NEW MEXICO
Public Education Department

8.G: GEOMETRY

Cluster Statement: A: Understand congruence and similarity using physical models, transparencies, or geometry software.

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.G.A.1: Verify experimentally the properties of rotations, reflections, and translations: • **8.G.A.1.A: Lines are taken to lines, and line segments to line segments of the same length.** • **8.G.A.1.B: Angles are taken to angles of the same measure.** • **8.G.A.1.C: Parallel lines are taken to parallel lines.**	SMP 4: Students model with mathematics. Students model on the coordinate plane to explore congruent and similar figures. SMP 5: Students use appropriate tools strategically. SMP 6: Students attend to precision. Students are careful to bring lines to lines and angles to angle when performing transformations. SMP 7: Students look for and make use of the structure of figures as they transform them.	• 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. **Webb's Depth of Knowledge:** 3-4 **Bloom's Taxonomy:** Analyze, Evaluate, Create
Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
8.G.A.2: 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: Students model with mathematics. Students model on the coordinate plane to explore congruent and similar figures. SMP 5: Students use appropriate tools strategically. SMP 6: Students attend to precision. Students are careful to bring lines to	• 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).

	lines and angles to angle when performing transformations. SMP 7: Students look for and make use of the structure of figures as they transform them.	• Understand that a series of rotations, translations or reflections preserves the size and shape of the figure (congruence). **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply, Create
Standard Text **8.G.A.3: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.**	**Standard for Mathematical Practices** SMP 4: Students model with mathematics. Students model on the coordinate plane to explore congruent and similar figures. SMP 5: Students use appropriate tools strategically. SMP 6: Students attend to precision. Students are careful to bring lines to lines and angles to angle when performing transformations. SMP 7: Students look for and make use of the structure of figures as they transform them.	**Students who demonstrate understanding can:** • 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 pre-image 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. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** understand
Standard Text 8.G.A.4: 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.	**Standard for Mathematical Practices** SMP 4: Students model with mathematics. Students model on the coordinate plane to explore congruent and similar figures. SMP 5: Students use appropriate tools strategically. SMP 6: Students attend to precision. Students are careful to bring lines to lines and angles to angle when performing transformations. SMP 7: Students look for and make use of the structure of figures as they transform them.	**Students who demonstrate understanding can:** • 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. **Webb's Depth of Knowledge:** 1-4 **Bloom's Taxonomy:** understand, apply, create
Standard Text 8.G.A.5: 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.*	**Standard for Mathematical Practices** SMP 3: Students construct viable arguments and critique the reasoning of others when explaining the relationships of angles and how they are used to find missing measurements. SMP 4: Students model with mathematics when using formulas and drawings to show angle sums adding to form a line.	**Students who demonstrate understanding can:** • 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. **Webb's Depth of Knowledge:** 2 **Bloom's Taxonomy:** Apply

Previous Learning Connections	**Current Learning Connections**	**Future Learning Connections**
• 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.

Clarification Statement:
Students describe and apply translations, rotations, reflections, and dilations to understand congruent and similar figures. Students explain and understand angle relationships.

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, apply rules to lines that are not parallel.

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 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.

Pre-teach (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.

Core Instruction

Access

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

- For example, learners engaging with understanding congruence and similarity using physical models, transparencies or geometry software benefit when learning experiences include ways to recruit interest such as creating socially relevant tasks because students will be more interested in activities or learning goals that are more relevant to their lives. One of the ways teachers can do this is by creating meaningful

activities that demonstrate the value of this learning towards the goals of the learner. Provide students with a purpose for the learning that is clear to all learners.

Build

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

- For example, learners engaging with understanding congruence and similarity using physical models, transparencies or geometry software 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 it is important for learners to be able to cooperate and collaborate with other learners. This can foster important conversations that will keep learners engaged in the goals of a task. For example, one task may be that students are asked to look at a set of figures and determine which ones are the same size and same shape. Students would be asked to explain their reasoning with their peers. In their explanation they may be asked to explain what it means for two figures to be the same size and the same shape. This task can initiate conversations about congruence and prior knowledge from earlier years of what same size and same shape means.

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 understanding congruence and similarity using physical models, transparencies or geometry software 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 this will make vocabulary more accessible to all learners. For example, in a task where students are asked to explain whether a set of given figures is the same size and the same shape, they may rely on previous knowledge gained throughout elementary school. The idea of congruence in year 8 is embedded in the standards throughout elementary. Students can use alternate expressions of the meaning for congruence to explain their thinking and make connections to the new word.

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 understanding congruence and similarity using physical models, transparencies or geometry software benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing sentence starters or sentence strips because they will support the learner in constructing an explanation or description of their thinking. This can be used during almost any activity to encourage and support discussion among peers. For example, when students are given the task of trying to explain whether figures are the same size and same shape, the student can use the sentence frame of "I notice ____, so…" or "First, I _____ because…".

Internalize

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

- For example, learners engaging with understanding congruence and similarity using physical models, transparencies or geometry software benefit when learning experiences set personal goals that increase ownership of learning goals and support healthy responses and interactions (e.g., learning from mistakes), such as increasing the length of on-task orientation in the face of distractions because some students may experience a certain amount of frustration in the face of a difficult task. Doing this will help learners to avoid being anxious about tasks and stay focused on being motivated to achieve their learning goal.

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 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.

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 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. Teacher may also decide whether content vocabulary is an issue for students and re-teach these vocabulary words on a more intensive basis. ...

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 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.

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?

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

mathematics and convey the creativity of mathematics by allowing for multiple solution strategies and development of the standards for mathematical practice lead 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 strategy and outcome.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: http://tasks.illustrativemathematics.org/content-standards/8/G/A/2/tasks/646

8.G.A.2 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.

- Learning Target: I can prove two figures are congruent.
- Webb's Depth of Knowledge: 2
- Students' first experience with transformations is likely to be with specific shapes like triangles, quadrilaterals, circles, and figures with symmetry. Exhibiting a sequence of transformations that shows that two generic line segments of the same length are congruent is a good way for students to begin thinking about transformations in greater generality.

Task

Line segments AB and CD have the same length. Describe a sequence of reflections that exhibits a congruence between them.

Relevance to families and communities:	**Cross-Curricular Connections:**
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.	Art: Geometric artwork