NEW MEXICO
Public Education Department

6.G: GEOMETRY

Cluster Statement: A: Solve real-world and mathematical problems involving area, surface area, and volume.

Supporting 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:** • Find the area of triangles and special quadrilaterals. • Decompose and compose shapes into right triangles, triangles and quadrilaterals. • Apply understanding of finding area of triangles and quadrilaterals to finding area of irregular shapes that are made up of these shapes. • Solve real world and mathematical problems by applying these techniques. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply
6.G.A.1: Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.	SMP 2: Students reason abstractly and quantitatively to explain why it is useful to compose and decompose shapes in finding the area of polygons with irregular shapes.	
Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:** • Find volume of a rectangular prism using formula (V=lwh and V=bh) and explain how this is the same as packing with unit cubes to find volume. • Apply this to using lengths that are fractional. • Solve real-world problems for volume involving fractional lengths of rectangular prisms. **Webb's Depth of Knowledge:** 1-2
6.G.A.2: Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l\ w\ h$ and $V = b\ h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	SMP 2: Students reason abstractly and quantitatively by making sense of quantities and their relationships in the problem situation. Students solve for volume of a rectangular prism by finding the number of cubes that fit into the figure. SMP 3: Students construct viable arguments and critique the reasoning of others by making conjectures about the form and meaning of the solution attempt. SMP 6: Students attend to precision when specifying units of measure to clarify the correspondence with	

	quantities in the context of the problem.	**Bloom's Taxonomy:** Apply
Standard Text 6.G.A.3: Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.	**Standard for Mathematical Practices** SMP 1: Students make sense of problems and persevere in solving them by accessing their relevant knowledge and experiences and make appropriate use of them in working through the task. Teachers may ask "How might you use your previous knowledge to help you begin?" or "What do you notice about the shape compared to the coordinate points?".[1] SMP 6: Students attend to precision when specifying units of measure to clarify the correspondence with quantities in the context of the problem.	**Students who demonstrate understanding can:** • Draw polygons on the coordinate plane when given coordinates for vertices. • Find the side lengths of the polygons using coordinates. • Solve real-world problems by applying the use of drawing coordinates.
		Webb's Depth of Knowledge: 1-2
		Bloom's Taxonomy: Apply
Standard Text 6.G.A.4: Represent three-dimensional figures using nets made up of rectangles and triangles and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.	**Standard for Mathematical Practices** SMP 3: Students construct viable arguments and critique the reasoning of other by making Mathematically proficient conjectures about the form and meaning of their representations. SMP 4: Students model with mathematics by creating three-dimensional figures using nets made up of rectangles and triangles. Students then analyze their models to draw conclusions and solve real-world problems.	**Students who demonstrate understanding can:** • Create a net (using triangles and rectangles) to represent three-dimensional figures. • Use nets to find surface area of three-dimensional figures. • Solve real-world problems by applying the use of nets of three-dimensional figures to find surface area.
		Webb's Depth of Knowledge: 1-2
		Bloom's Taxonomy: Apply

[1] http://mathpractices.edc.org/pdf/Finding_Parallelogram_Vertices.pdf

Previous Learning Connections	**Current Learning Connections**	**Future Learning Connections**
• Learners build on their knowledge of area from Grade 3 where they count the area of a rectangle and connect it to their understanding of multiplication in Grade 4. Learners understand how to find the volume of right rectangular prisms with whole numbers in Grade 5. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. (4.MD.3)	• Learners are flexible using the terms base and length when solving for the area of a two or three-dimensional shape. Develop the concept of surface area. Learners understand how to find the volume of right rectangular prisms using fractions in the length of the edges. Connects to lessons on negative integers (6.NS.8) and graphing points in all quadrants. (6.RP.3.a) Find distance on coordinate plane by counting the units on the coordinate plane (no formula). Create polygons in quadrants I, II, III, and IV so learners can apply their knowledge of absolute value. (6.NS.7)	• In Grade 7, learners will continue to draw, construct, and describe geometrical figures and discover relationships between them (without nets). Calculate and compare the volume of cones, cylinders, and spheres. (8.G.C.9) Prepare for grade 8 work with transformations by working with polygons in coordinate plane. Learners will further their knowledge on distance in 8th grade when they start to find the lengths of diagonal lines. Learners will use their knowledge of the Pythagorean Theorem to find distance on the coordinate plane and later use the distance formula. In high school, learners will apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). In high school, learners will give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. In high school, students will use the idea of nets to identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Clarification Statement:

This cluster builds on previous understanding of area and volume to deepen the understanding of volume and develop the concept of surface area. Students use knowledge and skills to solve real-world and mathematical problems and apply the concepts by manipulating nets, cubes, and other real-world materials.

Common Misconceptions

- To find the area of shapes, students may believe that every shape has a unique formula when in reality area can always be found by decomposing the shape into non-overlapping areas.
- Students may also believe that two triangles with the same area may look exactly alike, when it is possible to have two triangles with the same area that are not congruent triangles.
- The vocabulary term "unit cube" may be difficult for students to understand as the unit cube is 1 unit. The focus with the unit cube should be on developing students understanding that each smaller cube represents a

fraction of the unit cube. In addition, once this understanding is developed, students can use these smaller parts and apply them to rectangular prisms. This application may provide difficult if students are unsure about multiplying fractions.

- Students may confuse the slant height and not recognize it for the height of the triangles in the net. Being that these are nets, students may only find one area and not the area of each individual part of the net and add them together. The concept of nets may be difficult for students to understand, specifically the translation from the 3-D figure to the net and how they coincide. This may need to be reinforced as to how a pyramid and a rectangular prism coincide to their nets.

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 rehearses prior learning when studying 6.G.A because the 6th grade standard builds upon 5.MD.C.3 & 5.MD.C.5 where they went from building arrays to using arrays to find area and volume. 6.G.A utilizes their previous understanding on shape composition and decomposition to understand and develop the formulas necessary for area, surface area and volume.

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

- 5.MD.C.3, 5.MD.C.5 This standard provides a foundation for work with 6.G.A because they move from building to applying the concept of which the 6th grade standard then extends. 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

Physical Action: *How will the learning for students provide a variety of methods for navigation to support access?*

- For example, learners engaging with solving real-world and mathematical problems involving area, surface area and volume benefit when learning experiences ensure information is accessible to learners through a variety of methods for navigation. Such as varying methods for response and navigation by providing alternatives to requirements for rate, timing, speed, and range of motor action with instructional materials, physical manipulatives, and technologies; physically responding or indicating selections; physically interacting with materials by hand, voice, single switch, joystick, keyboard, or adapted keyboard. A hands-on approach using physical manipulatives such as pouring water to find volume, or the actual wrapping of a box in paper to find surface area are examples. Using technology to add marbles to water also helps to solidify the concept for students.

Build

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

- For example, learners engaging with solving real-world and mathematical problems involving area, surface area and volume benefit when learning experiences attend to students' attention and affect to support sustained effort and concentration such as creating cooperative learning groups with clear goals, roles, and responsibilities

because they learn from each other. For example, if using a box to find an area, the group has a physical box that they need to measure and calculate the area. To have equal access to learning the information, students who have clear goals, and specific roles and responsibilities give equal access to all students to learn.

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 solving real-world and mathematical problems involving area, surface area and volume benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity and comprehensibility for all learners such as presenting key concepts in one form of symbolic representation (e.g., math equation) with an alternative form (e.g., an illustration, diagram, table, photograph, animation, physical or virtual manipulative) because distinguishing between area, surface area and volume using different forms will give equal access to all students to learn the key vocabulary concepts needed to be successful. For example, just word definitions of area and volume will not hold as much meaning to students and using illustrations, animation and physical objects to demonstrate area(2d), surface area(to cover outside of object) and volume(3d) in understanding the differences. This will help students remember which they need to use when given problems or tasks.

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 solving real-world and mathematical problems involving area, surface area and volume benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as using providing sentence starters or sentence strips because it allows students to demonstrate their understanding in several ways such as their native language, thought pictures, through verbal explanations etc.

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 solving real-world and mathematical problems involving area, surface area and volume 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 embedding prompts to "show and explain your work" (e.g., portfolio review, art critiques) because students who can explain their work will be able to apply their knowledge in different concepts. This will help students to not just give a single number answer but to express their thought process. This can also clear up misconceptions that a student might have.

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 6.G.A by providing specific feedback to students on their work through a short mini

lesson because this can clear any misconceptions of incorrect formula usage and concept misunderstandings.

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 6.G.A by confronting student misconceptions because students need to understand which formula is used during which time and that area is 2D volume is 3D. Therefore, it is important to make sure students have a solid foundational understanding of the vocabulary, formulas and concepts associated with this standard.

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 application of and development of abstract thinking skills when studying to solve real-world and mathematical problems involving area, surface area, and volume because it is a skill that students need to improve upon. Making connections and generalizations between the area, surface area and volume of an object can help them deepen their understanding of the measurements and the formulas.

Culturally and Linguistically Responsive Instruction:

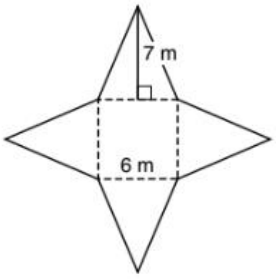
Validate/Affirm: How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?
Build/Bridge: How can you 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 6th grade geometry of solving real-world and mathematical problems involving area, surface area, and volume eliciting and using student thinking is critical because student thinking supports peer learning from different views and validating student thinking creates culture for students who contribute.

Standards Aligned Instructionally Embedded Formative Assessment Resources:

Source: Cognia Testlet for Grade 6 Geometry

1. A net of a solid figure is shown.



a. What solid figure is represented by the net?

b. What is the area, in square meters, of each triangle in the net? Show your work or explain how you know.

c. What is the surface area, in square meters, of the solid figure? Show your work or explain how you know.

6.G.01.04: Represent three-dimensional figures using nets made up of rectangles and triangles and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

- Learning Target: I can use a net to name a figure and find the surface area of that solid figure.
- Webb's Depth of Knowledge: 2
- This type of assessment question requires students to calculate the area and surface area of a figure represented by a net. This task will allow a teacher to determine multiple levels of a student's understanding. First if they can identify a figure based on a net. Second, can they determine the are of the square. This requires a student to recall attributes of a square since only one dimension is shown. Last the student will need to calculate the surface area of the figure which requires a student to also know the area formula for a triangle and how to determine the base using the missing dimension from part B. In each part a student is expected to explain their answer which allows a teacher to assess their understanding at a deeper level.

Relevance to families and communities:

During a unit focused on solving real-world and mathematical problems involving area, surface area, and volume , 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 mathematics used within the different careers of your family and community can provide a strong connections between school and careers. For example, how geometry of area, surface area and volume is used in one of New Mexico's economy in the oil field.

Cross-Curricular Connections:

Science & English:

- RST.6.8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
  RST.6.8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.
- RST.6.8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.