c + 1)(2c + 3) b) (5x + 1)(2x + 5) c) (2n + 3)(2n + 5)

8. (3p + 2)(2p - 1) b) (5g - 4)(2g + 1) c) (2a - 3)(4a + 7)

9. a) (2y - 3)(9y - 1) b) (5k - 4)(2k - 1) c) (2z - 9)(6z - 5)

Challenge Qs

25) $(r^2 + 6r + 5)(5r^2 + r - 5)$ 26) $(-3m^2 - 2mn - 8n^2)(8m^2 + 4mn + n^2)$

27) $(-8n^2 - n + 7)(5n + 4)$ 28) $(-6b^2 + b + 6)(-b + 8)$

29) $(x^2 + 2xy + y^2)(x - 2y)$ 30) $(6m^2 - 8mn + 4n^2)(8m + 8n)$

Answers to the Challenge Qs

25) $5r^4 + 31r^3 + 26r^2 - 25r - 25$ 26) $-24m^4 - 28m^3n - 75m^2n^2 - 34mn^3 - 8n^4$
27) $-40n^3 - 37n^2 + 31n + 28$ 28) $6b^3 - 49b^2 + 2b + 48$ 29) $x^3 - 3xy^2 - 2y^3$
30) $48m^3 - 16m^2n - 32mn^2 + 32n^3$

(D) Graphs of Quadratic Functions – Geogebra and translation vectors

a. Use GEOGEBRA to graph the function $f(x) = x^2$.

b. Create a vector.

c. Now use the "translate by vector" tool and apply it to the function $f(x)$. Describe what happens to the quadratic function.

d. Now let's all create the translation vector $\begin{pmatrix} 6 \\ -3 \end{pmatrix}$ and apply it to $f(x)$.

   i. State the coordinates of the vertex ➔ is there a connection to translation vector?

   ii. State the domain and range of the function ➔ is there a connection to translation vector?

   iii. Is the parabola symmetrical? If so, where is the line of symmetry? ➔ is their a connection to translation vector?

e. ***KEY POINT***: Write down the new "equation" of this quadratic function and explain how the equation of the quadratic function is related to the translation vector.

(E) Exploration 1 – Number Patterns & Data Sets (get new data sets

EX 1. For the following data sets,

(a) Determine whether the data set is linear, quadratic or exponential.

(b) What are the **next** three terms of the sequence?

(c) What are the 3 terms that **preceded** the first term?

a)

x	10	20	30	40
y	21	41	61	81

b)

x	1	2	3	4
y	4	7	12	17

c)

x	5	6	7	8
y	−2	−3	−5	−8

d)

x	0	1	2	3
y	1	−1	7	−11

e)

x	0	1	2	3
y	−2	−1	6	25

f)

x	0	1	2	3	4
y	1	2	4	8	16

(F)Investigating Quadratic Relations – Geometry Problems – Maximizing Area

(a) a rectangular field is to be fenced using 40 meters of fencing. Build different "fields" that could be constructed, given the fact that all 40 meters must be used. For each field, record the length, the width, and the area that results. Finally, what are the dimensions of the field that maximize the area?

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(b) Now for some variations on the rectangular field problem. The field backs onto a river, so now build the different "fields" that could be constructed, given the fact that all 40 meters must be used. For each field, record the length, the width, and the area that results. Finally, what are the dimensions of the field that maximize the area?

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(c) Now for some variations on the rectangular field problem. The field backs onto a river and will be divided into 2 adjacent fields, so now build the different "fields" that could be constructed, given the fact that all 40 meters must be used. For each field, record the length, the width, and the area that results. Finally, what are the dimensions of the field that maximize the area?

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(d) Finally, let's graph and try to write equations that model the relationship between the area of the field and its width. Now write an equation that models the relationship between the area of the field and its length. Are the equations the same or are the different? How do the equation(s) allow us to answer the original question ➔ what dimensions of the field will maximize the area enclosed by the fencing.

Enter data here ➔
https://docs.google.com/spreadsheets/d/1b7sgWxBZZ8c1XzVNDmk8cAhASy68b2zqUxYfgoQp7tI/edit?usp=sharing

(G) Investigating Quadratic Relations – Projectiles

Ping Pong Projectiles