Geometry

Content Standards

2022

Course Title:	Geometry
Course/Unit Credit:	1
Course Number:	431000
Teacher Licensure:	Please refer to the Course Code Management System (https://adedata.arkansas.gov/ccms/) for the most current licensure codes.
Grades:	9-12
Prerequisite:	Algebra I or Algebra A/B

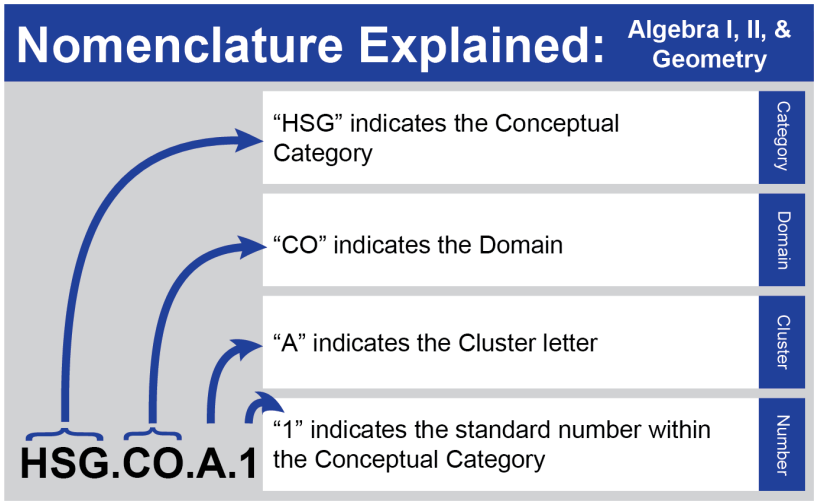
Course Description: The fundamental purpose of the course in Geometry is to formalize and extend students' geometric experiences from the middle grades. Students explore more complex geometric situations and deepen their explanations of geometric relationships, moving towards formal mathematical arguments. Important differences exist between this Geometry course and the historical approach taken in Geometry classes. For example, transformations are emphasized early in this course. Constructions, rather than being an isolated topic, are used throughout the investigation of transformations. These constructions assist students in developing and deepening their understanding of definitions, transformations, and proofs. Close attention should be paid to the introductory content for the Geometry conceptual category found in the high school Arkansas Mathematics Standards (AMS). Proofs are deductive arguments and are not isolated topics. Tools that students can use to make their arguments include two-column tables, flow charts, and narratives.

Introduction to the Algebra I, Algebra II, and Geometry Arkansas Mathematics Standards

When the Division of Elementary and Secondary Education (DESE) began the process of revising math standards, a diverse group of qualified educators from across the state came together to craft Arkansas standards specific to the schools and students in the state. The result of this work, the Arkansas Mathematics Standards, is contained in this document. These standards reflect what educators across the state know to be best for Arkansas students.

Standards Organization: The revision committee maintained the organizational structure and nomenclature of the previous standards. Algebra I, Algebra II, and Geometry Arkansas Mathematics Standards are categorized into conceptual categories, domains, clusters, and standards.

- **Conceptual category** represent the big picture across the high school grades.
- **Domains** represent the big ideas to be studied in each course. These big ideas support educators in determining the proper amount of focus and instructional time to be given to each of these topics.
- **Clusters** represent collections of standards grouped to help educators understand the building blocks of rich and meaningful instructional units. These units help students make connections within clusters and avoid seeing mathematics as a discrete list of skills they must master.
- **Standards** represent the foundational building blocks of math instruction. The standards outlined in this document work together to ensure that students are college and career ready and on track for success.



Standards Support: The revision of the Arkansas Mathematics Standards represent the work of the committee to provide greater clarity, strength, and support of the standards. Additionally, the revised mathematics standards are designed to help educators better understand the areas of emphasis and the focus within the standards. Educators should address the bulleted content as more than a checklist of items that they must teach individually. Content is bulleted to provide specificity of learning expectations included within some extensive standards. In some instances, the standard document includes Arkansas examples, teacher notes, specifications, and italicized words to assist educators with planning, teaching, and student learning.

- **Examples** included in the original standards were either changed for clarity or separated from the body of the actual standard. The examples included in the body of the standards document in no way reflect all of the possible examples. Likewise, these examples do not mandate curriculum or problem types. Local districts are free to select the high-quality curricula and instructional methods that best meet the needs of their students.
- **Teacher notes** offer clarification of the standards. These notes are intended to clarify, for teachers, what the expectations are for the learner. Likewise, these notes provide instructional guidance and limitations so that educators can better understand the scope of the standard. This will help with determining what is developmentally appropriate for students when working with specific standards.
- **Standard specifications** are to strengthen standards. The specifications are precise statements highlighting the need for mastery or function-type parameters for specific standards. This will assist educators in pinpointing the best opportunities for students to gain and master the knowledge and skills needed to succeed in a progression.
- **Asterisks (*)** are denoted to represent the modeling component of the standards. These standards should be presented in a modeling context which allows students to engage in the modeling process that is outlined in the Standards for Mathematical Process. (See Appendix A)
- **Italicized words** are defined in the glossary.

Finally, the Arkansas Mathematics Standards will be a living document. As these standards are implemented across schools in the state, DESE welcomes further suggestions related to notes of clarification, examples, professional development needs, and future revisions of the standards.

K - 12 Standards for Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Geometry Standards: Overview

Abbreviations: The following abbreviations are for the conceptual categories and domains for the Arkansas Mathematics Standards.

High School Geometry – HSG

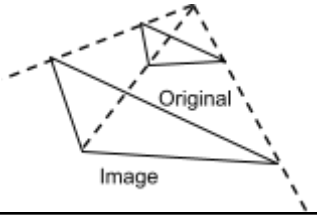
- **Congruence - CO**
  - Investigate transformations in the plane
  - Understand congruence in terms of rigid motions
  - Apply and prove geometric theorems
  - Make geometric constructions
  - Logic and Reasoning
- **Similarity, Right Triangles, and Trigonometry - SRT**
  - Understand similarity in terms of similarity transformations
  - Apply and prove theorems involving similarity
  - Define trigonometric ratios and solve problems involving right triangles
- **Circles - C**
  - Understand and apply theorems about circles
  - Find arc lengths and areas of sectors of circles
- **Expressing Geometric Properties with Equations - GPE**
  - Translate between the geometric description and the equation of a conic section
  - Use coordinates to prove simple geometric theorems algebraically
- **Geometric measurement and dimension - GMD**
  - Explain volume formulas and use them to solve problems
  - Visualize relationships between two-dimensional and three-dimensional objects
- **Modeling with Geometry - MG**
  - Apply geometric concepts in modeling situations

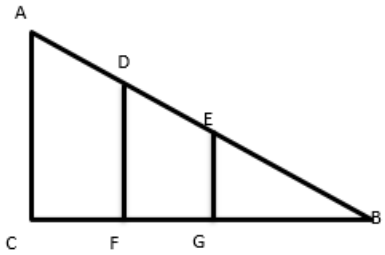
High School Statistics and Probability – HSS

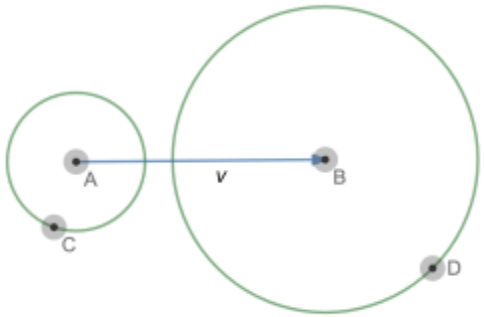
- **Interpreting categorical and quantitative data - ID**
  - Summarize, represent, and interpret data on two categorical and quantitative variables
  - Interpret linear models

Congruence	
Cluster A: Investigate transformations in the plane.	
HSG.CO.A.1	Based on the undefined notions of *point*, *line*, *plane*, distance along a *line*, and distance around a circular arc, define: ● *Angle* ● *Line segment* ● *Circle* ● *Perpendicular lines* ● *Parallel lines* Teacher Note: The teacher's role in this process is that of facilitator. Students will continue to develop and refine definitions through their experiences in the course.
HSG.CO.A.2	Experiment with transformations in the plane. ● Represent *transformations* in the *plane* (e.g., using tracing paper, geometry software). ● Describe *transformations* as functions that take *points* in the *plane* as inputs and give other *points* as outputs. ● Compare rigid *transformations* to non-rigid *transformations.*
HSG.CO.A.3	Given a *rectangle, parallelogram, trapezoid*, or *regular polygon*, describe *the rotations* and *reflections* that carry it onto itself. Teacher Note: Symmetry can be thought of as a *transformation* (namely, a *reflection* or *rotation*) that maps a figure onto itself so that the image of every *poin*t on the pre-image maps back onto the pre-image.
HSG.CO.A.4	Develop definitions of *rotations, reflections*, and *translations* in terms of *angles, circles, perpendicular lines, parallel lines*, and *line segments.* Teacher Note: Attention to precision is needed as students move beyond their initial understanding of *transformations* as slides, flips, and turns. Students should develop definitions of the *transformations* in terms of their properties.
HSG.CO.A.5	Experiment with transformations in the plane. ● Given a geometric figure and a *rotation, reflection,* or *translation*, draw the transformed figure (e.g., using graph paper, tracing paper, *miras*, geometry software). ● Specify a sequence of *transformations* that will carry a given figure onto another.
Cluster B: Understand congruence in terms of rigid motions.	
HSG.CO.B.6	Develop a defintion of triangle congruence in terms of *rigid motions*. ● 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	Develop understanding of triangle congruence criteria. ● Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of *rigid motions*.

	● Investigate congruence in terms of *rigid motion* and use findings to develop the criteria for triangle congruence, (i.e., ASA, SAS, AAS, SSS, and HL). Teacher Note: The emphasis in this standard should be placed on an investigation. This standard is to be completed after HSG.CO.B.6 and HSG.CO.B.7.
Cluster C: Apply and prove geometric theorems.	
HSG.CO.C.9	Apply and prove *theorems* about *lines* and *angles*. Teacher Note: Examples of *theorems* include: ● *Vertical angles* are *congruent.* ● *Parallel lines* cut by a *transversal* create congruent alternate interior and corresponding angles. ● *Points* on a *perpendicular bisecto*r are equidistant from the endpoints of the *line segment.*
HSG.CO.C.10	Apply and prove *theorems* about triangles. Teacher Note: *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*.
HSG.CO.C.11	Apply and prove *theorems* about quadrilaterals. Teacher Note: *Theorems* include relationships among the sides, angles, and diagonals of quadrilaterals and the following theorems concerning *parallelograms*: opposite sides are congruent, opposite angles are congruent, the diagonals of a *parallelogram* bisect each other, and conversely, *rectangles are parallelograms* with congruent diagonals.
Cluster D: Make geometric constructions.	
HSG.CO.D.12	Make formal geometric constructions with a variety of tools and methods (e.g., compass and straightedge, string, reflective devices, paper folding, dynamic geometric software). Teacher Note: Constructions include: 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.D.13	Construct an equilateral triangle, a square, and a regular hexagon *inscribed* in a circle.
Cluster E: Logic and Reasoning.	
HSG.CO.E.14	Apply *inductive reasoning* and *deductive reasoning* for making predictions based on real-world situations using: ● *Conditional Statements* (e.g., *inverse, converse, and contrapositive*) ● *Venn Diagrams* Teacher Note: This is not intended to be an isolated topic but instead to support concepts throughout the course. *Inductive reasoning* is essential for observations, recognizing patterns, and making predictions. While this is useful and necessary, only *deductive reasoning* constitutes a mathematical proof.

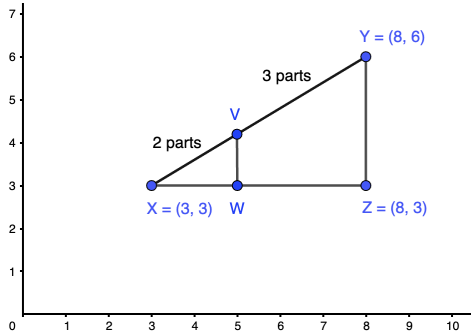
Similarity, Right Triangles, and Trigonometry	
Cluster A: Understand similarity in terms of similarity transformations.	
HSG.SRT.A.1	Verify experimentally the properties of *dilations* given by a center and a *scale factor:* ● A *dilation* takes a *line* not passing through the center of the *dilation* to a *parallel line* and leaves a *line* passing through the center unchanged. ● 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* to determine if two figures are *similar*. Two figures are *similar* if there is a *dilation* and/or sequence of rigid *transformations* that maps one figure to the other. ● Explain using *similarity transformations* that if two triangles are *similar* then the *corresponding* pairs of *angles* are *congruent* and the *corresponding* pairs of sides are proportional.
HSG.SRT.A.3	Use the properties of *similarity transformations* to establish the AA~, SAS~, and SSS~ criteria for two triangles to be *similar.*
Cluster B: Apply and prove theorems involving similarity.	
HSG.SRT.B.4	Use triangle *similarity* to apply and prove *theorems* about triangles, including: ● A *line* parallel to one side of a triangle divides the other two proportionally and conversely ● The Pythagorean Theorem proved using triangle *similarity* ● Geometric Mean Theorem
HSG.SRT.B.5	Apply congruence and similarity criteria. ● Use congruence (e.g., SSS, SAS, ASA, AAS, and HL) and *similarity* (e.g., AA~, SSS~, and SAS~) criteria for triangles to solve problems. ● Use congruence and *similarity* criteria to prove relationships in geometric figures.

Cluster C: Define trigonometric ratios and solve problems involving right triangles.	
HSG.SRT.C.6	Understand that definitions for trigonometric ratios can be developed by *similarity*. Side ratios in right triangles are properties of the *angles* in the triangle, leading to definitions of trigonometric ratios for acute *angles.* Teacher Note: Example: Trigonometric ratios are related to the acute *angles* of a triangle, not the right *angle*. The value of the trigonometric ratio depends only on the *angle*. Consider the following three *similar* right triangles. Since *angle* C is a right angle, then $\frac{EG}{EB} = \frac{DF}{DB} = \frac{AC}{AB}$ all represent sin *B.* 
HSG.SRT.C.7	Explain and use the relationship between the sine and cosine of *complementary angles.*
HSG.SRT.C.8	Use trigonometric ratios, *special right triangles*, and the Pythagorean Theorem to find unknown measurements of right triangles in applied problems. Teacher Note: Examples should include, but are not limited to *angles of elevation*, *angles of depression*, navigation, and surveying.

Circles	
Cluster A: Understand and apply theorems about circles.	
HSG.C.A.1	Prove that all circles are *similar*.  Teacher Note: Recognize that all *circles* are related by a *dilation*, possibly along a *translation.*
HSG.C.A.2	Identify and describe relationships among *inscribed angles*, *arcs*, 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*. Teacher Note: Students use these relationships to prove the properties of *angles* for a quadrilateral inscribed in a *circle.*

Cluster B: Find arc lengths and areas of sectors of circles.	
HSG.C.B.5	Explore various measurements of circles, building from arc measures. ● Use *similarity* to derive that the length of the *arc* intercepted by an *angle* is proportional to the *radius*. ● Derive and use the formula for the *area* of a *sector.* ● Understand the *radian* measure of the *angle* as a unit of measure. Teacher Note: Students recognize *radian* as an alternative method to define the *measure of an angle* based on the arc it cuts off.

Expressing Geometric Properties with Equations	
Cluster A: Translate between the geometric description and the equation of a conic section.	
HSG.GPE.A.1	Derive the equation of a *circle* of given center and *radius* using the Pythagorean Theorem. Find the center and *radius* of a *circle*, given the equation of the *circle*, including completing the square when necessary. Teacher Note: Specification: In problems involving completing the square, expectations of this standard are limited to equations with a leading coefficient of one.
Cluster B: Use coordinates to prove simple geometric theorems algebraically.	
HSG.GPE.B.4	On the coordinate plane, algebraically prove geometric *theorems* and properties. Teacher Note: Specification: Focus on quadrilaterals, right triangles, and *circles* .
HSG.GPE.B.5	Prove the *slope* criteria for parallel and perpendicular *lines* and use the *slope* criteria to solve geometric problems. Teacher Note: ● Asks students to explore the *slopes* of *parallel* and *perpendicular lines* and make conjectures about their relationships. ● Use *transformations* to explain why the relationships of the slope of *parallel* and *perpendicular* lines hold true. ● Ask students to solve problems involving equations of *parallel* and *perpendicular lines* .

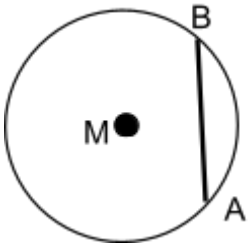
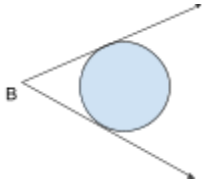
HSG.GPE.B.6	Find the *point* of a directed *line segment* between two given *points* that partitions the segment in a given ratio. Teacher Note: Intent is to include but move beyond the *midpoint* formula. This concept relates the proportional relationship formed to *dilations* and to coordinates and the coordinate system. Use *dilations* to find the coordinates of a *poin*t that divide a directed segment in a given ratio. Example: Suppose we want to find point *V* that divides the directed segment from *X* to *Y* in a 2:3 ratio, as shown.Then Δ*XVW* is a dilation of Δ*XYZ* using $\frac{2}{5}$ scale factor, since *XY* will be 5 parts total, and the initial segment of 2 parts serves as the image. Since *XZ* = 5 and *YZ* = 3, then $XW = \frac{2}{5} \bullet 5 = 2$, and $VW = \frac{2}{5} \bullet 3 = \frac{6}{5}$. Thus, the coordinates of *W* will be (3 + 2, 3) and *V* will be $(3 + 2, 3 + \frac{6}{5})$. 
HSG.GPE.B.7	Use coordinates to compute *perimeters* of *polygons* and *areas* of triangles and *rectangles.* Teacher Note: Examples should include but are not limited to using the distance formula and *area* of composite figures.

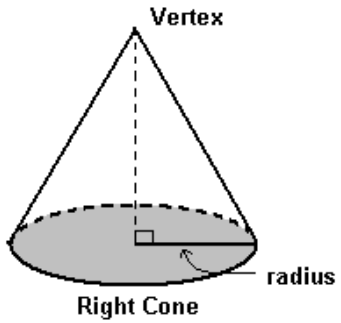
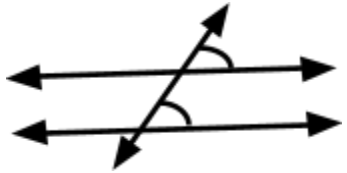
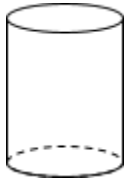
Geometric measurement and dimension	
Cluster A: Explain volume formulas and use them to solve problems.	
HSG.GMD.A.1	Give an informal argument for the formulas for the *circumference* and *area* of a *circle* and volume and *surface area* of a *cylinder*, *pyramid*, and *cone.* Teacher Note: ● Students should have seen the formulas in this standard in the middle grades. At this grade level, students are asked to justify why those formulas hold. ● Use dissection arguments and informal limit arguments.
HSG.GMD.A.3	Use *volume* formulas for *cylinders*, *pyramids*, *cones*, and spheres to solve real-world problems. Teacher Note: Provide students with opportunities to explore situations that can be modeled using geometric solids.
Cluster B: Visualize relationships between 2D and 3D objects.	
HSG.GMD.B.4	Identify the shapes of 2D *cross-sections* of 3D objects, and identify 3D objects generated by *rotations* of 2D objects.

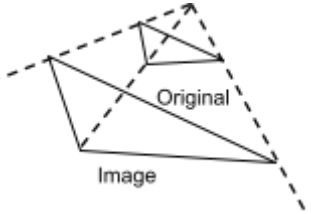
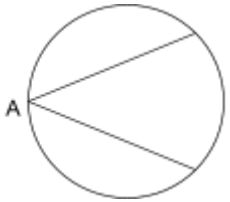
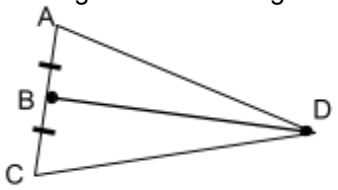
Modeling with Geometry	
Cluster A: Apply geometric concepts in modeling situations.	
HSG.MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a *cylinder*).
HSG.MG.A.2	Apply concepts of density based on *area* and *volume* in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
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).

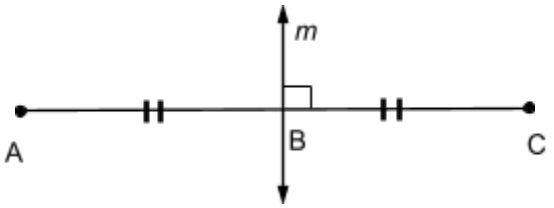
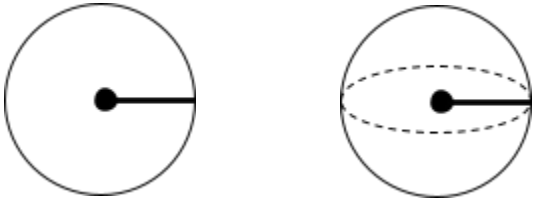
Interpreting categorical and quantitative data	
Cluster B: Summarize, represent, and interpret data on two categorical and quantitative variables.	
HSS.ID.B.5	Use categorical data to record counts or numbers of occurrences in experiments. ● Summarize categorical data for two categories in two-way frequency tables. ● Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). ● Recognize possible associations and trends in the data. Teacher Note: This is a shared standard with Algebra I.
HSS.ID.B.6	Represent data on two *quantitative variables* on a *scatter plot*, and describe how the *variables* are related: ● Fit a *function* to the data; use *functions* fitted to data to solve problems in the context of the data. Teacher Note: This is a shared standard with Algebra I and Algebra II. Specification: Use given *functions* or choose a *function* suggested by the context. Geometry students will use given *functions* or choose a *function* suggested by the context. The focus of Algebra I & Geometry should be on linear and exponential models.
Cluster C: Interpret linear models.	
HSS.ID.C.7	Interpret the *slope* (*rate of change*) and the *intercept* (constant term) of a linear model in the context of the data. Teacher Note: This is a shared standard with Algebra I.
HSS.ID.C.8	Compute (using technology) and interpret the *correlation coefficient* of a linear fit. Teacher Note: This is a shared standard with Algebra I. Specification: The focus is not on computing the *correlation coefficient* but on understanding what it tells us about the strength of the relationship between the two sets of data.
HSS.ID.C.9	Distinguish between *correlation* and *causation.* Teacher Note: This is a shared standard with Algebra I.

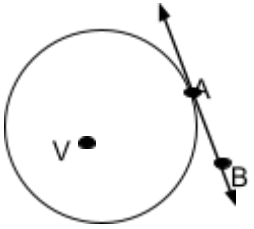
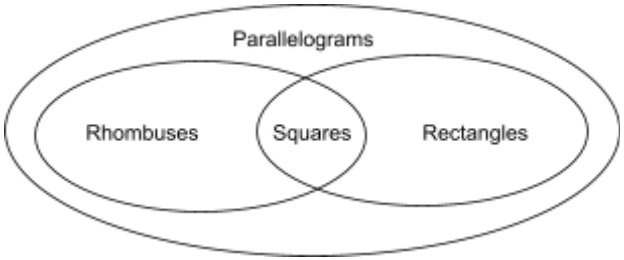
Glossary

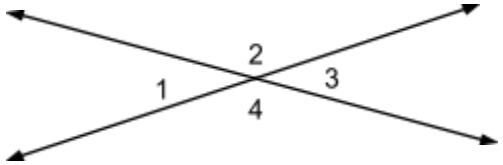
Angle	Two rays that share a common endpoint. The rays are called the sides of the angle and the common endpoint is the vertex of the angle.
Arc of a circle	Any continuous (unbroken) part of the circumference of a circle.
Area	The measure of the size of the interior of a figure, expressed in square units.
Center of a circle	The coplanar point from which all points of the circle are the same distance.
Chord	A segment whose endpoints lie on the circle. When the chord passes through the center of the circle, it is referred to as a diameter.  Line segment BA is a chord on circle M.
Circle	The set of all points in a plane equidistant from a given point called the **center**. The distance from the center to the circumference of the circle is called the **radius**.
Circumference	The perimeter of a circle, which is the distance around a circle.
Circumscribed angle	An angle whose vertex lies outside of a circle and whose sides are tangent to the circle.  Angle B is a circumscribed angle.
Complementary angles	Two angles (adjacent or nonadjacent) whose sum is 90 degrees.
Conditional statements	A statement that can be expressed in ‘if-then’ form.
Cone	A three-dimensional figure with one circular base and a vertex.

	
Congruent	Identical in shape and size (angles, line segments, circles, or polygons). In congruent polygons, corresponding angles and corresponding sides have the same measure (congruent).
Contrapositive	The statement formed by exchanging and negating the hypothesis and conclusion of a conditional statement.
Converse	The statement formed by exchanging the hypothesis and conclusion of a conditional statement.
Corresponding (side or angle)	A side (or angle) of a polygon that is in the same position as a side (or angle) of a congruent or similar polygon.
Corresponding angles	Two angles are formed by a transversal intersecting two lines that lie in the same position relative to the two lines and the transversal. 
Cross-section	A plane figure obtained by the intersection of a solid with a plane.
Cylinder	A three-dimensional figure with congruent, parallel bases. 
Deductive reasoning	The process of showing that certain statements follow logically from agreed-upon assumptions and proven facts.

Dilation	A nonrigid transformation that enlarges or reduces a geometric figure by a scale factor relative to a point. 
Inductive reasoning	The process of observing data, recognizing patterns, and making generalizations based on those patterns.
Inscribed angle	An angle whose vertex lies on a circle and whose sides are chords of the circle.  Angle A is an inscribed angle
Interior angle	An angle of a polygon that lies inside the polygon.
Inverse statement	The statement formed by negating the hypothesis and conclusion of a conditional statement.
Line	A straight, continuous arrangement of infinitely many points extending forever in two directions.
Line segment	Two points and all the points between them that are collinear with the two endpoints.
Measure of an Angle	The amount of rotation about the vertex required to bring one side of the angle into correspondence with the other side.
Median	A line segment connecting a vertex of a triangle to the midpoint of the opposite side  Line segment BD is the median of triangle ADC.
Midpoint	The point on the line segment that is the same distance from both endpoints; bisects the segment.
Mira	A transparent geometric tool used for exploration and construction with reflections and symmetry.
Parallel lines (segments or rays)	Coplanar lines (segments or rays) that do not intersect.
Parallelogram	A quadrilateral with both pairs of opposite sides parallel.
Perimeter	The sum of the lengths of the sides of a polygon; the distance around a geometric figure.

Perpendicular bisector	A line (segment or ray) that divides a line segment into two congruent parts, and is perpendicular to the line segment.  Line *m* is the perpendicular bisector of line segment *ab*.
Perpendicular lines (segments or rays)	Lines (segments or rays) that meet at 90° angles.
Plane	A flat surface that extends indefinitely along its edges; two-dimensional with a length and width, but no thickness
Point	An undefined term that names a location. A point has no size or dimension.
Polygon	A closed plane figure whose sides are segments that intersect only at their endpoints, with each segment intersecting exactly two other segments.
Pyramid	A polyhedron consisting of a polygon base and triangular lateral faces that share a common vertex.
Radian	A unit of measure for angles; the angle made at the center of a circle by an arc whose length is equal to the radius of the circle has a measure of one radian.
Radius (circle or sphere)	A line segment from the center of a circle or sphere to a point on the circle or sphere. 
Rectangle	A parallelogram with opposite sides congruent
Reflection	A transformation in which every point and its image are on opposite sides and the same distance from a fixed line.
Regular polygon	A polygon with all sides congruent and all angles congruent.
Rigid motion	A transformation that preserves size and shape; image congruent to the original figure.
Rotation	A transformation in which each point is moved by the same angle measure in the same direction along a circular path about a fixed point
Scale factor	The ratio of corresponding lengths in similar figures.
Similarity Transformation	A transformation that preserves angles and changes all distances in the same ratio. A dilation is a similarity transformation.
Similar	Two figures are similar if and only if all corresponding angles are congruent and lengths of all corresponding sides are proportional
Slope	The ratio of the vertical change to the horizontal change between two points on a line.

Special right triangles	A triangle whose angles are either 30-60-90 degrees or 45-45-90 degrees.
Sphere	A three-dimensional figure where all points on the surface are equally distant from a given point called the center of a sphere.
Supplementary angles	Two angles (adjacent or nonadjacent) whose sum is 180 degrees.
Surface area	The sum of the areas of all of the surfaces of a solid.
Tangent line	A line in a plane of the circle that intersects the circle in only one point.  Line AB is a tangent of circle V.
Theorem	A conjecture that has been proven within a deductive system.
Transformation	A rule that assigns to each point of a figure another point in the plane, called its image.
Translation	A transformation where each point is moved in the same direction and the same distance.
Transversal	A line that intersects two or more other coplanar lines.
Trapezoid	A quadrilateral with at least one pair of opposite sides parallel.
Venn diagram	A concept map of overlapping circles or ovals that shows the relationships among members of different sets. 

Vertical angles	Nonadjacent, nonoverlapping congruent angles formed by two intersecting lines; share a common vertex.  1 and 3 are vertical angles. 2 and 4 are vertical angles.
Volume	A measure of the amount of space contained in a solid expressed in cubic units.

Appendix A

Mathematical Modeling Cycle

The basic modeling cycle is summarized in this diagram. It involves: (1) identifying variables in the situation and selecting those that represent essential features; (2) formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables; (3) analyzing and performing operations on these relationships to draw conclusions; (4) interpreting the results of the mathematics in terms of the original situation; (5) validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable; (6) reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.