Section-by-Section Objectives

The following are the student goals for Elementary Geometry for College Students, Thrid Edition

Chapter One: Line and Angle Relationships

Section 1.1 : Statements and Reasoning

1. determine whether a collection of words/symbols forms a statement;
2. form the negation of a given statement;
3. form the conjunction, disjunction, or implication determined by two statements;
4. recognize the hypothesis/conclusion of a conditional statement;
5. state the three types of reasoning used in geometry;
6. determine the type of reasoning used in a specific situation; and
7. recognize/apply the Law of Detachment.

Section 1.2: Informal Geometry and Measurement

1. describe the terms point, line, and plane;
2. become familiar with geometric terms such as collinear, line segment, and angle;
3. measure a line segment with a ruler/measure an angle with a protractor;
4. write equations based upon statements involving midpoint, bisect, and congruent;
5. recognize the terms right angle, straight angle, and perpendicular;
6. use the compass to construct a line segment of specified length; and
7. use the compass to determine the midpoint of a given line segment.

Section 1.3: Early Definitions and Postulates

1. know the parts of a mathematical system: undefined terms, definitions, postulates, and theorems;
2. recognize the need for/characteristics of a precise definition;
3. know the definition/symbol for line segment and its length;
4. accept and state the initial postulates involving lines and planes (in your own words);
5. use the Segment-Addition Postulate to write equations;
6. understand the concepts parallel lines and parallel planes; and
7. recognize the significance of the term "unique" as it applies to geometry.

Section 1.4: Angles and Their Relationships

1. know the definition/symbol for angle and its measure;
2. understand/use terms related to angles (like sides, vertex, etc.);

3. state/apply postulates involving an angle(s);
4. recognize the type of angle shown/measured: acute, right, obtuse, and straight;
5. use the Angle-Addition Postulate to write equations;
6. know the classifications of pairs of angles: adjacent, congruent, complementary, supplementary, and vertical;
7. use the compass to construct an angle congruent to a given angle; and
8. use the compass to construct the bisector of a given angle.

Section 1.5: Introduction to Geometric Proof

1. demonstrate the two-column form of a proof;
2. understand the role of the Given, Prove, and Drawing for a proof problem;
3. provide reasons that justify statements supplied in partial proofs; and
4. provide statements that are justified by the reasons supplied in partial proofs;

Section 1.6: Relationships: Perpendicular Lines

1. know/apply the definition of perpendicular lines in practice and proof;
2. develop an understanding of the concept of "relation;"
3. understand/apply the reflexive, symmetric, and transitive properties of congruence;
4. construct the unique line perpendicular to a line at a point on the line; and
5. construct the unique perpendicular-bisector of a given line segment.

Section 1.7: The Formal Proof of a Theorem

1. state the hypothesis and conclusion of a given theorem;
2. state the five written parts of the formal proof of a theorem;
3. make the "Drawing" for the proof of a theorem based upon the hypothesis of the theorem;
4. write the "Given" for the proof of a theorem based upon its hypothesis and the "Drawing";
5. write the "Prove" for the proof of a theorem based upon its conclusion and the "Drawing";
6. state/apply theorems involving perpendicular lines, complementary angles, and so on; and
7. construct/complete the formal proof of a theorem.

A Look Beyond Chapter 1: Historical Sketch of Euclid

1. recognize Euclid (Greek) as a principal contributor to geometry; and
2. know that the Elements of Euclid are the basis for any plane geometry textbook.

Chapter Two: Parallel Lines

Section 2.1: The Parallel Postulate and Special Angles

1. construct the perpendicular line from a point not on a given line to that line;
2. recognize when two lines, a line and a plane, or two planes are perpendicular;
3. recognize when two lines, a line and a plane, or two planes are parallel;
4. define parallel lines and parallel planes;
5. understand/apply terms such as transversal, corresponding angles, etc.;
6. state/apply initial postulates involving parallel lines; and
7. state/complete/apply selected theorems involving given parallel lines.

Section 2.2: Indirect Proof

1. know the true/false relationships between a conditional statement and its converse, inverse, and contrapositive;
2. state/apply the Law of Negative Inference;
3. state/apply the method of indirect proof; and
4. recognize that negations/uniqueness theorems are often proved indirectly.

Section 2.3: Proving Lines Parallel

1. state/apply/prove selected theorems establishing that lines are parallel; and
2. construct the line parallel to a given line through a point outside the line.

Section 2.4: The Angles of a Triangle

1. know definitions of triangle and related terms (vertices, sides, etc.);
2. classify triangles by their sides (scalene, isosceles, equilateral);
3. classify triangles by their angles (acute, right, obtuse, and equiangular);
4. know/apply the theorem, "The sum of angles of a triangle is 180°."; and
5. state/apply/prove the corollaries of the theorem stated in (4).

Section 2.5: Convex Polygons

1. know the definitions of polygon and related terms;
2. classify polygons as convex/concave and by their numbers of sides;
3. determine the number of diagonals for a polygon of n sides;
4. state/apply theorems involving sums of angle measures of a polygon;
5. classify polygons as equiangular/equilateral/regular; and
6. recognize a figure that is a polygram/regular polygram.

A Look Beyond Chapter Two: Non-Euclidean Geometries

1. know that the Parallel Postulate characterizes Euclidean (plane) Geometry;
2. recognize the existence of geometries other than plane geometry.

Chapter Three: Triangles

Section 3.1: Congruent Triangles

1. state the definition of congruent triangles;
2. determine the correspondences between parts of congruent triangles;
3. determine the included side (angle) for 2 angles (2 sides) of a triangle; and
4. know/apply these methods for proving congruence of triangles: SSS, SAS, ASA, and AAS.

Section 3.2: Corresponding Parts of Congruent Triangles

1. use CPCTC to symbolize "Corresponding parts of congruent triangles are congruent";
2. recognize the types of conclusions that can be established by using CPCTC;
3. use markings on congruent triangles to indicate their corresponding parts;
4. state/apply the HL theorem;
5. state/apply the Pythagorean Theorem; and
6. determine the method that establishes that triangles are congruent.

Section 3.3: Isosceles Triangles

1. distinguish between angle-bisector of angle of triangle, altitude of triangle, perpendicular-bisector of a side of triangle, and median of a triangle;
2. know that a triangle has three angle-bisectors/altitudes/medians/perpendicular-bisectors of sides;
3. decide whether an auxiliary line is determined/overdetermined/underdetermined;
4 state/use "If two sides of a triangle are congruent, the angles opposite these sides are congruent.";
5 state/apply "If two angles of a triangle are congruent, the sides opposite these angles are congruent."; and
6. state/apply the definition of perimeter of a triangle.

Section 3.4: Basic Constructions Justified

1. construct/justify the construction of an angle congruent to a given angle;
2. construct/justify the angle-bisection method;
3. construct/validate the construction of line segments of specified length;
4. construct/validate the construction of angles of specified measure; and
5. construct/validate the construction of selected regular polygons.

Section 3.5: Inequalities in a Triangle

1. know/use the definition of "is less than";
2. know the relationships found in the lemma (helping theorems) of this section;
3. state/apply theorems involving inequalities in a triangle;
4. state/apply corollaries involving the length of a line segment from a point not on a line (or plane) perpendicular to the line or plane; and
5. state/apply the Triangle Inequality (or its alternate form).

A Look Beyond Chapter 3: Historical Sketch of Archimedes

1. know that Archimedes' contributions to geometry included a good approximation of π; and
2. know that Archimedes was famous for inventions such as the catapult.

Chapter Four: Quadrilaterals

Section 4.1: Properties of a Parallelogram

1. state definitions for quadrilateral and parallelogram;
2. state/apply/prove selected theorems involving given parallelograms;
3. use angle measures of a parallelogram to determine its longer/shorter diagonal; and
4. determine speed/direction of an airplane whose motion is subject to the wind.

Section 4.2: The Parallelogram and Kite

1. recognize that the parallelogram/kite each have two pairs of congruent sides;
2. know that quadrilaterals with congruent opposite sides are parallelograms;
3. know that quadrilaterals with a pair of congruent and parallel sides are parallelograms;
4. know that quadrilaterals with diagonals that bisect each other are parallelograms;
5. know that the kite has one pair of opposite angles that are congruent;
6. know that the kite has a diagonal that is the perpendicular-bisector of the other diagonal; and
7. state/apply the theorem in which the midpoints of two sides of a triangle are joined.

Section 4.3: The Rectangle, Square, and Rhombus

1. state definitions for the rectangle, square, and rhombus;
2. state/apply/prove theorems involving the rectangle/square/rhombus;
3. state/apply/prove corollaries involving the rectangle/square/rhombus; and
4. apply the Pythagorean Theorem to quadrilaterals..

Section 4.4: The Trapezoid

1. know the terminology related to the trapezoid and isosceles trapezoid;
2. state/apply/prove selected theorems and corollaries involving trapezoids; and
3. state/apply "If three (or more) parallel lines intercept congruent segments on one transversal, then they intercept congruent segments on any transversal."

A Look Beyond Chapter 4: Historical Sketch of Thales

1. know that Thales was called the "Father of Geometry"; and
2. know that Thales was famous for the wisdom he displayed in everyday affairs

Chapter Five: Similar Triangles

Section 5.1: Ratios, Rates, and Proportions

1. state/apply the terms ratio, rate, and proportion;
2. know the terminology (means, geometric mean, etc.) related to proportions;
3. state/apply the Means-Extremes Property (of a proportion); and
4. understand/apply further properties of proportions.

Section 5.2: Similar Polygons and Triangles

1. form an intuitive understanding of the concept "similarity of figures";
2. determine the correspondences between the parts of similar polygons;
3. state/apply the definition of similar polygons;
4. state/apply the AA corollary;
5. recognize/apply CSSTP, meaning "Corresponding sides of similar triangles are proportional;" and
6. recognize SAS$\sim$ and SSS$\sim$ as methods of verifying that triangles are similar.

Section 5.3: The Pythagorean Theorem

1. state/prove/apply Theorem 5.5.1 in establishing later theorems;
2. state/apply/prove theorems involving geometric means in the right triangle;
3. state/apply the Pythagorean Theorem and its converse;
4. determine whether (a,b,c) is a Pythagorean Triple; and
5. determine whether a triangle is acute, right, or obtuse based upon the lengths of sides.

Section 5.4: Special Right Triangles

1. state/apply/prove the 45°-45°-90° Theorem;
2. state/apply/prove the 30°-60°-90° Theorem; and

3. recognize/apply the equivalent theorems (Theorems 5.4.3 and 5.4.4).

Section 5.5: Segments Divided Proportionally

1. form an intuitive understanding of the concept "segments divided proportionally";
2. state/apply the definition of segments divided proportionally;
3. state/apply/prove the theorem that establishes that parallel lines determine proportional segments on transversals; and
4. state/apply the theorem, "The angle-bisector in a triangle separates the opposite side into segments whose lengths have the same ratio as the lengths of the sides of the bisected angle."

A Look Beyond Chapter 5: An Unusual Application of Similar Triangles

1. recognize the power of geometry in problem-solving; and
2. become familair with the concept of reflection as applied in this problem.

Chapter Six: Circles

Section 6.1: Circles and Related Segments and Angles

1. become familiar with the terminology (radius, center, chord, arc, etc.) of the circle;
2. state/apply postulates related to the circle;
3. state/apply/prove selected theorems related to the circle; and
4. state/apply methods of measuring central and inscribed angles in the circle.

Section 6.2: More Angle Measures in the Circle

1. state definitions for terms such as tangent and secant (of a circle);
2. recognize when polygons are inscribed in/circumscribed about circles;
3. recognize when circles are inscribed in/circumscribed about polygons; and
4. state/apply/prove theorems that relate angle and arc measures in the circle.

Section 6.3: Line and Segment Relationships in the Circle

1. state/apply/prove theorems relating radii and chords of a circle;
2. recognize/use terminology involving tangent circles;
3. recognize/use terminology involving common tangents to circles; and
4. state/apply/prove theorems involving lengths of chords, tangents, and secants.

Section 6.4: Some Constructions and Inequalities for the Circle

1. state/apply Theorem 6.4.1 (radius drawn to point of tangency is perpendicular to tangent);

2. perform constructions of tangent to circle from point *on* the circle or in *exterior* of circle; and
3. state/apply/prove theorems relating unequal chords, arcs, and central angles of a circle.

Section 6.5: Locus of Points

1. understand/state the definition of the term locus;
2. draw/construct/describe the locus of points for a selected condition(s);
3. recognize the locus of points equidistant from sides of angle (and from endpoints of line segment);
4. recognize/describe the differences between a locus in a plane/space; and
5. verify the locus theorem by establishing two results.

Section 6.6: Concurrence of Lines

1. understand/state the definition of concurrent lines;
2. state/apply/prove the concurrence of the three angle-bisectors of a triangle;
3. state/apply/prove the concurrence of the perpendicular-bisectors of sides of a triangle;
4. state/apply the concurrence of the three altitudes of a triangle; and
5. state/apply the concurrence of the three medians of a triangle.

A Look Beyond Chapter 6: The Value of π

1. know the fact, "The constant ratio of the circumference to the diameter of a circle is π."; and
2. know that some commonly used approximations of π are $\frac{22}{7}$, 3.14, and 3.1416.

Chapter Seven: Areas of Polygons and Circles

Section 7.1: Area and Initial Postulates

1. develop an intuitive understanding of the area concept;
2. distinguish between units of length and units of area measurement;
3. state/apply the initial postulates involving areas of regions; and
4. prove/apply theorems involving area of a square, parallelogram, or triangle.

Section 7.2: Perimeter and Area of Polygons

1. state/apply perimeter formulas for selected polygons;
2. state/apply Heron's Formula for the area of a triangle;
3. state/apply/prove formulas for the areas of trapezoid, rhombus, and kite; and
4. use the ratio between the lengths of corresponding sides of similar polygons to determine the ratio between their areas.

Section 7.3: Regular Polygons and Area

1. determine whether a given polygon can be inscribed in a circle;
2. determine whether a given polygon can be circumscribed about a circle;
3. perform constructions involving inscribed/circumscribed polygons and circles;
4. calculate measure of central angle, radius, and apothem of a regular polygon; and
5. determine the area of a regular polygon by applying the formula $A = \frac{1}{2}aP$.

Section 7.4: The Circumference and Area of a Circle

1. recall that π is the ratio of the circumference to the diameter of a circle;
2. know/apply the formulas $C = \pi d$ and $C = 2\pi r$ for circumference of a circle;
3. memorize the common approximations for π;
4. understand/apply the formula for the length of an arc; and
5. state/apply the formula for the area of a circle.

Section 7.5: More Area Relationships in the Circle

1. understand/apply the formula for the area of a sector;
2. determine the area of a segment of a circle;
3. prove that the area of a triangle with perimeter P and radius r of inscribed circle is given by $A = \frac{1}{2}rP$; and
4. determine the area of a triangle using the formula $A = \frac{1}{2}rP$.

A Look Beyond Chapter 7: Another Look at the Pythagorean Theorem

1. understand/compare the two "area" proofs of the Pythagorean Theorem.

Chapter Eight: Surfaces and Solids

Section 8.1: Prisms, Area and Volume

1. understand intuitively the notion of prism;
2. understand/use terminology (edges, vertices, etc.) related to prisms;
3. determine the lateral area/total area of a prism; and
4. memorize/apply the formula for the volume of a prism.

Section 8.2: Pyramids, Area and Volume

1. understand intuitively the notion of pyramid;
2. understand/use terminology (edges, vertices, etc.) related to pyramids;
3. apply $\ell^2 = a^2 + h^2$, which relates slant height, apothem, and altitude of a regular pyramid;

4. determine the lateral area/total area of a pyramid; and
5. memorize/apply the formula for the volume of a pyramid.

Section 8.3: Cylinders and Cones

1. understand intuitively the notions of cylinder and cone;
2. understand/use terminology related to cylinders and cones;
3. apply $\ell^2 = r^2 + h^2$, which relates slant height, radius, and altitude of a right circular cone;
4. memorize/apply formulas for lateral/total area of a right circular cylinder;
5. memorize/apply formulas for lateral/total area of a right circular cone; and
6. memorize/apply formulas for the volume of a right circular cylinder/cone.

Section 8.4: Polyhedrons and Spheres

1. understand intuitively the notion of polyhedron;
2. know/use the terminology related to a polyhedron/regular polyhedron;
3. verify Euler's Equation $V + F = E + 2$, relating vertices, faces, and edges of a polyhedron;
4. state the five regular polyhedrons;
5. know/apply the term sphere and terminology related to a sphere;
6. memorize/apply formulas for surface area/volume of a sphere; and
7. understand/apply the concept of solid of revolution.

A Look Beyond Chapter 8: Historical Sketch of Descartes

1. recognize Descartes as inventor of the rectangular coordinate system; and
2. recognize/state the geometric figures known as conic sections.

Chapter Nine: Analytic Geometry

Section 9.1: The Rectangular Coordinate System

1. know/use terms related to the rectangular coordinate system;
2. plot/read points in the coordinate system as ordered pairs;
3. find the distance between two points on a vertical/horizontal segment;
4. know/apply/prove the Distance Formula; and
5. know/apply the Midpoint Formula.

Section 9.2 : Graphs of Linear Equations and Slope

1. state/apply the definition of graph of equation;
2. determine/use intercepts in graphing straight lines;

3. know/apply the Slope Formula;
4. determine by sight if a line has positive, negative, 0, or undefined slope; and
5. use slope relationships to determine if lines are parallel/perpendicular.

Section 9.3: Preparing to do Analytic Proofs

1. determine the analytic formula necessary to prove a given statement;
2. prepare the drawing used to complete the analytic proof of a theorem;
3. name/describe general coordinates of vertices for a particular type of geometric figure; and
4. use algebraic relationships to develop geometric relationships in given figures.

Section 9.4: Analytic Proofs

1. develop a logical and orderly plan needed to complete an analytic proof; and
2. construct the analytic proof of a given geometric theorem.

Section 9.5: Equation of Lines

1. use the Slope-Intercept and Point-Slope Forms to find equations of lines;
2. use the equation of a line to draw its graph;
3. use graphs/algebra to solve systems of equations (find points of intersection); and
4. develop analytic proofs for theorems by using equations of lines.

A Look Beyond Chapter 9: The Banach-Tarski Paradox

1. recognize noncollinearity as the reason for the paradox.

Chapter Ten: Introduction to Trigonometry

Section 10.1: The Sine Ratio and Applications

1. define/apply the sine ratio of an acute angle of a right triangle;
2. use a table/calculator to determine the sine ratio of an acute angle;
3. use a table/calculator to determine the acute angle whose sine ratio is known; and
4. understand/apply the notion angle of elevation/depression.

Section 10.2: The Cosine Ratio and Applications

1. define/apply the cosine ratio of an acute angle of a right triangle;
2. use a calculator to determine the cosine ratio of an acute angle;
3. use a calculator to determine the acute angle whose cosine ratio is known; and
4. know/apply/prove the identity $\sin^2\alpha + \cos^2\alpha = 1$.

Section 10.3: The Tangent Ratio and Other Ratios

1. define/apply the tangent ratio of an acute angle of a right triangle;
2. recognize which trigonometric ratio (sine, cosine, tangent) can be used to determine an unknown measure in a right triangle;
3. use a calculator to determine the tangent ratio of an acute angle of a right triangle;
4. use a calculator to determine an acute angle whose tangent ratio is known;
5. state/apply the definitions of the cotangent, secant, and cosecant ratios for an acute angle of a right triangle; and
6. define/determine cot θ, sec θ, and csc θ as reciprocals of tan θ, cos θ, and sin θ respectively.

Section 10.4: More Trigonometric Relationships

1. state/apply the Reciprocal Identities;
2. state/apply the Quotient Relationships;
3. state/apply the Pythagorean Relationships;
4. state/apply the formula $A = \frac{1}{2}bc \sin \alpha$;
5. state/apply the Law of Sines;
6. state/apply the Law of Cosines; and
7. use given measures to decide whether the Law of Sines/Cosines should be used to find an unknown measure in a triangle.

A Look Beyond Chapter 10: Radian Measure of Angles

1. know that a counterclockwise/clockwise rotation corresponds to an angle whose measure is positive/negative;
2. draw/measure angles that have any positive/negative degree measure; and
3. know/apply the fact that $180^\circ = \pi$ radians.