Students Will:
- prove the slope relationship that exists between parallel lines and between perpendicular lines and then use those relationships to write the equations of lines
- extend the Pythagorean Theorem to the coordinate plane
- develop and use the formulas for the distance between two points and for finding the point that partitions a line segment in a given ratio
- revisit definitions of polygons while using slope and distance on the coordinate plane
- use coordinate algebra to determine perimeter and area of defined figures
- use Algebra to model Geometric ideas
- spend time developing equations from geometric definition of circles
- address equations in standard and general forms
- graph by hand and by using graphing technology
- develop the idea of algebraic proof in conjunction with writing formal geometric proofs

Vocabulary
- Distance Formula: \(d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\)
- Formula for finding the point that partitions a directed segment AB at the ratio of \(a : b\) from \(A(x_1, y_1)\) to \(B(x_2, y_2)\):
  \[
  \left( x_1 + \frac{a}{a+b}(x_2 - x_1), \ y_1 + \frac{a}{a+b}(y_2 - y_1) \right)
  \]
  or
  \[
  \left( \frac{a}{a+b}(x_2 - x_1) + x_1, \ \frac{a}{a+b}(y_2 - y_1) + y_1 \right)
  \]
  or
  \[
  \left( \frac{bx_1 + ax_2}{b + a}, \ \frac{by_1 + ay_2}{b + a} \right) \leftarrow \text{weighted average approach}
  \]
- Center of a Circle: The point inside the circle that is the same distance from all of the points on the circle.
- Circle: The set of all points in a plane that are the same distance, called the radius, from a given point, called the center. Standard form: \((x - h)^2 + (y - k)^2 = r^2\)
- Diameter: The distance across a circle through its center. The line segment that includes the center and whose endpoints lie on the circle.
- Pythagorean Theorem: A theorem that states that in a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the lengths of the legs.
- Radius: The distance from the center of a circle to any point on the circle. Also, the line segment that has the center of the circle as one endpoint and a point on the circle as the other endpoint.
- Standard Form of a Circle: \((x - h)^2 + (y - k)^2 = r^2\), where \((h,k)\) is the center and \(r\) is the radius.

Resources
- [http://www.purplemath.com/modules/sqrcircle.htm](http://www.purplemath.com/modules/sqrcircle.htm)
Sample Problems

1. Write the standard form of the equation of a circle that passes through the given point (7, -4) and whose center is at the origin.
2. Show that A(2, -1), B(1, 3), C(6, 5), and D(7, 1) are the vertices of a parallelogram

Answers

1. \( x^2 + y^2 = 65 \)
2. 

\[ \text{Method 1} \text{ Show that opposite sides have the same slope, so they are parallel.} \]
\[
\text{Slope of } \overline{AB} = \frac{3 - (-1)}{1 - 2} = -4 \\
\text{Slope of } \overline{CD} = \frac{1 - 5}{7 - 6} = -4 \\
\text{Slope of } \overline{BC} = \frac{5 - 3}{6 - 1} = \frac{2}{5} \\
\text{Slope of } \overline{DA} = \frac{-1 - 1}{2 - 7} = -\frac{2}{5} \\
\overline{AB} \text{ and } \overline{CD} \text{ have the same slope so they are parallel. Similarly, } \overline{BC} \parallel \overline{DA}. \]

Because opposite sides are parallel, \(ABCD\) is a parallelogram.

\[ \text{Method 2} \text{ Show that opposite sides have the same length.} \]
\[
\overline{AB} = \sqrt{(1 - 2)^2 + (3 - (-1))^2} = \sqrt{17} \\
\overline{CD} = \sqrt{(7 - 6)^2 + (1 - 5)^2} = \sqrt{17} \\
\overline{BC} = \sqrt{(6 - 1)^2 + (5 - 3)^2} = \sqrt{29} \\
\overline{DA} = \sqrt{(2 - 7)^2 + (-1 - 1)^2} = \sqrt{29} \\
\overline{AB} \cong \overline{CD} \text{ and } \overline{BC} \cong \overline{DA}. \text{ Because both pairs of opposite sides are congruent, } \overline{ABCD} \text{ is a parallelogram.} \]

\[ \text{Method 3} \text{ Show that one pair of opposite sides is congruent and parallel.} \]
Find the slopes and lengths of \( \overline{AB} \) and \( \overline{CD} \) as shown in Methods 1 and 2.
\[
\text{Slope of } \overline{AB} = \text{Slope of } \overline{CD} = -4 \\
\overline{AB} = \overline{CD} = \sqrt{17} \\
\overline{AB} \text{ and } \overline{CD} \text{ are congruent and parallel, so } \overline{ABCD} \text{ is a parallelogram.} \]