NEW MEXICO
Public Education Department

# 8.F: FUNCTIONS

**Cluster Statement:** B: Use functions to model relationships between quantities.

**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.B.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x, y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.** | SMP 4: Students model with mathematics as they construct functions to model linear relationships.<br><br>SMP 7: Students make use of qualitative features found in verbal descriptions of functions and sketch the functions. | • Write the function for a linear relationship between two quantities.<br>• Identify the rate of change<br>• Identify the slope of the function from two points (x,y), from a graph and a table.<br>• Interpret the rate of change (slope) and initial value of a linear function from a table, graph, equation or verbal description.<br>• Calculate the slope of a line using the rise over run ratio.<br><br>**Webb's Depth of Knowledge:** 1-3<br><br>**Bloom's Taxonomy:**<br>Apply, Analyze |
| **Standard Text** | **Standard for Mathematical Practices** | **Students who demonstrate understanding can:** |
| **8.F.B.5: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.** | SMP 3: Students construct viable arguments and critique the reasoning of others as they describe the relationship between two quantities.<br><br>SMP 4: Students model with mathematics when creating tables or sketching graphs of functional relationships. | • Interpret linear and nonlinear graphs.<br>• Describe the relationships between two quantities (linear, nonlinear, increasing or decreasing).<br>• Sketch graphs of linear and nonlinear functions.<br>• Analyze the sketches of linear and nonlinear functions.<br><br>**Webb's Depth of Knowledge:** 1-3<br><br>**Bloom's Taxonomy:**<br>Analyze, Create |

| Previous Learning Connection | Current Learning Connections | Future Learning Connections |
|---|---|---|
| • In 7th grade, students analyze proportional relationships and use them to solve real-world and mathematical problems. Students solved real-world and mathematical problems using numerical and algebraic expressions and equations. | • In 8th grade, students graph proportional relationships, interpreting the unit rate as the slope of the graph. Students are working to interpret the equation y = mx + b as defining a linear function and understand that a function is a rule that assigns to each input exactly one output. By the end of 8th grade, students will compare properties of two functions each represented in a different way. | • In high school, students begin to apply the concept of a function with use of function notation. Students will interpret functions that arise in application in terms of the context. |

**Clarification Statement:**
Students determine and interpret the rate of change and the initial value to construct a linear model. They use a real-world situation to sketch a graph and use a graph to write a verbal description of a real-world situation.

**Common Misconceptions**
Students may use different scales on the axes and then try to compare rates. Point out that in order to compare the constant rate of change visually, the scales and labels on the axes must be the same. Make sure students identify the correct scales on a graph, not all scales increase by 1 or by the same increment.

**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 use functions to model the relationship between quantities 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 use functions to model the relationship between quantities 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 using functions to model relationships between quantities benefit when learning experiences include ways to recruit interest such as providing contextualized examples to their lives because this will help students to make real world connections to mathematics as well as create a relevant goal. For example, learners can be given the task of completing a home experiment where they measure

heart rate in beats per minute as the function of a rate and graphed. They will measure heart rate with and without jumping jacks. This experiment can be conducted at home with family and then shared with their peers.

Build

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

- For example, learners engaging with using functions to model relationships between quantities benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as providing feedback that emphasizes effort, improvement, and achieving a standard rather than on relative performance because this will help the learner confront any feeling of discouragement in their work of using functions to model relationships. The feedback given may be about how to construct a more precise graph, or how to determine if their relationship is a function. it must be positive and focused on the learners' process of working through the task and putting effort rather than the outcome produced.

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 using functions to model relationships between quantities 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 the more exposure to symbols and ideas that learners have will help them comprehend and decode effectively. This can be anchor charts with tasks, graph and function tables displayed. This can be student group work and tasks taken home and displayed on chart paper.

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 <using functions to model relationships between quantities benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing differentiated feedback (e.g., feedback that is accessible because it can be customized to individual learners) because when students receive feedback not only from teachers but also from peers they can internalize that feedback and improve on their methods for using functions to model relationships. From a student perspective, receiving feedback can be a constructive experience in determining if functions are being displayed and used properly.

**Internalize**

Comprehension: *How will the learning for students' support transforming accessible information into usable knowledge, knowledge that is accessible for future learning and decision-making?*

- For example, learners engaging with using functions to model relationships between quantities benefit when learning experiences attend to students by intentionally building connections to prior understandings and experiences; relating important information to the learning goals; providing a process for meaning making of new learning; and, applying learning to new contexts such as providing explicit, supported opportunities to generalize learning to new situations (e.g., different types of problems that can be solved with linear equations)because this helps the learner transfer their

learning to new and relevant contexts. For example, students can be asked to think of their relationships or situations that can be represented as a function and modeled. This gives the learner the opportunity to make connections between the mathematics and the real world they live in.

**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 use functions to model the relationship between quantities by critiquing student approaches/solutions to make connections through a short mini-lesson because students may display small misunderstandings that could hinder their comprehension. Graphs are everywhere in the study of functions, but it is important to distinguish a function from its graph. For example, a linear function does not have a slope, but the graph of a non-vertical line has a slope.

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 use functions to model the relationship between quantities by addressing conceptual understanding because students use functions to model relationships between quantities, which makes this cluster one that has a primary focus on application problems. This builds on previous work with algebraic patterns, input/output rules, and ratios and proportional relationships for which students should be able to apply to real world situations. ...

**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 open-ended tasks linking multiple disciplines when studying use functions to model the relationship between quantities because this leaves opportunity for class discussion that offers students to verbally show their thinking. Students can create an extension activity that can be used with peers that examine connections between (x,y) values and interpret them from a table or graph.

**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?

Eliciting and Using Evidence of Student Thinking: Eliciting and using student thinking can promote a classroom culture in which mistakes or errors are viewed as opportunities for learning. When student thinking is at the center of classroom activity, "it is more likely that students who have felt evaluated or judged in their past mathematical experiences will make meaningful contributions to the classroom over time." For example, when studying using functions to model relationships between quantities eliciting and using student thinking is critical because this contributes to the classroom culture of all learners being mathematicians. Allowing students to express ideas as an opportunity to share thinking in different representations such as drawings, graphs, and verbal descriptions fosters

confidence in the conclusions they have made. Students who work together and share ideas in cooperative groups benefit from comparing their models of functions and those relationships.

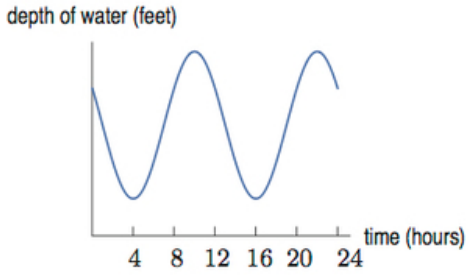
**Standards Aligned Instructionally Embedded Formative Assessment Resources:**
*Source:* http://tasks.illustrativemathematics.org/content-standards/8/F/B/5/tasks/628

8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

- Learning target: I can interpret the graph of a function.
- Webb's Depth of Knowledge: 3
- This is a simple task about interpreting the graph of a function in terms of the relationship between quantities that it represents.

## Task

The figure below gives the depth of the water at Montauk Point, New York, for a day in November.




a. How many high tides took place on this day?

b. How many low tides took place on this day?

c. How much time elapsed in between high tides?

| **Relevance to families and communities:** | **Cross-Curricular Connections:** |
|---|---|
| During a unit focused on using functions to model relationships between quantities, 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 can complete an experiment at home with family members where they are measuring heart rate as a function, with and without jumping jacks. Students can display their findings about the increase in beats per minute as a | Science: Students could examine scientific data and predict the effect of a change in one variable on another |

| | |
|---|---|
| function on a graph. These findings can then be brought and shared in the classroom environment. | |