Circles

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LESSON OVERVIEW

Subject(s)	Mathematics
Topic or Unit of Study	Conic Sections
Grade/Level	Grade 10
Objective	Students will be able to write the equation of a circle given the center and radius or a graph, graph a circle given the equation or the center and radius, and traslate a circle.
Summary	Students will learn about circles by having the teacher working to access their prior knowledge (geometry course) as much as possible. The students will learn the definitions of a circle, the vocabulary terms associated, and the standard form of the equation of a circle.

IMPLEMENTATION

Learning Context	This is the second day of the new unit on conic sections. Students have already worked on translating absolute values and quadratic equation in previous units this year. They have also seen the vertex form of quadratic equation (which is very similar to the standard form of a circle).
Teaching Strategies	Direct instruction, think-pair-share
Time Allotment	1 class periods. 50 Mins. per class.
Sample Student Products	
Author's Comments & Reflections	This lesson may need to be broken up into two or more lesson if the students are not familiar with translating equations/functions and/or with the properties of circles.

PROCEDURE

Anticipatory Set

Think-Pair-Share Brainstorm

What would a set of points all the same distance from a point look like? Would it be a scatter plot? A line? A parabola? Think for a minute, then turn to your elbow partner and discuss what you think it would look like.

Introduction

Go outside with the class and draw a circle using a string attached to a ruler with the other end tied to a piece of sidewalk chalk.

Tying a piece of string between the point and the writing instrument, we will be able to find all points which are equidistand from that point because the length of string is constant.

Interesting Fact of the Day

Did you know that the world's largest pieces of art is composed of circles? Jim Devevan, a local Santa Cruz artist, has drawn snow circles in Siberia and sand circles in Nevada, Austrailia, and Vancouver. The circumferance of the art circle in Nevada is approximately 9 miles. That is approximately 6.445 square miles or 1.79676×10^8 square feet!

http://www.jimdenevan.com/

http://metro.co.uk/2009/12/17/the-worlds-biggest-art-work-is-a-circle-in-the-sand-628171/

https://www.youtube.com/watch?v=qGaS92AGuNs

https://www.youtube.com/watch?v=848MS7pYHl0

Transition

Today we will working closely with circles, but not with their areas or diameters as you have before. This lesson focuses on the equations of circles in the Cartesian plane.

Modeling

Review

What do we know about circles? What parts do we have? Is there a directrix like a parabola? A vertex? Raise your hand to share a fact about circles.

Definitions

Circle: a circle is a set of points all equidistant from one point.
Center: the point we measure from is called the center that we write as the coordinates (h, k).
Radius: the distance we measure from the center to the points that comprise of the circle is called the radius which we denote as r.

Standard Form of a Circle (and its derivation)

Recall the distance formula:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Let the center (h, k) of the circle be one of our points as we know that every point on the circle must be equal distant from that point. Also, we know that this distance is known as r.

$$r = \sqrt{(x - h)^2 + (y - k)^2}$$

We try to avoid having square roots in our equations, so what should we do? Square both sides.

$$r^2 = (x - h)^2 + (y - k)^2$$

This is the standard form of an equation of a circle with center (h, k) and radius r.

Example 1

A circle has a center (3, 0) and a radius of 4. Write four points on the circle and draw the circle with those points on a piece of graph paper.

Points (7, 0), (3, 4), (-1, 0), and (3, -4).

Example 2

Write the equation of the circle which has a center (1, 2) and radius 3.

Guided Practice

Example 3

An artist who enjoys drawing circles in the sand has drawn a circle with a radius of 5. Let the center of that circle be the origin. The artist wants to draw a circle of radius 4 to the right of the first circle such that the first circle and the second circle share one point. What is center and four other coordinates of the second circle? Graph the circle.

Answer:

Center: (9, 4); Points: (9, 4), (13, 0), (9, -4), and (5, 0).

Example 4 (Think-Pair-Share)

Without graphing, what would be the equation of a third circle that is translated so that the center is 3 above the northern-most point of the second circle? Take a minute to write down what you believe would be the equation and then we will share with a neighbor.

Answer:

$$3^2 = (x - 9)^2 + (y - 7)^2$$

$$9 = (x - 9)^2 + (y - 7)^2$$

Independent Practice

Homework

Student will complete the following for homework: workbook 10-3: page 501, even numbered problems only.

Closure

Recap

The teacher will lead a quick review of the terms, definitions, and formulas learned in today's lesson.

Follow-Up

Warm-Up

The following problem will be given at the beginning of the next lesson as a warm-up.

Directions: Write the equation of a circle whose center is three units up and two units to the left of the origin with a radius of 6.

$$6^2 = (x + 2)^2 + (y - 3)^2$$

$$36 = (x + 2)^2 + (y - 3)^2$$

MATERIALS AND RESOURCES

Instructional Materials

Resources

- Materials and resources:
  Sidewalk chalk, string, ruler (or any other straightedge), document camera

STANDARDS & ASSESSMENT

Standards

Display: Collapse All Expand All

CA- California K-12 Academic Content Standards

Subject: Mathematics

Grade: Grades Eight Through TwelveThe standards for grades eight through twelve are organized differently from those for kindergarten through grade seven. In this section strands are not used for organizational purposes as they are in the elementary grades because the mathematics studied in grades eight through twelve falls naturally under disci-pline headings: algebra, geometry, and so

forth. Many schools teach this material in traditional courses; others teach it in an integrated fashion. To allow local educational agencies and teachers flexibility in teaching the material, the stan-dards for grades eight through twelve do not mandate that a particular discipline be initiated and completed in a single grade. The core content of these subjects must be covered; students are expected to achieve the standards however these subjects are sequenced. Standards are provided for algebra I, geometry, algebra II, trigonometry, math-ematical analysis, linear algebra, probability and statistics, Advanced Placement probability and statistics, and calculus. Many of the more advanced subjects are not taught in every middle school or high school. Moreover, schools and districts have different ways of combining the subject matter in these various disciplines. For example, many schools combine some trigonometry, mathematical analysis, and linear algebra to form a precalculus course. Some districts prefer offering trigonometry content with algebra II.

- **Area:** Algebra IIThis discipline complements and expands the mathematical content and concepts of algebra I and geometry. Students who master algebra II will gain experience with algebraic solutions of problems in various content areas, including the solution of systems of quadratic equations, logarithmic and exponential functions, the binomial theorem, and the complex number system.

  Sub-Strand 16.0: Students demonstrate and explain how the geometry of the graph of a conic section (e.g., asymptotes, foci, eccentricity) depends on the coefficients of the quadratic equation representing it.

- **Area:** Mathematical AnalysisThis discipline combines many of the trigonometric, geometric, and algebraic tech-niques needed to prepare students for the study of calculus and strengthens their conceptual understanding of problems and mathematical reasoning in solving prob-lems. These standards take a functional point of view toward those topics. The most significant new concept is that of limits. Mathematical analysis is often combined with a course in trigonometry or perhaps with one in linear algebra to make a year-long precalculus course.

  - **Sub-Strand 5.0:** Students are familiar with conic sections, both analytically and geometrically:

    Standard 5.2: Students can take a geometric description of a conic section—for example, the locus of points whose sum of its distances from (1, 0) and (-1, 0) is 6—and derive a quadratic equation representing it.

Assessment Plan

Homework is out of 20 points. The teacher will check 5 questions and grade each question (worth 4 points). The 5 questions will be from different sections of the assignment to avoid grading 5 questions that are the same problem-type (example: 5 problems asking to plot a linear equation) which may not adequately represent the student's progress towards the lesson's learning goal/standard.

Assessment/Rubrics

Rubrics:

1. Textbook Homework Rubric