Unit 1: Foundations of Geometry

Unit Overview: Students will learn the roles of postulates, definitions, theorems, and precise geometric notation in the construction of more formal geometric proofs. They will apply the Pythagorean theorem and the distance formula to calculate the perimeter and area of figures in the coordinate plane. They will use their knowledge of proportional reasoning to identify the midpoint of a line segment and to partition line segments into equal portions. Students will use the definitions of a circle and a right angle to help create triangles and solve for unknown distances. They will extend their understanding of congruency by learning to construct congruent segments and congruent angles using a variety of tools and methods. They will also use coordinates to prove or disprove that segments on the coordinate plane are congruent or perpendicular. (Focus on MP.1, MP.3, MP.5)

Concept 1: Explore the Building Blocks of Geometry

Concept Overview: Students discover the roles of postulates, definitions, and theorems and precise geometric notation in the construction of more formal geometric proofs. They begin their more formal explorations in geometry by interpreting and using the axioms and undefined terms that lay the foundation of the discipline. Students explore important definitions and postulates to prepare for the development of formal arguments to establish geometric facts. They explore evidence of vocabulary, postulates, and theorems in real-world scenarios and mathematical diagrams to prepare for geometric modeling.

> **Unit 1, Concept 1 Standards**
> - HSG-CO.A.1
> - HSG-CO.C.9
> - HSG-MG.A.1

Concept 2: Explore Measurements in the Coordinate Plane

Concept Overview: Students apply the Pythagorean theorem and the distance formula to calculate the perimeter and area of figures in the coordinate plane. They apply their knowledge of proportional reasoning to identify the midpoint of a line segment and to partition line segments into equal portions. Students use the definitions of a circle and a right angle to help create triangles and solve for unknown distances.

> **Unit 1, Concept 2 Standards**
> - HSG-CO.A.1
> - HSG-GPE.B.6
> - HSG-GPE.B.7

Concept 3: Explore Congruence Constructions in the Coordinate Plane

Concept Overview: Students extend their understanding of congruency by learning to construct congruent segments and congruent angles using a variety of tools and methods. They also use coordinates to prove or disprove that segments on the coordinate plane are congruent or perpendicular.

> **Unit 1, Concept 3 Standards**
> - HSG.CO.D.12
> - HSG.GPE.B.4

Unit 2: Geometric Transformations

Unit Overview: Students will recognize, describe, and construct reflections, rotations, and translations of points, segments, and polygons. They will also construct these transformations on the coordinate plane. In addition, students will recognize line and rotational symmetry of figures and use transformation to create tessellations. They will build on their understanding of congruence of two figures by expressing congruence in terms of rigid motion. They also will predict and demonstrate a sequence of translations, rotations, and reflections to carry a given figure onto another. Finally, students will use rigid motions to discover and establish the SSS, SAS, and ASA triangle congruence criteria. (Focus on MP.1, MP.3, MP.5)

Concept 1: Explore Transformations

Concept Overview: Students learn to recognize, describe, and construct reflections, rotations, and translations of points, segments, and polygons. They also construct these transformations on the coordinate plane. In addition, students recognize line and rotational symmetry of figures and use transformation to create tessellations.

Unit 2, Concept 1 Standards
- HSG-CO.A.2
- HSG-CO.A.3
- HSG-CO.A.4
- HSG-CO.A.5

Concept 2: Investigate and Apply Congruence Definitions

Concept Overview: Students realize that congruent figures are created by a finite number of isometries; that is, students build on their understanding of congruence of two figures by expressing congruence in terms of rigid motion. They also predict and demonstrate a sequence of translations, rotations, and reflections to carry a given figure onto another, using rigid motions to discover and establish the SSS, SAS, and ASA triangle congruence criteria.

Unit 2, Concept 2 Standards
- HSG-CO.B.6
- HSG-CO.B.7
- HSG-CO.B.8

Unit 3: Intersecting Lines

Unit Overview: Students will investigate and construct parallel and perpendicular lines. They will examine the relationship between geometric transformations and algebraic representations of parallel and perpendicular lines in preparation for the proof of the slope criteria. Students will extend their understanding of geometric evidence and valid arguments and apply their understanding of rigid motion transformations to formally prove theorems about angle pairs, parallel lines, and perpendicular lines. (Focus on MP.1, MP.3, MP.5)

Concept 1: Explore Parallel and Perpendicular Lines

Concept Overview: Students explore and construct parallel and perpendicular lines. They examine the relationship between geometric transformations and algebraic representations of parallel and perpendicular lines in preparation for the proof of the slope criteria.

> **Unit 3, Concept 1 Standards**
> - HSG-CO.A.1
> - HSG-CO.D.12
> - HSG-GPE.B.5

Concept 2: Prove Theorems about Lines and Angles

Concept Overview: Students extend their understanding of geometric evidence and valid arguments and apply their understanding of rigid motion transformations to formally prove theorems about angle pairs, parallel lines, and perpendicular lines.

> **Unit 3, Concept 2 Standards**
> - HSG-GPE.B.4
> - HSG-GPE.B.5
> - HSG-CO.C.9

Unit 4: Triangle Geometry

Unit Overview: Students will prove theorems about triangles including the triangle sum theorem, exterior angle theorem, and isosceles and equilateral triangles theorems. They will build on their understanding of congruence transformations to prove triangle congruence theorems. Students will learn to construct various figures, including equilateral triangles, perpendicular bisectors, and angle bisectors using a compass and a straight edge. They will use the converse of the perpendicular bisector theorem to justify their constructions. (Focus on MP.1, MP.3, MP.5)

Concept 1: Prove Congruence Theorems

Concept Overview: Students prove theorems about triangles, including the triangle sum theorem, exterior angle theorem, and isosceles and equilateral triangles theorems. They extend their understanding of congruence transformations to prove triangle congruence theorems.

Unit 4, Concept 1 Standards
- HSG-CO.B.8
- HSG-CO.C.10
- HSG-SRT.B.5

Concept 2: Construct Special Triangles and Angles

Concept Overview: Students make geometric constructions. They learn to construct various figures, including equilateral triangles, perpendicular bisectors, and angle bisectors using a compass and a straight edge. Students also use the converse of the perpendicular bisector theorem to justify their constructions.

Unit 4, Concept 2 Standards
- HSG-CO.C.9
- HSG-CO.D.12
- HSG-CO.D.13

Unit 5: Similarity

Unit Overview: Students will deepen their knowledge of dilations of figures by identifying a dilation as a nonrigid transformation. They will experimentally verify the properties of dilations as functions. Students will establish the definition of a similarity transformation as a composition of rigid motion transformations followed by a dilation. They will use triangle similarity criteria to help them prove theorems about triangles. Students will also use their understanding of similarity and congruence of triangles to solve real-world and mathematical problems. They will build on what they have learned about similarity and apply it to three-dimensional figures. Students will apply properties of similar figures in three dimensions to solve problems, including problems involving surface area and volume. (Focus on MP.3, MP.5, MP.7)

Concept 1: Explore Similarity and Dilation

Concept Overview: Students broaden their understanding of dilations of figures by identifying a dilation as a nonrigid transformation. They use their previous work with transformations to experimentally verify the properties of dilations as functions. Students establish the definition of a similarity transformation as a composition of rigid motion transformations followed by a dilation. They use and expand their knowledge of similarity to decide if two given figures are similar, and they justify their reasoning by examining all corresponding pairs of angles and sides.

Unit 5, Concept 1 Standards
- HSG-SRT.A.1
- HSG-SRT.A.1a
- HSG-SRT.A.1b
- HSG-SRT.A.2

Concept 2: Prove Similarity Theorems

Concept Overview: Students apply their prior knowledge of transformations and the properties of similar figures to establish triangle similarity criteria. They use triangle similarity criteria to help them prove theorems about triangles. Students also use their understanding of similarity and congruence of triangles to solve real-world and mathematical problems as they continue in their development to prepare and solve design problems.

Unit 5, Concept 2 Standards
- HSG-CO.C.10
- HSG-SRT.A.3
- HSG-SRT.B.4
- HSG-SRT.B.5
- HSG-MG.A.3

Concept 3: Apply Similarity Theorems

Concept Overview: Students build on what they have learned about similarity and apply it to three-dimensional figures. They develop an informal definition of similarity in three dimensions and use it to determine whether three-dimensional figures are similar. Students also apply properties of similar figures in three dimensions to solve problems, including problems involving surface area and volume.

Unit 5, Concept 3 Standards
- HSG-SRT.A.2
- HSG-SRT.B.5

Unit 6: Trigonometry

Unit Overview: Students will acquire an understanding of how the ratios of sides in similar right triangles lead to the definitions of trigonometric ratios of angles. They will also learn the relationship between the sine and cosine of complementary angles and apply this relationship to solve problems. Students will state and prove the law of sines and the law of cosines. They will apply the two laws to solve problems, investigating when to use the law of sines and when to use the law of cosines to solve a triangle. Real-world scenarios will be used to develop these laws, challenging students to apply geometric methods to satisfy physical constraints and to choose a level of accuracy appropriate to limitations on measurement. (Focus on MP.4, MP.7, MP.8)

Concept 1: Investigate Right Triangle Trigonometry

Concept Overview: Students develop an understanding of how the ratios of sides in similar right triangles lead to the definitions of trigonometric ratios of angles, and they use these ratios with the Pythagorean theorem to solve real-world problems. They also learn the relationship between the sine and cosine of complementary angles and apply this relationship to solve problems.

Unit 6, Concept 1 Standards
- HSG-SRT.C.6
- HSG-SRT.C.7
- HSG-SRT.C.8
- HSG-SRT.D.9

Concept 2: Investigate Laws of Sines and Cosines

Concept Overview: Students state and prove the law of sines and the law of cosines. They apply the two laws to solve problems, investigating when to use the law of sines and when to use the law of cosines to solve a triangle. Students explore the conditions when the law of sines generates a unique value and when it generates fewer than or more than one unique value. Real-world scenarios are used to develop these laws, challenging students to apply geometric methods to satisfy physical constraints and to choose a level of accuracy appropriate to limitations on measurement.

Unit 6, Concept 2 Standards
- HSN-Q.A.3
- HSG-SRT.D.10
- HSG-SRT.D.11
- HSG-MG.A.3

Unit 7: The Geometry of Circles

Unit Overview: Students will investigate relationships among central angles, arc measure, inscribed angles, and circumscribed angles. They will identify and describe relationships between inscribed angles, radii, and chords. Students also will prove that all circles are similar. Students will work on a limit argument that proves the formulas for circumference and area of a circle. They will also develop formulas for arc length and area of a sector and define the radian measure of an angle. Students will derive the equation of the circle in the coordinate plane. Given the equation of a circle, they will be able to complete the square to determine the center and radius of the circle and graph the circle in the coordinate plane. Students will apply their understanding of the equation of a circle to determine whether a given point lies on the circle. (Focus on MP.3, MP.5, MP.8)

Concept 1: Investigate Circles and Parts of Circles

Concept Overview: Students explore relationships between central angles, arc measure, inscribed angles, and circumscribed angles and identify and describe relationships between inscribed angles, radii, and chords. In addition, they construct tangents from a point outside the circle. Students also prove that all circles are similar.

Unit 7, Concept 1 Standards
- HSG-C.A.1
- HSG-C.A.2
- HSG-C.A.4

Concept 2: Investigate and Apply Area and Circumference Formulas

Concept Overview: Students develop a limit argument that proves the formulas for circumference and area of a circle and use the formulas to solve real-world problems involving area and circumference. They also develop formulas for arc length and area of a sector and define the radian measure of an angle.

Unit 7, Concept 2 Standards
- HSG-GMD.A.1
- HSG-C.B.5

Concept 3: Investigate and Interpret Circle Equations

Concept Overview: Students derive the equation of the circle in the coordinate plane. Given the equation of a circle, they are able to complete the square to determine the center and radius of the circle and to graph the circle in the coordinate plane. Students apply their understanding of the equation of a circle to determine whether a given point lies on the circle.

> **Unit 7, Concept 3 Standards**
> - HSG-GPE.A.1
> - HSG-GPE.B.4

Unit 8: Triangles and Circles

Unit Overview: Students will discover points of concurrency of a triangle and prove that the medians of a triangle meet at a point of concurrency. They will use points of concurrency to construct circumscribed and inscribed triangles. (Focus on MP.1, MP.3, MP.7)

Concept 1: Investigate Concurrency in Triangles

Concept Overview: Students explore points of concurrency of a triangle and prove that the medians of a triangle meet at a point of concurrency. They use points of concurrency to construct circumscribed and inscribed triangles.

> **Unit 8, Concept 1 Standards**
> - HSG-CO.C.10
> - HSG-C.A.3

Unit 9: Quadrilaterals and Other Polygons

Unit Overview: Students will demonstrate how to use constructions to inscribe a polygon in a circle and explore and prove properties of angles in inscribed polygons. They will prove theorems about parallelograms. Students will extend properties of parallelograms to other quadrilaterals and develop a classification of quadrilaterals. They will use coordinates to prove geometric theorems involving quadrilaterals algebraically. (Focus on MP.3, MP.4, MP.7)

Concept 1: Construct and Explore Polygons

Concept Overview: Students understand how to use constructions to inscribe a polygon in a circle and explore and prove properties of angles in inscribed polygons.

> **Unit 9, Concept 1 Standards**
> - HSG-CO.D.13
> - HSG-C.A.3

Concept 2: Prove and Apply Theorems about Quadrilaterals

Concept Overview: Students prove theorems about parallelograms. They extend properties of parallelograms to other quadrilaterals and develop a classification of quadrilaterals. Students use coordinates to prove geometric theorems involving quadrilaterals algebraically.

> **Unit 9, Concept 2 Standards**
> - HSG-CO.C.11
> - HSG-GPE.B.4

Unit 10: 3-D Figures

Unit Overview: Students will expand upon their understanding of cross sections to include two-dimensional slices of real-world three-dimensional objects and will identify three-dimensional objects generated by rotation of two-dimensional objects. They will use transformations of two-dimensional geometric shapes to describe and model real-world three-dimensional objects. Students will explore the cross sections and characteristics of figures through informal arguments for volume of cylinders, spheres, and other solid figures. They will use geometric shapes to describe and model real-world objects and apply their formulas for volume and surface area to solve problems. (Focus on MP.2, MP.4, MP.5)

Concept 1: Investigate Cross Sections and Rotations

Concept Overview: Students extend their understanding of cross sections to include two-dimensional slices of real-world three-dimensional objects and identify three-dimensional objects generated by rotation of two-dimensional objects. They use transformations of two-dimensional geometric shapes to describe and model real-world three-dimensional objects. Students apply their understanding of cross sections to solve design problems.

> **Unit 10, Concept 1 Standards**
> - HSG-GMD.B.4
> - HSG-MG.A.1
> - HSG-MG.A.3

Concept 2: Develop and Apply Volume Formulas

Concept Overview: Students explore the cross sections and characteristics of figures through informal arguments for volume of cylinders, spheres, and other solid figures. They use geometric shapes to describe and model real-world objects and apply their formulas for volume and surface area to solve problems.

> **Unit 10, Concept 2 Standards**
> - HSG-GMD.A.1
> - HSG-GMD.A.2
> - HSG-GMD.A.3
> - HSG-MG.A.1
> - HSG-MG.A.2
> - HSG-MG.A.3