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New Mexico Instructional S
Algebra 2 Interpreting Functions C

The purpose of this tool is to help educators understand each of the grade level standards and how those standards connect to the students' overall preparation for college and career readiness.

The NMIS is a teacher-influenced tool, designed to provide instructional planning support at the programmatic level for districts and instructional level for teachers. Its foundation stems from the vision and mission of the PED and came into existence to assure that students in NM will be engaged in a culturally and linguistically responsive educational system that meets the social, emotional, and academic needs of ALL students. This is also rooted in the belief that all students must have access to on-grade-level standards, focusing on acceleration. The purpose of this tool is to help educators understand each of the grade level standards and how those standards connect to the students' overall preparation for college and career readiness.

Standards are defined as the most critical prerequisite skills and knowledge. This document is color-coded to reflect both anchor and priority standards. Though previous emphasis was placed on priority standards to address lost learning due to COVID-19, New Mexico teachers should note that moving forward, while priority standards allow for acceleration of learning, **all** standards should be addressed in instruction throughout the school year.

In this guide you will find:

- A breakdown of each of the grade level standards within the cluster, including:
  - Standards of Mathematical Practice
  - Common Misconceptions
  - Identification of Priority Standards, as identified by NMPED.
  - Level of Rigor Identification
- Sample aligned assessment items
- Suggested Student Discourse Guide
- A multilayered system of supports (MLSS) and culturally and linguistically responsive instruction (CLR) guide

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

Key		
	Priority Standard	Priority standards, as identified by NMPED, are denoted with red highlighting. Priority standards are the most critical prerequisite skills and knowledge a student needs. This does not mean that these are only standards required to be taught, just these are the standards that will allow for the acceleration the students of New Mexico need during this time.
	*Conceptual Understanding*	Conceptual Understanding standards help students build a deep understanding of the **how** and **why** of mathematics.
	*Application*	Application standards help students identify the appropriate concepts and skills to tackle **novel real-world problems.**
	*Procedural Skill and Fluency*	Procedural standards help students develop **efficiency** and **accuracy** in computations.

Standards Breakdown

- Interpret functions that arise in applications in terms of the context.
  - HSF.IF.B.4
  - HSF.IF.B.5
  - HSF.IF.B.6
- Analyze functions using different representations.
  - HSF.IF.C.7
  - HSF.IF.C.8
  - HSF.IF.C.9

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

Grade	CCSS Domain	CCSS Cluster
A2	Interpreting Functions	Interpret functions that arise in applications in te the context

Cluster Standard: HSF.IF.B.4

Standard	Standards for Mathematical Practice
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*.	• **SMP 1:** Make sense of problems and persevere in solving them. • **SMP 4:** Model with mathematics.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students interpret the **key features** of the different **functions** listed in the standard. When given a **table** or **graph** of a function that models a **real-life situation**, explain the meaning of the characteristics of the table or graph in the **context** of the problem. Key features of a **linear function** are **slope** and **intercepts**; of a **quadratic function** are **intervals of increase/decrease**, **positive/negative**, **maximum/minimum**, **symmetry**, and **intercepts**; of an **exponential function** include ***y*-intercept** and **increasing/decreasing intervals** and of an **absolute value** include ***y*-intercept**, **minimum or maximum**, **increasing or decreasing intervals**, and **symmetry**.	• Identify intercepts of a function. • Identify intervals where the function is increasing. • Identify intervals where the function is decreasing. • Identify intervals where the function is positive. • Identify intervals where the function is negative. • Identify relative maximums of a function. • Identify relative minimums of a function. • Identify symmetries in the functions. • Identify the end behavior of the functions. • Sketch graphs given a list of key features or a verbal model. • Sketch functions that model key feature behavior. • Label intercepts and intervals of a graph. • Interpret where the function is increasing, decreasing, positive, or negative. • Interpret relative maximums and minimums. • Interpret various symmetries, end behaviors, and periodicity.
DOK	**Blooms**
1-2	Understand, Apply and Analyze

Grade	*CCSS Domain*	*CCSS Cluster*
A2	Interpreting Functions	Interpret functions that arise in applications in te the context

Cluster Standard: HSF.IF.B.5

Standard	Standards for Mathematical Practice
Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *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.*	• **SMP 3:** Construct viable arguments and critique the reasoning of others**.** • **SMP 4:** Model with mathematics.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students should focus their attention on possible **input and output values**, framing them as the **domain and range of a function**. When given a description of a function that represents a situation, the students should determine reasonable domain and range. Students relate the domain of a function to its graph and, where applicable, to the **quantitative relationship** it describes. Students need to explain the reasonableness of a domain for a given context. • Students should understand that the domain of a function is the set of all possible inputs and the range is the set of all possible outputs. Also looking at if a function is **continuous** (time, amount of liquid filling a container) or discrete (number of people or things) and connecting back to number classifications.	• Make connections between a graph of a function and its domain. • Make connections between the graph of a function and the context it describes. • Identify when the domain of a given context is discrete or continuous and explain why.
DOK	**Blooms**
1-2	Understand, Apply and Analyze

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

Grade	CCSS Domain	CCSS Cluster
A2	Interpreting Functions	Interpret functions that arise in applications in te the context

Cluster Standard: HSF.IF.B.6

Standard	Standards for Mathematical Practice
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.	• **SMP 4**: Model with mathematics. • **SMP 5:** Use appropriate tools strategically.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students will calculate and interpret the **average rate of change** of a linear, quadratic, **piecewise linear** (to include absolute value), and exponential function (presented **symbolically** or as a table) over a specified **interval.** Students will **estimate** the rate of change from a graph. In addition to finding average rates of change from functions given symbolically, graphically, or in a table, students may collect **data** from **experiments** or **simulations** (ex. falling ball, velocity of a car, etc.) and find average rates of change over various intervals.	• Calculate the average rate of change of a function over a specified interval presented symbolically. • Calculate the average rate of change of a function over a specified interval presented in a table. • Interpret the average rate of change of a function over a specified interval presented symbolically for a given context. • Interpret the average rate of change of a function over a specified interval presented in a table for a given context. • Estimate the rate of change of a function from a graph.
DOK	**Blooms**
1-2	Understand, Apply and Analyze

Common Misconceptions

- Students may confuse scatter plots and correlations.
- Students may focus on the y values of the graph instead of the x values of the interval, when identifying key features of a graph.
- Students may have difficulty understanding the domain.
- Students may confuse independent and dependent variables.

- Students may confuse shift with rate of change.

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

Grade	CCSS Domain	CCSS Cluster
A2	Interpreting Functions	Analyze functions using different representatio

Cluster Standard: HSF.IF.C.7

Standard	Standards for Mathematical Practice
Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. • HSF.IF.C.7.B: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. • HSF.IF.C.7.C: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. • HSF.IF.C.7.E: Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	• **SMP 4:** Model with mathematics • **SMP 7:** Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students should be able to describe the significant features of different **functions graphically** and **algebraically**. Students should be able to use the **significant features** to **sketch** the graph of the function. Students should graph **linear** and **quadratic functions** and show **intercepts**, **maxima**, and **minima.** Students should know the **slope-intercept form** of linear functions, $y = mx + b$, and how to extract enough information from the equation to be able to draw it. When graphing **roots**, remember that for $\sqrt[n]{x}$, if n is **even,** the domain includes all **positive integers**. Otherwise, **negative** values are included as well. When graphing roots of the for $y = a\sqrt{x} + b$, remember the **y-intercept** is b. Students should remember that roots are	• Graph exponential, logarithmic, and trigonometric functions. • Describe key features of exponential, logarithmic, and trigonometric functions. • Graph functions expressed symbolically showing key features of the graph by hand in simple cases and with technology for more complicated cases. • Compare and contrast functions.

fractional exponents. Students should know to look at the **highest degree of the polynomial** and its **coefficient,** ax^n. If *n* is even, the function will extend either **up** or **down** on both ends (as *x* goes to **positive** or **negative infinity**). If *n* is **odd**, they'll go in **opposite directions**. If *a* is positive, the even powered functions will go up and the odd powered functions will start down and go up. If *a* is negative, the even powered functions will go down, and the odd powered functions will start up and go down.	
DOK	**Blooms**
1-2	Understand, Apply and Analyze

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

Grade	CCSS Domain	CCSS Cluster
A2	Interpreting Functions	Analyze functions using different representatio

Cluster Standard: HSF.IF.C.8

Standard	Standards for Mathematical Practice
Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. • HSF.IF.C.8.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. • HSF.IF.C.8.B: Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.	• **SMP 4:** Model with mathematics. • **SMP 7:** Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students should be able to rewrite quadratic and **exponential functions** in different ways to find key features of the expression and interpret those key features in terms of the context they represent. Students should be able to find the ***x*-intercepts** of a quadratic function using both **factoring** and **completing the square**.	• Rewrite a function to find and highlight key features. • Factor a quadratic expression to find zeros, extrema and symmetry • Interpret the meaning of zeros, extrema and symmetry within the context of a problem. • Complete the square for a quadratic function to reveal its key features. • Interpret the key features of a quadratic expression in terms of the context it represents. • Use properties of exponents to relate parts of an exponential function to its context (e.g., describe the initial value, growth/decay rate or factor and the growth period). • Identify how key features of an exponential function relate to characteristics in a real-world context. • Classify real-world problems as an exponential growth or decay.

DOK	Blooms
1-2	Understand, Apply and Analyze

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

Grade	CCSS Domain	CCSS Cluster
A2	Interpreting Functions	Analyze functions using different representatio

Cluster Standard: HSF.IF.C.9

Standard	Standards for Mathematical Practice
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*.	• **SMP 5:** Use appropriate tools strategically. • **SMP 7:** Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students should be able to compare two given functions (linear, exponential, quadratic) whether that be as a function or **equation**, in a **table,** in a **graph,** or by **verbal description**. Students should start by knowing the difference between linear, quadratic and exponential functions, and be able to identify them by equation and by graph. Students should be able to compare two functions even when they're both represented differently. To do this successfully, they must be able to **translate** between an equation, a graph, verbal, and a table of values, and understand how certain aspects of one **representation** impact the rest.	• Make comparisons between functions in different forms using their knowledge of key features.
DOK	**Blooms**
1-2	Understand, Apply, Analyze

Common Misconceptions

- Students may have difficulty identifying the key features needed to sketch the graphs or identifying those features algebraically.

- Students may have difficulty with contextualizing and decontextualizing expressions.
- Students will often confuse functions given in a table as a representation of a finite set of numbers rather than a subset of the entire function. They also may have difficulty with the abstractness of determining what is happening with a function over intervals of the domain that they cannot see.
- Students may not distinguish between the different type of logarithms, i.e., natural logs, when using calculator
- Students may struggle with applying translations, stretches, compressions, and reflections to a parent function.

Student Discourse Guide

- Purposeful, rich classroom discourse offers students the opportunity to express their ideas, thi critique the reasoning of others in a variety of ways (writing, drawing, verbal). Purposeful imple classroom discourse allows students to activate funds of knowledge and to refine their mathema understanding. When students have frequent opportunities for discourse they find various path and reveal knowledge or misunderstandings to educators. This also allows educators to access students' culture, lived experiences and evolving math identities.
- Discourse that focuses on tasks that promote reasoning and problem solving is a primary mec developing conceptual understanding and meaningful learning of mathematics (Michaels, O'C Resnick, 2008)

Domain: Interpreting Functions	Strand: Interpret functions that arise in application terms of the context

Suggested Student Discourse Questions

- Can you identify (insert key feature here - increasing / decreasing interval, relative maximum / minimum, zeros, positive / negative intervals, symmetries, etc.) using the table? Can you identify it on the graph?
- Turn and talk to your partner - how is their strategy in finding (insert key feature here - increasing / decreasing interval, relative maximum / minimum values, zeros, positive / negative intervals, intercepts, symmetries, etc.) different from yours? Which strategy is more efficient? In what contexts would your strategy work better? In which contexts would your partner's strategy work better?
- How are graphical, analytical, and tabular representations of this function the same? How do they differ? (guide student thinking towards key features of given functions)
- Which function would be better used to model growth of a tree? Population growth? A football's trajectory across the field? (extension - use regression to model each)

Domain: Interpreting Functions	Strand: Analyze functions using different represent

Suggested Student Discourse Questions

- A sine wave models the height of a rider in a Ferris wheel. What does the amplitude mean in this context? What about midline? Period?
- Can you identify your partner's zeros? End
- Compare graphs polynomial, trigonometric and logarithmic functions - how are the zeros, intercepts, and end behavior similar? How are they different?

behaviors? Intercepts? Asymptotes? How your sketches and your partner's sketches same? How are they different? (Sub functions repeat with cubic / quartic functio sine and cosine functions).	• Would you use a polynomial, trigonometric, or logarithmic function to model the volume of your water bottle? Would that function also be useful to model sound waves? Why or why not?

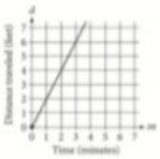
ASSESSMENT GUIDE

- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

Grade	*CCSS Domain*	*CCSS Strand*
A2	Interpreting Functions	Interpret functions that arise in applications in t of the context
	Sample Task #1 (Constructed Response)	

CollegeBoard **Question ID 1474415**

Assessment	Test	Cross-Test and Subscore	Difficulty	Primary Dimension	Secondary Dimension	Tertiary Dimension	Calculator
SAT	Math	Heart of Algebra	Easy	Heart of Algebra	Linear functions	4. Make connections between verbal, tabular, algebraic, and graphical representations of a linear function, by c. determining how a graph is affected by a change to its equation.	No Calculator



The graph above shows the distance traveled d, in feet, by a product on a conveyor belt m minutes after the product is placed on the belt. Which of the following equations correctly relates d and m ?

Question Difficulty: Easy

A. $d = 2m$

B. $d = \frac{1}{2}m$

C. $d = m + 2$

D. $d = 2m + 2$

Choice A is correct. The line passes through the origin. Therefore, this is a relationship of the form $d = km$, where k is a constant representing the slope of the graph. To find the value of k, choose a point (m,d) on the graph of the line other than the origin and substitute the values of m and d into the equation. For example, if the point $(2,4)$ is chosen, then $4 = k(2)$, and $k = 2$. Therefore, the equation of the line is $d = 2m$.

Choice B is incorrect and may result from calculating the slope of the line as the change in time over the change in distance traveled instead of the change in distance traveled over the change in time. Choices C and D are incorrect because each of these equations represents a line with a d-intercept of 2. However, the graph shows a line with a d-intercept of 0.

Grade	*CCSS Domain*	*CCSS Strand*
A2	Interpreting Functions	Analyze functions using different representati

Sample Task #1 (Constructed Response)

Standards Aligned Instructionally Embedded Formative Assessment Resources:

http://tasks.illustrativemathematics.org/content-standards/HSF/IF/C/9/tasks/1279

This type of assessment question requires students to analyze function and a graph and compare the key features in context of a scenario. Students will engage with SMP 7 as they use the structure of both the equation and the graph to answer questions in context.

Additional assessment:
Analyzing Graphs
https://www.map.mathshell.org/lessons.php?unit=9245&collection=8
https://www.map.mathshell.org/lessons.php?unit=9240&collection=8

MLSS AND CLR GUIDE

- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

CCSS Domain	*CCSS Cluster*
Interpreting Functions	Interpret functions that arise in applications in terms of the cont

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on interpreting functions that arise in applications in terms of the context, consider options for learning from your families and communities the cultural and linguistic ways mathematics exists outside of school to create stronger home to school connections for students. For example, families create their own story and make the connection with a table and graph and identify key features. Every family will have a different story.	
Cross-Curricular Connections	In this lesson, students use exponential decay and rational functions to understand why addicted patients seek more and stronger opioids to alleviate their pain. Students discuss the role that various parties played in creating the crisis and ways they can help to solve it. House of Pain: A Lesson by Mathalicious	
Validate/Affirm/Build/Bridge	• *How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?* • *How can you create connections between the cultural and linguistic behaviors of your students' home culture and language, the culture and language of*	• Tasks: The type of mathematical tasks and instruction students receive provides the foundation for students' mathematical learning and their mathematical identity. Tasks and instruction that provide greater access to the mathematics and convey the creativity of mathematics by allowing for multiple solution strategies and development of the standards for mathematical practice leads to more students viewing themselves as capable mathematicians. For example, when interpreting functions that arise in applications in terms of the context the types of mathematical tasks are critical because clearly defined tasks set the routine for interaction and support for students. Interpreting and sketching key characteristics of graphs and tables, students make the connections graphically, verbally, tabularly, and symbolically. Allowing students to explain, think out loud, making conjectures, and communicate with peers to come

	school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?	up with mathematical ideas.

Planning for Multilayered System of Supports

Vertical Alignment

Previous Learning	*Current Learning*	*Future Learning*
• Connect to the work of Algebra 1 within this cluster around linear, quadratic, and exponential. **(HSF.IF.B)**	• Connect to discovering features of families of functions. **(HSF.IF.7)** • Connect to finding key features of the entire family of functions. **(HSF.IF.4)**	• Connect to the work with trigonometric functions. **(HST.TF.B)**

Suggested Instructional Strategies

Pre-Teach

Level of Intensity	*Essential Question*	*Examples*
Targeted	*What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*	Some learners may benefit from targeted pre-teaching that analyzes common misconceptions when interpreting functions because quantities in graphs and tables should be interpreted in context to the problem and domains should be within the context as well.
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	8.F.A.1: This standard provides a foundation for work with interpreting functions that arise in applications in terms of the context because students need to interpret the ordered pairs on the graph for analyzing or making predictions. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.

Universal Support Framework

NEW MEXICO
Public Education Department

New Mexico Instructional S
Algebra 2 Interpreting Functions C

A student should know/understand...	A student should be able to do...	***Potential Scaffolds***
• What the domain of a function represents in terms of the function and what values are appropriate (i.e. discrete v. continuous values and other restrictions based on the type of function and the given context). • In functions there is an underlying structure that determines the transformation of any function, regardless of its type. • How to use trigonometric ratios, reference angles, and symmetry to find patterns on the unit circle. • Inverse trigonometric functions have restricted domains and ranges and are one to one.	• Find and interpret key features of a graph or table of a function, including extreme values, end behavior, and intervals of increase and decrease. • identify and graph parent functions and their transformations (i.e. vertical translation, horizontal translation, vertical stretch/shrink, reflect over x-axis, etc.). • Calculate values of sine, cosine, and tangent for given angles. • Solve trigonometric equations, including those written in quadratic form and equations containing more than one angle.	• Build on students' experience with the following skills: ○ Graphing on the coordinate plane (6.NS.C.8) ○ Building and solving proportional relationships (7.RP.A.2) ○ Recognize and use function notation (HSF.IF.A) ○ Recognizing inverse functions (HSF.BF.B.4) ○ Graphing, solving and modeling quadratic, linear, exponential and absolute value functions (HSF.LE.A, HSF.LE.B) ○ Recognize, build and solve trigonometric ratios (HSG.CRT.C) • Cognitive Strategies ○ Repeatedly model the strategies ○ Monitor the students' use of the strategies ○ Provide feedback to students ○ Teach self-questioning and self-monitoring strategies ○ Introduce multiple means of representation for mathematical ideas • Encourage students to use alternative tools to better access the grade level content. Examples include: ○ Desmos.com ○ Graphing calculator ○ Sketch a graph ○ Create a table of values ○ Algebra tiles ○ Graphic organizers ○ SOH CAH TOA

Re-Teach

Level of Intensity	***Essential Question***	***Examples***
Targeted	What formative assessment data (e.g., tasks, exit tickets,	This standard 8.F.A.1 provides a foundation for work with interpret functions that arise in applications in terms of

	observations) will help identify content needing to be revisited during a unit?	the context because students need to interpret the ordered pairs on the graph for analyzing or making predictions. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.
Intensive	What assessment data will help identify content needing to be revisited for intensive interventions?	For example, some students may benefit from intensive extra time during and after a unit interpreting functions that arise in applications in terms of the context by addressing conceptual understanding because students need to make connections about the numbers they choose for their domain and range in context with the problem. They will need to interpret the characteristics of a graph

Extension	
Essential Question	***Examples***
What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?	Some learners may benefit from an extension such as in-depth, self-directed exploration of self-selected topics when interpreting functions that arise in applications in terms of the context because students can interpret their own graphs and explore how graphs can be integrated according to their interest.

CCSS Domain	*CCSS Cluster*
Interpreting Functions	Analyze functions using different representations

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on analyzing functions using different representations, consider options for learning from your families and communities the cultural and linguistic ways mathematics exists outside of school to create stronger home to school connections for students. For example, use community data and technology to graph, calculate and analyze the regression between the variables. Data and graphs can be used to make comparisons between the communities.	
Cross-Curricular Connections	Many of the Navajo rug designs you will discover by following the project will be good examples of symmetrical balance. Symmetrical balance is a type of visual balance where the overall composition is arranged to look like it is the same on both sides of the center of the design. In other words, it is a design which could be folded in half, and as the design folds, each part of the design would match up with its symmetrical counterpart on the opposite side of the center. The rug design on the right is symmetrical left-to-right. If a line was drawn vertically down the center of the rug, the arrangement of shapes and colors would appear to be exactly the opposite of each other on both sides of that line. Design a Navajo Rug	
Validate/Affirm/Build/Bridge	• *How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?* • *How can you create connections between the cultural and linguistic behaviors of your students' home culture and language, the culture and language of school mathematics to*	• Posing Purposeful Questions: CLRI requires intentional planning around the questions posed in a mathematics classroom. It is critical to consider "who is being positioned as competent, and whose ideas are featured and privileged" within the classroom through both the types of questioning and who is being questioned. Mathematics classrooms traditionally ask short answer questions and reward students that can respond quickly and correctly. When questioning seeks to understand students' thinking by taking their ideas seriously and asking the community to build upon one another's ideas a greater sense of belonging in mathematics is created for students from marginalized cultures and languages. For example, when studying analyzing functions using different representations the pattern of questions within the classroom is critical because asking open ended questions allows the students to think, answer and have a reason for their answer. Ask probing questions that allow students to elaborate

	support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?	and clarify their different graphs and key representations. The explanation of the different family functions from linear to trigonometric functions include all types of learners from the low to the high so everyone feels included.

Planning for Multilayered System of Supports

Vertical Alignment

Previous Learning	*Current Learning*	*Future Learning*
• Connect to the work in Algebra 1 with this cluster which focused on linear, exponential, quadratic, absolute value, step, and piecewise defined by supporting Algebra 2 students to focus on using key features to guide selection of an appropriate type of model function.	• Connect to writing linear, quadratic, and exponential functions to describe relationships between quantities. **(HSA.CED.1-3)** • Connect to analyzing transformations of parent functions for linear, quadratic, and exponential functions. **(HSF.BF.3)**	• Connect to graphing all parent functions by hand and using technology and identifying their key features. **(HSF.IF.7)** • Connect to factoring to complete the square with quadratic functions with complex zeros. **(HSN.CN.7)**

Suggested Instructional Strategies

Pre-Teach

Level of Intensity	*Essential Question*	*Examples*
Targeted	*What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*	Some learners may benefit from targeted pre-teaching that introduces new representations (e.g., number lines) when analyzing functions because connections between the different representations allow students exposure to the family of functions (linear, quadratic, polynomial, etc.)
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	This standard 8.F.A.1 provides a foundation for working with analyzing functions using different representations because ordered pairs have a relationship and the point is represented on the graph contextually. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-

		teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.
Universal Support Framework		
A student should know/understand...	A student should be able to do...	***Potential Scaffolds***

• What the domain of a function represents in terms of the function and what values are appropriate (i.e. discrete v. continuous values and other restrictions based on the type of function and the given context).
• In functions there is an underlying structure that determines the transformation of any function, regardless of its type.
• How to use trigonometric ratios, reference angles, and symmetry to find patterns on the unit circle.
• Inverse trigonometric functions have restricted domains and ranges and are one to one.
	• Find and interpret key features of a graph or table of a function, including extreme values, end behavior, and intervals of increase and decrease.
	• identify and graph parent functions and their transformations (i.e. vertical translation, horizontal translation, vertical stretch/shrink, reflect over x-axis, etc.).
	• Calculate values of sine, cosine, and tangent for given angles.
	• Solve trigonometric equations, including those written in quadratic form and equations containing more than one angle.
		• Build on students' experience with the following skills:
		  ○ Graphing on the coordinate plane (6.NS.C.8)
		  ○ Building and solving proportional relationships (7.RP.A.2)
		  ○ Recognize and use function notation (HSF.IF.A)
		  ○ Recognizing inverse functions (HSF.BF.B.4)
		  ○ Graphing, solving and modeling quadratic, linear, exponential and absolute value functions (HSF.LE.A, HSF.LE.B)
		  ○ Recognize, build and solve trigonometric ratios (HSG.CRT.C)
		• Cognitive Strategies
		  ○ Repeatedly model the strategies
		  ○ Monitor the students' use of the strategies
		  ○ Provide feedback to students
		  ○ Teach self-questioning and self-monitoring strategies
		  ○ Introduce multiple means of representation for mathematical ideas
		• Encourage students to use alternative tools to better access the grade level content. Examples include:
		  ○ Desmos.com
		  ○ Graphing calculator
		  ○ Sketch a graph
		  ○ Create a table of values
		  ○ Algebra tiles
		  ○ Graphic organizers
		  ○ SOH CAH TOA

Re-Teach		
Level of Intensity	***Essential Question***	***Examples***
Targeted	What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisited during a unit?	For example, students may benefit from re-engaging with content during a unit on analyzing functions using different representations by providing specific feedback to students on their work through a short mini lesson because immediate feedback provides support for learning. There are several family functions with different key features and interpretation.
Intensive	What assessment data will help identify content needing to be revisited for intensive interventions?	For example, some students may benefit from intensive extra time during and after a unit on analyzing functions using different representations by offering opportunities to understand and explore different strategies because explaining the context of the problem verbally, graphically and writing, students comprehend the different family functions/equations.

Extension	
Essential Question	***Examples***
What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?	Some learners may benefit from an extension such as in-depth, self-directed exploration of self-selected topics when analyzing functions using different representations because making a real-world connection with a choice to select what the learner is interested in will make a deeper connection to the mathematical concept and skill.