

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 through 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 line 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 through 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 form equation of a circle is derived from the Pythagorean Theorem

CONTENT AREA STANDARDS

G.C

- A. Understand and apply theorems about circles**
- B. Find arc lengths and areas of sectors of circles**

G.CO

- A. Experiment with transformations in the plane**
- B. Understand Congruence in terms of rigid motions**
- C. Prove geometric theorems**
- D. Make geometric constructions**

G.GMD

- A. Explain volume formulas and use them to solve problems**
- B. Visualize relationships between two-dimensional and three-dimensional objects**

G.GPE

- A. Translate between the geometric description and the equation for a conic section**
- B. Use coordinates to prove simple geometric theorems algebraically**

G.MG

A. Apply geometric concepts in modeling situations

G.SRT

A. Understand similarity in terms of similarity transformations

B. Prove theorems involving similarity

C. Define trigonometric ratios and solve problems involving right triangles

D. Apply trigonometry to general triangles

MA.K-12.2	Reason abstractly and quantitatively.
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-12.6	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-SRT.A.1	Verify experimentally the properties of dilations given by a center and a scale factor:
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.

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

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.
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.
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:

- 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 form equation of a circle is derived from the Pythagorean Theorem

Procedural Knowledge

Students will be able to:

- 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
- 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

Benchmark Assessments

Benchmark Assessments conducted three times per year, using Pear Assessment (Standards Based Assessments)

Alternative Assessments

- Portfolios
- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

Formative Assessments

- Student feedback/questioning/observation
- Exit Ticket
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Reflection questions
- Scored/evaluated class work or homework
- Task completion

Summative Assessments

Lesson Quizzes
Unit Test

RESOURCES (Instructional, Supplemental, Intervention Materials)

Core Instructional Materials

Envisions Geometry

Kuta Software

Supplemental Materials

Illustrative Mathematics unit: [Coordinate Geometry](#)

Khan Academy unit: [Analytic Geometry](#)

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

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.