

Coordinate Geometry

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EDUC 6400: Reading Across the Curriculum and ELL

Overview

According to the PA State Standards for mathematics, students must be proficient in eleven areas of math by the end of eleventh grade. Graphing and evaluating points on a coordinate plane is applicable to most of these areas. For the purposes of this unit, coordinate geometry is most relevant in the areas of problem solving and communication, algebra and functions, geometry, trigonometry, and concepts of calculus. These areas not only use the idea of graphing and evaluating points but also use the idea of representing and analyzing geometric figures on the coordinate plane. Therefore, this unit includes content and skills that are directly related to the PSSA exam. In addition, this unit prepares students for advanced courses such as algebra II and pre-calculus.

Throughout this unit, students will “use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas and results” as stated in 2.5.G.B of the PA State Standards. As students practice geometry communication, they will learn that lines and circles can be represented by equations. They will use the equations to analyze shapes formed by lines, and they will graph lines and circles from equations. These lessons prepare students for the PSSA and for algebra II, where they will extend their knowledge of equations to include ellipses, parabolas, and hyperbolas. These lessons also teach students how to solve problems, construct proofs, and identify a figure as a specific type, such as a square or rectangle, based on its properties in the coordinate plane. Students will also extend their knowledge of the properties of geometric figures by how those figures are represented on the coordinate plane.

Standards for the Unit

PA State Standards

2.5.G.A. (Geometry Problem Solving) Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.

2.5.G.B. (Geometry Communication) Use symbols, mathematical terminology, standard notation, mathematical rules, graphing, and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.

2.9.G.C. (Geometry Definitions, Properties, and Relations) Use techniques from coordinate geometry to establish properties of lines, 2-dimensional shapes.

2.8.G.B. (Algebraic Representations) Use algebraic representations to solve problems using coordinate geometry.

2.9.G.A. (Geometry Definitions, Properties, and Relations) Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.

Common Core State Standards

Section “Reading Standards for Literacy in Science and Technical Subjects 6–12” (p. 62) of the *Common Core State Standards for ENGLISH LANGUAGE ARTS & Literacy in History/Social Studies, Science, and Technical Subjects*, states the following standards:

- 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*.
- Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

Introduction

The unit kick-off activity will engage students in a search for treasure (edible treat). Students will work in pairs. One student will write directions to the treasure, which will be hidden in a room such as the gym or cafeteria. The partner will then try to follow the directions to locate the treasure. Both students will enjoy the treasure when it is found. The purpose of this activity is to get students thinking about location and directions.

Lesson Title	Objectives
	Students will be able to...
Day 1 Unit Preview	<ul style="list-style-type: none">• Correctly define notebook terms using words and/or illustrations given the terms.• Correctly list and categorize properties of geometric figures using words and/or illustrations given the figures.• Adequately determine what they know and what they want to know about finding locations on a grid.
Day 2 Introduction to Coordinate Geometry DETAILED LESSON PLAN PROVIDED FOR THIS LESSON	<ul style="list-style-type: none">• Correctly define key terms using words and/or illustrations given the terms.• Correctly construct and label a coordinate plane using mathematical language and notation given a grid worksheet.• Correctly graph points on a coordinate plane using mathematical language and notation given a grid and the coordinates of the points.• Correctly write the coordinates of a point on a coordinate plane.• Correctly determine the quadrant in which a point resides, without graphing the point, given the coordinates.
Day 3 Coordinate Systems DETAILED LESSON PLAN PROVIDED FOR THIS LESSON	<ul style="list-style-type: none">• Geographic Coordinate System modified cloze.• Adequately demonstrate an understanding of the real-life applications of coordinate planes.• Correctly recognize the similarities and differences between the Cartesian and geographic coordinate systems.
Day 4 Distance Formula and Midpoint Formula	<ul style="list-style-type: none">• Correctly define key terms using words and/or illustrations given the terms.• Correctly compute the distance between two points and the midpoint between two points given the distance and midpoint formulas and the two points.• Correctly prove the distance formula given a visual representation.

Lesson Title	Objectives
	Students will be able to...
Day 5 Graphs of Linear Equations and Slope	<ul style="list-style-type: none"> • Correctly define key terms using words and/or illustrations given the terms. • Correctly graph a line given the equation. • Correctly calculate the slope of a line given the formula and two points. • Correctly classify two lines as being parallel, perpendicular, the same line, or none of these.
Day 6 Equations of Lines	<ul style="list-style-type: none"> • Correctly define key terms using words and/or illustrations given the terms. • Correctly derive the equation of a line given the necessary information such as two points or one point and the slope or y-intercept. • Correctly determine if a point lies on a line given the point and the formula for the line. • Correctly determine if a set of points are collinear. • Correctly graph a line on the coordinate plane given the equation. • Correctly determine the point of intersection of two lines. • Correctly convert an equation from one form to another given the equation and other necessary information.
Day 7 Intersections of Lines and Vertices	<ul style="list-style-type: none"> • Correctly define key terms using words and/or illustrations given the terms. • Correctly determine the point of intersection of two lines. • Correctly determine the vertices of a geometric figure given the equations of the lines that form the figure.
Day 8 Triangles on the Coordinate Plane	<ul style="list-style-type: none"> • Correctly evaluate triangles located on the coordinate plane using the slopes of lines and related properties, distance formula, and properties of various triangles such as right, acute, obtuse, Isosceles, equilateral, and scalene. • Correctly determine the vertices of a triangle given the equations of the three lines that make up its sides. • Correctly solve problems related to triangles on the coordinate plane.
Day 9 Quadrilaterals on the Coordinate Plane	<ul style="list-style-type: none"> • Correctly evaluate quadrilaterals located on the coordinate plane using the slopes of lines and related properties, distance formula, and properties of various quadrilaterals such as trapezoids, parallelograms, rhombuses, rectangles, and squares. • Correctly determine the vertices of a quadrilateral given the equations of the four lines that make up its sides. • Correctly solve problems related to quadrilaterals on the coordinate plane.

Lesson Title	Objectives
	Students will be able to...
Day 10 Circles on the Coordinate Plane	<ul style="list-style-type: none"> • Correctly define key terms using words and/or illustrations given the terms. • Correctly identify an equation as being that of a circle given the equation. • Correctly graph a circle and name its center and radius given the equation. • Correctly determine if a point lies on a circle given the point and the equation for the circle. • Correctly solve problems related to circles on the coordinate plane.

Culminating Activity

The culminating activity will engage students in higher level thinking as they create a city, amusement park, or other area that has features whose locations can be represented on a coordinate plane. This activity will show that students understand how to create and use a coordinate system.

For this project, students will...

1. Choose an area and at least three features that fit into the area. For example, students may choose an amusement park with a roller coaster, arcade, and log jammer.
2. Sketch their area and its features on a poster board.
3. Construct and label a coordinate plane over their area
4. Create a key to the features using the plane's coordinates.

Performance Assessment

I will administer a performance assessment to assess students' knowledge of the unit topics. The assessment will be derived from the lesson objectives. All questions will assess understanding of vocabulary as students must read and understand the terminology in the question in order to answer it. I will provide illustrations as appropriate to assist ELL and special education students in understanding the questions. I will provide additional modifications as needed, which may include allowing students to use the vocabulary illustrations that they created throughout the unit.

Materials

- Graph paper (two sheets)
 - Ruler
1. Construct a coordinate plane on one sheet of graph paper. Label the axes and number each axis from -12 to 12 with the origin at (0, 0).
 2. Graph and label the following points on your coordinate plane.
 - A (0, 12)
 - B (-6, 0)
 - C (3, -3)
 - D (1, -7)
 - E (2, -1)
 - F (-6, 3)
 - G (4, 4)
 - H (12, 0)

- [illegible]

18. What is the equation of the perpendicular bisector of line segment AC? _____

19. Graph the circle $x^2 + y^2 = 9$.

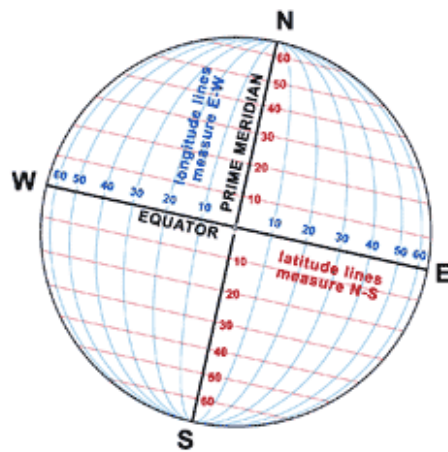
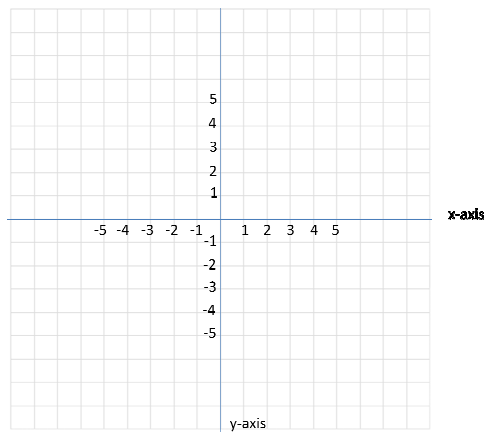
20. What is the radius of the circle? _____

21. What is the center of the circle? _____

22. Is the point (4, -1) on the circle? _____

23. List and explain two similarities between the Cartesian and the geographic coordinate systems.

24. List and explain two differences between the Cartesian and the geographic coordinate systems.



Geographic coordinate system image is from http://www.mbmgt.mtech.edu/gmr/lewis_clark/lewis_clark-equip.asp