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New Mexico Instructional Scope

8th Grade Geometry Guide

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

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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

- Understand congruence and similarity using physical models, transparencies, or geometry software.
  - 8.G.A.1
  - 8.G.A.2
  - 8.G.A.3
  - 8.G.A.4
  - 8.G.A.5
- Understand and apply the Pythagorean Theorem.
  - 8.G.B.6
  - 8.G.B.7
  - 8.G.B.8
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres
  - 8.G.C.9

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand congruence and similarity using physical models, transparencies, or geometry software.**

Cluster Standard: 8.G.A.1

Standard	**Standards for Mathematical Practice**
Verify experimentally the properties of rotations, reflections, and translations: • **A:** Lines are taken to lines, and line segments to line segments of the same length. • **B:** Angles are taken to angles of the same measure. • **C:** Parallel lines are taken to parallel lines.	• **SMP 4:** Model with mathematics. • **SMP 5**: Use appropriate tools strategically. • **SMP 6:** Attend to precision. • **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students describe and apply translations, rotations, reflections, and dilations to understand congruent and similar figures. Students explain and understand angle relationships.	• Construct transformations by using models, transparencies or geometry software, and develop an understanding of the relationship of the original to its image. • Analyze the relationships between corresponding sides and corresponding angles of the original figure to its image. • Translate figures, given a set of rules, on the coordinate plane. • Evaluate and describe transformations. • Accurately transform figures on the coordinate plane using rotations, translations, reflections, and the correct notation. • Identify transformations performed to transform an image to the original.
DOK	**Blooms**
3-4	Analyze, Evaluate, Create

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand congruence and similarity using physical models, transparencies, or geometry software.**

Cluster Standard: 8.G.A.2

Standard	**Standards for Mathematical Practice**
Understand that a two dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them	• **SMP 4:** Model with mathematics. • **SMP 5**: Use appropriate tools strategically. • **SMP 6:** Attend to precision. • **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students describe and apply translations, rotations, reflections, and dilations to understand congruent and similar figures. Students explain and understand angle relationships.	• Identify congruent figures by describing a sequence of rotations, translations or reflections that map one figure onto another. • Effectively describe the series of transformations verbally or in writing. • Create congruent figures by applying a series of transformations (use correct notation).Understand that a series of rotations, translations or reflections preserves the size and shape of the figure (congruence).
DOK	**Blooms**
1-2	Understand, Apply, Create

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand congruence and similarity using physical models, transparencies, or geometry software.**

Cluster Standard: 8.G.A.3

Standard	**Standards for Mathematical Practice**
Describe the effect of dilations, translations, rotations, and reflections on two dimensional figures using coordinates.	• **SMP 4:** Model with mathematics. • **SMP 5**: Use appropriate tools strategically. • **SMP 6:** Attend to precision. • **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students describe and apply translations, rotations, reflections, and dilations to understand congruent and similar figures. Students explain and understand angle relationships.	• Identify the image of a figure on a coordinate grid given a scale factor and center of dilation. • Create a dilation of a polygon on a square grid given a scale factor and center of dilation. • Describe (orally) a figure on a coordinate grid and its image under a dilation, using coordinates to refer to points. • Draw and label a diagram of a line segment rotated 90 degrees clockwise or counterclockwise about a given center. • Generalize (orally and in writing) the process to reflect any point in the coordinate plane. • Identify (orally and in writing) coordinates that represent a transformation of one figure to another. • Determine and describe a series of transformations from a preimage to an image. • Recognize the relationship between the original coordinates and the coordinates of the image and understand that rotations, reflections and translations follow a specific pattern on the coordinate plane. • Recognize that you can use coordinates to find the scale factor of a dilation.
DOK	**Blooms**

1-2	Understand

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand congruence and similarity using physical models, transparencies, or geometry software.**

Cluster Standard: 8.G.A.4

Standard	**Standards for Mathematical Practice**
Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.	• **SMP 4:** Model with mathematics. • **SMP 5**: Use appropriate tools strategically. • **SMP 6:** Attend to precision. • **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students describe and apply translations, rotations, reflections, and dilations to understand congruent and similar figures. Students explain and understand angle relationships.	• Understand the concept of similar figures. • Conclude that a two-dimensional figure is similar to another by describing a sequence of translations, rotations, reflections and dilations that will map the original figure onto the image (vice-versa). • Express their understanding verbally and in written form. • Create similar figures given a sequence of transformations.
DOK	**Blooms**
1-4	understand, apply, create

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand congruence and similarity using physical models, transparencies, or geometry software.**

Cluster Standard: 8.G.A.5

Standard	**Standards for Mathematical Practice**
Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.	• **SMP 3:** Construct viable arguments and critique the reasoning of others. • **SMP 4**: Model with mathematics.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students describe and apply translations, rotations, reflections, and dilations to understand congruent and similar figures. Students explain and understand angle relationships.	• Use informal arguments to establish facts about the angles created when parallel lines are cut by a transversal. • Apply their knowledge of angle relationships to reason about parallel lines. • Identify exterior and interior angles of triangles. • Apply their knowledge to determine if two triangles are similar. • Use the angle-angle criterion for similarity of triangles. • Determine if two triangles are similar or not and explain how they know.
DOK	**Blooms**
2	Apply

Common Misconceptions

- Students may see a reflection as a translation
- Students may think rotation, reflection, or translations change the size or shape of a figure.
- Students may forget that dilations with a scale factor between 0 and 1 result in a smaller image. Students may forget to change signs in coordinates when reflecting over an axis.
- Students will make errors if he/she looks at the wrong transversal. Students may confuse congruent and supplementary angles and apply rules to lines that are not parallel.

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand and apply the Pythagorean Theorem.**

Cluster Standard: 8.G.B.6

Standard	**Standards for Mathematical Practice**
Explain a proof of the Pythagorean Theorem and its converse.	• **SMP 3:** Construct viable arguments and critique the reasoning of others. • **SMP 4**: Model with mathematics.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students explore the relationships between sides of a right triangle to understand the formula $\mathbf{a^2 + b^2 = c^2}$ **.** They solve problems applying the Pythagorean Theorem.	• Model a proof of the Pythagorean Theorem and verbally or in written form explain the proof. • Understand the converse of the Pythagorean Theorem and be able to apply it to any triangle to prove it is or is not a right triangle.
DOK	**Blooms**
2-4	Apply, Evaluate

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand and apply the Pythagorean Theorem.**

Cluster Standard: 8.G.B.7

Standard	**Standards for Mathematical Practice**
Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	• **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students explore the relationships between sides of a right triangle to understand the formula $\mathbf{a^2 + b^2 = c^2}$ **.** They solve problems applying the Pythagorean Theorem.	• Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. • Solve problems where they must apply the Pythagorean Theorem.
DOK	**Blooms**
1-2	Understand, Apply

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Understand and apply the Pythagorean Theorem.**

Cluster Standard: 8.G.B.8

Standard	**Standards for Mathematical Practice**
Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	• **SMP 7**: Look for and make use of structure. • **SMP 6**: Attend to precision.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students explore the relationships between sides of a right triangle to understand the formula $a^2 + b^2 = c^2$. They solve problems applying the Pythagorean Theorem.	• Apply the Pythagorean Theorem to find the distance between two points on a coordinate system. • Recognize the diagonal line is the hypotenuse and the vertical and horizontal legs that connect are the legs. • Solve real-world problems using the Theorem as a strategy. • Explain solution strategies using correct mathematical vocabulary.
DOK	**Blooms**
1-2	Understand, Apply

Common Misconceptions

- Some students might calculate the length of the triangle leg instead of the hypotenuse. Confuse the leg for the hypotenuse.
- Students may forget to find the square root.
- Students try to find missing side lengths for triangles that are not right triangles and need experiences reconstructing the proof by drawing squares on the sides of the triangle to see that the areas do not add up

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**GEOMETRY**	**Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.**

Cluster Standard: 8.G.C.9

Standard	**Standards for Mathematical Practice**
Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	• **SMP 1:** Make sense of problems and persevere in solving them. • **SMP 3**: Construct viable arguments and critique the reasoning of others. • **SMP 6:** Attend to precision.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students know and apply the volume formulas of a cylinder, cone, and a sphere.	• Write formulas from memory for finding the volume of cones, spheres, and cylinders. are special equations that are specific in use. • Make connections between the 3- D figures and their formulas. • Use formulas to calculate volumes of cones, cylinders and spheres. • Explain the relationship in their volumes. • Apply the formulas to solve real world application problems related to volume.
DOK	**Blooms**
1-3	Understand, Apply, Evaluate

Common Misconceptions

- Errors may occur if students do not substitute lengths correctly. Students may confuse the volume solids for different solids. They may forget how height, radius, and diameter relate to volume, confuse diameter and radius, forget the approximate value of pi.

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Student Discourse Guide

- **Purposeful, rich classroom discourse offers students the opportunity to express their ideas, thinking, and to critique the reasoning of others in a variety of ways (writing, drawing, verbal). Purposeful implementation of classroom discourse allows students to activate funds of knowledge and to refine their mathematical understanding. When students have frequent opportunities for discourse, they find various paths to solutions and reveal knowledge or misunderstandings to educators. The process also allows educators to honor students' culture, lived experiences and evolving math identities.**
- **Discourse that focuses on tasks that promote reasoning and problem solving is a primary mechanism for developing conceptual understanding and meaningful learning of mathematics (Michaels, O'Connor, and Resnick, 2008)**

Domain: **Geometry**	Strand: **Understand congruence and similarity using physical models, transparencies, or geometry software**.

Suggested Student Discourse Questions

- How could you use (a student's name) strategy to check to make sure your solution is reasonable?
- How is your strategy different from (student's name)?
- What feedback could you give to your fellow students?
- What video games do you play that use transformation?
- How is dilation of a figure different from translation, reflection or rotation of a figure?

Domain: **Geometry**	Strand: **Understand and apply the Pythagorean Theorem**

Suggested Student Discourse Questions

- Is the Pythagorean theorem the only strategy we can use to solve triangle problems?
- What ways can we check if our answer is correct or reasonable?
- Where can we see the use of triangles in the real world such as bridges, home building etc.
- What is the Pythagorean theorem and What is it used to find?

Domain: **Geometry**	Strand: **Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres**
Suggested Student Discourse Questions	
• How could you use estimation to check to make sure your solution is reasonable? • Why is it important to know the volume or surface area of items?	• What real life items are shaped like a cylinder? A cone? A sphere? • What is the relationship between area and volume?

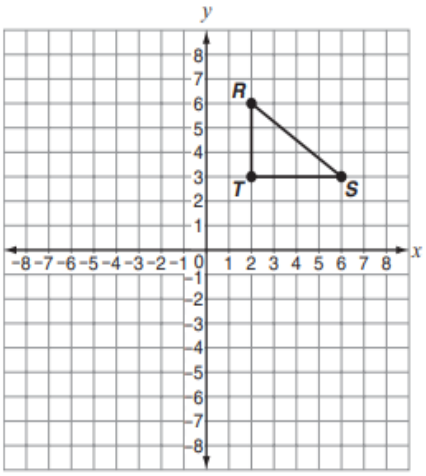
ASSESSMENT GUIDE

- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

Grade	*CCSS Domain*	*CCSS Strand*
8	**GEOMETRY**	**Understand congruence and similarity using physical models, transparencies, or geometry software.**

Sample Task #1 (Constructed Response)

Triangle *RST* is graphed on this coordinate plane.



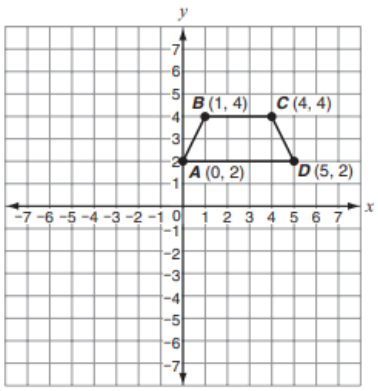
Triangle *RST* is translated to the left 4 units and then that image is rotated 90 degrees clockwise about the origin to form triangle $R'S'T'$.

What is the length, in units, of segment $R'T'$?

Enter your answer in the box. Be sure to enter your answer as a number.

	Sample Task #2 (Multiple Choice)

3. Trapezoid *ABCD* is shown on a coordinate plane.



A student will rotate trapezoid *ABCD* 90 degrees clockwise about the origin to form its image, trapezoid $A'B'C'D'$.

Which statement will be true about line segments $A'D'$ and $B'C'$?

Ⓐ The line segments will be parallel.

Ⓑ The line segments will be perpendicular.

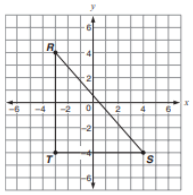
Ⓒ The line segments will be parallel to line segments *AD* and *BC*.

Ⓓ The line segment $B'C'$ will be twice the length of line segment $A'D'$.

Grade	*CCSS Domain*	*CCSS Strand*
8	**GEOMETRY**	**Understand and apply the Pythagorean Theorem.**

Sample Task #1 (Constructed Response)

This coordinate plane shows a map with the locations of the houses of three friends, Randy (*R*), Tomas (*T*), and Sondre (*S*). Each unit on the map is one block.

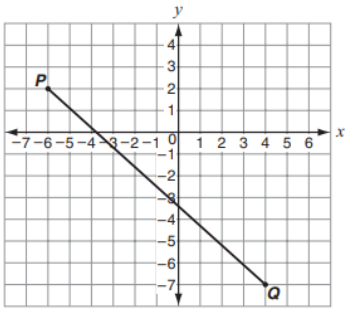


Randy is walking from his house to Sondre's house.

How many blocks farther will Randy travel if he walks to Tomas's house on the way to Sondre's house rather than walking directly to Sondre's house? Round your answer to the nearest whole block. Enter your answer in the box. Be sure to enter your answer as a number.

Sample Task #2 (Multiple Choice)

A line segment is graphed on a coordinate plane.



What is the length of $\overline{PQ}$, rounded to the nearest tenth?

Ⓐ 5.4
Ⓑ 11.2
Ⓒ 13.5
Ⓓ 19.0

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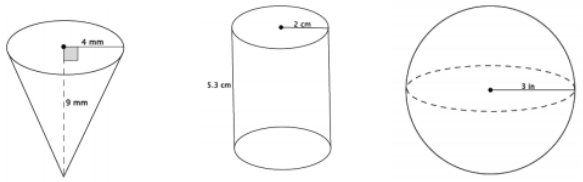
Grade	*CCSS Domain*	*CCSS Strand*
8	**GEOMETRY**	**Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.**

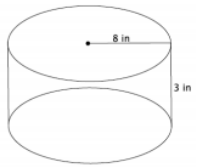
Sample Task #1 (Constructed Response)

For each part below, leave your answers in terms of π.

a. Determine the volume for each three-dimensional figure shown below.

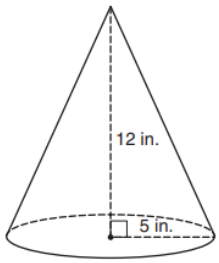


b. You want to fill the cylinder shown below with water. All you have is a container shaped like a cone with a radius of 3 inches and a height of 5 inches; you can use this cone-shaped container to take water from a faucet and fill the cylinder. How many cones will it take to fill the cylinder?



Sample Task #2 (Multiple Choice)

Here is a cone with a radius of 5 inches and a height of 12 inches.



What is the volume, to the nearest cubic inch, of the cone? Use 3.14 for π.

Ⓐ 79 cubic inches
Ⓑ 314 cubic inches
Ⓒ 942 cubic inches
Ⓓ 1,256 cubic inches

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MLSS AND CLR GUIDE

- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

CCSS Domain	*CCSS Cluster*
Geometry	**Understand congruence and similarity using physical models, transparencies, or geometry software**

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on understanding congruence and similarity using physical models, transparencies, and geometry software, 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 connections students can make with vocabulary such as rotation, translation, rotations and dilations, to their home languages can help to build independence and confidence.	
Cross-Curricular Connections	• **Art:** Geometric artwork	
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*	• 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 52 7 mathematics and convey the creativity of mathematics by allowing for multiple solution strategies and development of the standards for mathematical practice led to more students viewing themselves mathematically successful capable mathematicians than tasks and instruction which define success as memorizing and repeating a procedure demonstrated by the teacher. For example, when studying understanding congruence and similarity using physical models, transparencies, and geometry software the types of mathematical tasks are critical because they can allow for multiple, creative solutions. Tasks should be worded to support a wide variety of approaches and solutions. Open ended tasks that elicit a wide range of ideas are better than tasks that prescribe a certain

	support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?	strategy and outcome.

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	***Current Learning***	***Future Learning***
• In 4th-7th grade, students draw, construct, and describe geometric figures (such as angles and polygons) and their relationships. Students solve real-life and mathematical problems involving angle measure.	• In 8th grade, this cluster does not directly connect to any other cluster.	• In future courses, students develop a more formal understanding of transformations in the plane and prove theorems about triangles, lines, and angles.

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?*	For example, some learners may benefit from targeted pre-teaching that rehearses new mathematical language when studying congruence and similarity using physical models, transparencies and geometry software because students will be able to make connections to vocabulary using examples and definitions. Some of this vocabulary could be names of figures and angles and others can be about the topic of congruence and similarity.
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	*7.G.A.2: This standard provides a foundation for work with congruence and similarity because when students are asked to sketch, draw, and compose geometric shapes, they are laying the foundation for the practice of geometric deduction that will be used further on throughout their education . 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***

• Rotations, reflections, and translations produce: line segments that are the same measure, angle measures that are the same measure, parallel lines that remain parallel.
• Figures are congruent if a transformation (or a sequence of transformations) maps one figure onto another figure, including rotations, reflections, and translations.
• Figures are similar if one figure can be obtained from the other from a transformation (or a sequence of transformations), including rotations, reflections, translations, and dilations.
• The relationships between the sum of the angles of a triangle, exterior angles of a triangle, and angles created
	• Describe the transformation (or the sequence of transformations) that maps one congruent figure onto another.
	• Describe what happens to the coordinates when a figure is dilated, translated, rotated, or reflected.
	• Describe the transformation (or the sequence of transformations) that obtains one figure from another.
	• Solve problems that can be solved by looking at angle relationships of triangles and parallel lines cut by a transversal.
		• Build on students' experience with the following skills:
		  ○ Draw, construct and describe geometric figures (angles and polygons)and their relationships
		  ○ Solve problems involving angles measures.
		
		• 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:
		  ○ Tracing paper
		  ○ Graphic Organizer Transformation Rules
		  ○ Draw a picture from a scale drawing
		  ○ Tessellation Tiles

when parallel lines are cut by a transversal.		
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 understanding congruence and similarity using physical models, transparencies and geometry software by revisiting student thinking through a short mini-lesson because this will allow the learner to review what their thinking was prior to the lesson and reflect on changes in thinking that have been made. This will also allow the instructor to identify any misconceptions based on the concept of congruence, or a misunderstanding of the process in determining congruence and similarity.
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 of understanding congruence and similarity using physical models, transparencies and geometry software by confronting student misconceptions because once misconceptions are identified whether based on misunderstanding of congruence or modeling the concept with dilations rotations, reflections and translations, then the teacher can address those misunderstandings on a more specific level. Teachers may also decide whether content vocabulary is an issue for students and re-teach these vocabulary words on a more intensive basis. .
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?	For example, some learners may benefit from an extension such as open ended tasks linking multiple disciplines when studying and understanding congruence and similarity using physical models, transparencies and geometry software because this type of task would allow for some integration of other disciplines such as art in order to express understanding. An example of this would be allowing students to create a mosaic using transformations.

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CCSS Domain	*CCSS Cluster*
Geometry	**Understand and apply the Pythagorean Theorem**

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on to understand and apply Pythagorean Theorem, 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 connection between school and careers.	
Cross-Curricular Connections	**Language Arts:** Students can do research on a famous mathematician that has a known proof of the Pythagorean Theorem and write an essay about the proof.	
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 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 to understand and apply Pythagorean Theorem facilitating meaningful mathematical discourse is critical because when students can articulate what they understand or are confused about helps them validate what they currently know/not know. In some instances, students share what they know about triangles based on their cultural background.

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	*Current Learning*	*Future Learning*
• In 6th grade, students graph points in a coordinate system and find the horizontal or vertical distance between two points in a coordinate system. Students draw polygons in a coordinate system when given vertices. In 7th grade, students expand these skills to find the area of squares.	• In 8th grade, students will use square root symbols to represent solutions and approximate square root values.	• In high school, students prove theorems about triangles. Students use Pythagorean Theorem to solve problems and discover other mathematical relationships.

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?*	For example, some learners may benefit from targeted pre-teaching that uses images/resources (especially those being used the first time) when studying to understand and apply the Pythagorean Theorem because students are already very familiar with triangles and to revisit the type of triangles, angles of a triangle and know that this theorem is only applicable to a right triangle. They will also benefit from reviewing exponents, squares and square roots
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	*7.G.B.6 : This standard provides a foundation for work to understand and apply the Pythagorean Theorem- because reviewing what they learned about triangles from the previous year will help them connect to the right triangle. 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.*

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New Mexico Instructional Scope
8th Grade Geometry Guide

Universal Support Framework		
A student should know/understand...	A student should be able to do...	***Potential Scaffolds***

• In a right triangle, the sum of the squares of the legs equals the square of the hypotenuse. ($a^2 + b^2 = c^2$: a and b are legs, c is hypotenuse)
• When the sum of the squares of the two short sides of a triangle equals the square of the largest side of a triangle, that triangle is a right triangle.
• Between any two points in a coordinate system, a right triangle can be constructed.
	• Identify the given side lengths of a right triangle as a leg or hypotenuse.
	• Find the missing side length of a right triangle in two and three dimensions.
	• Find the hypotenuse of a right triangle in a coordinate system.
	• Apply the Pythagorean Theorem to a real-world problem to find a missing side length.
		• Build on students' experience with the following skills:
		  ○ Graph points in a coordinate system and find the horizontal or vertical distance between two points in a coordinate plane.
		  ○ Draw polygons in a coordinate system when given vertices.
		  ○ Find an area of squares
		• 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:
		  ○ Perfect Square Chart
		  ○ Graphic Organizer- Pythagorean Theorem Labeled
		  ○ Calculator

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 how to understand and apply the Pythagorean Theorem by clarifying mathematical ideas and/or concepts through a short mini-lesson because a clear understanding of a right triangle and the part of a right triangle will make the application of the Pythagorean Theorem clearer.

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 to understand and apply the Pythagorean Theorem-insert language of cluster by addressing conceptual understanding because application of the theorem is a multilayer approach and students will have a better learning path if concepts underlying the theorem is clear to them.
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?		For example, some learners may benefit from an extension such as open-ended tasks linking multiple disciplines when studying to understand and apply the Pythagorean Theorem because students will have a better appreciation of the mathematics around them and know that the presence of mathematics is beyond math class.

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New Mexico Instructional Scope
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CCSS Domain	*CCSS Cluster*
Geometry	**Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres**

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on how to solve real world mathematical problems involving volume of cylinders, cones and spheres , 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 create their own tasks for finding volume that include spheres, cylinders and cones that they are familiar with in their own home culture. They can take these abstract figures and assign items that they come in contact within other situations and develop scenarios in which they would need to find the volume of these items	
Cross-Curricular Connections	• **Art:** Students are given a 3-D glass shape to create sand art. They can calculate the amount of sand needed to create their art piece.	
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 support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?*	• Supporting Productive Struggle in Learning Mathematics: The standard for mathematical practice, makes sense of mathematics and persevere in solving them is the foundation for supporting productive struggle in the mathematics classroom. "Too frequently, historically marginalized students are overrepresented in classes that focus on memorizing and practicing procedures and rarely provide opportunities for students to think and figure things out for themselves. When students in these classes struggle, the teacher often tells them what to do without building their capacity for persistence." Teachers need to provide tasks that challenge students and maintain that challenge while encouraging them to persist. This encouragement or "warm-demander" requires a strong relationship with students and an understanding of the culture of the students. For example, when studying how to solve real world mathematical problems involving volume of cylinders, cones and spheres supporting productive struggle is critical because it will allow students to move past only trying to attain correct solutions, but instead focus on the struggle of working through a difficult problem. Working through a task should help the learner attach meaning to the answers they are getting as well as determine the relationship between the solutions

		they are getting and the work they are doing. When finding the volume of cylinders, cones and spheres, students can engage in a meaningful task that is relevant and therefore encourages the student to persist.

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	*Current Learning*	*Future Learning*
• In 5th and 6th grade, students find the volumes of right rectangular prisms. In 7th grade, students find the area of a circle and solve real-world problems involving area and volume.	• In 8th grade, students continue this work using square root and cube root symbols	• In high school, students use geometric shapes and their measurements to describe objects and solve design problems

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?*	For example, some learners may benefit from targeted pre-teaching that provides additional time for confusion to happen with new mathematical ideas when studying how to solve real world mathematical problems involving volume of cylinders, cones and spheres because students will be expected to know and understand how to use formulas for finding volume of cylinders, cones and spheres.
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	*8.EE.A.2: This standard provides a foundation for working with solving real world mathematical problems involving volume of cylinders, cones and spheres because students must understand how to use square root and cubed root symbols in order to represent solutions to equations . 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.*

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New Mexico Instructional Scope
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Universal Support Framework		
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 solving real world mathematical problems involving volume of cylinders, cones and spheres by providing specific feedback to students on their work through a short mini-lesson because while students are engaged in using formulas to find volume for these figures, errors may occur that are small but will result in a learner not achieving a correct solution. This would be a good time for the instructor to provide immediate feedback to the learner during this process that will then help the learner correct his/her process.
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 for solving real world mathematical problems involving volume of cylinders, cones and spheres by addressing conceptual understanding because if a learner is demonstrating an incorrect solution, it can be assumed that the student is either having conceptual misunderstandings or procedural misunderstandings. If students are attending to precision in their work, then it may help to focus on attaching meaning to the concept that is being learned.
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?		For example, some learners may benefit from an extension such as open-ended tasks linking multiple disciplines when studying solving real world mathematical problems involving volume of cylinders, cones and spheres because students can use different forms of expression to show what they have learned about volume of cylinders, cones and spheres by working on a project to display or build a silo and demonstrate the volume. They will calculate the volume of a real-world silo and use their model to explain.