MATHEMATICS COMMON CORE CURRICULUM UNIT #4 Geometry*
North Smithfield School District

TITLE OF UNIT: Connecting Algebra to Geometry **COURSE :** Geometry

DATE PRESENTED: _____3/27/13_____**DATE DUE:** _____ **LENGTH OF TIME:** Several weeks,

OVERVIEW OF UNIT:

In this unit, we will explore analytic geometry , which is the study of geometry Using a coordinate plane. We will use the distance formula to write the equation Of a circle and the equation of a parabola. We will investigate parallel and Perpendicular lines by finding and comparing slope. We will use coordinates to Classify polygons, as well as find their area and perimeter.

ESSENTIAL QUESTIONS

How do you write the equation of a circle if you know its radius and the coordinates of its center?
How do you write the equation of a parabola given its focus and directrix?
How can you use ratios to partition a segment in the coordinate plane?
What is the connection between slope and parallel and perpendicular lines?

STANDARDS: Common Core Math Standards – Grade level Categories 9-12

Number and Quantity	Algebra	Functions	Modeling	Geometry	Statistics and Probability
☐ **The Real Number System N-RN**	☐ **Seeing Structure in Expressions A-SSE**	☐ **Interpreting Function F-If**	☐	☐ **Congruence G-CO**	☐ **Interpreting Categorical and Quantitative Data S-ID**
☐ **Quantities N-Q**	☐ **Arithmetic with Polynomials and Rational Expressions A-APR**	☐ **Building Functions F-BF**	☐	☐ **Similarity, Right Triangles, and Trigonometry G-SRT**	☐ **Making Inferences and Justifying Conclusions S-IC**
☐ **The Complex Number System N-CN**	☐ **Creating Equations A-CED**	☐ **Linear, Quadratic, and Exponential Models F-LE**		☐ **Circles G-c**	
☐ **Vector and Matrix Quantities N-VM**	☐ **Reasoning with Equations and Inequalities A-REI**	☐ **Trigonometric Functions F-TF**		☐ **Expressing Geometric Properties with Equations G-GPE**	
☐	☐	☐		☐ **Geometric Measurement and Dimensions G-GMD**	
☐	☐	☐		☐ **Modeling with Geometry G-MG**	

STANDARDS: Mathematical Practices grades K-12

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

FOCUS MATHEMATICS STANDARDS:

- Use coordinates to prove simple geometric theorems algebraically. G-GPE.4,5,6,7
- Translate between the geometric description and the equation for a conic section. G-GPE.1,2

Applied Learning Standards:

problem solving communication critical thinking research reflection/ evaluation

Expectations for Student Learning (High School only):

Problem Solving, Communication, Body of Knowledge, Proficiency in the Arts, Responsibility

ENDURING UNDERSTANDING:

At the end of this unit, students will be proficient in the following:

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

PRIOR KNOWLEDGE:

- Algebra 1
- Geometry Units 1-3

*Referenced templates from *Common Core Curriculum Maps, English Language Arts* and *The Understanding By Design Guide to Creating High Quality Units*

STUDENT OBJECTIVES, SKILLS and/or NEW KNOWLEDGE:

- The equation of a circle can be derived using the Pythagorean theorem.
- The center and radius of a circle can be found by completing the square.
- How do you derive the equation of a parabola, given a focus and a directrix?
- The equation of a parabola can be derived given its focus and directrix.
- What information do you need to derive the equation of a parabola and why?
- Coordinate geometry can be used to solve simple geometric theorems algebraically.
- Coordinate geometry can be used to prove that parallel lines have the same slope and perpendicular lines have opposite reciprocal slopes.
- Find the distance between points in the coordinate plane and partition the segment into a given ratio.
- How is the distance formula related to the Pythagorean theorem?
- The area and perimeter of a polygon can be found by placing the polygon on a coordinate plane.

SUGGESTED PROBLEMS:

Teaching Examples

- G-GPE1 relates to G.GPE.4. Reasoning with triangles is limited to right triangles; e.g. derive the equation for a line through two points using similar right triangles.
- Students may use geometric simulation software to explore the connection between circles and the Pythagorean theorem.
- The standard form of a circle is $(x-h)^2+(y-k)^2=r^2$ where the center is (h,k) with a radius of r.

Examples:

- Write an equation for a circle with a radius of 2 units and center at (1, 3).
- Write an equation for a circle given that the endpoints of the diameter are (-2, 7) and (4, -8).
- Find the center and radius of the circle $4x^2 + 4y^2 - 4x + 2y - 1 = 0$.

Teaching Examples

- The conic forms of a parabola is regular: $4p(y-k) = (x-h)^2$ sideways: $4p(x-h) = (y-k)^2$, where the vertex is (*h,k*) and *p* is the distance between the focus and the directrix.

Examples:

  - Write and graph an equation for a parabola with focus (2, 3) and directrix $y = 1$.
  - Given the equation $20(y-5)=(x+3)^2$, find the focus, vertex and directrix.

- Solution: The vertex is at (-3,5) and to find the vertex we know that the constant of the unsquared term is 20. Since *4p = 20* then *p=5*. The focus is 5 units above the vertex at (-3,5+5) or (-3,10). The directrix is 5 units below the vertex so *y = 0.*

Teaching Examples

- Use slope and distance formula to verify the polygon formed by connecting the points (-3, -2), (5, 3), (9, 9), (1, 4) is a parallelogram.
- 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).

Teaching Examples

Example:

- Find the equation of a line perpendicular and parallel to $3x+5y=15$ through the point (-3,2).

Teaching Examples

- Students may use geometric simulation software to model figures or line segments.

Examples:

- Given A(3, 2) and B(6, 11),
- Find the point that divides the line segment AB two-thirds of the way from A to B.

The point two-thirds of the way from A to B has x-coordinate two-thirds of the way from 3 to 6 and y coordinate two-thirds of the way from 2 to 11.
So, (5, 8) is the point that is two-thirds from point A to point B.

- Find the midpoint of line segment AB.

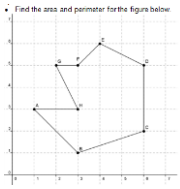
Teaching Examples

- This standard provides practice with the distance formula and its connection with the Pythagorean theorem.
- Students may use geometric simulation software to model figures.

Example:

- Find the area and perimeter for the figure below.

*Referenced templates from *Common Core Curriculum Maps, English Language Arts* and *The Understanding By Design Guide to Creating High Quality Units*



ASSESSMENT PROBLEMS

G.GPE.4

- http://www.illustrativemathematics.org/illustrations/605

G.GPE.5

- http://www.illustrativemathematics.org/illustrations/1332

ACTIVITIES, PRODUCTS, PERFORMANCE, and ASSESSMENTS: see curriculum introduction

1. Application to real world problems
2. Creating charts/collecting data
3. Collaboration - interpersonal
4. Conferencing
5. Exhibits
6. Tests and quizzes
7. Warmups
8. Exit Slips
9. Polls
10. Graphic organizers
11. Graphing
12. Interviews
13. Journals
14. KWL charts
15. Mathematical Practices
16. Modeling ★
17. Oral presentations
18. Problem/Performance based/common tasks
19. Real-life applications involving graphing
20. Represent numbers
21. Rubrics/checklists (mathematical practice, modeling)
22. Technology
23. Summarizing and note-taking
24. Tests and quizzes
25. Writing genres Arguments/ opinion Informative

HIGHER ORDER THINKING SKILLS: Web's Depth of Knowledge 2 – 4 or Bloom's Taxonomy

Web's Depth of Knowledge

- skill/conceptual understanding
- strategic reasoning
- extended reasoning

Bloom's Taxonomy

- apply
- analyze
- synthesize/create
- evaluate

ADDITIONAL RESOURCES: see curriculum for specifics

Textbook

- *McDougal Littell Geometry*, Applying, Reasoning and Measuring (Sections 3.6, 3.7, 6.7, 10.6)
- *McDougal Littell Algebra* 2 (Section 5.5 Completing the Square)
- Houghton Mifflin Harcourt; *On Core Mathematics Geometry* (Unit 8 – Sections 8.1-8.6)

Technology

- Computers
- Dynamic geometry software (Geometer's Sketchpad®, Cabri®, or Geogebra®)
- Graph paper
- Instructional Resources/Tools
- Interactive boards
- LCD projectors
- Parabolic reflectors to illustrate practical applications of parabolas
- Physical models of cones sliced to show cross sections that are circles, ellipses parabolas and hyperbolas
- Scientific or graphing calculators

VOCABULARY

- Area
- Conic
- Coordinate plane
- Directrix
- Distance
- Distance formula
- Equation of a line
- Focus
- Line segment
- Midpoint
- Parabola
- Parallel lines
- Perimeter
- Perpendicular lines
- Polygon
- Pythagorean Theorem
- Ratio
- Reciprocal
- Slope
- Standard form of a circle

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LESSON PLAN for UNIT _____

LESSONS

- **Lesson # 1 Summary:**

- **Lesson #2 Summary:**

- **Lesson #3 Summary:**

OBJECTIVES for LESSON # _____

- **Materials/Resources:**

- **Procedures:**
  - **Lead –in**
  - **Step by step**
  - **Closure**

- **Instructional strategies:** see curriculum introduction

- **Assessments:** see curriculum introduction
  - **Formative**
  - **Summative**

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