

**MOORESTOWN TOWNSHIP PUBLIC SCHOOLS  
MOORESTOWN, NEW JERSEY**

**Moorestown High School  
Mathematics**

**CP Geometry  
*Grades 9-10***

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## [Course Description and Fundamental Concepts](#)

This course provides students with a foundation in the essentials of Geometry. Major concepts include points, lines & planes, deductive reasoning, parallel lines & planes, congruent lines, quadrilaterals, inequalities in Geometry, similar polygons, right triangles, circles, areas of plane figures, surface area & volume of solids, coordinate geometry and transformations. Proofs are infused throughout the course for the students in the M02-28 course. Algebraic applications of geometric concepts are infused throughout the curriculum.

## New Jersey Student Learning Standards (NJSLS)

### **Subject/Content Standards**

*Include grade appropriate subject/content standards that will be addressed*

#### **N -VM Vector and Matrix Quantities**

##### A. Represent and model with vector quantities.

1. Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g.,  $v$ ,  $|v|$ ,  $\|v\|$ ,  $v$ ).
2. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
3. Solve problems involving velocity and other quantities that can be represented by vectors.

##### B. Perform operations on vectors.

4. Add and subtract vectors.
  - a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
  - b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
  - c. Understand vector subtraction  $v - w$  as  $v + (-w)$ , where  $-w$  is the additive inverse of  $w$ , with the same magnitude as  $w$  and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.
5. Multiply a vector by a scalar.
  - a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as  $c(v_x, v_y) = (cv_x, cv_y)$ .
  - b. Compute the magnitude of a scalar multiple  $cv$  using  $\|cv\| = |c|v$ . Compute the direction of  $cv$  knowing that when  $|c|v \neq 0$ , the direction of  $cv$  is either along  $v$  (for  $c > 0$ ) or against  $v$  (for  $c < 0$ ).

#### **G-CO Congruence**

##### A. Experiment with transformations in the plane

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.
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).
3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

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.
- B. Understand congruence in terms of rigid motions
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.
  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.
  8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- C. Prove geometric theorems
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.
  10. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to  $180^\circ$ ; 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.
  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.
- D. Make geometric constructions
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.
  13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

### **G-SRT Similarity, Right Triangles, and Trigonometry**

- A. Understand similarity in terms of similarity transformations
1. Verify experimentally the properties of dilations given by a center and a scale factor:
    - a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
    - b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
  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.
  3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
- B. Prove theorems involving similarity
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.

5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- C. Define trigonometric ratios and solve problems involving right triangles
  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.
  7. Explain and use the relationship between the sine and cosine of complementary angles.
  8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- D. Apply trigonometry to general triangles
  9. Derive the formula  $A = \frac{1}{2} ab \sin (C)$  for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
  10. Prove the Laws of Sines and Cosines and use them to solve problems.
  11. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

### **G-C Circles**

- A. Understand and apply theorems about circles
  1. Prove that all circles are similar.
  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.
  3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
  4. Construct a tangent line from a point outside a given circle to the circle.
- B. Find arc lengths and areas of sectors of circles
  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.

### **G-GPE Expressing Geometric Properties with Equations**

- A. Translate between the geometric description and the equation for a conic section
  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.
- B. Use coordinates to prove simple geometric theorems algebraically
  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).
  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).
  6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
  7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

### **G-GMD Geometric Measurement and Dimension**

- A. Explain volume formulas and use them to solve problems

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.
  2. Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
  3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- B. Visualize relationships between two-dimensional and three-dimensional objects
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.

### **G-MG Modeling with Geometry**

- A. Apply geometric concepts in modeling situations
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).
  2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
  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).

### **S-CP Conditional Probability and the Rules of Probability**

- A. Understand independence and conditional probability and use them to interpret data
1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
  2. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
  3. Understand the conditional probability of A given B as  $P(A \text{ and } B)/P(B)$ , and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.

### **Mathematical Practice Standards**

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.



**21st-Century Skills and Technology Integration ([Standard 8](#))***List appropriate units below for which strands (A through F) will be addressed*

<b>Standard 8.1 (K-12)</b>		<b>Educational Technology:</b> <i>All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.</i>
<b>Unit Addressed</b>	<b>Strand Letter</b>	<b>Standard Description</b>
Units 1, 2, 3, 4, 5	<b>Strand A</b>	<b>Technology Operations and Concepts:</b> <i>Students demonstrate a sound understanding of technology concepts, systems, and operations.</i>
Units 1, 3	<b>Strand B</b>	<b>Creativity and Innovation:</b> <i>Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.</i>
Units 1, 2, 3, 4, 5	<b>Strand C</b>	<b>Communication and Collaboration:</b> <i>Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.</i>
	<b>Strand D</b>	<b>Digital Citizenship:</b> <i>Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.</i>
Unit 4	<b>Strand E</b>	<b>Research and Information Fluency:</b> <i>Students apply digital tools to gather, evaluate, and use information.</i>
Units 1, 2, 3, 4, 5	<b>Strand F</b>	<b>Critical thinking, problem-solving, and decision making:</b> <i>Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.</i>

**Career Ready Practices ([Standard 9](#))***List appropriate units below for which CRPs will be addressed*

<b>Unit Addressed</b>	<b>Standard #</b>	<b>Standard Description</b>
Units 1, 2, 3, 4, 5	<b>CRP1</b>	<i>Act as a responsible and contributing citizen and employee.</i>
Units 1, 2, 3, 4, 5	<b>CRP2</b>	<i>Apply appropriate academic and technical skills.</i>

	<b>CRP3</b>	<i>Attend to personal health and financial well-being.</i>
Units 1, 2, 3, 4, 5	<b>CRP4</b>	<i>Communicate clearly and effectively and with reason.</i>
	<b>CRP5</b>	<i>Consider the environmental, social and economic impacts of decisions.</i>
Units 1, 2, 3, 4, 5	<b>CRP6</b>	<i>Demonstrate creativity and innovation.</i>
	<b>CRP7</b>	<i>Employ valid and reliable research strategies.</i>
Units 1, 2, 3, 4, 5	<b>CRP8</b>	<i>Utilize critical thinking to make sense of problems and persevere in solving them.</i>
Units 1, 2, 3, 4, 5	<b>CRP9</b>	<i>Model integrity, ethical leadership, and effective management.</i>
	<b>CRP10</b>	<i>Plan education and career paths aligned to personal goals.</i>
Units 1, 2, 3, 4, 5	<b>CRP11</b>	<i>Use technology to enhance productivity.</i>
Units 1, 2, 3, 4, 5	<b>CRP12</b>	<i>Work productively in teams while using cultural global competence</i>

### Interdisciplinary Connections

List any other content standards addressed as well as appropriate units

### Visual & Performing Arts Integration ([Standard 1](#))

List appropriate units below for which standards (1.1 through 1.4) may be addressed

Unit Addressed	Standard #	Standard Description
Unit 1	<b>Standard 1.1</b>	<b>The Creative Process:</b> <i>All students will demonstrate an understanding of the elements and principles that govern the creation of works of art in dance, music, theatre, and/or visual art.</i>
	<b>Standard 1.2</b>	<b>History of the Arts and Culture:</b> <i>All students will understand the role, development, and influence of the arts throughout history and across cultures.</i>
Units 1, 2, 3, 4, 5	<b>Standard 1.3</b>	<b>Performing/Presenting/Producing:</b> <i>All students will synthesize those skills, media, methods, and technologies appropriate to creating, performing, and/or presenting works of art in dance, music, theatre, and/or visual art.</i>
	<b>Standard 1.4</b>	<b>Aesthetic Responses &amp; Critique Methodologies:</b> <i>All students will demonstrate and apply an understanding of arts philosophies, judgment, and analysis to works of art in dance, music, theatre, and/or visual art.</i>

**Other Interdisciplinary Content Standards**

List appropriate units below for any other content/standards that may be addressed

<b>Unit Addressed</b>	<b>Content / Standard #</b>	<b>Standard Description</b>
Units 1, 3	<b>HS-ETS1-3</b>	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants
Unit 1	<b>9.1.12.A.9</b>	Analyze how personal and cultural values impact spending and other financial decisions.
Unit 1	<b>HS-LS4-4</b>	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
Unit 1	<b>1.1.12.D.1</b>	Distinguish innovative applications of the elements of art and principles of design in visual artworks from diverse cultural perspectives and identify specific cross-cultural themes.
Units 1, 3	<b>8.2.12.D.3</b>	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
Units 2, 3	<b>HS-PS2-3</b>	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
Unit 2	<b>2.1.8.A.3</b>	Relate advances in technology to maintaining and improving personal health.
Unit 3	<b>HS-ESS1-6</b>	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
Unit 3	<b>HS-ESS1-6</b>	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
Unit 4	<b>HS-ESS2-1</b>	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features

Unit 4	<b>HS-PS2-1</b>	Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
Unit 5	<b>6.1.12.B.14.a</b>	Determine the impact of recent immigration and migration patterns in New Jersey and the United States on demographic, social, economic, and political issues.
Unit 5	<b>9.1.12.B.2</b>	Compare strategies for saving and investing and the factors that influence how much should be saved or invested to meet financial goals.

**Pacing Guide** (All Dates are approximate based on the school calendar)

<b>Unit/ Topic</b>	<b>Month</b> (w/Approx number of Teaching Days)
<b>UNIT 1</b> Essential Geometric Tools and Concepts	<b>September</b> (~19 days)
<b>UNIT 1</b> Essential Geometric Tools and Concepts	<b>October</b> (~19 days)
<b>UNIT 1</b> Essential Geometric Tools and Concepts	<b>November</b> (~16 days)
<b>UNIT 2</b> Transformations  <b>UNIT 3</b> Triangles and Quadrilaterals	<b>December</b> (~15 days)
<b>UNIT 3</b> Triangles and Quadrilaterals	<b>January</b> (~18 days)
<b>UNIT 3</b> Triangles and Quadrilaterals	<b>February</b> (~18 days)
<b>UNIT 3</b> Triangles and Quadrilaterals	<b>March</b> (~15-20 days)
<b>UNIT 3</b> Triangles and Quadrilaterals	<b>April</b> (~15-20 days)
<b>UNIT 4</b> Circles	<b>May</b> (~18 days)
<b>UNIT 5</b> Circumference, Area, and Volume	<b>June</b> (~15 days)

## [Units](#)

Contact the Content Supervisor for unit details.