NEW MEXICO
Public Education Department

HS: FUNCTIONS- BUILDING FUNCTIONS

Cluster Statement: A: Build a function that models a relationship between two quantities.

Widely Applicable as Prerequisite for a Range of College Majors, Postsecondary Programs and Careers

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
HSF.BF.A.1: Write a function that describes a relationship between two quantities.* • HSF.BF.A.1.B 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.* *Note: Algebra 1 focuses on linear, exponential, and quadratic. Algebra 2 includes all types of functions studied.*	SMP 2: Students can reason abstractly and quantitatively to make sense of quantities and their relationships in problem situations. SMP 4: Students can model with mathematics by discovering patterns in each contextual problem and creating verbal, symbolic or explicit symbolic rules to describe them. SMP 7: Students can look for and make use of structure by using the operations of math to combine functions.	• Build a function using different functions and arithmetic operations in context. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply, Analyze

Previous Learning Connections	**Current Learning Connections**	**Future Learning Connections**
• Connect to Algebra 1 work focusing on linear, exponential, and quadratic within this cluster. • Connect to recognizing situations that grow by a constant rate or percent. **(HSF.LE.1)**	• Connect to identifying patterns in the function's rate of change, specifying intervals of increase and decrease, and graphing to model functions. **(HSF.IF.4,6)** • Connect to discussing the relative strength sand weaknesses of each representation and which are most efficient to be able to assist them in making symbolic functions. **(HSF.IF.9)**	• Connect to arithmetic and geometric sequences and using them to model situations. **(HSF.BF.A.2)**

Clarification Statement
HSF.BF.A.1: Students should write **functions** for given **relationships** between **quantities**. Students can use functions to **model real-life situations** and make **predictions**. Students should be able to use functions describe relationships between two quantities, usually x and f(x), where f(x) is some **output** value that depends on the **input** value x. Within a context, students should be able to express a given relationship as a function.

Common Misconceptions

- Students may want to try to use a linear function, specifically the slope-intercept form for every situation.
- Students may tend to focus on the symbolic form of a function and may need additional support in working with other forms.

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 building a function that models a relationship between two quantities because the new contexts will show an alignment to new material that will be covered.

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

- 8.F.B.4: This standard provides a foundation for work with building a function that makes a relationship between two quantities because prior learning on constructing a function modeling a linear relationship between two quantities is learned and will be expanded on in the current unit. 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 building a function that models a relationship between two quantities benefit when learning experiences include ways to recruit interest such as providing novel and relevant problems to make sense of complex ideas in creative ways because <building functions will provide practice for student and keep them engaged in the actual solving and working with the function.

Build

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

- For example, learners engaging with building a function that models a relationship between two quantities benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as prompting or requiring learners to explicitly formulate or restate learning goals because students can continue working towards goals when they are prompted to formulate and restate learning goals which keeps them focused.

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 building a function that models a relationship between two quantities benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as pre-teaching vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge because students understanding the vocabulary and symbols before the instruction allows for them to connect with the content when it is being explained and they will have a better understanding of what the content is explaining as it is being taught.

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 building a function that models a relationship between two quantities benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as using physical manipulatives (e.g., blocks, 3D models, base-ten blocks) because students can make a visual connection to the material being learned. With multiple types of learners, visuals provide a different perspective of the content and can aid in building the functions.

Internalize

Executive Functions: *How will the learning for students support the development of executive functions to allow them to take advantage of their environment?*

- For example, learners engaging with <insert the mathematics examined in the cluster> benefit when learning experiences provide opportunities for students to set goals; formulate plans; use tool and processes to support organization and memory; and analyze their growth in learning and how to build from it such as posting goals, objectives, and schedules in an obvious place because students will be able to quickly refer to the posted goals and objectives for the lesson. Posting these into an obvious place allows for less time with students not on task and allows for them to remain focused on the outcomes for the lesson and reflecting on building functions.

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 building a function that models a relationship between two quantities by revisiting student thinking through a short mini-lesson because students should be able to recall prior knowledge in the content previously learned and can use that prior knowledge to build on current content.

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 building a function that models a relationship between two quantities by helping students move from specific answers to generalizations for certain types of problems because recalling prior knowledge will aid the student with current understanding and show the alignment to prior knowledge and will engage the student in the current content.

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 the opportunity to understand concepts more quickly and explore them in greater depth than other students when studying building a function that models a relationship between two quantities because activating prior knowledge will allow for students to take the understanding of the current content to a greater level and will allow for better understanding of the content.

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?

Task: When planning with your HQIM consider how to modify tasks to represent the prior experiences, culture, language and interests of your students to "portray mathematics as useful and important in students' lives and promote students' lived experiences as important in mathematics class." Tasks can also be designed to "promote social justice [to] engage students in using mathematics to understand and eradicate social inequities (Gutstein 2006)." For example, when studying building a function that models a relationship between two quantities the types of mathematical tasks are critical because when students are able to make connections, it is easier for them to learn and store information, like making a connection to background knowledge or prior learning to create an optimal environment for learning, as they bring this knowledge with them to class each day.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: http://tasks.illustrativemathematics.org/content-standards/HSF/BF/A/2/tasks/1695
This type of assessment question requires students to analyze a number pattern described in context and fit both a recursive function to the pattern and use it to answer questions. Students will engage with SMP 1 and SMP 4 as they persevere to express the pattern mathematically and model the scenario with an equation.

Relevance to families and communities:

During a unit focused on building a function that models a relationship between two 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, learning about the various ways that functions relate to quantities can be a great way to connect school and home with making references to those quantities that can be encountered at home and how they relate to the tasks being created in the classroom. Making that connection allows for students to become more comfortable with learning the content and provides evidence of prior knowledge that the student can bring into the lessons.

Cross-Curricular Connections:

Science: In high school the NGSS students should apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. Consider providing a connection for students to examine scientific data and predict the effect of a change in one variable on another.

https://www.nextgenscience.org/topic-arrangement/hsinheritance-and-variation-traits