05 Analytic and Coordinate Geometry

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **5 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

[NJSLS Geometry Overview](#)

In this unit students analyze Geometric relationships on the coordinate plane and develop algebraic connections. This begins with a reexamination of transformations on the coordinate plane though the use of function rules. Students will develop and use the midpoint and distance formulas to be used with examining quadrilateral properties as well as calculating the perimeters of polygons. This unit also uses linear equations to examine parallel and perpendicular lines. It is here too, where we address the "finding a point on a directed lines segment" problem. These and other ideas are combined so that students can prove geometric concepts using coordinate proofs. Lastly and as segue to the next unit, the equation of a circle is developed from the Pythagorean Theorem, and students use completing the square to find the center and radius of a circle from an equation.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Students will utilize function rules to analyze and represent geometric transformations
- Students will understand and apply the midpoint and distance formulas
- Students will write equations of parallel and perpendicular lines
- Students will use coordinate proofs
- Students will write equations of circles in standard form

Essential Questions:

- How are functions used to represent geometric transformations?
- How are algebraic equations used to describe geometric figures?
- What are advantages and/or disadvantages of analyzing geometry on the coordinate plane?

Enduring Understandings:

- The coordinate plane allows us to analyze geometric figures though algebraic means.
- Function notation and related mapping rules can be used to represent transformations in the coordinate plane
- Transformations can be analyzed in the coordinate plane
- The distance formula is derived from the Pythagorean theorem
- The standard from equation of a circles is derived from the Pythagorean Theorem

CONTENT AREA STANDARDS

MA.G-CO.A.2	Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.G-GPE.A.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
MA.G-GPE.B.4	Use coordinates to prove simple geometric theorems algebraically.
MA.G-GPE.B.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
MA.G-GPE.B.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
MA.G-GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
MA.G-SRT.A.1	Verify experimentally the properties of dilations given by a center and a scale factor:

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.

CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Points will lie on either the x axis (x value, 0). y axis (0, y value), in the first quadrant (+, +), 2nd quadrant (-, +), 3rd quadrant (-, -) or forth quadrant (+, -)
- Function notation and related mapping rules can be used to represent transformations in the coordinate plane
- Transformations can be analyzed in the coordinate plane
- The distance formula is derived from the Pythagorean theorem
- The length of a horizontal or vertical segment can be found by counting the number of units contained in the segment
- The length of a diagonal segment can be found by creating a right triangle that contains the diagonal segment as its hypotenuse.
- The standard from equation of a circle is derived from the Pythagorean theorem
- The slope formula be used to determine its value.
- The slope of a vertical line is undefined
- The slope of a horizontal line is zero
- Positive slopes rise at the right.
- Negative slope fall at the right.
- Knowing the slope of two lines will determine whether they are parallel, perpendicular or neither

Procedural Knowledge

Students will be able to:

- Sketch a circle whose center and radius is given.
- Determine the center and radius of a circle in a diagram
- Derive the equation of a circle of given center and radius using the Pythagorean Theorem. Knowledge Utilization

- Prove simple geometric theorems algebraically using coordinates. Knowledge Utilization
- Determine if two lines are parallel, perpendicular or neither.
- Draw a segment that is parallel, perpendicular or neither parallel or perpendicular to another line segment
- Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems. Knowledge Utilization
- Verify experimentally that 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. Analysis
- Verify experimentally that the dilation of a line segment is longer or shorter in the ratios given by the scale factor. Analysis
- Complete the square to find the center and radius of a circle given by an equation. Comprehension
- Find the point on a directed line segment between two given points that partitions the segment in a given ratio. Comprehension
- Represent transformations in a plane. Comprehension
- Use coordinates to compute perimeters of polygons and areas of triangles and rectangles. (★) Comprehension

EVIDENCE OF LEARNING

Formative Assessments
- Student feedback/questioning/observation
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Task completion and review of quizzes and material presented in the Geometry class

Summative Assessments
There will be no formal assessments in this course.

RESOURCES (Instructional, Supplemental, Intervention Materials)
Illustrative Mathematics unit: Coordinate Geometry

Khan Academy unit: Analytic Geometry

NJCTL unit: [Analytic (coordinate) Geometry](#)

Desmos Activities:[The coordinate plane](#), [Introduction: Graphing Circles](#), [Parallel and Perpendicular lines](#), [dilating lines activity](#) [distance and midpoint formula](#), [partitioning a line](#)

Course approved textbook

Kuta Software worksheets

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations taken from business, physics, engineering, biology, statistics, geography, and numerous other fields. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.