

Marking Period: 1	Unit Title: Functions and Graphs	Recommended Instruction Days: 40 -45
Standard-New Jersey Student Learning Standards: F-IF, F-BF, S-ID Functions and Graphs (Chapter 1)		
<p>Strand: F-IF: Interpreting Functions Interpret functions that arise in applications in terms of the context</p> <ol style="list-style-type: none">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.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. <p>Analyze functions using different representations</p> <ol style="list-style-type: none">7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.<ol style="list-style-type: none">a. Graph linear and quadratic functions and show intercepts, maxima, and minimab. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.<ol style="list-style-type: none">a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. <p>F-BF: Building Functions Build a function that models a relationship between two quantities</p> <ol style="list-style-type: none">1. Write a function that describes a relationship between two quantities<ol style="list-style-type: none">b. Combine standard function types using arithmetic operations.c. Compose functions <p>Build New Functions from Existing Functions</p>		

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.
4. Find inverse functions
 - a. Solve an equation of the form $f(x) = c$ for a simple function that has an inverse and write an expression for the inverse.
 - b. Verify by composition that one function is the inverse of another.
 - c. Read values of an inverse function from a graph or a table, given that the function has an inverse.
 - d. Produce an invertible function from a non-invertible function by restricting the domain.

S-ID: Interpreting Categorical and Quantitative Data

Interpret Linear Models

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*

Leonardo Da Vinci - Famous artist. Believed to be dyslexic as handwriting was often in reverse. Used linear perspective in his drawings, such as parallel lines, to create the illusion of depth on a flat surface.

The mission is to ensure that every student is able to see themselves in our rich and diverse history.

Social and Emotional Learning: <i>Competencies</i>	Social and Emotional Learning: <i>Sub-Competencies</i>
<p>Self-Awareness</p> <p>Social Awareness</p>	<ul style="list-style-type: none"> ● Recognizing the importance of self-confidence in handling daily tasks and challenges. ● Demonstrate an awareness of the expectations for social interactions in a variety of ways.

Self-Management Relationship Skills Responsible Decision-Making	<ul style="list-style-type: none"> ● Demonstrate an understanding of the need for mutual respect when viewpoints differ. ● Recognize the skills needed to establish and achieve personal and educational goals. ● Utilize positive communication and social skills to interact effectively with others. ● Develop, implement, and model effective problem solving and critical thinking skills.
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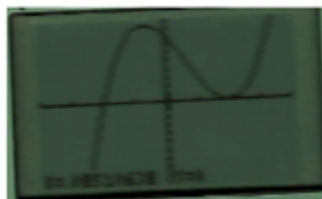
Recommended Activities, Investigations, Interdisciplinary Connections, and/or Student Experiences to Explore NJSLS-CLKS within Unit

Essential Questions	Progress Indicators	Activity Description
<ul style="list-style-type: none"> ● How are the domain and range of function determined? ● How can the graphing calculator be used to identify the main properties of functions, such as domain, range, minimums, maximums, and zeros? ● How can functions be combined algebraically? ● How do you evaluate the composition of functions? 	<ul style="list-style-type: none"> ● Tests ● Quizzes ● Practice problems for homework ● Worksheets ● Leveled assessments ● Projects 	<ul style="list-style-type: none"> ❖ Modeling and Equation Solving ❖ Functions and Their Properties ❖ Twelve Basic Functions ❖ Building Functions from Functions ❖ Parametric Relations and Inverses ❖ Graphical Transformations ❖ Modeling with Functions ❖ Example Tasks Below <p style="text-align: center;"><u>Interdisciplinary Connections:</u> <u>Science Domain: Energy and Matter</u></p> <p>According to the Global Wind Energy Council, a wind turbine can generate about 16,400 kWh of power each day. According to the Alternative Fuels Data Center, an average electric car can travel approximately 100 miles on 34 kWh of energy. An environmental nonprofit organization is interested in analyzing how wind power could offset the energy use of electric vehicles.</p>

<ul style="list-style-type: none">• How can functions be used to model practical situations?		<ol style="list-style-type: none">Write a function that represents the relationship between the number of wind turbines operating in a wind farm and the amount of energy they generate per day (in kilowatt-hours). Define the input and output.Write a function that represents the relationship between the energy expended by an electric car (in kilowatt-hours) and the number of miles driven.Write a function that could be used to determine the number of miles that an electric car could drive based on the number of wind turbines operating at a wind farm. Interpret this function in context.Determine the appropriate domain and range for part c. Explain why your domain and range are reasonable in this context.How many miles of driving could be generated daily by 20 wind turbines in a day? <p>Answer:</p> <ol style="list-style-type: none">$E(t) = 16400t$; t = number of turbines operating daily; $E(t)$ = energy (in kilowatt-hours) produced daily by the turbines.The relationship between miles driven and energy used is directly proportional, so $m = kE$. Since the car drives 100 miles using 34 kWh, $100 = k(34)$ and k is approximately 2.9. $m(e) = 2.9E$. E is the amount of energy expended by an average electric car (in kilowatt-hours). $m(e)$ is miles driven by the electric car.$m(E(t)) = m(16400t) = 2.9(16400t) = 47560t$; For every turbine operating in a wind farm daily, an average electric car can drive 47,560 miles.Domain: Whole numbers-the domain represents the number of turbines, which can only be represented with whole numbers. Range: Whole numbers-Given the function $m(E(t)) = 47560t$, the outputs are found by multiplying a whole number by an input that is a whole number, which always produces a whole number. The range represents miles drive, and these values cannot be negative.$m(E(20)) = 20(47560) = 951200$. 951,200 miles of driving can be generated. <p>Task</p>
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- Graph the equation $f(x) = (x + 2)(x^2 - 4x + 4)$ in the window $[-4]$ by $[-10, 10]$.
- Confirm algebraically that the function has zeros only at $x = -2$ and $x = 2$.
- Find each of the following:
 - a. Interval(s) where $f(x)$ is increasing.
 - b. Interval(s) where $f(x)$ is decreasing.
 - c. A local minimum value of f .
 - d. A local maximum value of f .

Answer



- $f(x) = (x + 2)(x^2 - 4x + 4)$
 $0 = (x + 2)(x^2 - 4x + 4)$
 $0 = (x + 2)(x + 2)(x - 4)$
 $0 = (x + 2), x = -2$
 $0 = (x - 2), x = 2$
- - a. $f(x)$ is increasing: $(-\infty, -1], [2, \infty)$
 - b. $f(x)$ is decreasing: $[-1, 2]$
 - c. local maximum: 0.0071 which occurs at $x = 1.96$
 - d. local minimum: 9.48 which occurs at $x = -0.68$

Task

Let $f(x) = \sqrt{x}$ and let $g(x) = x^2 - 4$

- Find an expression for $(f \circ g)(x)$ and give its domain.
- Find an expression for $(g \circ f)(x)$ and give its domain.
- Find an expression for $(fg)(x)$ and give its domain,
- Find an expression for $(f/g)(x)$ and give its domain.
- Describe the end behavior of the graph of $y = f(x)$.
- Describe the end behavior of the graph of $y = f(g(x))$.

Answer

$$(f \circ g)(x) = f(g(x)) = f(x^2 - 4) = \sqrt{x^2 - 4}.$$

Since $x^2 - 4 \geq 0$, $x^2 \geq 4$, $x \leq -2$ or $x \geq 2$.

The domain is $(-\infty, -2] \cup [2, \infty)$.

$$(g \circ f)(x) = g(f(x)) = g(\sqrt{x}) = (\sqrt{x})^2 - 4 =$$

$x - 4$. Since $\sqrt{x} \geq 0$, $x \geq 0$. The domain is $[0, \infty)$.

$$(f \cdot g)(x) = f(x) \cdot g(x) = \sqrt{x} \cdot (x^2 - 4).$$

Since $\sqrt{x} \geq 0$, the domain is $[0, \infty)$.

Spot Light On: *Seek multiple perspectives and different answers to questions.*

Mathematical Practices			
<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. 			
Assessments (Formative) <i>To show evidence of meeting the standard/s, students will successfully engage within:</i>		Assessments (Summative) <i>To show evidence of meeting the standard/s, students will successfully complete:</i>	
<u>Formative Assessment:</u> <ul style="list-style-type: none"> ● Entry and Exit Slips ● Quizzes ● Self Assessments ● Focus Packets 		<u>Benchmarks:</u> <ul style="list-style-type: none"> ● Chapter Tests ● Projects <u>Summative Assessments:</u> <ul style="list-style-type: none"> ● District assessments 	
Differentiated Student Access to Content: Teaching and Learning Resources/Materials			
Core Resources	Alternate Core Resources <i>IEP/504/At-Risk/ESL</i>	ELL Core Resources	Gifted & Talented Core Resources

<p>online albert resource online achievethecore resource online learnzillion resource online khanacademy resource online desmos resource online edulastic resource</p>	<p>Reteaching worksheets Skill building workbook Math manipulatives Leveled practice worksheets</p>	<p>Dictionary for native language Video tutorial in native language Success for English Learners worksheets Leveled Strategies for English Learners Linguistic Support</p>	<p>Enrichment worksheets Art of Problem Solving Leveled assessments</p>
<p>Supplemental Resources</p>			
<ul style="list-style-type: none"> ● Technology: Chromebooks, Graphing Calculators, Smartboards, ● Other: Zoom and Google Meets, Schoology, Google Classroom 			
<p>Differentiated Student Access to Content: Recommended <i>Strategies & Techniques</i></p>			
<p>Core Resources</p>	<p>Alternate Core Resources <i>IEP/504/At-Risk/ESL</i></p>	<p>ELL Core Resources</p>	<p>Gifted & Talented Core Resources</p>
<p>Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat</p>	<p>Utilize a multi-sensory (VAKT) approach during instruction, provide alternate presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential</p>	<p>Extend time requirements, preferred seating, positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of an online bilingual dictionary, and modified assessment and/or rubric.</p>	<p>Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related</p>

	seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.		
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New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)							
	Amistad Law: <i>N.J.S.A. 18A 52:16A-88</i>	Holocaust Law: <i>N.J.S.A. 18A:35-28</i>	X	LGBT and Disabilities Law: <i>N.J.S.A. 18A:35-4.35</i>	X	Diversity & Inclusion: <i>N.J.S.A. 18A:35-4.36a</i>	Standards in Action: <i>Climate Change</i>