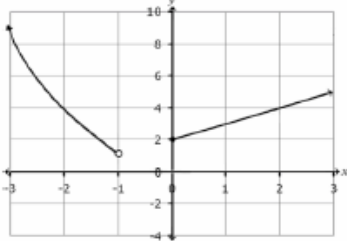


Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

Pacing: 5 weeks

Mathematical Practices
<p><i>Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning.</i></p> <p><i>Practices in bold are to be emphasized in the unit.</i></p> <ol style="list-style-type: none">1. Make sense of problems and persevere in solving them.2. Reason abstractly and quantitatively.3. Construct viable arguments and critique the reasoning of others.4. Model with mathematics.5. Use appropriate tools strategically.6. Attend to precision.7. Look for and make use of structure.8. Look for and express regularity in repeated reasoning.
Standards Overview
<p>Analyze functions using different representations.</p> <p>Build a function that models a relationship between two quantities.</p> <p>Build new functions from existing functions.</p>

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

Priority and Supporting CCSS	Explanations and Examples*
<p>CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*</p>	<p>Key characteristics include but are not limited to maxima, minima, intercepts, symmetry, end behavior, and asymptotes. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.</p> <p>Examples:</p> <ul style="list-style-type: none"> Describe key characteristics of the graph of $f(x) = x - 3 + 5$. Sketch the graph and identify the key characteristics of the function described below. $F(x) = \begin{cases} x + 2 & \text{for } x \geq 0 \\ -x^2 & \text{for } x < -1 \end{cases}$
	 <ul style="list-style-type: none"> Graph the function $f(x) = 2^x$ by creating a table of values. Identify the key characteristics of the graph. Graph $f(x) = 2 \tan x - 1$. Describe its domain, range, intercepts, and asymptotes. Draw the graph of $f(x) = \sin x$ and $f(x) = \cos x$. What are the similarities and differences between the two graphs?
<p>CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>	

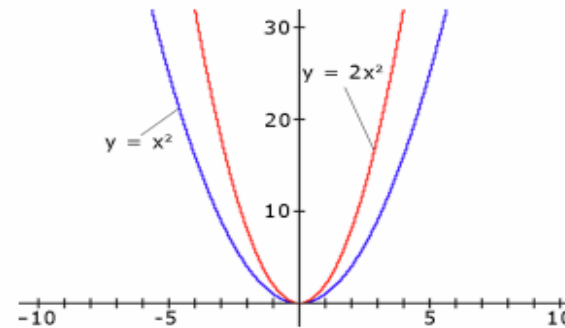
Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Students will apply transformations to functions and recognize functions as even and odd. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.

Examples:

- Is $f(x) = x^3 - 3x^2 + 2x + 1$ even, odd, or neither? Explain your answer orally or in written format.
- Compare the shape and position of the graphs of $f(x) = x^2$ and $g(x) = 2x^2$, and explain the differences in terms of the algebraic expressions for the functions

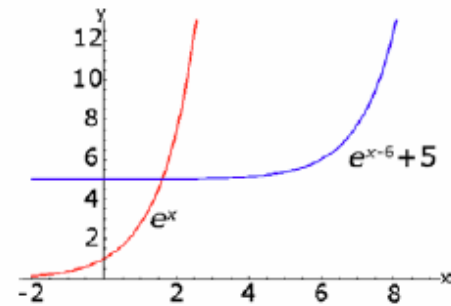


- Describe effect of varying the parameters a , h , and k have on the shape and position of the graph of $f(x) = a(x-h)^2 + k$.
- Compare the shape and position of the graphs of $f(x) = e^x$ to $g(x) = e^{x-6} + 5$, and explain the differences, orally or in written format, in terms of the algebraic expressions for the functions

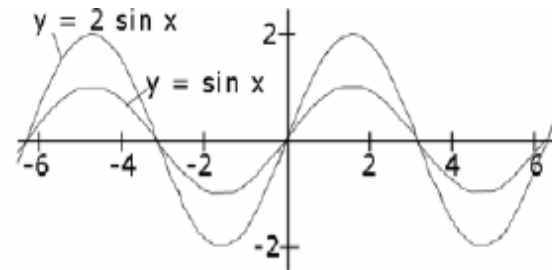
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Integrated Math 3

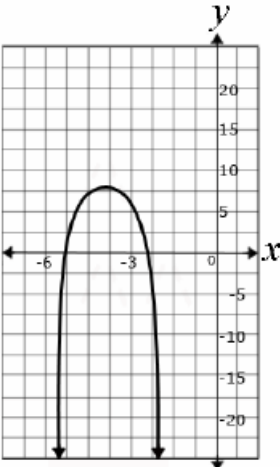
Unit 1: Functions – Features, Families, and Transformations



- Describe the effect of varying the parameters a , h , and k on the shape and position of the graph $f(x) = ab^{(x+h)} + k$, orally or in written format. What effect do values between 0 and 1 have? What effect do negative values have?
- Compare the shape and position of the graphs of $y = \sin x$ to $y = 2 \sin x$.



Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

<p>CC.9-12.F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*</i></p>	<p>Students may explain orally, or in written format, the existing relationships.</p>
<p>CC.9-12.F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</p>	<p>Example:</p> <ul style="list-style-type: none"> Examine the functions below. Which function has the larger maximum? How do you know? <div style="text-align: center;"> $f(x) = -2x^2 - 8x + 20$  </div>

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

CC.9-12.F.BF.4 Find inverse functions	
CC.9-12.F.BF.4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2(x^3)$ for $x > 0$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$ (x not equal to 1).	
CC.9-12.F.BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.	<p>Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to model functions.</p> <p>Examples:</p> <ul style="list-style-type: none"> • For the function $h(x) = (x - 2)^3$, defined on the domain of all real numbers, find the inverse function if it exists or explain why it doesn't exist. • Graph $h(x)$ and $h^{-1}(x)$ and explain how they relate to each other graphically. • Find a domain for $f(x) = 3x^2 + 12x - 8$ on which it has an inverse. Explain why it is necessary to restrict the domain of the function.

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
<ul style="list-style-type: none"> Functions (expressed symbolically) <ul style="list-style-type: none"> Square root, Cube root, Quadratic, Absolute Value, Cubic, Piecewise-defined Key Features <ul style="list-style-type: none"> Intercepts intervals <ul style="list-style-type: none"> ➤ increasing, decreasing, constant ➤ positive or negative relative maximums and minimums Technology (graphing complicated functions) Functions Inverse functions Equation (of form $f(x)=c$) 	<ul style="list-style-type: none"> Graph Show (key features) Use (technology) Write (function) Evaluate Graph translations Find (inverse functions and attend to domain e.g. restrictions) Solve (equation) Write (expression) 	<ul style="list-style-type: none"> 3 4 3 3 2 3 4 3 3

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

Essential Questions
How can the relationship between quantities best be represented?
Corresponding Big Ideas
Equations, verbal descriptions, graphs, and tables provide insight into the relationship between quantities.
Standardized Assessment Correlations (State, College and Career)
<u>Expectations for Learning (in development)</u> CollegeBoard PSAT and SAT

Unit Vocabulary
Function, domain, range, x and y-intercepts, symmetry, intervals of increase and decrease, local maximum, local minimum, quadratic, cubic, square root, cube root, piece-wise, constant function, transformations (vertical and horizontal shifts, vertical compression and stretch, horizontal compression and stretch, reflection about the x-axis, reflection about the y-axis), inverse functions, symmetry of inverse functions, domain of inverse functions

Unit Assessments
The items developed for this section can be used during the course of instruction when deemed appropriate by the teacher.
Section quizzes End-of-unit test

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

Learning Activities

Topic	Section in Text	CCSS
Reading a graph <ul style="list-style-type: none"> Given input, find output Given output, find input Identify domain and range 	Pre Calc 2.2	F.IF.7 F.IF.9
Function notation - algebraically <ul style="list-style-type: none"> Given input, find output Given output, find input 	PH Algebra 2 2.1	F.IF.7 A.REI.2
Algebraically finding features of functions <ul style="list-style-type: none"> Input and output x and y-intercepts Applications – explain what input and output mean in context to problem 	Pre Calc 2.2	F.IF.7 A.REI.2
More features of functions <ul style="list-style-type: none"> Domain and range Intervals of increase and decrease Local maximum and/or minimum Where is a function constant 	Pre Calc 2.3	F.IF.5 F.IF.7
Parent Functions <ul style="list-style-type: none"> know quadratic, square root, cubic, cube root transformations of these functions work with piece-wise functions 	Pre-Calc 2.4 2.5 PH Algebra 2 (vary scattered throughout text)	F.BF.3 F.IF.7b A.CED.2

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

	<p>p. 71 (extension)</p> <p>2.5</p> <p>2.6</p> <p>5.3</p> <p>7.8</p> <p>8.2</p> <p>8.3</p> <p>9.2</p> <p>9.3</p>	
<p>Inverse Functions</p> <ul style="list-style-type: none"> Finding the inverse a function both graphically and algebraically 	<p>Pre-Calc</p> <p>5.2</p>	<p>F.BF.4</p> <p>F.BF.4a</p>

Integrated Math 3
Unit 1: Functions – Features, Families, and Transformations

Application

1. A squirrel sitting in a tree drops an acorn. The function $h(t) = -16t^2 + 24$ gives the height of the acorn h in feet after t seconds.
 - (a) Identify the independent and dependent variables.
 - (b) Using function notation, evaluate the function for each given value of t . Explain the meaning of your answer in the context of the situation.
 $t = 0$
 $t = 0.5$
 - (c) Is 2 a reasonable domain value? Explain why or why not.

2. Ivermectin is the active ingredient in *Heartgard*, a preventative heartworm medication for dogs. The function $D(x) = 5.44x$ describes the recommended dosage D , in milligrams, for a dog weighing x pounds.
 - (a) Find $D(75)$. Explain the meaning of your answer in the context of the situation.

 - (b) Find the value of x such that $D(x) = 136$. Explain the meaning of your answer in the context of the situation.

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Pacing: 5 weeks

Mathematical Practices

Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning.

Practices in bold are to be emphasized in the unit.

1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.**
3. Construct viable arguments and critique the reasoning of others.
- 4. Model with mathematics.**
- 5. Use appropriate tools strategically.**
6. Attend to precision.
- 7. Look for and make use of structure.**
- 8. Look for and express regularity in repeated reasoning.**

Standards Overview

Understand the concept of a function and use function notation.
Interpret functions that arise in applications in terms of the context
Analyze functions using different representations
Interpret expressions for functions in terms of the situation they model

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Priority and Supporting CCSS	Explanations and Examples*		
F-LE 1: Distinguish between situations that can be modeled with linear functions and with exponential functions	Example: Common differences for world population growth show an increasing trend, suggesting that an exponential model may be more appropriate than a linear one.		
	Years since 1980	Population (billions)	Common differences
	0	4.453	---
	1	4.529	.076
	2	4.609	.080
	3	4.690	.081
	4	4.771	.081
	5	4.852	.081
	6	4.936	.084
	7	5.022	.086
	8	5.109	.087
	9	5.196	.087
F-LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	Example:		
	Determine an exponential function of the form $f(x) = ab^x$ using data points from the table. Graph the function and identify the key characteristics of the graph.		
	x	f(x)	
	0	2	
	1	6	
	3	54	

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Priority and Supporting CCSS	Explanations and Examples*
F-LE.5: Interpret the parameters in a linear or exponential function in terms of a context.	Example: A function of the form $f(n) = P(1 + r)^n$ is used to model the amount of money in a savings account that earns 5% interest, compounded annually, where n is the number of years since the initial deposit. What is the value of r ? What is the meaning of the constant P in terms of the savings account?
F-IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima. F-IF.7b: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.	Exponential functions are similar to linear functions in that the y-intercept often represents a starting point. In exponential growth models, as the independent variable increases, the dependent variable increases at continually increasing rates. In exponential decay models, as the independent variable increases, the dependent variable approaches zero asymptotically.
F-IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	All exponential functions may be written in the form $f(x) = ab^x$. In a later course students may learn that they may also be written in the form $f(x) = ae^{bx}$.
GPE.5: Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	Relate slopes of parallel or perpendicular line
A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	For two-step equations, flow charts may be used to help students “undo” the order of operations to find the value of a variable. For example, this flow chart may be used to solve the equation $4x - 2 = 30$.

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Priority and Supporting CCSS	Explanations and Examples*
	<div style="text-align: center;"> $x \rightarrow \boxed{\text{multiply by 4}} \rightarrow \boxed{\text{subtract 2}} \rightarrow 30$ </div> <div style="text-align: center; margin-top: 20px;"> $x = \underline{\quad} \leftarrow \boxed{\quad} \leftarrow \boxed{\quad} \leftarrow 30$ </div> <p>Then students learn to solve equations by performing the same operation (except for division by zero) on both sides of the equal sign.</p> $4x - 2 = 30$ $\begin{array}{r} +2 \\ \hline \end{array} \quad \begin{array}{r} +2 \\ \hline \end{array}$ $\frac{4x}{4} = \frac{32}{4}$ $x = 8$
<p>F.BF.3: Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs.</p>	<p>Students should recognize these transformations of the parent graph $f(x) = x^2$:</p> <p>$f(x) = x^2 + k$ is a vertical translation $f(x) = (x + k)^2$ is a horizontal translation $f(x) = kx^2$ stretches the graph for $k > 0$ $f(x) = -x^2$ reflects the graph over the x-axis.</p>

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
Linear Functions	<ul style="list-style-type: none"> ○ Write equation (point-slope form) ○ Graph 	<p>3</p> <p>3</p>
Linear Inequalities	<ul style="list-style-type: none"> ○ Solve graphically ○ Solve algebraically 	<p>3</p> <p>3</p>
Absolute Value Functions	<ul style="list-style-type: none"> ○ Write equation ($y = a x-h +k$) ○ Graph ○ Solve graphically ○ Solve algebraically 	<p>3</p> <p>3</p> <p>3</p> <p>3</p>

Essential Question
<p>How can the relationship between quantities best be represented?</p> <p>When does a function best model a situation?</p> <p>How can algebra be useful when expressing geometric properties?</p>
Corresponding Big Ideas
<p>Equations, verbal descriptions, graphs, and tables provide insight into the relationship between quantities.</p> <p>Lines, exponential functions, and parabolas each describe a specific pattern of change.</p> <p>Algebra can be used to efficiently and effectively describe and apply geometric properties.</p>

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Standardized Assessment Correlations (State, College and Career)

<u>Expectations for Learning (in development)</u>
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CollegeBoard PSAT and SAT

Unit Vocabulary

Linear functions, parent function, point-slope form, transformation form, horizontal translation, vertical translation, stretch, compression, reflection, evaluate, slope, parallel, perpendicular, reciprocal, quadrilateral, diagonal, interval notation, domain, range, interval of increase/decrease, x-intercept, y-intercept, maximum/minimum values, absolute value function

Unit Assessments

The items developed for this section can be used during the course of instruction when deemed appropriate by the teacher.
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Section quizzes

End-of-unit test

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Learning Activities

Topic	Section in Text	CCSS
Linear Functions <ul style="list-style-type: none"> ○ write the equation in point-slope form, given graph ○ graph, given equation in point-slope form 	Worksheets 2.1& 2.2	F-LE.2
Linear Functions <ul style="list-style-type: none"> ○ write equation in point-slope, given two points ○ write equation in point-slope, given 1 point and the equation of a parallel and/or perpendicular line 	Worksheets 2.3 & 2.4	F-LE.2 F-LE 5 F-IF.8 GPE.5
Linear Inequalities <ul style="list-style-type: none"> ○ solve graphically ○ solve algebraically 	Worksheet 2.5	A-REI.3
Absolute Value Functions <ul style="list-style-type: none"> ○ write the equation in point-slope form, given graph ○ graph the functions, given the equation 	Worksheet 2.6	F-IF.7b
Absolute Value Functions <ul style="list-style-type: none"> ○ solve graphically ○ solve algebraically ○ solve as system with a linear function 	Teacher generated	F-IF.7b F.BF.3
Absolute Value Inequalities <ul style="list-style-type: none"> ○ solve graphically ○ solve algebraically 	Teacher generated	F-LE 1

Integrated Math 3
Unit 2: Linear and Absolute Value Functions

Application

1. At time 0 seconds an elevator starts 400 feet above the ground. After 8 seconds the elevator is 320 feet above the ground.
 - a. Identify two points from the given information.
 - b. Find the slope of the line.
 - c. Write the linear function, $h(x)$, that models the height of the elevator after x seconds.
 - d. Find $h(25)$. Explain the meaning of the answer.
 - e. Find the value of x such that $h(x) = 0$. Explain the meaning of your answer.

2. The average value of a certain type of automobile was \$14,580 in 2005 and depreciated to \$6180 in 2009.
 - a. Let v be the average value of the automobile in the year x , where **$x = 0$ represents 2005**.
Write the coordinates of two points that model the given information.
 - b. Find the slope. Explain its meaning in context to the problem.
 - c. Write a linear equation representing the value of the car as a function of time, $v(x)$.
 - d. Predict the value of the car in 2013.

Integrated Math 3
Unit 3: Radicals and Square Root Function

Pacing: 5 weeks

Mathematical Practices
<p><i>Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning.</i></p> <p><i>Practices in bold are to be emphasized in the unit.</i></p> <ol style="list-style-type: none">1. Make sense of problems and persevere in solving them.2. Reason abstractly and quantitatively.3. Construct viable arguments and critique the reasoning of others.4. Model with mathematics.5. Use appropriate tools strategically.6. Attend to precision.7. Look for and make use of structure.8. Look for and express regularity in repeated reasoning.
Standards Overview
<p>Understand solving equations as a process of reasoning and explain the reasoning.</p> <p>Analyze functions using different representations.</p> <p>Use properties of rational and irrational numbers.</p>

Integrated Math 3
Unit 3: Radicals and Square Root Function

Priority and Supporting CCSS	Explanations and Examples*
CC.9-12.A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise	<p>Examples:</p> <ul style="list-style-type: none"> • $\sqrt{x+2} = 5$ • $\frac{7}{8}\sqrt{2x-5} = 21$ • $\frac{x+2}{x+3} = 2$ Solv • $\sqrt{3x-7} = -4$
CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*	<p>Key characteristics include but are not limited to maxima, minima, intercepts, symmetry, end behavior, and asymptotes. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.</p>
CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them	<p>Students will apply transformations to functions and recognize functions as even and odd. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Is $f(x) = x^3 - 3x^2 + 2x + 1$ even, odd, or neither? Explain your answer orally or in written format. • Compare the shape and position of the graphs of $f(x) = x^2$ and $g(x) = 2x^2$, and explain the differences in terms of the algebraic expressions for the functions

Integrated Math 3
Unit 3: Radicals and Square Root Function

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
<ul style="list-style-type: none"> • Radicals <ul style="list-style-type: none"> ○ Add/Subtract ○ Multiply ○ Divide • Square Root Functions 	Simplify	3
	Operate	2
	Graph	3
	Solve algebraically	3

Essential Questions
How does knowledge of integers help when working with rational and irrational numbers?
Corresponding Big Ideas
Algebraic expressions, such as polynomials and rational expressions symbolize numerical relationships and can be manipulated in much the same way as numbers. Operations and properties of integers can be extended to situations involving rational and irrational numbers.
Standardized Assessment Correlations (State, College and Career)
<u>Expectations for Learning (in development)</u> CollegeBoard PSAT and SAT

Integrated Math 3
Unit 3: Radicals and Square Root Function

Unit Vocabulary

Real number, rational number, irrational number, sum, product, radicals, exponent, rational exponent, laws of exponents, simplify, radical expression, integer, transformation, horizontal/vertical translation

Unit Assessments

The items developed for this section can be used during the course of instruction when deemed appropriate by the teacher.

Section quizzes, end-of-unit test

Learning Activities

Topic	Section in Text	CCSS
Simplify radicals (in context of applications such as problems involving the Pythagorean Theorem and distance problems)	PH Algebra 1 Section 11.1	CC9-12.RN.1 CC9-12.RN.2
Operations on Radicals – add/subtract	Section 11.2	
Operations on Radicals – Multiply	Sections 11.1 - 11.2	
Operations on Radicals - Divide	PH Algebra 1 section 11.1 PH Geometry section 7.3	
Graph Square Root Function	PH Algebra 1 section 11.3	CC.9-12.F.IF.7b
Solve Square Root Equations	Section 11.4	CC.9-12.A.REI.2

Integrated Math 3
Unit 3: Radicals and Square Root Function

Application

1. The time t in seconds for a trapeze to complete one full cycle is given by the function $t(l) = 1.11\sqrt{l}$, where l is the length of the trapeze in feet.
 - a. Describe the transformation in relation to the parent function $y = \sqrt{x}$.
 - b. Evaluate $t(30)$ to the nearest tenth. Explain the meaning of your answer in context to the application.
 - c. Find the value of l such that $t(l) = 6.66$. Show your work.

2. The diagonal of a square is $\sqrt{150}$ feet.
 - a. Determine the length of each side of the square. (Hint: the diagonal divides the square into two 45-45-90 right triangles).
 - b. What is the area of the square? What is its perimeter?

Integrated Math 3
Unit 4: Quadratics

Pacing: 6 weeks

Mathematical Practices

Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning.

Practices in bold are to be emphasized in the unit.

1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.**
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
- 7. Look for and make use of structure.**
- 8. Look for and express regularity in repeated reasoning.**

Standards Overview

Use properties of rational and irrational numbers.
Write expressions in equivalent forms to solve problems
Perform arithmetic operations on polynomials
Solve equations and inequalities in one variable
Interpret functions that arise in applications in terms of the context
Analyze functions using different representations

Integrated Math 3
Unit 4: Quadratics

Priority and Supporting CCSS	Explanations and Examples*
A-SSE 3. a Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.	<p>Three forms of the quadratic function reveal different features of its graph.</p> <p>Standard form: $f(x) = ax^2 + bx + c$ reveals the y intercept, (0, c).</p> <p>Vertex form: $f(x) = a(x - h)^2 + k$ reveals the vertex (h, k) and thus the maximum or minimum value of the function.</p> <p>Factored form: $f(x) = a(x - x_1)(x - x_2)$ reveals the x-intercepts (x₁,0) and (x₂,0) .</p>
A-APR 1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	<p>The product of two binomials of degree one is generally a trinomial of degree two; the process of expanding this product may be reversed to produce the factored form of the polynomial.</p>
F-IF 7a. Graph ... quadratic functions and show intercepts, maxima, and minima.	
<p>CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.</p>	<p>Students will apply transformations to functions and recognize functions as even and odd. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.</p> <ul style="list-style-type: none"> Describe effect of varying the parameters a, h, and k have on the shape and position of the graph of $f(x) = a(x-h)^2 + k$.

Integrated Math 3
Unit 4: Quadratics

Priority and Supporting CCSS	Explanations and Examples*
<p>A-REI 4. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.</p>	

**Integrated Math 3
Unit 4: Quadratics**

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
Polynomials	Classify	1
	Multiply	2
	Factor (GCF, trinomial, difference of squares)	3
Quadratics	Solve (factoring, quadratic formula)	3
	Graph	3
	Apply to real life situation	3

Essential Questions
<p>How can the relationship between quantities best be represented?</p> <p>How can the properties of the real number system be useful when working with polynomials and rational expressions?</p>

**Integrated Math 3
Unit 4: Quadratics**

Corresponding Big Ideas
Equations, verbal descriptions, graphs, and tables provide insight into the relationship between quantities. Algebraic expressions, such as polynomials and rational expressions, symbolize numerical relationships and can be manipulated in much the same way as numbers.
Standardized Assessment Correlations (State, College and Career)
<u>Expectations for Learning (in development)</u> CollegeBoard PSAT and SAT

Unit Vocabulary
Monomial, binomial, trinomial, polynomial, standard form of a polynomial, quadratic term, linear term, constant term, parabola, axis of symmetry, vertex, maximum, minimum, zeros (roots), factored form, zero-product property, quadratic formula

Unit Assessments
The items developed for this section can be used during the course of instruction when deemed appropriate by the teacher.
Section quizzes, End-of-unit test

Integrated Math 3
Unit 4: Quadratics

Learning Activities

Topic	Section in Text	CCSS
Quadratics - characteristics of graph	Worksheet 4.1	F-IF 7a
Polynomials - Classify - Multiply	Text: Section 5.4	A-APR 1
Polynomials - Factor trinomial - Greatest common factor - Difference of two squares	Worksheet 4.2, 4.3, 4.4	A-SSE.3a A-APR 1
Quadratics -Solve by factoring - Graph using zeros from factoring and vertex from zeros - Solve using Quadratic formula	Worksheet 4.5,4.6,4.7,4.8	A-REI 4.b
Applications	Worksheet 4.9	

Integrated Math 3
Unit 4: Quadratics

Application

1. A ball is dropped from a height of 100 feet. The function $h(t) = -16t^2 + 100$ models the height of the ball as a function of time.
 - a. Find the height of the ball 1.5 seconds after it has been dropped.
 - b. Find the length of time it takes for the ball to reach a height of 36 feet. Show your work.

2. The height of a penny thrown from the top of the Empire State Building is modeled by the equation, $h(t) = -16t^2 + 12t + 1454$. How long does it take the penny to reach the ground? Round your answer to the nearest tenth of a second.

Integrated Math 3
Unit 5: Circles

Pacing: 5 weeks

Mathematical Practices

Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning.

Practices in bold are to be emphasized in the unit.

- 1. Make sense of problems and persevere in solving them.**
- 2. Reason abstractly and quantitatively.**
- 3. Construct viable arguments and critique the reasoning of others.**
4. Model with mathematics.
- 5. Use appropriate tools strategically.**
- 6. Attend to precision.**
- 7. Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Standards Overview

Use coordinates to prove simple geometric theorems algebraically.
Understand and apply theorems about circles.

Integrated Math 3
Unit 5: Circles

Priority and Supporting CCSS	Explanations and Examples*
CC.9-12.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point $(0, 2)$.	Find the distance between two points in the coordinate plane. Find the coordinates of the midpoint of a segment in the coordinate plane. Define and classify special types of quadrilaterals. Determine whether a quadrilateral is a parallelogram. Determine whether a parallelogram is a rectangle or rhombus. Name coordinates of special figures by using their properties.
CC.9-12.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	
CC.9-12.G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*	
CC.9-12.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	Use the relationship between a radius and a tangent. Use the relationship between two tangents from one point. Use congruent chords, arc, and central angles. Recognize properties of lines through the center of a circle. Find the measure of an inscribed angle. Find the measure of an angle formed a tangent and a chord.
CC.9-12.G.C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	Use the corollary of the inscribed angle theorem to find missing measures and lengths in circles.

Integrated Math 3
Unit 5: Circles

Priority and Supporting CCSS	Explanations and Examples*
CC.9-12.G.C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.	Find the circumference of a circle. Find the measure of central angles and arcs. Find the circumference and arc length for a circle with a given radius.
CC.9-12.G.GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	Write an equation of a circle. Find the center and radius of a circle.

Integrated Math 3
Unit 5: Circles

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
Distance and Midpoint Formulas	Derive	3
	Apply	2
Equation of a Circle	Use	2
	Write	3
Relationships among	Describe	3
<ul style="list-style-type: none"> ○ central angles ○ inscribed angles ○ radii ○ diameters ○ chords ○ tangent ○ point of tangency ○ arcs 	Use	2
Areas of Circles and Sectors	Solve	3

**Integrated Math 3
Unit 5: Circles**

Essential Questions
<p>How can algebra be useful when expressing geometric properties? How can the properties of circles, polygons, lines and angles be useful when solving geometric problems?</p>
Corresponding Big Ideas
<p>Algebra can be used to efficiently and effectively describe and apply geometric properties. The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.</p>
Standardized Assessment Correlations (State, College and Career)
<p><u>Expectations for Learning (in development)</u> CollegeBoard PSAT and SAT</p>

Unit Vocabulary
<p>Coordinates, coordinate plane, distance formula, midpoint formula, radius (radii), diameter, chord, tangent, point of tangency, perpendicular, arc, intercepted arc, radian measure, central angle, inscribed angle</p>

Unit Assessments
<p>The items developed for this section can be used during the course of instruction when deemed appropriate by the teacher.</p> <p>Section quizzes End-of-unit test</p>

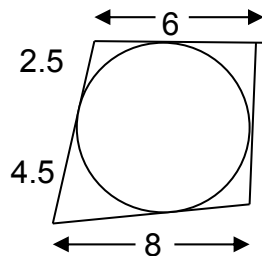
Integrated Math 3
Unit 5: Circles

Learning Activities

Topic	Section in Text	CCSS
Distance and Midpoint Formulas	Worksheet 5.1	G-GPE4, G-GPE7, G-GPE6
Equation of a Circle	Worksheet 5.2	G-GPE1
Tangent Lines	Worksheet 5.3	G-C.2
Circles and Arcs	Worksheet 5.4	G-C.2
Areas of Circles and Sectors	Worksheet 5.5	G-C.5
Chords and Arcs	Worksheet 5.6	G-C.2
Inscribed Angles	Worksheet 5.7	G-C.3

Application

- The plotted location of a cellular phone tower on a coordinate grid is $(-3, 2)$ and the range is 5 units. Write an equation that describes the position and range of the tower.
- In the figure below, the polygon circumscribes the circle. Find the perimeter of the polygon.



**Integrated Math 3
Unit 6: Exponentials**

Pacing: 5 weeks

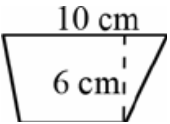
Mathematical Practices
<p><i>Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning.</i></p> <p><i>Practices in bold are to be emphasized in the unit.</i></p> <ol style="list-style-type: none"> 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.
Standards Overview
<p>Analyze functions using different representations.</p> <p>Construct and compare linear, quadratic, and exponential models and solve problems.</p>

Priority and Supporting CCSS	Explanations and Examples*
<p>CC.9-12.F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.</p>	

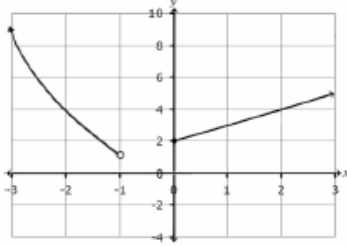
Integrated Math 3
Unit 6: Exponentials

Priority and Supporting CCSS	Explanations and Examples*
CC.9-12.F.IF.8b Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{(t/10)}$, and classify them as representing exponential growth or decay	
CC.9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context.*	Students should understand the vocabulary for the parts that make up the whole expression and be able to identify those parts and interpret there meaning in terms of a context.
CC.9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P	
CC.9-12.A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*	Example: <ul style="list-style-type: none"> In February, the Bezanson family starts saving for a trip to Australia in September. The Bezanson's expect their vacation to cost \$5375. They start with \$525. Each month they plan to deposit 20% more than the previous month. Will they have enough money for their trip?
CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i>	Equations can represent real world and mathematical problems. Include equations and inequalities that arise when comparing the values of two different functions, such as one describing linear growth and one describing exponential growth. Examples: <ul style="list-style-type: none"> Given that the following trapezoid has area 54 cm^2, set up an

Integrated Math 3
Unit 6: Exponentials

Priority and Supporting CCSS	Explanations and Examples*
	<p>equation to find the length of the base, and solve the equation.</p>  <p>Lava coming from the eruption of a volcano follows a parabolic path. The height h in feet of a piece of lava t seconds after it is ejected from the volcano is given by $h(t) = -t^2 + 16t + 936$. After how many seconds does the lava reach its maximum height of 1000 feet?</p>
CC.9-12.F.BF.1 Write a function that describes a relationship between two quantities.*	<p>Students will analyze a given problem to determine the function expressed by identifying patterns in the function's rate of change. They will specify intervals of increase, decrease, constancy, and, if possible, relate them to the function's description in words or graphically. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to model functions.</p>
CC.9-12.F.BF.1b Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model	<p>Examples:</p> <ul style="list-style-type: none"> You buy a \$10,000 car with an annual interest rate of 6 percent compounded annually and make monthly payments of \$250. Express the amount remaining to be paid off as a function of the number of months, using a recursion equation. A cup of coffee is initially at a temperature of 93° F. The difference between its temperature and the room temperature of 68° F decreases by 9% each minute. Write a function describing the temperature of the coffee as a function of time. The radius of a circular oil slick after t hours is given in feet by $r = 10t^2 - 0.5t$, for $0 \leq t \leq 10$. Find the area of the oil slick as a function

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Unit 6: Exponentials

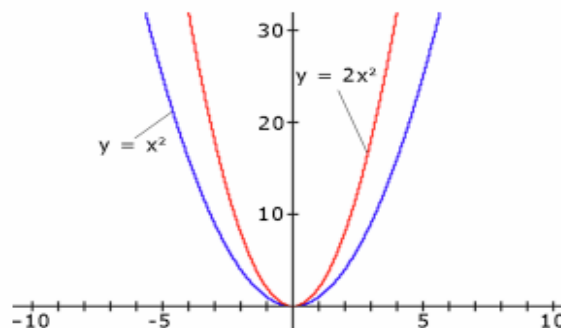
Priority and Supporting CCSS	Explanations and Examples*
	of time.
CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*	Key characteristics include but are not limited to maxima, minima, intercepts, symmetry, end behavior, and asymptotes. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.
CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude	<p>Examples:</p> <ul style="list-style-type: none"> Describe key characteristics of the graph of $f(x) = x - 3 + 5$. Sketch the graph and identify the key characteristics of the function described below. $F(x) = \begin{cases} x + 2 & \text{for } x \geq 0 \\ -x^2 & \text{for } x < -1 \end{cases}$  <ul style="list-style-type: none"> Graph the function $f(x) = 2^x$ by creating a table of values. Identify the key characteristics of the graph. Graph $f(x) = 2 \tan x - 1$. Describe its domain, range, intercepts, and asymptotes. Draw the graph of $f(x) = \sin x$ and $f(x) = \cos x$. What are the similarities and differences between the two graphs?

Integrated Math 3
Unit 6: Exponentials

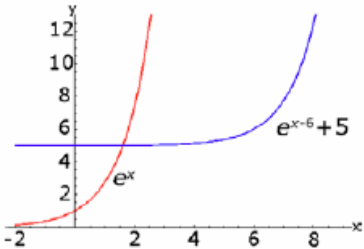
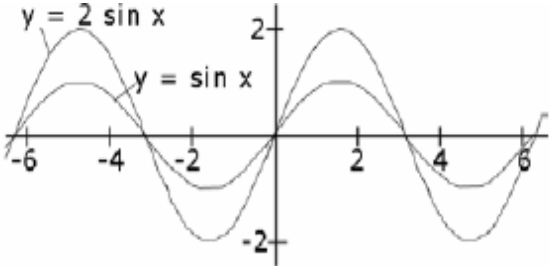
Priority and Supporting CCSS	Explanations and Examples*
CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	
CC.9-12.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*	<p>Students may be given graphs to interpret or produce graphs given an expression or table for the function, by hand or using technology.</p> <p>Examples:</p> <ul style="list-style-type: none"> ● A rocket is launched from 180 feet above the ground at time $t = 0$. The function that models this situation is given by $h = -16t^2 + 96t + 180$, where t is measured in seconds and h is height above the ground measured in feet. <ul style="list-style-type: none"> ○ What is a reasonable domain restriction for t in this context? ○ Determine the height of the rocket two seconds after it was launched. ○ Determine the maximum height obtained by the rocket. ○ Determine the time when the rocket is 100 feet above the ground. ○ Determine the time at which the rocket hits the ground. ○ How would you refine your answer to the first question based on your response to the second and fifth questions? ● Compare the graphs of $y = 3x^2$ and $y = 3x^3$. ● Let $R(x) = \frac{2}{\sqrt{x-2}}$. Find the domain of $R(x)$. Also find the range,

Integrated Math 3
Unit 6: Exponentials

Priority and Supporting CCSS	Explanations and Examples*
	<p>zeros, and asymptotes of $R(x)$.</p> <ul style="list-style-type: none"> Let $f(x) = 5x^3 - x^2 - 5x + 1$. Graph the function and identify end behavior and any intervals of constancy, increase, and decrease. It started raining lightly at 5am, then the rainfall became heavier at 7am. By 10am the storm was over, with a total rainfall of 3 inches. It didn't rain for the rest of the day. Sketch a possible graph for the number of inches of rain as a function of time, from midnight to midday.
<p>CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them</p>	<p>Students will apply transformations to functions and recognize functions as even and odd. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.</p> <p>Examples:</p> <ul style="list-style-type: none"> Is $f(x) = x^3 - 3x^2 + 2x + 1$ even, odd, or neither? Explain your answer orally or in written format. Compare the shape and position of the graphs of $f(x) = x^2$ and $g(x) = 2x^2$, and explain the differences in terms of the algebraic expressions for the functions



Integrated Math 3
Unit 6: Exponentials

Priority and Supporting CCSS	Explanations and Examples*
	<ul style="list-style-type: none"> Describe effect of varying the parameters a, h, and k have on the shape and position of the graph of $f(x) = a(x-h)^2 + k$. Compare the shape and position of the graphs of $f(x) = e^x$ to $g(x) = e^{x-6} + 5$, and explain the differences, orally or in written format, in terms of the algebraic expressions for the functions  <ul style="list-style-type: none"> Describe the effect of varying the parameters a, h, and k on the shape and position of the graph $f(x) = ab^{(x+h)} + k$, orally or in written format. What effect do values between 0 and 1 have? What effect do negative values have? Compare the shape and position of the graphs of $y = \sin x$ to $y = 2 \sin x$. 

Integrated Math 3
Unit 6: Exponentials

Priority and Supporting CCSS	Explanations and Examples*
<p>CC.9-12.A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*</p>	<p>Students need to understand that numerical solution methods (data in a table used to approximate an algebraic function) and graphical solution methods may produce approximate solutions, and algebraic solution methods produce precise solutions that can be represented graphically or numerically. Students may use graphing calculators or programs to generate tables of values, graph, or solve a variety of functions</p> <p>Example:</p> <ul style="list-style-type: none"> Given the following equations determine the x value that results in an equal output for both functions. $f(x) = 3x - 2$ $g(x) = (x + 3)^2 - 1$

Integrated Math 3
Unit 6: Exponentials

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
<ul style="list-style-type: none"> • Equivalent forms of expression • Properties of exponents • Exponential growth or decay • Functions (expressed symbolically) <ul style="list-style-type: none"> • Exponential • Key Features <ul style="list-style-type: none"> ○ Intercepts ○ intervals <ul style="list-style-type: none"> ➤ increasing or decreasing ➤ positive or negative ○ end behavior / asymptotes • Technology (graphing complicated functions) • Exponential 	<ul style="list-style-type: none"> • Write (function to model) • Use (properties of exponents) • Interpret / Classify (growth or decay) • Graph • Show (key features / intercepts / end behavior) • Use (technology) • Evaluate • Solve 	<ul style="list-style-type: none"> 4 3 4 3 4 3

**Integrated Math 3
Unit 6: Exponentials**

Essential Questions
When does a function best model a situation?
Corresponding Big Ideas
Lines, exponential functions, and parabolas each describe a specific pattern of change.

Standardized Assessment Correlations (State, College and Career)
<u>Expectations for Learning (in development)</u> CollegeBoard PSAT and SAT

Unit Vocabulary
Exponential Function, growth/decay factor, growth/decay rate, asymptote/end behavior, intercepts, compound interest applications; continuous, yearly, monthly, quarterly, biweekly, semiannually, domain and range, exponential equations

Unit Assessments
The items developed for this section can be used during the course of instruction when deemed appropriate by the teacher.
Section quizzes End-of-unit test

Integrated Math 3
Unit 6: Exponentials

Learning Activities

Topic	Section in Text	CCSS
Derive the exponential function as a formula for the sum of a finite geometric series (when common ratio is 1)	PH Algebra 2 8.1 Pre-Calc 5.3	A.SSE.4
Interpret exponential functions <ul style="list-style-type: none"> Find the y-intercept Find the horizontal asymptote Find zero – if it exists Identify growth/decay rate Identify growth/decay factor Irrational number “e” 	PH Algebra 2 8.1 8.2 Pre-Calc 5.3	F.IF.8 F.IF.8b
Interpret the parts of the exponential function in context <ul style="list-style-type: none"> Growth/decay rate Growth/decay factor 	PH Algebra 2 8.1 8.2	A.SSE.1 A.SSE.1b

**Integrated Math 3
Unit 6: Exponentials**

<ul style="list-style-type: none"> Initial/starting amount 	Pre-Calc 5.3	
Create/build an exponential function <ul style="list-style-type: none"> Given initial amount and growth/decay factor Given initial amount and growth/decay rate Given two points Increasing vs decreasing function Use the created function to answer other related questions 	PH Algebra 2 8.1 8.2 Pre-Calc 5.3 5.7 5.8 5.9	A.CED.1 F.BF.1 F.BF.1b F.IF.4
Graph exponential function and show key features <ul style="list-style-type: none"> Y-intercept Horizontal asymptote Key points: $f(1)$ and $f(-1)$ Use knowledge of transformations to graph 	PH Algebra 2 8.1 8.2 Pre-Calc 5.3	F.IF.7 F.IF.7e F.BF.3
Solve exponential equations	Pre-Calc 5.9	A.CED.2

Integrated Math 3
Unit 6: Exponentials**Application**

1. A pie is taken out of a 350°F oven and set on the counter to cool. The pie's temperature decreases at a rate of 3% each minute.
 - a. Does this model exponential growth or decay?
 - b. What is the temperature of the pie when it is first taken out of the oven?
 - c. What is the growth/decay rate?
 - d. What is the growth/decay factor?
 - e. Using the form $f(x) = a \cdot b^x$, write an exponential function modeling the pie's temperature $T(x)$ as a function of time, x , in minutes.
 - f. Using your function, predict the pie's temperature 30 minutes after it is taken out of the oven. Round your answer to the nearest whole degree.
2. The function $D(x) = 15(0.84)^x$ models the amount, $D(x)$ in mg, of antibiotic remaining in the bloodstream after x hours.
 - a. Does the function model exponential growth or decay?
 - b. What was the initial amount of antibiotic given to the patient?
 - c. What is the growth/decay factor?
 - d. Evaluate $D(4)$.
 - e. Explain the meaning of your answer in (d).
3. In 1997 Love of Learning College's annual tuition was \$10,000. The tuition has increased by 8% yearly.
 - a. What is the growth/decay rate?
 - b. What is the growth/decay factor?
 - c. Using the form $f(x) = a \cdot b^x$, write an exponential function modeling the college's tuition as a function of time in years.
 - d. Using your function, determine the tuition 2017.

