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 POLYNOMIAL FUNCTIONS AND RATIONAL FUNCTIONS? • How can we extend our knowledge of FUNCTIONS, given our BASIC understanding of Functions and quadratic functions?		
CONTEXT of this LESSON:	Where we've been In Unit 3, you worked with quadratic functions in vertex, standard, and factored forms.	Where we are HOW do we apply the concepts of quadratics to better understand higher order polynomials? Day 2	Where we are heading How do we extend our knowledge & skills of polynomials given what we know about quadratics functions?

B. Lesson Objectives

a. Introduce cubic functions through a 3D box building modeling investigation

C. Fast Five (Skills Review/Preview Focus)

1(a). Expand and simplify $(2x + 3y)^3$

Verify your expansion using WolframAlpha.

1(b). Multiply and then simplify $-3(x + 2)(x – 1)(2x + 3)$. Verify your expansion using WolframAlpha.

2(a). The formula for the volume of cylinder is $V = \pi r^2 h$. If the height of a cylinder is twice its radius and its radius is 5 cm, determine the volume of this cylinder.

3(a). Use DESMOS/TI-84 to graph and sketch:

$y = x^3$, $y = x^3 – 2$ and $y = (x – 2)^3$.

3(b). Sketch a function that crosses the x-axis at x = 6.

3(c). Sketch a function with x-intercepts at x = 6 & x = -1

3(d). Sketch a function with zeroes at x -2, 3 and 4.

4(b). The formula for the volume of a sphere is $V = 4/3\pi r^3$. Determine the volume of a sphere if its radius is 4 cm.

5(a). Use DESMOS/TI-84 to graph and sketch the polynomial functions:

(i) $y = (x – 1)(x + 2)(x – 3)$ and

(ii) $y = -(x – 2)(x + 1)(x + 4)$.

4(c). Determine the radius of a sphere if its volume is 200 cm^3.

5(b). Use WolframAlpha to factor $x^3 - x^2 - 14x + 24$. Sketch the graph as well.

Day 2 Work: Phase 2: Creating Class Data with Volume of our Box

Step 1: Get back into the **google doc** and use the data that the class generated. If you have time fill in your Surface Area Data for your box.
Step: Use your TI-84 or Microsoft excel to input your data for the size of the corner square and the volume.
Step 3: Construct a graph, one showing the relationship between corner size and volume and. Prepare the graph electronically or do it by hand on another sheet of paper. Please label your axes. If you have time, prepare the second graph showing the relationship between corner size and surface area.

Step 4: Looking at your scatter plots, what type of function could we use to model our relationships in this investigation? Justify your choice(s)._____

Step 5:
Trial 1: Use your TI-84 (or EXCEL) to determine an ***equation*** for the curve of best fit.

Volume Equation: V(x) =_____
Surface Area Equation: S(x) = _____ (if you have time)
How did you get your Equation: What regression did you use?_____

Trial 2: Use your TI-84 (or EXCEL) to determine an ***equation*** for the curve of best fit.

Volume Equation: V(x) =_____
Surface Area Equation: S(x) = _____ (if you have time)
How did you get your Equation: What regression did you use?_____

Evaluate the following and interpret.
V(x) = Volume of Box as a function of x the size of the corner square.
S(x) = Surface Area of Box as a function of x the size of the corner square.

V(2.3) =	Find x when, V(x) = 810	S(6.8) =	Find x when, S(x) = 350
Interpret your answer	Interpret your answer	Interpret your answer	Interpret your answer

1. Use your model to predict the size of the corner that you should cut out in order to ***optimize the volume*** of the box.

2. Determine the ***domain and range*** for your model, explaining WHY you've decided upon your domain and range.

3. EXTENTION: Can you PREDICT what the equation for the model should be, simply given the construction instructions?

4. EXTENTION: Boxes with reinforced sides ➔ to construct a box with reinforced sides, use your original box (2 cm corners cut) and make one adjustment on the four side "flaps" ➔ fold this flap TWICE (once at the 2 cm mark and a second time at the 1 cm side), so that your sides are now twice as thick. Again, determine the volume of this box. Then, as before, predict an equation for an equation modeling the relationship between corner size and volume.

D. Examples and Non-Examples of Polynomials

So in the box below are pictures of Polynomials and Non Polynomials… See if you can guess which ones are which… Mark Polynomials by circling them and underline the non-polynomials… remember this is a guess. Just see if you can make some observations and make a system for your choices. . Then flip the page to check your work. Discuss what makes a polynomial and what it takes to make it a non-polynomials.

$2x+1$

$8x^3+2x^2+3x-7$

$10x^3-2x+1$

$17x^2+11$

x^3-11x^2

$2x+\frac{3}{x}-5x^2+3x^6+\frac{2}{x^6}$

$-3x+17x^4+2x^2$

$30x^{-5}$

$x^3-7x^2-\sqrt{x}$

-130

3^x

$2+3x+4x^2+3x^3$

$-1+3x+2x^2$

$4a^2+7a-10$

$3x+\frac{17}{x^4}+6x^2$

$4a^{-2}+7a-10$

6^x

What are you observations about what is allowed for a polynomial and what is not. Did this match your perdiction from the previous page? _____

_____

_____

_____

Can you create more examples of Polynomials and Non-Polynomials

Your Exampes of Polynomials

Your Examples of Non-Polynomials

(E) Attributes of a Polynomial: Given the Following pictures and tables see if you can, determine what each of the follow vocabluary word means. The fill out the following information based off of your perdictions

Degree	*Name*	*Example*
0	Constant	5
1	Linear	3x+2
2	Quadratic	$X^2 - 4$
3	Cubic	$X^3 + 3x + 1$
4	Quartic	$-3x^4 + 4$
5	Quintic	$X^5 + 5x^4 - 7$

Polynomial	Terms	Degree
$2x^2 - 3x + 4$	$2x^2, -3x, 4$	2
$x^8 + 5x$	$x^8, 5x$	8
$3 - x + x^2 - \frac{1}{2}x^3$	$3, -x, x^2, -\frac{1}{2}x^3$	3
$5x + 1$	$5x, 1$	1
$9x^5$	$9x^5$	5
6	6	0

Vocabulary Prediction:

Term: _____

_____

Degree: _____

_____

Coefficients: _____

_____

Leading Coefficient: _____

_____

Name: _____

_____