NEW MEXICO
Public Education Department

8.F: FUNCTIONS

Cluster Statement: A: Define, evaluate, and compare functions.

Major Cluster (Students should spend the large majority of their time (65-85%) on the major work of the grade/course. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade).

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
8.F.A.1: Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	SMP 2: Students can reason abstractly and quantitatively by determining if a relationship is a function.	• Know and flexibly use the terms function, input, and output. • Analyze tables and graphs by interpreting their relationships as functions. • Understand that a function is a rule that states each input has exactly one output, not just how to recognize them. • Understand that each function produces a graph. • Formulate and defend opinion on whether a table or graph is a function or not with use of counterexamples.
		Webb's Depth of Knowledge: 1-2
		Bloom's Taxonomy: Understand, Apply
Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
8.F.A.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function	SMP 4: Students can model with mathematics by identifying important quantities such as rate of change and y-intercept in a real-world situation. SMP 5: Students can use tools by utilizing the coordinate plane (graph paper) to graph relationships	• Determine the slope and the y-intercept from an equation, a table, a graph, and a verbal description. • Explain orally and in writing that slope represents rate of change and y-intercept represents initial value or starting value. • Understand how to generate additional ordered pairs for a function. • Compare the properties of a graph, an equation, a table, and verbal descriptions given a real-world linear situation.

<table>
<tr><td>has the greater rate of change</td><td></td><td>Webb's Depth of Knowledge: 1-2

Bloom's Taxonomy:
Analyze, Evaluate</td></tr>
<tr><td>Standard Text
8.F.A.3: Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 (s squared) giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.</td><td>Standard for Mathematical Practices

SMP 1: Students can make sense of problems and persevere in solving them by explaining correspondences between equations, verbal descriptions, tables, and graphs of important features such as rate of change and y-intercepts.

SMP 7: Students can look for and make use of structure by using y = mx + b as the equation for a linear function</td><td>Students who demonstrate understanding can:
• Understand a linear function has a constant rate of change called slope and will produce a line on a graph.
• Understand a nonlinear function does not have a constant rate of change and will not produce a line on a graph.

Webb's Depth of Knowledge: 1-2

Bloom's Taxonomy:
Understand, Apply, Analyze</td></tr>
<tr><td><u>Previous Learning Connections</u>
• In 7th grade, learners analyze proportional relationships and use them to solve real-world and mathematical problems. They solve real-world and mathematical problems using numerical and algebraic expressions and equations These previously learned skills help build connections between expressions and linear equations in Grade 7 to linear relationships of functions in Grade 8.</td><td><u>Current Learning Connections</u>
• This learning connects to the learning that will occur later in 8th grade when students begin analyzing graphs of functional relationship and construct functions to model relationships between two quantities.</td><td><u>Future Learning Connections</u>
• In high school, student make connections to the learning done within this cluster when they interpret functions that arise in application in terms of the context.</td></tr>
<tr><td colspan="3">Clarification Statement:
Students understand that a function is a rule that takes an input and produces only one output; therefore, functions occur when there is exactly one y-value associated with any x-value. Students identify functions from equations, graphs, and tables/ordered pairs and are not expected to use the function notation f(x) at this level. This standard requires students to clarify the definitions of key terms including function, input, output, y-value, and x-value.</td></tr>
</table>

Common Misconceptions

It is vital to ensure students have a common understanding of the vocabulary terms in this unit as common errors are often correlated to the confusion of the terms function, input, output, x-value, and y-value. Students can confuse the relationship between an input and output and the idea that each input only has one output. When making connections to graphs and tables, this same confusion is found when using the terms x-value and y-value. The confusion around the relationship between the input and output is heightened when students realize that more than one input can give the same output.

Multi-Layered System of Supports (MLSS)/Suggested Instructional Strategies

Pre-Teach

Pre-teach (targeted): *What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*

- For example, some learners may benefit from targeted pre-teaching that previews new contexts for tasks within the unit (e.g., cell phone plans) when studying how to define, evaluate and compare functions because this allows the learner to become engaged with the content in real world situations. This helps to build interest as well as expose the learner to new content. Students can also begin to form basic definitions of a function by being exposed to new contexts.

Pre-teach (intensive): *What critical understandings will prepare students to access the mathematics for this cluster?*

- 7.RP.A.2 : This standard provides a foundation for work with how to define, evaluate and compare functions because students must first develop an understanding of proportional relationships and how they correspond among a table, graph and equation. 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.

Core Instruction

Access

Interest: *How will the learning for students provide multiple options for recruiting student interest?*

- For example, learners engaging with define, evaluate, and compare functions benefit when learning experiences include ways to recruit interest such as providing contextualized examples to their lives because in order to promote interest in the content that is being learned, the learner needs to feel that the information is relevant and meaningful. In a task where students may be asked to look at tables to determine if it represents a function, the tables should represent information and relationships that are relevant.

Build

Effort and Persistence: *How will the learning for students provide options for sustaining effort and persistence?*

- For example, learners engaging with define, evaluate, and compare functions benefit when learning experiences attend to students' attention and affect to support sustained effort and concentration such as constructing communities of learners engaged in common interests or activities because engagement with peers can significantly increase sustained effort in learning the content. A task where students must look at tables and determine whether they represent functions might seem

daunting or difficult for some students and therefore students may not want to persist in the task. If learners are interacting with peers in flexible groups where each learner has a role, the content can be engaging and accessible.

Language and Symbols: *How will the learning for students provide alternative representations to ensure accessibility, clarity and comprehensibility for all learners? (e.g., a graph illustrating the relationship between two variables may be informative to one learner and inaccessible or puzzling to another; picture or image may carry very different meanings for learners from differing cultural or familial backgrounds.*

- For example, learners engaging with define, evaluate, and compare functions benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as allowing for flexibility and easy access to multiple representations of notation where appropriate (e.g., formulas, word problems, graphs) because access to information should not be a hindrance to the learning. Displaying the task on an anchor chart and the graphs where students can easily see them will allow better capacity for processing the information and not decoding the prompt, task or symbols.

Expression and Communication: *How will the learning provide multiple modalities for students to easily express knowledge, ideas, and concepts in the learning environment?*

- For example, learners engaging with define, evaluate, and compare functions benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing multiple examples of novel solutions to authentic problems because providing students with multiple opportunities to express their learning will help to develop independence when identifying functions from graphs. Students should be given graphs that represent different situations that students can express their ideas, connections, and thinking about.

Internalize

Self-Regulation: *How will the design of the learning strategically support students to effectively cope and engage with the environment?*

- For example, learners engaging with define, evaluate, and compare functions benefit when learning experiences set personal goals that increase ownership of learning goals and support healthy responses and interactions (e.g., learning from mistakes), such as supporting students with metacognitive approaches to frustration when working on mathematics because learners need to be able to deal with frustration and avoid anxiety when confronting a difficult task. When examining a graph that doesn't make sense to the learner, it would be helpful to offer options for what may be giving the student issues in understanding whether the graph represents a function. If learners feel that we can move past frustration, then they can focus on internalizing the ideas presented in the task.

Re-teach

Re-teach (targeted): *What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisiting during a unit?*

- For example, students may benefit from re-engaging with content during a unit on how to define, evaluate and compare functions by providing specific feedback to students on their work through a short mini-lesson because if a student is struggling with understanding that a function is a rule that assigns exactly one output to one input. These misunderstandings can go back throughout elementary and relate to a

misunderstanding of proportionality. This can be a quick exit ticket of defining a function of a table. Then feedback should be given promptly.

Re-teach (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 how to define, evaluate and compare functions by addressing conceptual understanding because students should be able to apply their understanding of defining, evaluating and comparing functions in different contexts. The teacher should be able to see that the students can define functions based on different representations and contexts.

Extension

What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?

- For example, some learners may benefit from an extension such as in-depth, self-directed exploration of self-selected topics when studying how to define, evaluate and compare functions because students can transfer their understanding into different scenarios where a function is an appropriate representation of the data. The burden of proving that this is a function relationship will depend on their ability to display and make connections between functions and how to evaluate if the example is really a function. Students can connect the verbal rule of the function with a representation in a table, and then a graph and an expression.

Culturally and Linguistically Responsive Instruction:

Validate/Affirm: 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?
Build/Bridge: 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 support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?

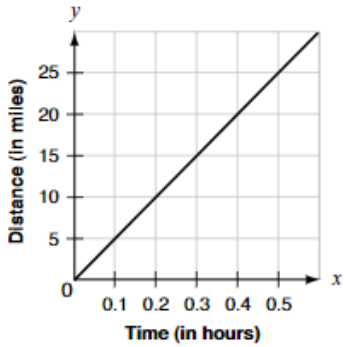
Facilitating Meaningful Mathematical Discourse: Mathematics discourse requires intentional planning to ensure all students feel comfortable to share, consider, build upon and critique the mathematical ideas under consideration. When student ideas serve as the basis for discussion we position them as knowers and doers of mathematics by using equitable talk moves students and attending to the ways students talk about who is and isn't capable of mathematics we can disrupt the negative images and stereotypes around mathematics of marginalized cultures and languages. "A discourse-based mathematics classroom provides stronger access for every student — those who have an immediate answer or approach to share, those who have begun to formulate a mathematical approach to a task but have not fully developed their thoughts, and those who may not have an approach but can provide feedback to others." For example, when studying how to define, evaluate and compare functions facilitating meaningful mathematical discourse is critical because it is important to motivate students to define the meaning of a function as they understand it. Allowing students to communicate their different definitions of a function by analyzing different relationships. In this way students are led to not only share their ideas but also to listen to others in a positive way. Students may be asked or challenged to defend their ideas, and this gives way building discourse as a mathematical community of learners.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: Cognia Formative Item Set for Grade 8 Functions

8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

- Learning Target: I can compare two rates given in a statement and a graph.
- Webb's Depth of Knowledge: 2

A zebra runs at a rate of 40 miles per hour. The graph shows the rate at which a gazelle runs.



What is the difference in their running rates in miles per hour?

- ● 10
- Ⓑ 15
- Ⓒ 40
- Ⓓ 50

Relevance to families and communities:	**Cross-Curricular Connections:**
During a unit focused on how to define, evaluate and compare functions , consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, students may provide ideas for what kids of relationships can be shown using a function. These relationships or situations can be unique to the learner's home culture or surrounding community. This is an opportunity for students to connect real word scenarios to mathematics.	Science: Physical Science constant speed/average speed Social Studies: Geography/History of Travel looking at distance/time Art: Mixing Paint adjusting paint parts to create a certain shade/quantity Gym: Keeping score in a game (For every touchdown, you get x amount of points)