Richmond Public Schools
Curriculum Framework
Geometry

<table>
<tr><th colspan="3">Strand: Polygons and Circles</th></tr>
<tr><td>G.11</td><td colspan="2">The student will solve problems, including practical problems, by applying properties of circles. This will include determining
a) angle measures formed by intersecting chords, secants, and/or tangents;
b) lengths of segments formed by intersecting chords, secants, and/or tangents;
c) arc length; and
d) area of a sector.</td></tr>
<tr><td>G.4h</td><td colspan="2">The student will construct and justify the construction of an equilateral triangle, a square, and a regular hexagon inscribed in a circle.</td></tr>
<tr><th colspan="2">Suggested Pacing</th><th>Cognitive Demand</th></tr>
<tr><td colspan="2" rowspan="2">Third Nine Weeks

6 instructional days (including assessment)</td><td>G.11a-d</td><td>G.4h</td></tr>
<tr><td>Apply</td><td>Create</td></tr>
<tr><th colspan="2">Spiraling Down Standards</th><th colspan="2">Spiraling Up Standards</th></tr>
<tr><td colspan="2">6.7 The students will
a) derive π
b) solve problems, including practical problems, involving circumference and area of a circle; and
c) solve problems, including practical problems, involving area and perimeter of triangles and rectangles.</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Essential Questions</th><th colspan="2">Common Misconceptions</th></tr>
<tr><td colspan="2">G.11a
Why is an inscribed angle equal to half of the intercepted arc?</td><td colspan="2">• Students confuse length of arc and measure of an arc.</td></tr>
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● The proof begins with the case where one side of the inscribed angle is a diameter. Then the central angle is an external angle of an isosceles triangle and the result follows. **When radii, chords, secants, and tangents intersect in a circle, how are the angles formed different?** ● A central angle is an angle formed by two radii with the vertex at the center of the circle. ● An inscribed angle is an angle with its vertex "on" the circle, formed by two intersecting chords. ● An angle formed by an intersecting tangent and chord has its vertex "on" the circle. ● When two chords intersect inside a circle, four angles are formed. At the point of intersection, two sets of congruent vertical angles are formed in the corners of the X that appears. ● Two tangents that intersect form an angle outside of the circle. ● Two secants that intersect form an angle outside of the circle. ● A tangent and a secant that intersect form an angle outside of the circle. **G.11b** **Why are two line segments that are tangent to a circle and who share a common exterior point congruent?** ● Draw a segment from the external point to the center of the circle. The triangles formed are congruent by Hypotenuse Leg for Right Triangles. The radii of a circle are congruent (the legs), and the triangles share a side (the hypotenuses). The triangles have right angles at *A* and *C* since a radius drawn to the point of tangency is perpendicular to the tangent. By CPCTC, the tangents are congruent. **What is the difference between tangents, secants, and chords?**	● Before students can complete these constructions, they must understand the geometry vocabulary associated with it. For example, if students don't know what it means to be inscribed, constructing a regular hexagon inscribed in a circle will be difficult.

● A chord is a line segment and both secant and tangents are straight lines. A chord is a line segment with the end points lying on a curve while a secant is a line passing through exact two points on a curve. A tangent is a line that just touches and passes through exactly one point on a curve. **G.11c** **How can you use a known circumference to find the length of an arc of a circle and vice versa?** ● The length of an arc (part of circumference) is equal to the circumference of the circle times the fraction of the circle represented by the arc's measure. **What is a real world example of needing to know the length of an arc?** ● You might need to know how far your leg of a relay race is on a circular track. **G.11d** **How can you use a known area to find the area of a sector of a circle and vice versa?** ● The areas of a sector (part of circle's area) is equal to the area of the circle times the fraction of the circle represented by the sector arc's measure. **What is a real world example of needing to know the sector area?** ● You need to know the area of the lawn that will be covered by your sprinkler.	
Understanding the Standard	**Essential Knowledge and Skills**
G.11a-d	**G.11a-d**

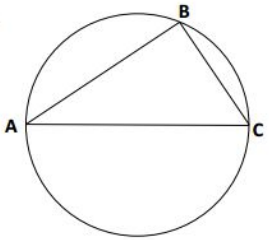
• All circles are similar. • A chord is a line segment that joins any two points on a circle. A chord is a segment of a secant. • Arcs can be measured in degrees or in units of length. • Applications of the properties of circles may be drawn from architecture, art, and construction. • Properties of circles can be verified using deductive reasoning, algebraic, and coordinate methods. • Inscribed quadrilaterals have opposite angles that are supplementary. • Properties associated with segment lengths can be verified using similar triangles. • The ratio of the central angle to 360° is proportional to the ratio of the arc length to the circumference of the circle. • The ratio of the central angle to 360° is proportional to the ratio of the area of the sector to the area of the circle. • The construction for an inscribed equilateral triangle, square and regular hexagon can be justified using properties of a circle. **G.4h** • Construction techniques are used to solve practical problems in engineering, architectural design, and building construction. • Construction techniques include using a straightedge and compass, paper folding, and dynamic geometry software. • Geometric constructions assist in justifying, verifying, and visually reinforcing geometric relationships.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve problems, including practical problems, by applying properties of circles. (a, b, c, d) • Determine angle measures and arc measures associated with - two intersecting chords; - two intersecting secants; - an intersecting secant and tangent; - two intersecting tangents; and - central and inscribed angles. (a) • Determine segment lengths associated with: - two intersecting chords; - two intersecting secants; - an intersecting secant and tangent; and - two intersecting tangents. (b) • Calculate the length of an arc of a circle. (c) • Calculate the area of a sector. (d) **G.4h** **The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct and justify the constructions of - an equilateral triangle, a square, and a regular hexagon inscribed in a circle. (h)

- There are multiple methods to most geometric constructions. Students would benefit from experiences with more than one method and should be able to justify each step of geometric constructions.
- Individual steps of constructions can be justified using angle relationships, properties of quadrilaterals, congruent triangles, and/or circles.

  - The constructions for an equilateral triangle, square, or regular hexagon inscribed in a circle can be justified using properties of circles.

- Constructions can be completed within the context of complex figures.

Example:



Given inscribed ΔABC with diameter $\overline{AC}$, complete a construction to identify the center of the circle.

Vocabulary		
Circle	Chord	Secant
Tangent	Diameter	Radius
Length	Semicircle	Inscribed angle
Central angle	Area	Sector

Instructional Activities Organized by Learning Objective

Virginia Department of Education

- Angles, Arcs, and Segments in Circles
- Arc Length and Area of a Sector

Textbook

Arc length	Sector area	proportional
Square	Circumference	Major arc
Minor arc	Arc	Center
Inscribed polygon	Equilateral triangle	Regular hexagon
Perpendicular bisector	Quadrilateral	

Assessment

1. Powerschool Assessments
   G.11a (E:9YJB8A)
   G.11b (E:3GSG2G)
   G.11c (E:MZV17H)
   G.11d (E:1GRDC1)
   G.4h (TBA)

2. Mulligan Checkpoint G.11
   Checkpoint G.11

3. Formative Assessments
   G.11a-d FA

4. Cumulative Assessment #9
   (SOLs G.1, G.2, G.3, G.4, G.5, G.6, G.7, G.8, G.9, G.10, G.11, G.12)
   Cumulative Assessment #9

- Geometry, ©2012, Price, et al, McGraw-Hill School Education Group page(s) 683-742 and 782-788

Notes and Homework

- G.11a-d Notes and Keys
- G.4h Notes and Keys
- G.11a-d Homework and Keys

Resources:

- **Print**
  - Coach book, Virginia edition Lessons 23-26 page(s) 186-206
- **Technology**
  - **Gizmo**
    - Chords and Arcs
  - **Geogebra**
    - Circles Unit Exploration Activities
    - Square Inscribed in a Circle
  - **Youtube Videos**
    - How to Construct a Square Inscribed in a Circle
    - How to Construct a Regular Hexagon and Equilateral Triangle Inscribed in a Circle
    - Arc Length and Area of Sector (Math Mashup)
    - Arc Length and Area of Sector Real World Problems (Math Mashup)
    - Tangent Lines (Math Mashup)
    - Circle Theorems in 3 minutes
    - Angles Outside a Circle
    - Angles On and Inside a Circle
    - Segment Lengths in Circles
  - **Quizizz Practice**

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- G.11a Practice
- G.11b Practice
- G.11c,d Practice
- G.4h Practice

Instructional Activities

- Circle Angle Theorem Discovery Activity
- Arc Length and Area of Sector Discover Activity
- Circles Station Task Card Sheets

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<tr><th>Cross-Curricular Connections</th><th>Tiered Interventions</th></tr>
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- Use *The Librarian Who Measured the Earth* by Kathryn Lasky and Kevin Hawkes to investigate Eratosthenes' method for estimating the circumference of the earth.
- Search the web for other descriptions of Eratosthenes' method of estimating the circumference of the Earth.
- Have students do a "Think-Pair-Share" activity in the classroom. Show various pictures of ramps with their measurements. Have students work in pairs to determine which ramps are better for a beginning skater to use. Have them share their results with the class.
- A school track is formed by two straight segments joined by two semicircles. Each straight segment is l meters long, and each semicircle is d meters in diameter. Write a formula for finding the distance, D, around the track.
- Arrange for students to go to the school's baseball diamond, and have them use a tape measure to measure the dimensions of infield. Have them find the area of the infield to determine the amount of dirt needed to cover the infield.

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Tier 3: Recall and Reproduction
Vocabulary
Have students study flashcards, create their own flashcards, play a matching game or test themselves on Quizlet.
Circles Flashcards on Quizlet

Circle Angle Theorem Reference Sheet Students may benefit from a graphic organizer or reference chart with all the angle formulas.
Circle Vocabulary Quiz

Tier 2: Basic Skills and Concepts
Practice and Drill
Circle Drills
Construction G.4h Drill
SOL G.11 Practice Problems

Tier 1: Strategic Thinking and Reasoning
Application
G.4h Application Activity Students will create figures from construction of inscribed regular hexagon.

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● Arrange for students to visit a local skating park, take measurements, and draw sketches. Have them determine which ramps are the safest after measuring them. ● The book *Around the World in 80 Days* by Jules Verne tells the tale of a voyage around the world by rail and steamer. If an 80-day voyage around the world follows the equator (it didn't in the book) about how long should the voyagers allow to travel from Quito, Ecuador to Libreville, Gabon?	