AzMERIT | Arizona's Statewide Achievement Assessment for English Language Arts and Mathematics

Mathematics Item Specifications

GEOMETRY

Arizona Department of Education with American Institutes for Research - 2018

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Introduction

The Arizona Statewide Achievement Assessment for English Language Arts and Mathematics (AzMERIT) is Arizona's statewide achievement test. AzMERIT assesses the Arizona English Language Arts Standards and Arizona Mathematics Standards adopted by the Arizona State Board of Education in December 2016. AzMERIT will inform students, teachers, and parents about preparedness for college and careers upon graduating from high school. AzMERIT tests are computer-based, meaning that they can better assess students' critical thinking skills and provide them with opportunities to demonstrate a deeper understanding of the materials. Computer-based testing also allows for the use of a variety of innovative items types.

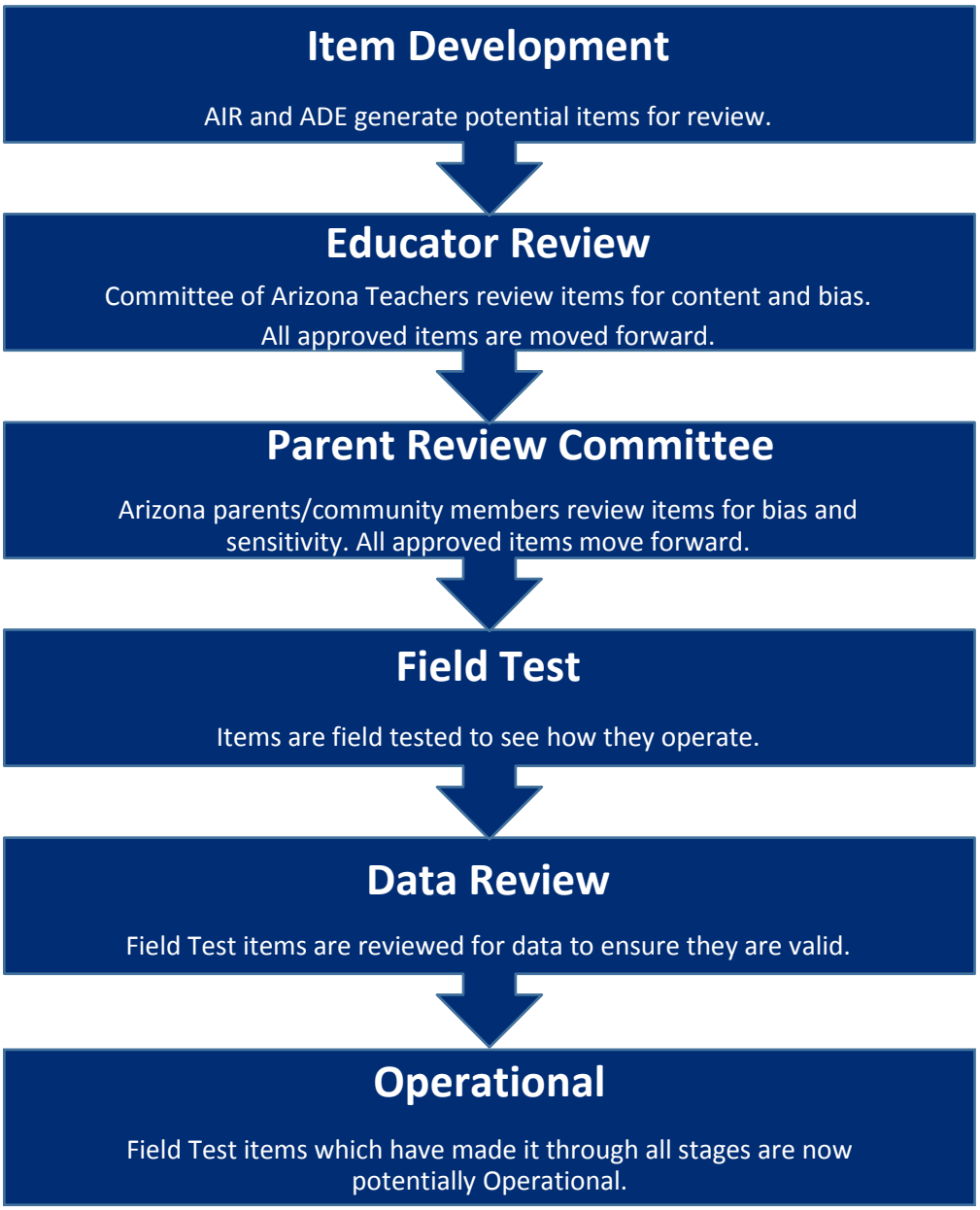
During the item-development process, all AzMERIT items are written in accordance with the Item Specifications and are reviewed and approved by a committee of Arizona educators to confirm alignment and appropriateness for inclusion in the test. AzMERIT items are generally representative of Arizona's geographic regions and culturally diverse population. Items are reviewed for the following kinds of bias: gender, racial, ethnic, linguistic, religious, geographic, and socioeconomic. Item reviews also include consideration of issues related to individuals with disabilities. Arizona community members also have an opportunity to review items for issues of potential concern to members of the community at large. Reviewers are asked to consider the variety of cultural, regional, philosophical, political, and religious backgrounds throughout Arizona, and then to determine whether the subject matter will be acceptable to Arizona students, families, and other members of Arizona communities.

This *AzMERIT Item Specifications* is a resource document that defines the content and format of the test and test items for item writers and reviewers. Each *Item Specifications* document indicates the alignment of items with the Arizona Mathematics Standards. It also serves to provide all stakeholders with information about the scope and function of assessment items. This document can also serve to assist educators to understand how assessment items are developed in alignment with the standards for English language arts and math. These item specifications for AzMERIT are intended to provide information regarding standards, item formats and response types. The descriptions of blueprints, and depth of knowledge in this document are meant to provide an overview of the test. Item specifications are meant for the purposes of assessment, not instruction. They are not intended to be tools for instruction or the basis for curricula. AzMERIT has a test blueprint that was developed by Arizona and is different from any other state or consortium test blueprint.

For the math portion of AzMERIT, all of the test questions are aligned to the mathematic content standards for these subject areas. Any item specifications that are absent for standards listed in this document may be under development. This document does not endorse the exclusion of the instruction of any grade-level content standards. The test will ask questions that check a student's conceptual understanding of math as well as their procedural skills. These items have been written to be free from bias and sensitivity, and widely vary in their degree of difficulty.

Item Development Process

AzMERIT items go through a rigorous review before they are operational. When an item is "operational" it means it is used to determine a student's score on the assessment. This is a description of the process every item must go through before it is operational on AzMERIT.



Sample tests are available online for the math portion of AzMERIT. For more information view the Guide to the Sample Tests at www.azmeritportal.org.

Test Construction Guidelines

The construction of the AzMERIT assessment is guided by the depth and rigor of the Arizona College and Career Ready Standards. Items are created to address key components of the standards and assess a range of important skills. The AzMERIT Blueprint provides an overview of the distribution of items on the AzMERIT according to the standards. The standards for Math Practices are embedded within all AzMERIT items. Further, the AzMERIT blueprint outlines the Depth of Knowledge distribution of items.

Blueprint

Geometry AzMERIT Blueprint 2016 Standards		
Reporting Category	**Min.**	**Max.**
Congruence	**28%**	**32%**
Similarity, Right Triangles and Trigonometry	**30%**	**34%**
Geometric Properties with Equations	**19%**	**23%**
Circles, Geometric Measurement & Dimension, and Modeling	**15%**	**19%**
Circles	2%	4%
Geometric Measurement & Dimension	4%	9%
Modeling and Geometry	6%	13%

Depth of Knowledge (DOK)

DOK refers to the level of rigor or sophistication of the task in a given item, designed to reflect the complexity of the Arizona Mathematics Standards. Items at DOK level 1 focus on the recall of information, such as definitions, terms, and simple procedures. Items at DOK 2 require students to make decisions, solve problems, or recognize patterns; in general, they require a greater degree of engagement and cognitive processing than items at DOK 1. Items at DOK 3 feature higher-order cognitive tasks that assess students' capacities to approach abstract or complex problems.

Percentage of Points by Depth of Knowledge (DOK) Level			
Geometry	DOK Level 1	DOK Level 2	DOK Level 3
	10% - 20%	60% - 70%	12% - 30%

For more information on DOK go to www.azed.gov/AzMERIT.

Calculators

Arizona Desmos Graphing Calculator is permitted for both the paper-based and computer-based assessment for High School Math.

Item Formats

The AzMERIT Assessments are composed of item formats that include traditional multiple-choice response items and technology-enhanced response items (TEI). TEIs are computer-delivered response items that require students to interact with test content to select, construct, and/or support their responses. TEIs are better able to assess a deeper level of understanding.

Currently, there are nine types of TEIs that may appear on the Math computer based assessment for AzMERIT:

- Editing Tasks (ET)
- Editing Task Choice (ETC)
- Equation Editor (EQ)
- Graphic Response Item Display (GRID)
- Hot Text (HT)
    - Selectable Hot Text
    - Drag-and-Drop Hot Text
- Matching Item (MI)
- Multi-Select (MS)
- Open Response
- Table Item (TI)

For paper-based assessments (including those for students with an IEP or 504 plan that specifies a paper based accommodation), TEIs will be modified so that they can be scanned and scored electronically or hand-scored.

See the table below for a description of each TEI. In addition, for examples of each response item format described, see the AzMERIT Training Tests at www.azmeritportal.org.

Item Format	Description
Editing Task (ET)	The student clicks on a highlighted word or phrase that may be incorrect, which reveals a text box. The directions in the text box direct the student to replace the highlighted word or phrase with the correct word or phrase. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
Editing Task Choice (ETC)	The student clicks a highlighted word or phrase, which reveals a drop-down menu containing options for correcting an error as well as the highlighted word or phrase as it is shown in the sentence to indicate that no correction is needed. The student then selects the correct word or phrase from the drop-down menu. For paper-based assessments, the item is modified so that it can be scanned and scored electronically. The student fills in a circle to indicate the correct word or phrase.

Item Format	Description
Equation Editor (EQ)	The student is presented with a toolbar that includes a variety of mathematical symbols that can be used to create a response. Responses may be in the form of a number, variable, expression, or equation, as appropriate to the test item. For paper-based assessments, this item type may be replaced with a modified version of the item that can be scanned and scored electronically or replaced with another item type that assesses the same standard and can be scanned and scored electronically.
Graphic Response Item Display (GRID)	The student selects numbers, words, phrases, or images and uses the drag-and-drop feature to place them into a graphic. This item type may also require the student to use the point, line, or arrow tools to create a response on a graph. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
Hot Text (HT)	**Selectable Hot Text -** Excerpted sentences from the text are presented in this item type. When the student hovers over certain words, phrases, or sentences, the options highlight. This indicates that the text is selectable ("hot"). The student can then click on an option to select it. For paper- based assessments, a "selectable" hot text item is modified so that it can be scanned and scored electronically. In this version, the student fills in a circle to indicate a selection.
	Drag-and-Drop Hot Text - Certain numbers, words, phrases, or sentences may be designated "draggable" in this item type. When the student hovers over these areas, the text highlights. The student can then click on the option, hold down the mouse button, and drag it to a graphic or other format. For paper-based assessments, drag-and-drop hot text items will be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
Matching Item (MI)	The student checks a box to indicate if information from a column header matches information from a row. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
Multi-Select (MS)	The student is directed to select all of the correct answers from among a number of options. These items are different from multiple-choice items, which allow the student to select only one correct answer. These items appear in the online and paper-based assessments.
Open Response	The student uses the keyboard to enter a response into a text field. These items can usually be answered in a sentence or two. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.

Item Format	Description
Table Item (TI)	The student types numeric values into a given table. The student may complete the entire table or portions of the table depending on what is being asked. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.

Arizona Mathematics Standards Geometry

Number and Quantity - N		
Quantities (N-Q)		
G.N-Q.A **Reason quantitatively and use units to solve problems.**	**G.N-Q.A.1**	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.
	G.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.
	G.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.
Geometry - G		
Congruence (G-CO)		
G.G-CO.A **Experiment with transformations in the plane.**	**G.G-CO.A.1**	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
	G.G-CO.A.2	Represent and describe transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.
	G.G-CO.A.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
	G.G-CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
	G.G-CO.A.5	Given a geometric figure and a rotation, reflection, or translation draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another.
G.G-CO.B **Understand congruence in terms of rigid motions.**	**G.G-CO.B.6**	Use geometric definitions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

	G.G-CO.B.7	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
	G.G-CO.B.8	Explain how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
G.G-CO.C **Prove geometric theorems.**	**G.G-CO.C.9**	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
	G.G-CO.C.10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
	G.G-CO.C.11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.
G.G-CO.D **Make geometric constructions.**	**G.G-CO.D.12**	Make formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
	G.G-CO.D.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle; with a variety of tools and methods.
Similarity, Right Triangles, and Trigonometry (G-SRT)		
G.G-SRT.A **Understand similarity in terms of similarity transformations.**	**G.G-SRT.A.1**	Verify experimentally the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
	G.G-SRT.A.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for

		triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
	G.G-SRT.A.3	Use the properties of similarity transformations to establish the AA, SAS, and SSS criterion for two triangles to be similar.
G.G-SRT.B **Prove theorems involving similarity.**	**G.G-SRT.B.4**	Prove theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
	G.G-SRT.B.5	Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing real-world context.
G.G-SRT.C **Define trigonometric ratios and solve problems involving right triangles.**	**G.G-SRT.C.6**	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
	G.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
	G.G-SRT.C.8	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.
Circles (G-C)		
G.G-C.A **Understand and apply theorems about circles.**	**G.G-C.A.1**	Prove that all circles are similar.
	G.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
	G.G-C.A.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
G.G-C.B **Find arc lengths and areas of sectors of circles.**	**G.G-C.B.5**	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.
Expressing Geometric Properties with Equations (G-GPE)		
G.G-GPE.A	**G.G-GPE.A.1**	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Translate between the geometric description and the equation for a conic section.		
G.G-GPE.B **Use coordinates to prove geometric theorems algebraically.**	**G.G-GPE.B.4**	Use coordinates to algebraically prove or disprove geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.
	G.G-GPE.B.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.
	G.G-GPE.B.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
	G.G-GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
Geometric Measurement and Dimension (G-GMD)		
G.G-GMD.A **Explain volume formulas and use them to solve problems.**	**G.G-GMD.A.1**	Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.
	G.G-GMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.
G.G-GMD.B **Visualize relationships between two-dimensional and three-dimensional objects.**	**G.G-GMD.B.4**	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
Modeling with Geometry (G-MG)		
G.G-MG-A **Apply geometric concepts in modeling situations.**	**G.G-MG.A.1**	Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.
	G.G-MG.A.2	Apply concepts of density based on area and volume in modeling situations utilizing real-world context.
	G.G-MG.A.3	Apply geometric methods to solve design problems utilizing real-world context.

Geometry Item Specifications

Congruence (G-CO)

G.G-CO.A.1

Content Standards	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only. Item writers should take care that the key does not stand out compared to the distractor options.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to select a definition for a geometric object.	• Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	Informally define angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Proficient	**Highly Proficient**
Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	Create precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G.G-CO.A.2

Content Standards	Represent and describe transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify a correct transformation given a starting shape and an ending shape.	• Graphic Response • Multiple Choice Response
Students will be required to construct a transformation given a starting shape and a sequence of steps.	
Students will be required to explain the difference between two transformations or a transformation and a stretch in terms of preservation of properties.	
Students will be required to given a transformation, describe a rule that maps the coordinates of a starting shape to an ending shape.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify transformations in the plane as functions that take points in the plane as inputs and give other points as outputs.	Interpret transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Identify transformations that preserve distance and angle to those that do not.
Proficient	**Highly Proficient**
Represent and describe transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.	Create and rewrite transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Evaluate and compare transformations that preserve distance and angle to those that do not.

G.G-CO.A.3

Content Standards	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only. Shapes should be given on a coordinate grid
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe rotations and/or reflections that carry a figure onto itself.	• Multiple Choice Response • Multi-Select Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Given a rectangle, parallelogram, trapezoid, or regular polygon, identify a rotation or reflection that could carry it onto itself.	Given a rectangle, parallelogram, trapezoid, or regular polygon, identify the rotations and reflections that carry it onto itself.
Proficient	**Highly Proficient**
Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.	Given a rectangle, parallelogram, trapezoid, or regular polygon, create and justify the rotations and reflections that carry it onto itself.

G.G-CO.A.4

Content Standards	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
Explanations	Students may observe patterns and develop definitions of rotations, reflections, and translations.
Content Limits	This standard is aligned to Geometry only. Items should focus on formal definitions of these concepts, i.e. what makes a definition complete or incomplete. Simply recognizing a description of a rotation compared with ones for reflections or rotations is a middle-school skill.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe definitions for a given transformation.	• Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	Interpret definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
Proficient	**Highly Proficient**
Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	Create and evaluate definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.G-CO.A.5

Content Standards	Given a geometric figure and a rotation, reflection, or translation draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only. Two-dimensional figures
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to recognize and identify transformations of a given figure.	• Graphic Response • Multiple Choice Response
Students will be required to construct a transformation of a figure from given information.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Given a geometric figure and a rotation, reflection, or translation, identify the transformed figure.	Given a geometric figure and a rotation, reflection, or translation, describe the transformed figure. Identify a sequence of transformations that will carry a given figure onto another.
Proficient	**Highly Proficient**
Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another.	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. Specify sequences of transformations that will carry a given figure onto another.

G.G-CO.B.6

Content Standards	Use geometric definitions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
Explanations	A rigid motion is a transformation of points in space consisting of a sequence of one or more translations, reflections, and/or rotations. Rigid motions are assumed to preserve distances and angle measures.
Content Limits	This standard is aligned to Geometry only. Two-dimensional figures
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe rigid motions involved in a given transformation in terms of size and orientation.	• Multiple Choice Response • Multi-Select Response
Students will be required to describe how rigid motions can be used to show congruence.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use geometric definitions of rigid motions to transform a figure; given two figures, use the definition of congruence in terms of rigid motions to identify if they are congruent.	Use geometric definitions of rigid motions to transform a figure or to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to identify if they are congruent.
Proficient	**Highly Proficient**
Use geometric definitions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.	Use geometric definitions of rigid motions to transform figures and to predict and describe the effect of a sequence of rigid motions on a given figure; given two figures, use the definition of congruence in terms of rigid motions to describe if and why they are congruent.

G.G-CO.B.7

Content Standards	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
Explanations	A rigid motion is a transformation of points in space consisting of a sequence of one or more translations, reflections, and/or rotations. Rigid motions are assumed to preserve distances and angle measures. Two triangles are said to be congruent if one can be exactly superimposed on the other by a rigid motion, and the congruence theorems specify the conditions under which this can occur.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to show/explain that if two triangles are congruent, their corresponding sides and angles are congruent.	• Graphic Response • Multiple Choice Response
Students will be required to show/explain that if two triangles' corresponding sides and angles are congruent, then the figures are congruent.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use the definition of congruence in terms of rigid motions to understand that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	Use the definition of congruence in terms of rigid motions to identify that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
Proficient	**Highly Proficient**
Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	Use the definition of congruence in terms of rigid motions to justify that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G.G-CO.B.8

Content Standards	Explain how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
Explanations	Understand congruence in terms of rigid motions.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to explain how, given that rigid motions preserve congruence, the criteria ASA, SAS, and/or SSS are true.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Understand how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	Show how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
Proficient	**Highly Proficient**
Explain how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	Justify how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

G.G-CO.C.9

Content Standards	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
Explanations	Prove geometric theorems.
Content Limits	This standard is aligned to Geometry only. Theorems are not limited to only those in the "include" list, however they must be about lines and angles.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Interpret theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
Proficient	**Highly Proficient**
Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Construct and evaluate proofs for theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.

G.G-CO.C.10

Content Standards	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
Explanations	Prove geometric theorems.
Content Limits	This standard is aligned to Geometry only. Theorems are not limited to only those in the "include" list, however they must be about triangles.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.	Interpret theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
Proficient	**Highly Proficient**
Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.	Construct and evaluate proofs for theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

G.G-CO.C.11

Content Standards	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.
Explanations	Prove geometric theorems.
Content Limits	This standard is aligned to Geometry only. Theorems are not limited to only those in the "include" list, however they must be about parallelograms
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.	Interpret theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.
Proficient	**Highly Proficient**
Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.	Construct and evaluate proofs for theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.

G.G-CO.D.12

Content Standards	Make formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
Explanations	Make geometric constructions.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to draw a shape within a construction framework (item must require or at least refer student to use common construction techniques).	• Graphic Response • HotText Response • Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	Complete formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
Proficient	**Highly Proficient**
Make formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	Critique formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

G.G-CO.D.13

Content Standards	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle; with a variety of tools and methods.
Explanations	Make geometric constructions.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to construct a figure or show the vertices of the figure inscribed in a circle.	• Graphic Response • Multiple Choice Response
Students will be required to explain the reason(s) points on a circle are vertices of a figure.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify steps needed to construct an equilateral triangle, a square, or a regular hexagon inscribed in a circle.	Identify steps needed to construct an equilateral triangle, a square, or a regular hexagon inscribed in a circle with a variety of tools and methods.
Proficient	**Highly Proficient**
Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle with a variety of tools and methods.	Make observations about a constructed equilateral triangle, square, and regular hexagon inscribed in a circle with a variety of tools and methods.

Similarity, Right Triangles, and Trigonometry (G-SRT)

G.G-SRT.A.1, G.G-SRT.A.1a, G.G-SRT.A.1b

Content Standards	G.G-SRT.A.1 Verify experimentally the properties of dilations given by a center and a scale factor: G.G-SRT.A.1a Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. G.G-SRT.A.1b The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
Explanations	Dilation is a transformation that moves each point along the ray through the point emanating from a fixed center, and multiplies distances from the center by a common scale factor. Students may observe patterns and verify experimentally the properties of dilations.
Content Limits	This standard is aligned to Geometry only. For 1a, limited to polygons with an emphasis on line segments and right triangles Items should include centers of dilation on a line segment, and not just in the middle of a figure For 1b, limit figures to points, triangles, or rectangles
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify the slope of a given side of a dilation, based on the slope of the corresponding side of the original figure.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to understand a given scale factor and construct a dilation.	
Students will be required to describe and relate properties of dilations.	
Students will be required to find the length of one side of a dilated figure, given the original figure and a scale factor.	
Students will be required to describe how a scale factor relates to side lengths, and use this relationship to solve problems.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	Interpret examples demonstrating the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
Proficient	**Highly Proficient**
Verify experimentally the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	Explain quantitatively the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

G.G-SRT.A.2

Content Standards	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
Explanations	A similarity transformation is a rigid motion followed by dilation.
Content Limits	This standard is aligned to Geometry only. Figures should be given on a coordinate plane Items for task demand 3 should assess knowledge of this line of reasoning - "Two shapes are similar if one can be obtained using reflections, rotations, translations, and/or dilations on the other. All of these transformations maintain angle measure and ratios of side lengths. Therefore, similar figures have equal corresponding angle measures and corresponding pairs of sides are proportional."
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify similar figures.	• Equation Response • Multiple Choice Response
Students will be required to identify a transformation or series of transformations, including dilations (including scale factors of dilations), that show that two figures are similar.	
Students will be required to describe the connection between similarity and transformations.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; identify the meaning of similarity for triangles as the equality of all corresponding pairs of angles or the proportionality of all corresponding pairs of sides.	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; qualitatively describe the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
Proficient	**Highly Proficient**
Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; make observations using similarity transformations on the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

G.G-SRT.A.3

Content Standards	Use the properties of similarity transformations to establish the AA, SAS, and SSS criterion for two triangles to be similar.
Explanations	Understand similarity in terms of similarity transformations.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required toidentify similar triangles based on AA.	• Multiple Choice Response
Students will be required to informally describe why the AA criterion is true.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use the properties of similarity transformations to identify the AA, SAS, and SSS criterion for two triangles to be similar.	Use the properties of similarity transformations to interpret the AA, SAS, and SSS criterion for two triangles to be similar.
Proficient	**Highly Proficient**
Use the properties of similarity transformations to establish the AA, SAS, and SSS criterion for two triangles to be similar.	Use the properties of similarity transformations to develop definitions for the AA, SAS, and SSS criterion for two triangles to be similar.

G.G-SRT.B.4

Content Standards	Prove theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
Explanations	Prove theorems involving similarity
Content Limits	This standard is aligned to Geometry only. Theorems about triangles are restricted to the following: Prove that a line constructed parallel to one side of a triangle intersecting the other two sides of the triangle divides the intersected side proportionally. Prove that a line that divides two sides of a triangle proportionally is parallel to the third side. Prove that if three sides of one triangle are proportional to the corresponding sides of another triangle, the triangles are similar. Prove the Pythagorean Theorem using similarity.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.	Interpret theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
Proficient	**Highly Proficient**
Prove theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.	Construct and evaluate proofs of theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.

G.G-SRT.B.5

Content Standards	Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing real-world context.
Explanations	Similarity postulates include SSS, SAS, and AA. Congruence postulates include SSS, SAS, ASA, AAS, and H-L.
Content Limits	This standard is aligned to Geometry only. Items use SSS, SAS, ASA, and/or AAS for congruence Items use AA, SAS (ratios) and/or SSS (ratios) for similarity
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to solve a problem that uses congruence and/or similarity criteria.	• Equation Response • HotText Response • Multiple Choice Response
Students will be required to construct, analyze, and/or critique a proof that uses congruence and/or similarity criteria to shows a relationship between two figures.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Use congruence and similarity criteria to interpret problems.	Use congruence and similarity criteria to identify relationships in geometric figures and solve problems utilizing real-world context.
Proficient	**Highly Proficient**
Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing real-world context.	Use congruence and similarity criteria to construct and evaluate proofs for relationships in geometric figures and solve complex problems utilizing real-world context.

G.G-SRT.C.6

Content Standards	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
Explanations	Define trigonometric ratios and solve problems involving right triangles.
Content Limits	This standard is aligned to Geometry only. The trigonometric ratios are limited to sine, cosine, and tangent.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to define the trigonometric ratios: sine, cosine, and tangent.	• Equation Response • Multiple Choice Response • Matching Item Response
Students will be required to identify the sine, cosine, and/or tangent ratio of a given triangle.	
Students will be required to use the trigonometric ratios to find the length of an unknown side.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	Specify that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
Proficient	**Highly Proficient**
Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	Explain that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

G.G-SRT.C.7

Content Standards	Explain and use the relationship between the sine and cosine of complementary angles.
Explanations	Define trigonometric ratios and solve problems involving right triangles.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify the relationship between the sine and cosine of acute angles in a right triangle: the sine of an angle is equal to the cosine of its complement and vice versa.	• Equation Response • Multiple Choice Response
Students will be required to use the sine and cosine functions to find the measure of an unknown angle given the measure of its complementary angle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the relationship between the sine and cosine of complementary angles.	Interpret and use the relationship between the sine and cosine of complementary angles.
Proficient	**Highly Proficient**
Explain and use the relationship between the sine and cosine of complementary angles.	Prove the relationship between the sine and cosine of complementary angles.

G.G-SRT.C.8

Content Standards	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.
Explanations	Define trigonometric ratios and solve problems involving right triangles.
Content Limits	This standard is aligned to Geometry only. Items at this standard must require the student to solve real-life problems (e.g., use Pythagorean to find distance traveled on a map), and not simply find side lengths or angles of given triangles
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to use the Pythagorean Theorem and/or trigonometric ratios to solve problems involving right triangles.	• Equation Response • Graphic Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Use trigonometric ratios and the Pythagorean Theorem to identify unknown measurements in right triangles.	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles.
Proficient	**Highly Proficient**
Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to describe a solution process to find unknown measurements in right triangles utilizing real-world context.

Circles (G-C)

G.G-C.A.1

Content Standards	Prove that all circles are similar.
Explanations	Understand and apply theorems about circles.
Content Limits	This standard is aligned to Geometry only. Aside from items that ask the student to find the ratio of dilation between circles, items should focus on the fact that any circle can be obtained by a translation and dilation of any other circle - thus, they are similar (this is related to many of the SRT standards).
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to use transformations between two or more circles to show similarity.	• Equation Response • Graphic Response • Multiple Choice Response • Matching Item Response
Students will be required to show that the ratios of the circumference to the diameter of any circle are the same.	
Students will be required to graph the resulting circle from a transformed circle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Recognize that all circles are similar.	Explain qualitatively that all circles are similar.
Proficient	**Highly Proficient**
Prove that all circles are similar.	Construct and evaluate proofs that all circles are similar.

G.G-C.A.2

Content Standards	Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
Explanations	Understand and apply theorems about circles.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe the relationship between inscribed angles, radius, and chords of a circle.	• Equation Response • Graphic Response • Multiple Choice Response • Proposition Response
Students will be required to find measures of central, inscribed and circumscribed angles.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	Find relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
Proficient	**Highly Proficient**
Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	Prove relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

G.G-C.A.3

Content Standards	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
Explanations	Understand and apply theorems about circles.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct an inscribed/circumscribed circle of a triangle.	• Graphic Response • HotText Response • Multiple Choice Response • Proposition Response
Students will be required to explain the validity of proofs using properties of angles for a quadrilateral inscribed in a circle.	
Students will be required to complete a two-column proof proving properties of angles for a quadrilateral inscribed in a circle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify inscribed and circumscribed circles of a triangle.	Construct the inscribed and circumscribed circles of a triangle, and use properties of angles for a quadrilateral inscribed in a circle.
Proficient	**Highly Proficient**
Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	Evaluate constructions of inscribed and circumscribed circles of a triangle, and prove unique relationships between the angles for a quadrilateral inscribed in a circle.

G.G-C.B.5

Content Standards	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.
Explanations	Find arc lengths and areas of sectors of circles.
Content Limits	This standard is aligned to Geometry only. Emphasize the similarity of all circles. Note that by similarity of sectors with the same central angle, arc lengths are proportional to the radius. Use this as a basis for introducing radian as a unit of measure. It is not intended that it be applied to Use radian measures for all angles
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to understand that sectors with different arcs have arc lengths that are proportional.	• Equation Response • Multiple Choice Response
Students will be required to understand that sectors with the same arc of two different circles are proportional.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify that the length of the arc intercepted by an angle is proportional to the radius and that the radian measure of the angle is the constant of proportionality; define the formula for the area of a sector. Identify the relationship between degrees and radians.	Solves problems using the fact that the length of the arc intercepted by an angle is proportional to the radius and that the radian measure of the angle is the constant of proportionality; solve problems using the formula for the area of a sector. Convert between degrees and radians.
Proficient	**Highly Proficient**
Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.	Prove using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; prove the formula for the area of a sector. Derive the formula to convert between degrees and radians.

Expressing Geometric Properties with Equations (G-GPE)

G.G-GPE.A.1

Content Standards	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
Explanations	Translate between the geometric description and the equation for a conic section.
Content Limits	This standard is aligned to Geometry only. All four quadrants of the coordinate plane, whole number coordinates, and a perfect square radius.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct an equation of a circle given information about the center and radius.	• Equation Response • Multiple Choice Response
Students will be required to find the center and/or radius of a circle given an equation not in standard form.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the center and radius of a circle given by an equation of the form $(x-h)^2 + (y-k)^2 = r^2$.	Create the equation of a circle of given center and radius; find the center and radius of a circle given by an equation of the form $(x-h)^2 + (y-k)^2 = r^2$.
Proficient	**Highly Proficient**
Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	Explain the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

G.G-GPE.B.4

Content Standards	Use coordinates to algebraically prove or disprove geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.
Explanations	Use coordinates to prove geometric theorems algebraically.
Content Limits	This standard is aligned to Geometry only. All four quadrants, may use radical values
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to rearrange statements to form a proof.	• Equation Response • Hot Text Response • Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Use coordinates to identify geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.	Use coordinates to algebraically solve problems involving geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.
Proficient	**Highly Proficient**
Use coordinates to algebraically prove or disprove geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.	Use coordinates to algebraically justify statements about geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.

G.G-GPE.B.5

Content Standards	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.
Explanations	Lines can be horizontal, vertical, or neither.
Content Limits	This standard is aligned to Geometry only. All four quadrants of the coordinate plane; coordinates are restricted to whole numbers.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to construct an equation of a line parallel or perpendicular to another line and containing a specific point.	• Equation Response • Multiple Choice Response • Proposition Response
Students will be required to solve a problem using slope criteria for parallel and perpendicular lines.	
Students will be required to describe aspects of why parallel lines have the same slope and why perpendicular lines have slopes that are negative reciprocals.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Use the slope criteria for parallel or perpendicular lines to solve simple geometric problems, including finding the equation of a line parallel or perpendicular to a given line.	Use the slope criteria for parallel and perpendicular lines to solve simple geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.
Proficient	**Highly Proficient**
Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.	Prove and explain the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.

G.G-GPE.B.6

Content Standards	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
Explanations	Use coordinates to prove geometric theorems algebraically.
Content Limits	This standard is aligned to Geometry only. Rational numbers
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify the ratio a point divides a line segment into.	• Equation Response • Multiple Choice Response
Students will be required to identify points on a line segment that partition it based on a given ratio.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the point on a directed horizontal or vertical line segment between two given points that partitions the segment in a given ratio, given visual representation.	Identify the point on a directed line segment between two given points that partitions the segment in a given ratio, given visual representation.
Proficient	**Highly Proficient**
Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	Construct a line segment that partitions the segment in a given ratio.

G.G-GPE.B.7

Content Standards	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
Explanations	Use coordinates to prove geometric theorems algebraically.
Content Limits	This standard is aligned to Geometry only. At least part of the computation must require the distance formula. Coordinates of all points must be given.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify the perimeter of a polygon.	• Equation Response
Students will be required to identify the area of a triangle or rectangle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use coordinates to compute perimeters and areas of right triangles and rectangles.	Use coordinates to compute perimeters of regular polygons and areas of right triangles and rectangles.
Proficient	**Highly Proficient**
Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.	Use coordinates to justify perimeters of polygons and areas of triangles and rectangles.

Geometric Measurement and Dimensions (G-GMD)

G.G-GMD.A.1

Content Standards	Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.
Explanations	Cavalieri's principle is if two solids have the same height and the same cross-sectional area at every level, then they have the same volume.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete an informal argument.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the formulas for the volume of a cylinder, pyramid, and cone.	Informally describe the formulas for the volume of a cylinder, pyramid, and cone.
Proficient	**Highly Proficient**
Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.	Create and interpret the relationships between the formulas for the volume of a cylinder, pyramid, and cone.

G.G-GMD.A.3

Content Standards	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.
Explanations	Missing measures can include but are not limited to slant height, altitude, height, diagonal of a prism, edge length, and radius.
Content Limits	This standard is aligned to Geometry only. Focus should be on solving problems, not simply finding the volume of given figures.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to solve problems based on the volume of cylinders, pyramids, cones, or spheres.	• Equation Response
Students will be required to solve problems based on the volumes of compositions or parts of cylinders, pyramids, cones, or spheres.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Substitute given measures into volume formulas for cylinders, pyramids, cones, and spheres to solve simple problems.	Use volume formulas for cylinders, pyramids, cones, and spheres to solve simple problems.
Proficient	**Highly Proficient**
Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.	Compare volume formulas for cylinders, pyramids, cones, and spheres.

G.G-GMD.B.4

Content Standards	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
Explanations	Visualize relationships between two-dimensional and three-dimensional objects.
Content Limits	This standard is aligned to Geometry only. The focus for the first part of the standard should be on diagonal (not horizontal or vertical) cross-sections.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify cross-sections of three-dimensional objects to two-dimensional shapes.	• Multiple Choice Response • Matching Item Response
Students will be required to identify the three-dimensional object generated by a rotation of a given two-dimensional object.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify the shapes of two-dimensional horizontal or vertical cross-sections of three-dimensional objects.	Identify three-dimensional objects generated by rotations of two-dimensional objects about a line of symmetry.
Proficient	**Highly Proficient**
Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	Describe or create the shapes of two-dimensional cross-sections of three-dimensional objects, and describe three-dimensional objects generated by rotations of two-dimensional objects.

Modeling with Geometry (G-MG)

G.G-MG.A.1

Content Standards	Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.
Explanations	Apply geometric concepts in modeling situations.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to explain how a real-life object can be modeled by three-dimensional geometric objects.	• Equation Response • Multiple Choice Response
Students will be required to construct an equation that models an object and can be used to find its unknown measure (i.e., the object's volume, area).	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use simple geometric shapes to qualitatively describe objects utilizing real-world context.	Use geometric shapes and their properties to qualitatively describe objects utilizing real-world context.
Proficient	**Highly Proficient**
Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.	Use geometric shapes, their measures, and their properties to model complex objects utilizing real-world context.

G.G-MG.A.2

Content Standards	Apply concepts of density based on area and volume in modeling situations utilizing real-world context.
Explanations	Apply geometric concepts in modeling situations.
Content Limits	This standard is aligned to Geometry only. Only some of these items should deal with density of an object, etc. Others should deal with broader applications of the word density, like wolves per square mile.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to calculate a density.	• Equation Response • Multiple Choice Response
Students will be required to draw conclusions based on a density.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Calculate density based on area and volume.	Calculate density based on area and volume in modeling situations utilizing real-world context.
Proficient	**Highly Proficient**
Apply concepts of density based on area and volume in modeling situations utilizing real-world context.	Apply concepts of density based on area and volume in comparative modeling situations utilizing real-world context.

G.G-MG.A.3

Content Standards	Apply geometric methods to solve design problems utilizing real-world context.
Explanations	Apply geometric concepts in modeling situations.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to satisfy a constraint given parameters in a geometric context.	• Equation Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify relevant geometric models to solve design problems utilizing real-world context.	Apply geometric methods to identify solutions for design problems utilizing real-world context.
Proficient	**Highly Proficient**
Apply concepts of density based on area and volume in modeling situations utilizing real-world context.	Apply geometric methods to create composite structures as solutions for design problems utilizing real-world context.