| **Unit 1** | **Unit 2** | **Unit 3** | **Unit 4** | **Unit 5** | **Unit 6** | **Unit 7** | **Unit 8** | **Unit 9** | **Unit 10** | **Unit 11** |
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| **Introduction to Geometric Concepts, Construction, and Proof** | **Congruence Transformations** | **Congruence through Transformations** | **Synthetic and Analytic Proofs: Triangles** | **Synthetic and Analytic Proofs: Parallelism** | **Similarity through Transformations** | **Triangle Similarity and Congruence** | **Trigonometric Ratios and Right Triangles** | **Three-Dimensional Figures and Applications** | **Equations of Circles** | **Properties of Circles and Geometric Constructions** |
| **14 days** | **10 days** | **17 days** | **11 days** | **14 days** | **19 days** | **19 days** | **19 days** | **19 days** | **14 days** | **14 days** |
| G-CO.C.9 | G-CO.A.2 | G-CO.B.6 | G-CO.C.10 | G-CO.C.11 | G-SRT.A.1 | G-SRT.A.3 | G-SRT.C.6 | G-MG.A.2 | G-GPE.B.4 | G-CO.D.13 |
| G-MG.A.1 | G-CO.A.3 | G-CO.B.7 | G-GPE.B.7 | G-GPE.B.4 | G-SRT.A.2 | G-SRT.B.4 | G-SRT.C.7 | G-GMD.A.1 | G-C.A.1 | G-C.A.2 |
| G-CO.A.1 | G-CO.A.4 | G-CO.B.8 |  | G-GPE.B.5 | G-GPE.B.6 | G-SRT.B.5 | G-SRT.C.8 | G-GMD.A.3 | G-C.B.5 | G-C.A.3 |
| G-CO.D.12 | G-CO.A.5 |  |  |  | G-MG.A.3 |  |  | G-GMD.B.4 | G-GPE.A.1 |  |
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| **Major Clusters** | **Supporting Clusters** | **Additional Clusters** | **Other** |
| G. CO – Congruence (6, 7, 8, 9, 10, 11)G.SRT – Similarity, Right Triangles, andTrigonometry (1, 2, 3, 4, 5, 6, 7, 8)G.GPE – Expressing Geometric Properties with Equations (4, 5, 6, 7)G.MG – Modeling with Geometry (1, 2, 3) | G.CO – Congruence (1, 2, 3, 4, 5, 12, 13) | G.C – Circles (1, 2, 3, 5)G.GPE – Expressing Geometric Properties with Equations (1)G.GMD – Geometric Measurement and Dimension (1, 3, 4) | **MP** – Standards for Mathematical Practice |

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| **Summary of Year for Geometry** |
| Transformations on the coordinate plane are introduced in 8th grade. The basic ideas of congruence and similarity are also established then and are connected to corresponding transformations. In Geometry students will gain a sophisticated understanding of the geometric properties of transformations. They will also connect their understanding of functions to view transformations as a relationship between an input and its corresponding output. Rigid motion will then be used to define congruence. Similarity is defined through similarity transformations. From here, the criteria for triangle congruence and triangle similarity are established. This forms the basis of the proofs students will complete. Students will then use their understanding of similarity and right triangles to develop and establish trigonometric ratios for acute angles. The Pythagorean Theorem along with trigonometric ratios will allow students to solve right triangles that arise in a modeling context. Following a study of three-dimensional figures, the course finishes with an in-depth study of circles and their properties. |
| **Standards Clarification for Geometry** |
| Some standards may be revisited several times during the course; others may be only partially addressed in different units, depending on the focus of the unit. See the Standards Clarification column for information on the repeated standards.  |
| **Mathematical Practices Recommendations for Geometry** |
| It is important that all Standards for Mathematical Practice are incorporated throughout the year. Below are examples of how they can be connected to this content.* **Reason abstractly and quantitatively** (MP.2). Abstraction is used in geometry when, for example, students use a diagram of a specific isosceles triangle as an aid to reason about *all* isosceles triangles (G-CO.9). Quantitative reasoning in geometry involves the real numbers in an essential way: Irrational numbers show up in work with the Pythagorean Theorem (G-SRT.8), area formulas often depend on passing to the limit and real numbers are an essential part of the definition of dilation (G-SRT.1).
* **Construct viable arguments and critique the reasoning of others** (MP.3). While all of high school mathematics should help students see the importance of deductive arguments, geometry is an ideal arena for developing the skill of creating and presenting proofs (G-CO.9.10). One reason is that conjectures about geometric phenomena are often about many cases at once. For example, *every* angle inscribed in a semicircle is a right angle (G-C.2).
* **Model with mathematics** (MP.4). Students use geometry to solve design problems. Specific modeling standards appear in the high school standards indicated by (★).
* **Use appropriate tools strategically** (MP.5). Dynamic geometry environments help students look for invariants in a whole class of geometric constructions, and the constructions in such environments sometimes lead to an idea behind a proof of a conjecture.
* **Attend to precision** (MP.6). Teachers might use the activity of creating definitions as a way to help students see the value of precision. While this is possible in every course, the activity has a particularly visual appeal in geometry. For example, a class can build the definition of *quadrilateral* by starting with a rough idea (“four sides”), gradually refining the idea so that it rules out figures that do not fit the intuitive idea.
* **Look for and make use of structure** (MP.7). Seeing structure in geometric configurations can lead to insights and proofs. This often involves the creation of auxiliary lines not originally part of a given figure. Two classic examples are the construction of a line through a vertex of a triangle parallel to the opposite side as a way to see that the angle measures of a triangle add to 180 degrees and the introduction of a symmetry line in an isosceles triangle to see that the base angles are congruent (G-CO.9, 10).
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| **Fluency Recommendations for Geometry** |
| **G-SRT.5** Fluency with the triangle congruence and similarity criteria will help students throughout their investigations of triangles, quadrilaterals, circles, parallelism, and trigonometric ratios. These criteria are necessary tools in many geometric modeling tasks. **G-GPE.4, 5, 7** Fluency with the use of coordinates to establish geometric results, calculate length and angle, and use geometric representations as a modeling tool are some of the most valuable tools in mathematics and related fields. **G-CO.12** Fluency with the use of physical and computational construction tools, helps students draft models of geometric phenomenon and can lead to conjectures and proofs. |

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| **Unit 1: Introduction to Geometric Concepts, Construction, and Proof** | **Possible time frame**:14 days |
| This unit starts with familiar geometric concepts: angle, circle, perpendicular line, parallel line, and line segment. However, the students’ understanding of these topics will deepen as students move from informal definitions used in previous math courses to precise definitions of all concepts. As students reengage with geometry they will also begin modeling objects using two- and three-dimensional geometric figures to solve simple problems. Students will make formal geometric constructions (copying a segment; copying an angle; bisecting a segment; bisecting an angle; 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). Students will begin to explore the idea of a formal proof as they prove theorems about lines and angles (theorems: 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). Most of these are informally developed in 7th or 8th grade and formally proven in Geometry. |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Prove geometric theorems****HSG-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.***Apply geometric concepts in modeling situations****HSG-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).★ | ★Modeling Standard**HSG-MG.A.1** Students continue to use geometric figures to model real-word objects and solve problems with the most emphasis in Units 7, 8, 9, and 11. |
| **Supporting Cluster Standards**  | **Standards Clarification** |
| **Experiment with transformations in the plane****HSG-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.**Make geometric constructions****HSG-CO.D.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; 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.* | **HSG-CO.A.1** Students will continue to use the precise definitions of geometric figures throughout the year, but most notably in Unit 10. |
| **Applying Mathematical Practices to CCSS** |
| **MP.3** Construct viable arguments and critique the reasoning of others. | Students build proficiency with **MP.3** and **MP.7** as they build a mathematical system with structured statements, including postulates and proven theorems. Students should be exposed to a variety of proof styles, including flow-chart proofs, two-column proofs, and paragraph proofs, as they begin to build viable logical arguments. Again, the use of precise language, **MP.6**, is critical to building a logical argument. |
| **MP.6** Attend to precision. |
| **MP.7** Look for and make use of structure. |

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| **Unit 2: Congruence Transformations** | **Possible time frame**:10 days |
| In 8th grade students informally experiment with transformations of figures. In this unit, the students’ understanding of congruence transformations will be formalized. Students will develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and segments. Students will also compare transformations which preserve segment length and angle measure with transformations that do not. Students will also understand these transformations as functions that take points in the coordinate plane as inputs and provide transformed points as outputs. Once these transformations have been formalized, students will identify a sequence of transformations that will carry one figure onto another on the coordinate plane, and they will draw a transformed figure given the original figure and a transformation to apply. Students will also describe the rotations or reflections that would carry a rectangle, parallelogram, trapezoid, or regular polygon onto it. The result of this unit should be that students understand and can use congruence transformations, but also that they understand the definition of congruence in terms of rigid motions. A solid understanding of these transformations will provide students with the knowledge and skill needed to be successful in Units 3, 6, and 7. |
| **Supporting Cluster Standards**  | **Standards Clarification** |
| **Experiment with transformations in the plane****HSG-CO.A.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations 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 (e.g., translation versus horizontal stretch).**HSG-CO.A.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.**HSG-CO.A.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.**HSG-CO.A.5** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. | These standards are foundational to Units 3, 6, and 7. In these units students will use rigid motions (in addition to dilations used in Unit 6) to transform figures, determine if pairs of figures are similar, determine if pairs of figures are congruent, explain the criteria for two triangles to be congruent, and establish the AA criterion for two triangles to be similar. |
| **Applying Mathematical Practices to CCSS**  |
| **MP.4** Model with mathematics. | Students can use transformations to model the world in which they live, attending to **MP**.**4**, as they consider symmetry in nature. Students should strategically use tools, including tracing paper or dynamic geometry software, to perform transformations (**MP.5**). As they describe motion, students will need to attend to **MP.6**, using precise language. |
| **MP.5** Use appropriate tools strategically. |
| **MP.6** Attend to precision. |

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| **Unit 3: Congruence Through Transformations** | **Possible time frame**:17 days |
| In this unit students will use congruence in terms of rigid motion to transform figures, to establish whether or not figures are congruent, and to support the criteria for triangle congruence. Given a geometric description of rigid motions students will transform a given figure and/or predict the effect of the rigid motion on that figure. Given two figures students will decide if the figures are congruent (using the definition of congruence in terms of rigid motion). Additionally, students will use congruence in terms of rigid motion to show that two triangle are congruent if and only if corresponding sides and angles are congruent. Students will also explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from this understanding of congruence. (Note: In 7th grade students will informally determine the minimum information needed to describe a unique triangle.) |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Understand congruence in terms of rigid motions****HSG-CO.B.6** Use geometric descriptions 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.**HSG-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.**HSG-CO.B.8** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. | **HSG-CO.B.8** The criteria for triangle congruence will be used to prove theorems and solve problems involving similar and/or congruent triangles in Units 4, 5, and 7.Students will continue to use rigid motions to transform figures, determine if figures are congruent, and to explain the criteria for two triangles to be congruent. (Unit 2) |
| **Applying Mathematical Practices to CCSS**  |
| **MP.3** Construct viable arguments and critique the reasoning of others. | Students build proficiency with **MP.3** and **MP.7** as they create congruent triangle proofs. Allowing students to critique proofs of other students, whether the work of classmates or fictional student work, will help them develop their own skill in writing proofs. Students continue to build understanding of the structure of a mathematical system and recognize the importance of precise language (**MP.6**). |
| **MP.6** Attend to precision. |
| **MP.7** Look for and make use of structure. |

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| **Unit 4: Synthetic and Analytic Proofs: Triangles** | **Possible time frame**:11 days |
| Now that students have established and verified (using transformations) the criteria for triangle congruence, these criteria can be used to prove theorems about triangles (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.). Some proofs throughout the course will be analytic in nature (on the coordinate plane, usually relying heavily on algebraic skills) which others will be synthetic (devoid of the coordinate plane, usually relying heavily on geometric theorems and/or postulates). In this unit the focus is on synthetic proofs but students begin to use the coordinate plane to solve problems and perform simple proofs. To accomplish analytic proofs students will need to find distance between points on the coordinate plane using skills they already have (the Pythagorean Theorem) and/or new skills (the distance formula). Additionally in this unit, students will use distance between points in order to compute perimeters of polygons and areas of triangles and rectangles given coordinates of their vertices. |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Prove geometric theorems****HSG-CO.C.10** Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles 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.***Use coordinates to prove simple geometric theorems algebraically****HSG-GPE.B.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.★ | ★Modeling Standard The criteria for triangle congruence will be used to prove theorems about triangles. (HSG-CO.B.8 from Unit 3)**HSG-GPE.B.7** Students will continue to find the distance between points in order to calculate segment lengths or perimeter of figures as they begin to focus more heavily on Analytic Proofs in Unit 5. |
| **Applying Mathematical Practices to CCSS**  |
| **MP.3** Construct viable arguments and critique the reasoning of others. | As students explore properties of triangles, they will attend to **MP.5,** strategically choosing tools such as tracing paper, compass and straightedge, flow charts, and dynamic geometry software for a given situation. As students use the tools to look for patterns, they will make conjectures about properties of triangles. Students gain proficiency in **MP.3** as they continue to write simple proof using a variety of styles. |
| **MP.5** Use appropriate tools strategically. |

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| **Unit 5: Synthetic and Analytic Proofs: Parallelism** | **Possible time frame**:14 days |
| This unit builds on Unit 4 and provides students with more opportunities to prove geometric theorems. Students continue to work with both synthetic and analytic proofs. Students will prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems. Other proofs involve the concepts of parallel lines, perpendicular lines, and/or parallelograms. Theorems to prove about parallelograms include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. Additionally, students will use coordinates to prove simple geometric theorems (not including problems involving circles). |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Prove geometric theorems****HSG-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 conversely, rectangles are parallelograms with congruent diagonals.***Use coordinates to prove simple geometric theorems algebraically****HSG-GPE.B.4** Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).***HSG-GPE.B.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). | The criteria for triangle congruence will be used to prove theorems about parallelograms. (HSG-CO.B.8 from Unit 3)Students will continue to find the distance between points in order to calculate segment lengths or perimeter of figures as they focus more heavily on analytic proofs in this unit. (HSG-GPE.B.7 from Unit 4)**HSG-GPE.B.4** Students will not use coordinates to prove relationships involving circles until Unit 11. |

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| **Applying Mathematical Practices to CCSS**  |
| **MP.2** Reason abstractly and quantitatively. | As students become more proficient in geometric reasoning, they begin to consolidate all of their learning to solve problems and prove theorems (**MP.2, MP.3**).Coordinate proofs are a strategic tool students can use. (**MP.5**) |
| **MP.3** Construct viable arguments and critique the reasoning of others. |
| **MP.5** Use appropriate tools strategically. |

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| **Unit 6: Similarity Through Transformations** | **Possible time frame**:19 days |
| Students will begin this unit having worked with rigid motions for several units. This unit will begin by expanding their knowledge of transformations to include dilations. Students will initially experiment with dilating lines (both lines passing through the origin and lines not passing through the origin) and dilating line segments. The work students did in Unit 5 involving slope will inform their discovery of the effects of dilating lines. Students will then use the definition of similarity in terms of similarity transformations to determine if figures are similar. Students will also explain (using similarity) the meaning of similarity of triangles as the equality of corresponding pairs of angles and proportionality of corresponding pairs of sides. Additionally, students will find the point on a given line segment that partitions the segment into a given ratio. This can be explored in conjunction with similar right triangles on the coordinate plane to support students’ understand of similar triangles. Finally, students will use the concepts of similarity and similar triangles to solve design problems (with a focus on problems arising from proportional relationships). |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Understand similarity in terms of similarity transformations****HSG-SRT.A.1** Verify experimentally the properties of dilations given by a center and a scale factor:1. 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.
2. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

**HSG-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.**Use coordinates to prove simple geometric theorems algebraically****HSG-GPE.B.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.**Apply geometric concepts in modeling situations****HSG-MG.A.3** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).★ | ★Modeling Standard**HSG-MG.A.3** Throughout this course students should use geometric methods to solve design problems. Solving design problems will connect well with the content of Units 8 and 9 as students use trigonometric ratios and as students use three-dimensional figures to solve problems.**HSG-SRT.A.2** Students will continue to use similarity transformations in Unit 7 to establish the AA criterion for triangle similarity and to solve problems involving congruent and/or similar figures.Students will continue to use rigid motions (and also dilation of figures) to determine if pairs of figures are similar. (Unit 2) |
| **Applying Mathematical Practices to CCSS**  |
| **MP.1** Make sense of problems and persevere in solving them. | Similarity and proportional reasoning provide powerful tools in representing and solving real-world problems, allowing students to develop proficiency with **MP.1**. As students investigate design problems (**HSG-MG.A.3**), they will often need to model the problem (**MP.**4)with scaled images. Much of **MP.1** has to do with understanding how to represent a situation and what mathematical tools can be applied to the situation. In this unit, students continue to build their mathematical system, attending to **MP.8** as they look for patterns in geometric relationships, and then prove their conjectures, attending to **MP.3.** |
| **MP.3** Construct viable arguments and critique the reasoning of others. |
| **MP.4** Model with mathematics. |
| **MP.8** Look for and express regularity in repeated reasoning. |

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| **Unit 7: Triangle Similarity and Congruence** | **Possible time frame**:19 days |
| In this unit students’ knowledge of congruence and similarity will culminate in proving theorems and solving geometric problems. Students will use similarity transformations and the relationship between similar triangles to establish the AA criterion for two triangles to be similar. Students will then use the criteria for triangle congruence and/or similarity as they prove theorems about triangles and solve problems involving congruent and/or similar figures. Theorems to prove include: line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Understand similarity in terms of similarity transformations****HSG-SRT.A.3** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.**Prove theorems involving similarity****HSG-SRT.B.4** Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.***HSG-SRT.B.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. | Students will continue to use similarity transformations to establish the AA criterion for two triangles to be similar. (Unit 2 and HSG-SRT.A.2 from Unit 6)Students will continue to use geometric figures to model real-word objects/situations and to solve problems involving triangle similarity and/or congruence. (HSG-MG.A.1 from Unit 1)Students will continue to use the criteria for triangle congruence to solve problems involving triangle similarity and/or congruence. (HSG-CO.B.8 from Unit 3) |
| **Applying Mathematical Practices to CCSS**  |
| **MP.1** Make sense of problems and persevere in solving them. | Similarity and proportional reasoning provide powerful tools in representing and solving real-world problems, allowing students to develop proficiency with **MP.1**. As students investigate design problems (**HSG-MG.A.3**), they will often need to model the problem (**MP.**4)with scaled images. Much of **MP.1** has to do with understanding how to represent a situation and what mathematical tools can be applied to the situation. In this unit, students continue to build their mathematical system, attending to **MP.8** as they look for patterns in geometric relationships, and then prove their conjectures, attending to **MP.3.** |
| **MP.3** Construct viable arguments and critique the reasoning of others. |
| **MP.4** Model with mathematics. |
| **MP.8** Look for and express regularity in repeated reasoning. |

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| **Unit 8: Trigonometric Ratios and Right Triangles** | **Possible time frame**:19 days |
| Based on their work with similar triangles, students will be able to discover the basic concepts of trigonometric ratios by experimenting with ratios of side lengths of similar right triangles. Students will understand that side ratios in right triangles are properties of the angles in the triangles. Additionally, students will explain and use the relationship between the sine and cosine of complementary angles. Finally, students will use right triangles, the Pythagorean Theorem, and trigonometric ratios to model and solve real-world problems. |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Define trigonometric ratios and solve problems involving right triangles****HSG-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.**HSG-SRT.C.7** Explain and use the relationship between the sine and cosine of complementary angles.**HSG-SRT.C.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.★ | ★Modeling Standard Students will continue to use geometric figures to model real-word objects/situations and to solve problems involving right triangles. (HSG-MG.A.1 from Unit 1)Students will use geometric methods to solve design problems involving right triangles or trigonometric ratios. (HSG-MG.A.3 from Unit 6) |
| **Applying Mathematical Practices to CCSS**  |
| **MP.1** Make sense of problems and persevere in solving them. | The standards in this unit give students an opportunity to consolidate old learning and new learning as they solve more complex problems with an array of mathematical tools to choose from. These problem-solving experiences attend to **MP.1** and **MP.4**. As students decide how to model situations geometrically and apply properties to the situations, they are attending to **MP.2**.  |
| **MP.2** Reason abstractly and quantitatively. |
| **MP.4** Model with mathematics. |

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| **Unit 9: Three-Dimensional Figures and Applications** | **Possible time frame**:19 days |
| In this unit students will use their understanding of two-dimensional geometric figures to explore properties of three-dimensional geometric figures. In middle school students calculate volume and surface area of various regular and irregular figures. The focus in this course is the connection between two-dimensional cross-sections and the three-dimensional objects they are cross-sections of, the connection between a two-dimensional figure and the three-dimensional figure formed by rotating the figure, and using three-dimensional figures to model and solve problems. Students will begin by exploring and providing informal arguments for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Additionally, students will identify the shapes of two-dimensional cross-sections of three-dimensional objects and identify three-dimensional objects generated by rotations of two-dimensional objects. Finally, students will model with two- and three-dimensional figures and use these to solve problems. Students should include applying concepts of density based on area and volume. |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Apply geometric concepts in modeling situations****HSG-MG.A.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).★ | ★Modeling Standard Students will continue to use geometric figures to model real-word objects/situations (especially three-dimensional objects) and to solve problems involving circular figures. (HSG-MG.A.1 from Unit 1)Students will use geometric methods to solve design problems involving three-dimensional figures. (HSG-MG.A.3 from Unit 6 |
| **Additional Cluster Standards** | **Standards Clarification** |
| **Explain volume formulas and use them to solve problems****HSG-GMD.A.1** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri’s principle, and informal limit arguments.***HSG-GMD.A.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.★**Visualize relationships between two-dimensional and three-dimensional objects****HSG-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 Standard |
| **Applying Mathematical Practices to CCSS**  |
| **MP.1** Make sense of problems and persevere in solving them. | The problems presented in this unit should require students to struggle and collaborate, thus building their mathematical persistence (**MP.1**). Students should see ways to use the geometric relationships they have been learning throughout the course to model real-world situations (**MP.4**). As students model situations geometrically, they will often have to decontextualize the problem and apply geometric properties (**MP.2**). |
| **MP.2** Reason abstractly and quantitatively. |
| **MP.4** Model with mathematics. |

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| **Unit 10: Equations of Circles** | **Possible time frame**:14 days |
| This will be the students’ first formal work with circles since 7th grade. Students will use their understanding of similarity transformations to prove that all circles are similar. Students gained a deep conceptual understanding of angle measures in terms of degrees and their relationship to circles in the 4th grade. In this unit students will 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. Students will derive the formula for the area of a sector. Students will then use the Pythagorean Theorem and the precise definition of a circle to derive the equation of the circle with given center and radius. Students will also use their knowledge of completing the square (introduced in Algebra I) to find the center and radius of a circle given by an equation. Finally, students will use coordinates to determine if specified points are on a circle given by an equation or given by a radius and center. |
| **Major Cluster Standards**  | **Standards Clarification** |
| **Use coordinates to prove simple geometric theorems algebraically****HSG-GPE.B.4** Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).* |  |
| **Additional Cluster Standards** | **Standards Clarification** |
| **Understand and apply theorems about circles****HSG-C.A.1** Prove that all circles are similar.**Find arc lengths and areas of sectors of circles****HSG-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.**Translate between the geometric description and the equation for a conic section****HSG-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. | Students continue to use the precise definition of a circle as they explore and use equations of circles. (HSG-CO.A.1 from Unit 1)**HSG-C.A.1** Students will use the similarity of all circles as they develop and use other properties of circles in Unit 11.**HSG-GPE.A.1** Students will continue to use the relationship between the equation of a circle and the radius and center in Unit 11. |

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| **Applying Mathematical Practices to CCSS**  |
| **MP.2** Reason abstractly and quantitatively. | Circle problems provide an opportunity for complex problem-solving situations that consolidate many different geometric relationships (**MP.2** and **MP.4**). In developing the relationships, students will look for patterns, make conjectures, and then construct logical arguments to justify their conjectures. Again, allow opportunities for students to share their own reasoning and critique the reasoning of others in these problem situations (**MP.3**).  |
| **MP.3** Construct viable arguments and critique the reasoning of others. |
| **MP.4** Model with mathematics. |

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| **Unit 11: Properties of Circles and Geometric Constructions** | **Possible time frame**:14 days |
| In this unit students will identify and describe properties of circles and construct inscribed and circumscribed circles. Students will identify and describe relationships among inscribed angles, radii, and chords. Students will also describe the relationship between central, inscribed, and circumscribed angles and understand that inscribed angles on a diameter are right angles and that the radius of a circle is perpendicular to the tangent where the radius intersects the circle. Students will also create geometric constructions (as they did in Unit 1) involving circles. Students will construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. Additionally, students will construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. Students will use the ability to construct geometric figures and the properties of circles to model real-world objects and solve problems. |
| **Supporting Cluster Standards**  | **Standards Clarification** |
| **Make geometric constructions****HSG-CO.D.13** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. |  |
| **Additional Cluster Standards** | **Standards Clarification** |
| **Understand and apply theorems about circles****HSG-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.***HSG-C.A.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. | Students will continue to use geometric figures to model real-word objects/situations and to solve problems involving circles and/or circular objects. (HSG-MG.A.1 from Unit 1) |
| **Applying Mathematical Practices to CCSS**  |
| **MP.2** Reason abstractly and quantitatively. | Circle problems provide an opportunity for complex problem-solving situations that consolidate many different geometric relationships (**MP.2** and **MP.4**). In developing the relationships, students will look for patterns, make conjectures, and then construct logical arguments to justify their conjectures. Again, allow opportunities for students to share their own reasoning and critique the reasoning of others in these problem situations (**MP.3**). |
| **MP.3** Construct viable arguments and critique the reasoning of others. |
| **MP.4** Model with mathematics. |